PALYNOLOGICAL ANALYSIS OF FLORAL CHANGES CAUSED BY REPEATED VOLCANIC ASH BURIAL OF A COAL-FORMING UPPER CRETACEOUS PEAT SWAMP, UTAH, U.S.A.

By

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ABSTRACT

PALYNOLOGICAL ANALYSIS OF FLORAL CHANGES CAUSED BY REPEATED VOLCANIC ASH BURIAL OF A COAL-FORMING UPPER CRETACEOUS PEAT SWAMP, UTAH, U.S.A.

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Palynomorphs from 165 samples of the Ferron Sandstone C coal horizon and several outcrop samples from the upper Tununk Shale, Ferron Sandstone, and the lower Bluegate Shale Members of the Mancos Shale from the Castle Valley area of east-central Utah, were studied palynologically. This information was used to reconstruct the constituent floristic assemblages of the coal-forming peat swamps; and to determine the extent of destruction of the vegetation by repeated burial by volcanic ash, and the sequence of paleosuccession of the plant communities following such events.

Seven floristic assemblages are differentiated in the C coal swamps of the Ferron Sandstone. These include an Herbaceous Fern Assemblage, Mixed Assemblage, Angiosperm Assemblage, Gymnosperm Assemblage, Wet, Fern-Gymnosperm Swamp Assemblage, Wet, Mixed, Swamp Assemblage, and the Brackish, Gymnosperm Swamp Assemblage.

Both lateral (geographic) and vertical (successional) floristic trends are identified in the Ferron C coal. Extremely low diversity, fern dominated assemblages are

mature coal swamp assemblage appears to be the Gymnosperm Assemblage.

Periodic volcanic eruptions had varying effects on the paleocommunity structure of the Ferron C coal swamp vegetation. The thicker ash fall accumulations were more devastating to the flora than the thin ash accumulations and caused more profound ecological effects. Hydrologic, pedologic, and floristic changes are associated with the thickest ash fall. After such a major destructive ash fall, the coal swamps were first repopulated by herbaceous ferns. A return to predisturbance palynomorph assemblages is evident by the time sufficient peat to form 30-60 cm of coal had been deposited after a major ash fall.

The palynoflora of the Ferron Sandstone (middle to late Turonian) is similar to other Middle Cretaceous floras of western United States. No depositional or age relationships were established between the productive samples from northern Castle Valley and those from the southern Castle Valley area.

The palynoflora of the upper Tununk Shale based upon four productive samples from two localities is characteristic of the Cenomanian-Turonian (Middle Cretaceous). The lower Bluegate Shale palynoflora is latest Turonian in age or younger based on four productive samples from three localities.

The palynoflora of the lower Bluegate Shale is latest Turonian in age or younger. The four productive samples from three localities yield a palynoflora characteristic of normal marine conditions.

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INTRODUCTION

STATEMENT OF PROBLEM

The Ferron Sandstone Member of the Mancos Shale formed part of the western coastal plain depositional environment of the Upper Cretaceous Interior Seaway. This seaway began encroaching upon the North American craton during the Early Cretaceous. It reached its zenith during Coniacian-Santonian time. This transgression was interrupted by numerous regressions of varying magnitude. Although the overall transgression was probably eustatically controlled, several of the regressions have been linked to orogenic events to the west of the seaway (Spieker, 1946, 1949; Osmond, 1964; Nichols and Warner, 1978; and Pratt, 1985). Richter (1982) and Weimer (1983) have correlated the Frontier Formation with middle Cretaceous events while Katich (1951, 1954) and Fouch et al. (1983) have linked the Ferron to such events. Mountain building activities to the west of the seaway were a source for an ample supply of sediment for the development of numerous deltas, such as the Frontier and the "Last Chance Delta" of the Ferron, along the western margin of the interior seaway (Spieker, 1946).

In the area of Castle Valley, Utah, the Ferron Sandstone Member of the Mancos Shale consists of fluvial-deltaic sediments. The Ferron, as identified in many studies, includes at least two distinct deltaic episodes of slightly different time. Recently, Ryer and Lovekin (1985) have proposed that the "Vernal Delta" actually represents a paleotectonic feature and is not a sedimentary deltaic feature. However, additional work is needed in order to confirm or deny this proposition. The "Vernal Delta" is generally believed to be the earliest of the Ferron deltas. It extends from the north or northwest into northern Castle Valley. A delta, which began to develop at a slightly later time, the "Last Chance Delta," was produced by the Ferron River (Cotter, 1971), which originated to the south and west of Castle Valley (Katich, 1951, 1954). It is the Last Chance Delta which is of primary focus to this study.

The Last Chance Delta, as defined by Cotter (1971, 1975a) and further studied by Cross, Maxfield, Cotter, and Cross (1975), Cross and Maxfield (1976), Ryer (1981b), and Ryer and McPhillips (1983), is a high-constructive lobate delta consisting of five major and numerous minor prograding deltaic cycles. Each cycle may be composed of several units which include a marine shale, a beach sandstone, delta-front sandstone, mixed delta-front and alluvial plain strata, and a coal unit.

Besides fluvial-deltaic sediments, the Ferron contains sediments indicative of a volcanically active source area, which was probably located west or northwest of Castle Valley (McGookey *et al*., 1972). Some of these volcanic sediments occur as tonstein partings in the C coal unit.

Tonsteins, along with bentonites, are altered volcanic ash. The main difference between these two volcanic ash deposits is based on the nature of their alteration. Tonsteins are the altered product of ash falls subjected to an acidic environment and therefore contain mainly kaolinitic clays. Bentonites are altered in a basic, typically marine environment, and contain primarily montmorillonite clays.

Ash falls or tonsteins occur at a number of stratigraphic levels throughout the Ferron. Because each volcanic event or eruption is geologically instantaneous, ash falls, which often cover large geographic areas, may be excellent time markers to which both lithologic and paleobiological events can be referred. Four distinct, laterally traceable tonsteins occur in the C coal of the third deltaic cycle in the Ferron.

The "cyclic" nature of the Ferron and the several synchronous and laterally extensive tonsteins provide an excellent time frame for examining both the vertical sequence of peat accumulation and the lateral distribution of the palynomorph assemblages in the Ferron delta. It is the sediment accumulation of the third deltaic cycle and, specifically, the C coal unit associated with the third cycle, that is the object of this study. The specific objectives of this study are:

1) To characterize the palynoflora of the Ferron Sandstone Member of the Mancos Shale in Castle Valley, Utah.

2) To determine the relative frequency of occurrence of the palynomorphs.

3) To identify lateral (geographic) or vertical (time) trends in the assemblages, primarily in the C coal unit of the Ferron.

4) To relate the palynoflora to the source plant communities from which they were derived.

5) To ascertain the effects of volcanic eruptions on the composition of the palynoflora and infer their impact on the source plant communities.

6) To develop some information on the environmental and stratigraphic significance of the palynoflora.

PREVIOUS WORK

General Geology

Geological studies of the Castle Valley area began in the second half of the 19th century. Following the initial government railroad surveys, G. K. Gilbert mapped and named many of the formations in east-central Utah in the 1870's. Forrester, also in the 1870's, and J. H. Taff (1806) reported on the coal-bearing strata in the southern part of Castle Valley. Lupton (1916) summarized these early geological studies of the area and provided the first detailed geological and ecological study of the Castle Valley area.

Since Lupton's work, numerous investigations have been made on the geology of the Castle Valley area. Notable among these are Bartram (1937), Spieker (1946, 1949), Katich (1951, 1953, 1954), Davis (1954), Hale and Van de Graaff (1964), Cotter (1971, 1975a, 1975b, 1975c, 1976), Hale (1972), and F. Peterson and Ryder (1975). The most recent summaries of Ferron geology are Uresk (1979), F. Peterson, Ryder, and Law (1980), Ryer (1981a, 1981b, 1981c, 1982a), Hill (1982), Ryer and McPhillips (1983), and Ryer and Lovekin (1985).

Coal

Lupton (1916) published the first major study on Ferron coals. His report included detailed stratigraphic sections and the naming and correlation of numerous coals. Maurer (1966) summarized the economic potential of the coals in both the Ferron and the Blackhawk Formations. Doelling (1972a, 1972b, 1976) also summarized the geology and the economic importance of the Ferron coal. Doelling, Smith, and Davis (1979) reported on the methane content of several Utah coals including several samples from the Ferron. Hatch, Affolter, and Law (1979) conducted chemical analyses of coals from both the Emery Sandstone and the Ferron Sandstone. Ryer and Langer (1980) discussed the formation and development of one of the Ferron coals. The stratigraphy and paleoecology of these coals and their associated tonsteins have been discussed by Ryer (1981a, 1981c, 1982b) and Ryer, Phillips, Bohor, and Pollastro (1980). I am not aware of published petrographic studies of the Ferron coals in the literature other than the paper by Gray and Schapiro (1966). Thiessen studied several thin-sections of the Ferron coals (Schopf and Oftedahl, 1976). Presently, S. S. Crowley is conducting petrographic studies of the C coal bed in the Emery coal field, Utah (Crowley, 1985).

Regional Paleoecology

The general paleoecology of the Western Interior Seaway has been summarized by Reeside (1957) and Kauffman (1977, 1984). Some aspects of the ecological significance of various plants represented by the fossil pollen and spores have been considered by Sarmiento (1957), Zaitzeff (1967), Zaitzeff and A. T. Cross (1970), and Thompson (1969, 1972). Micropaleontological and invertebrate ecological studies have been made by R. H. Peterson, Gauger, and Lankford (1953), Lessard (1973), Cobban (1976), and Maxfield (1976). Cotter (1971), Cleavinger (1974), and Ryer (1981b) have discussed the sedimentary environments of the Ferron.

Paleobotany and Palynology

May (1972) reported on the analyses of three samples from the Ferron coals, two from the Emery coal field in Castle Valley and the third was from the Henry Mountains area. He described a pteridophyte-angiosperm palynoflora in which phytoplankton and triporate angiosperm pollen were lacking. Table 1 summarizes the palynoflora of the Ferron as reported by May (1972). Based upon the composition of this flora, he concluded that the Ferron palynoflora was Cenomanian in age and represented a terrestrial, humid, and subtropical environment.

A limited report on the palynological analysis of seventy core samples was published by Gray, Patalski, and Schapiro (1966). The core test holes were drilled in the vicinity of Price, Utah in the northwest part of Castle Valley in coal-bearing sediments of the Vernal Delta. They established three floristic zones, based on palynomorph assemblages, to correlate the several coal seams in the coal test cores of that area.

TABLE 1: PALYNOFLORA OF THE FERRON SANDSTONE (MAY, 1972)

(May 1972) identified sixteen taxa from the Ferron Sandstone of the Henry Mountains region. These included:

Schizosporis sp.	*Ephedripites* sp.
Cyathidites sp.	*Classopollis* sp.
Cicatricosisporites dorogensis	*Tricolporopollenites* sp. 1
Cicatricosisporites crassiterminatus	*Tricolporopollenites* sp. 2
Appendicisporites sp.	*Tricolpites* (7 species)

From the A Sandstone horizon of the Emery Coal Field, he identified thirty-one taxa. These included:

Schizosporis sp.	*Concavisporites cf subgranulosis*
Foveosporis sp.	*Eucommiidites* sp.
Deltoidospora sp.	*Cycadopites* sp.
Verrucosisporites sp.	*Inaperturopollenites* sp.
Osmundacidites sp.	*Retitricolpites* (2 species)
Appendicisporites (2 species)	*Psilatricolpites parvulus*
Camarozonosporites rudis	
Tricolpites (16 species)	

Numerous paleobotanical and palynological studies have been made of Upper Cretaceous sediments in North America. The major palynological studies have been summarized by Lammons (1969, Table 1) and Jameossanaie (1983). Parker (1976b, Table 5) summarized the major Cretaceous paleobotanical macrofloras. Additional pertinent palynological studies include Orlansky (1967, 1971), Thompson (1969, 1972), P. H. Griggs (1970b), Burgess (1971), Kidson (1971), Stone (1971), Gies (1972), May and Traverse (1973), Norris, Jarzen, and Awai-Thorne (1975), and Nichols and Warner (1978).

REGIONAL GEOLOGIC SETTING

PHYSIOGRAPHY AND GEOMORPHOLOGY

Castle Valley is situated in east-central Utah in the northwestern corner of the Colorado Plateau physiographic province. It is bounded on the west by the Wasatch Plateau and on the north by the Book Cliffs and Uinta Basin and on the east by the San Rafael Swell. The southern end of Castle Valley is delimited by the Fish Lake Plateau volcanics of Tertiary age (Fig. 1).

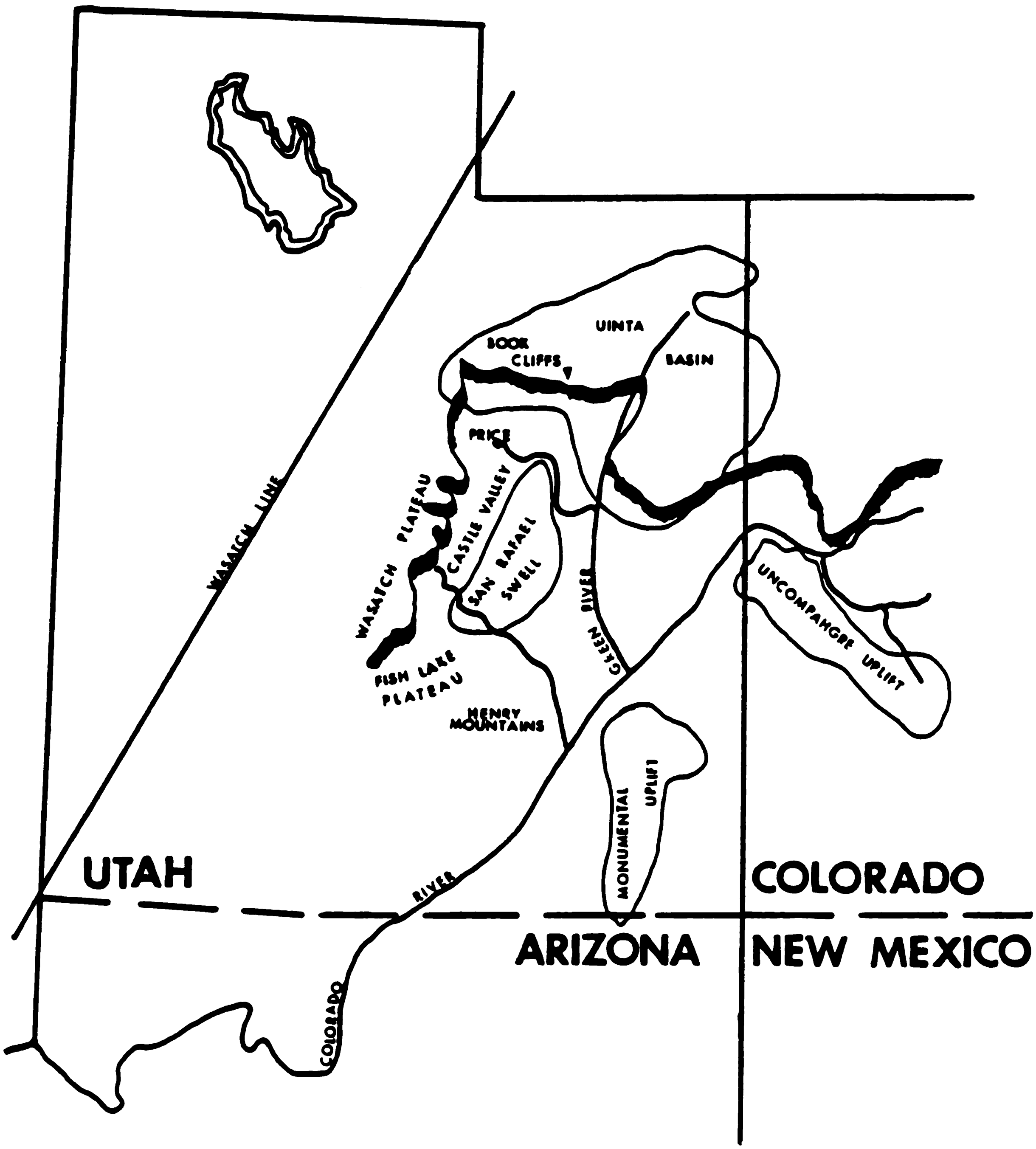
The valley itself resulted from faulting (Fig. 2) with the faults trending along the Wasatch Front. The area west of the major faults was uplifted. Upper Cretaceous deposits, including the Bluegate Shale, the Ferron Sandstone, and the Tununk Shale are exposed on the valley floor.

The Bluegate Shale crops out along the western side of the valley. The Ferron, which dips slightly westward, is found in outcrops along the length of the central valley and forms a prominent plateau or cuesta. East of the Tununk Shale, which is located east of the Ferron Plateau, some earlier Cretaceous and Jurassic deposits are exposed. In that area, numerous canyons have been cut into the soft shale.

GEOLOGIC HISTORY

The geologic history of central Utah has been influenced by its pivotal position relative to the hypothetical "Wasatch Line" (Stokes, 1977). Depositional patterns and tectonic history are in sharp contrast on either side of this line. The Wasatch Line extends southwest to northeast through west-central Utah (Fig. 1). Castle Valley lies roughly parallel to the Wasatch Line.

The Wasatch Line is identified as early as the late Precambrian. It has been inferred that the area along the Wasatch Line represents the late Precambrian rifting of a proto-North American continent (Burchfiel and Davis, 1972, 1975). Following the rifting and throughout the Paleozoic, the eugeosynclinal depocenter was to the west of the Wasatch Line. Throughout the Paleozoic the area east of the Wasatch Line was the primary source region for the sediment supplied to the eugeosyncline (Hintze, 1973). During the early Paleozoic, uplift just west of the Wasatch Line probably represents the first phase of the Farallon-North American



<u>FIGURE 1</u>: INDEX MAP

The study area is located in Castle Valley, which is in east-central Utah.

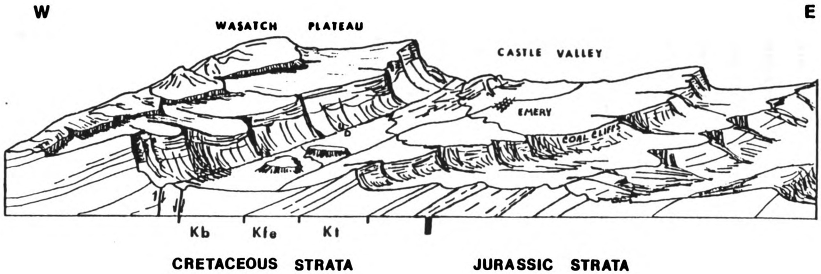


FIGURE 2: PHYSIOGRAPHY OF A PORTION OF THE STUDY AREA

Redrawn from Doelling, 1972b (Figure 7, p. 426).
Kb refers to the Bluegate Shale. Kfe refers to the Ferron Sandstone and Kt refers to the Tununk Shale.

plate collisions that lead to the subduction of the Farallon plate and the accretion of various segments of western North America (Howard, 1977). The Paleozoic Antler and Sonoma Orogenies represent later phases of this process.

By the late Triassic, the tectonic and depositional setting across the Wasatch Line had shifted and western Utah was a tectonically active highland. These new highlands, created by the Nevadian orogeny, supplied thousands of feet of clastics to the eastern Utah depocenter from the Triassic through the Jurassic (Armstrong, 1968a, 1968b; Hintze, 1973).

This Mesozoic trend of an eastern depocenter and a western source area continued through the Cretaceous, but with two additional developments. First, another orogenic pulse, the Sevier Orogeny, occurred. Like the Nevadian Orogeny, the Sevier Orogeny built mountains to the west of the Wasatch Line, which, in turn, supplied clastic sediments to the eastern Cordilleran miogeosyncline (Armstrong, 1968b).

The Sevier Orogeny, which continued through the Campanian (Armstrong, 1968b), was episodic. Many of these orogenic pulses have been correlated to specific clastic influxes (Spieker, 1946, 1949). Since the time of Spieker's summary, improved stratigraphic and structural correlations have related additional clastic wedges to western orogenic events (Katich, 1951, 1954; Osmond, 1964; Ryder and Ames, 1970; Gill and Cobban, 1973; King, 1977; Ryer, 1977b;

Nichols and Warner, 1978; Law, 1980; Richter, 1982; Cumella, 1983; Fouch et al., 1983; Ryer and McPhillips, 1983; Weimer, 1983; and Merewether and Cobban, (1985).

The second major event during the Cretaceous was the transgression of the Interior Seaway which began in the Early Cretaceous. By the Late Cretaceous, the Western Interior Sea formed a continuous broad seaway from the Arctic to the Gulf. By Santonian time, the transgression had reached its maximum and the sea regressed throughout the remainder of the Cretaceous (Hale and Van de Graaff, 1964; Kauffman, 1977, 1984). Both the transgression and regression of the sea were marked by many unequal, episodic reversals. Nine transgressive-regressive cycles during the Cretaceous have been postulated by Kauffman (1977, 1984). Of these nine cycles, the last four occurred in the Late Cretaceous. Kauffman (1977) refers to the Ferron as the R6 Cretaceous regression. Others (Hale and Van de Graaff, 1964; McGookey et al., 1972) refer to the Ferron as the R1 regression of the Late Cretaceous.

During the Laramide Orogeny, from the latest Cretaceous through Eocene time, much of Utah was uplifted and deformed. Marine sedimentation ended with the uplift. However, eastern Utah remained a center of deposition receiving both fluvial and lacustrine sediments. During the Oligocene, intense volcanic activity occurred in eastern Utah. This was followed by continued uplift, block faulting, and basaltic volcanism from the Miocene through Recent time.

Episodic alpine glaciation occurred from the Pleistocene through Recent time in the Wasatch, Uinta, and other mountain ranges throughout Utah (Hintze, 1973).

THE GEOLOGY OF THE MANCOS SHALE

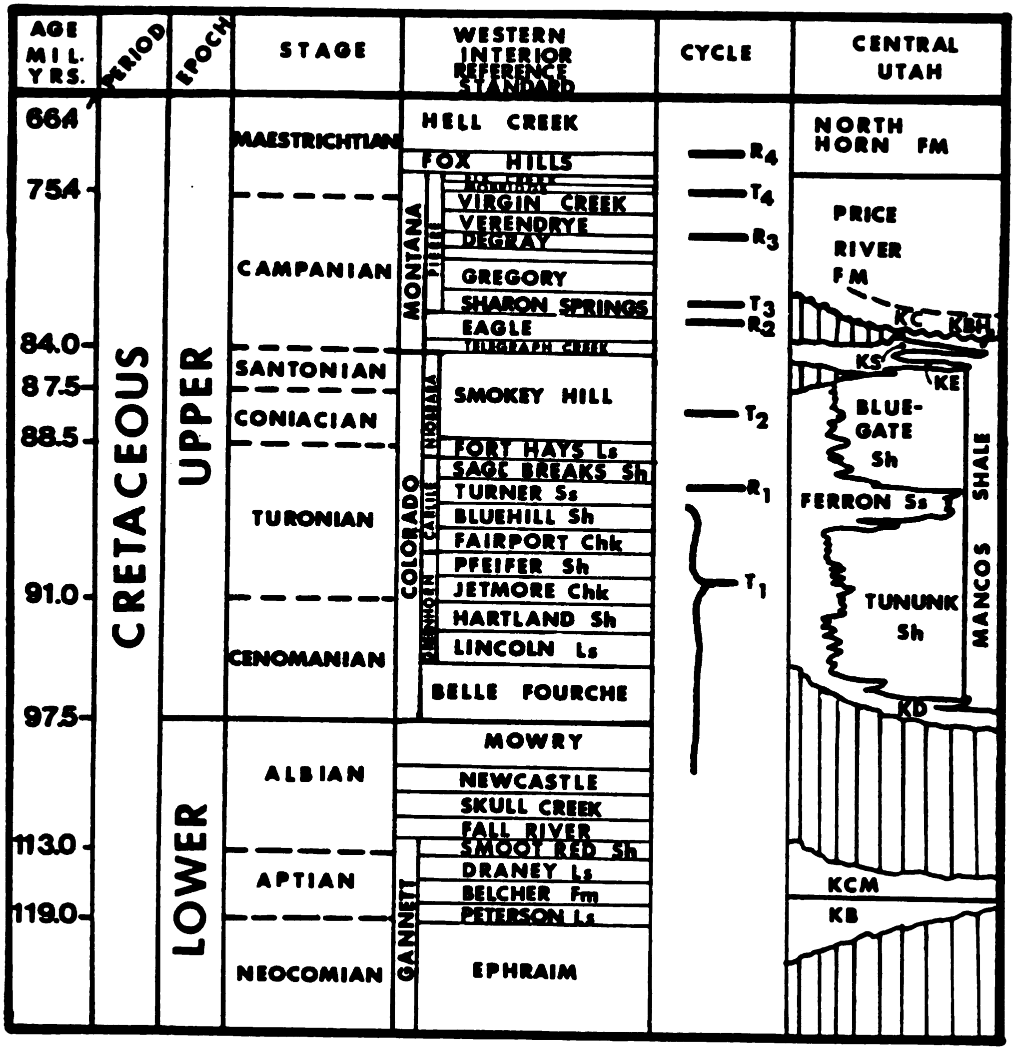
GENERAL REMARKS

The Mancos Shale was named by Whitman Cross (1899) for outcrops near the town of Mancos in southwestern Colorado. The Mancos Shale was deposited in the Western Interior Seaway from Cenomanian through Santonian time (Table 2; Fig. 3). It typically consists of over 2,000 ft (600-2,000 m) of shale, sandstone, and some limestone. The majority of the Mancos Shale represents marine facies, but several conspicuous terrestrial units occur in the western outcrops intercalated with marginal marine sediments. Several minor terrestrial units occur along the eastern margin of the seaway located between marginal marine sediments. The Mancos shale of the Castle Valley area is divided into several members. The basal three members, the Tununk Shale, Ferron Sandstone, and the Bluegate Shale, are considered in this study.

TUNUNK SHALE MEMBER

The Tununk Shale Member of the Mancos Shale was named by G. K. Gilbert (1877) for outcrops in the Tununk Plateau of the Henry Mountains region in Utah. It is comprised of argillaceous marine shales and mudstones. It conformably

TABLE 2: A CRETACEOUS GEOLOGICAL TIME SCALE



Modified from Hale and Van de Graaff (1964), McGookey *et al.* (1972), and Palmer (1983).

T = Transgression, R = Regression, KB = Buckhorn Member
KCM = Cedar Mountain Formation, KD = Dakota Sandstone
KE = Emery Sandstone, KS = Starpoint Sandstone
KBH = Blackhawk Formation, KC = Castlegate Sandstone

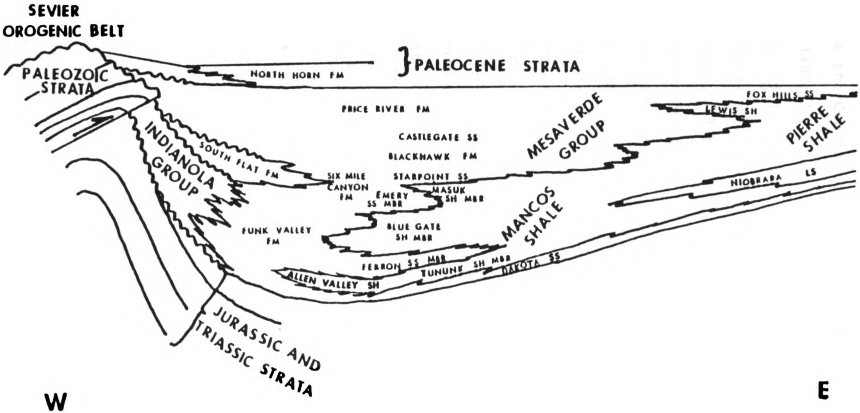


FIGURE 3: DIAGRAMMATIC CROSS SECTION OF CRETACEOUS STRATA THROUGH CENTRAL UTAH

After Armstrong, 1968b, Figure 5, p. 446.

Line of section from western Utah through western Colorado.

overlies the Cenomanian Dakota Sandstone and forms the basal 400 ft (100-150 m) of the Mancos in the Castle Valley area (Lupton, 1916; Fisher, Erdmann, and Reeside, 1960). The Tununk Shale is late Cenomanian (?) to middle Turonian in age (Cobban, 1976) and is, at least in part, equivalent to the Tropic Shale of central Utah, the lower Frontier Formation of northern Utah, and the Greenhorn Limestone of Colorado and New Mexico (Cobban and Reeside, 1952). The Upper Tununk Shale is part of the _Collignoniceras_ _wollgari_ Mantell biostratigraphic ammonite zone (Cobban and Reeside, 1952; Cobban, 1976; Kauffman, 1977). Lessard (1973) suggests that _C_. _wollgari_ may be indicative of nearshore environments and, therefore, may not be a time restricted index fossil.

FERRON SANDSTONE MEMBER

General Remarks

The Ferron Sandstone Member of the Mancos Shale was named by Lupton (1914) for sandstone and coal-bearing strata near the town of Ferron in the Castle Valley area of east-central Utah. The Ferron conformably overlies the Tununk Shale and is overlain by the Bluegate Shale. In the southern end of Castle Valley near the Fish Lake Plateau area, it is almost 800 ft (250 m) thick. It thins rapidly northward and near Price, Utah it is only 75 (23 m) thick in outcrop (Lupton, 1916). The sediments of the Ferron in northern Castle Valley and the lower Ferron in southern

Castle Valley form part of the Vernal Delta, which originated to the north and/or west of Castle Valley. The sediments of the upper Ferron in southern Castle Valley were deposited by the Last Chance Delta, which originated to the south and/or west of Castle Valley (Katich, 1953).

Age

The Ferron Sandstone is late middle to early late Turonian in age based upon invertebrate data (Cobban, 1976; Katich, 1954). Kauffman (1984) presented a Cretaceous time scale, which was based upon K-Ar dating of bentonites located throughout the western United States and upon invertebrate faunal zonation. Correlating the Ferron's position relative to the time scale presented by Kauffman yields an estimate of 500,000 years for the total deposition of the Ferron, which began nearly 89 million years age. Ryer and McPhillips (1983) estimated a duration of approximately one million years for the Ferron based upon invertebrate faunal zones.

Tectonics, Sedimentation, and Stratigraphy

The main body of the Ferron Sandstone represents a fluvial-deltaic system developed along the western margin of the Interior Seaway. Outcrops of the Ferron occur in Castle Valley and in the Henry Mountains region, which is located south and east of the valley. The Ferron continues in the subsurface west to the Wasatch Plateau, but core data are minimal and correlations tenuous. The Ferron Sandstone has been correlated, in part, to the Smoky Hollow Member of the Straight Cliffs Formation in south central Utah; to the lower Frontier Formation, Cody Shale, Carlile Shale, and the Turner Sandstone of Wyoming; to the Wall Creek Sandstone of Colorado and Wyoming; and the Juana Lopez Member of the Mancos Shale, the Dilco Formation, and the Gallup Sandstone in New Mexico (McGookey et al., 1972; Cobban and Reeside, 1952).

The Ferron Sandstone can be divided into two sedimentary phases: the lower Ferron and upper Ferron (Davis, 1954). The lower Ferron consists of the Washboard and the Clawson units (Cotter, 1975b, 1975c) and probably part of the first major sandstone, which represents approximately the lower 60-70 ft (18-21 m) of the Ferron (Ryer and McPhillips, 1983). This lower portion of the Ferron, which is primarily a broad sheet-like sandstone where exposed on the seaward margin of the coastal plain and adjacent continental shelf, originated from the north and west (Vernal Delta area).

The upper Ferron represents a fluvial-deltaic environment. Katich (1953) determined that the upper Ferron in the southern part of Castle Valley was derived from the west and southwest from the same highland source that deposited the Funk Valley Formation (Fig. 3). Cotter (1971) described the paleoflow characteristics of the Ferron River based upon an analysis of the sedimentary structures in the Ferron

Sandstone. The upper Ferron consists of alternating sands, shales, and coals. Ryer (1981b) differentiated five major cycles of deltaic sedimentation. He concluded that there was a genetic relationship between the geometries of the coal units and the delta front sandstones and considered that the Ferron coals occurred landward of each of the delta front sandstones. F. Peterson, Ryder, and Law (1980, p. 158) concluded that "most of the thick coal or carbonaceous mudstone beds lie on or directly landward from the coastal-barrier sandstone beds. . . ." Howard (1977) concluded that much of the coal deposition of the Western Interior developed behind active barrier island sands and represents the final stage of lagoonal filling. Marley et al. (1985) recognized several environments of coal deposition during the Campanian of the Western Interior but noted that back barrier environments were "conducive for the accumulation of thick, laterally extensive coals."

During the time of deposition of the Ferron, the area west of Castle Valley was tectonically active (McGookey et al., 1972; Armstrong, 1963, 1968b). This is evidenced by the thick sequence of coarse clastics of the Indianola Group, the clastic wedge (R1 regression of the Upper Cretaceous) that intertongues with the Mancos Shale along the entire western coast of the Interior Seaway, and the hiatus between the Allen Valley Shale and the Funk Valley Formation that indicates a period of uplift and erosion. Volcanic episodes were also numerous. Volcanic ash deposits, which have been altered to tonsteins and bentonites, are frequent and widespread in this region during the Turonian. Based upon the atmospheric circulation patterns postulated for the middle Cretaceous (Lloyd, 1982), the source of these volcanics must have been to the west and/or northwest in eastern Nevada-western Utah or southern Idaho. Gilluly (1965) also cited a north-western volcanic source region. This volcanic source area also was the site of plutonic emplacements during the middle Cretaceous (Lanphere and Reed, 1973).

BLUEGATE SHALE MEMBER

The Bluegate Shale Member of the Mancos Shale was named by G. K. Gilbert (1877) for outcrops in the Henry Mountains region. It is a marine shale and siltstone averaging 1,000 ft (300 m) thick. It is in sharp, but apparently conformable, contact with the underlying Ferron Sandstone in the Castle Valley area (Lupton, 1916). In the Henry Mountains region however, the Bluegate-Ferron contact is a disconformity representing most of late Turonian and all of Coniacian time (F. Peterson, Ryder, and Law, 1980; F. Peterson and Ryder, 1975). The Bluegate Shale Member of the Mancos Shale varies in age from late Turonian to Santonian (Cobban, 1976; D. J. Fisher, Erdmann, and Reeside, 1960; F. Peterson, Ryder, and Law, 1980).

REGIONAL PALEOBOTANICAL SETTING

GENERAL REMARKS

The flora of the Cretaceous contrasts strongly with that of earlier periods. During the Cretaceous the relative importance of bisaccate gymnosperms was waning. Bisaccate gymnosperms were rare or absent in South America and North Africa (Couper, 1964). Several fern groups, such as the Matoniaceae, Gleicheniaceae, and especially the Schizaeaceae, were diversifying while pteridosperms were rapidly declining. During the Aptian-Neocomian a new group of plants, the angiosperms, appeared in the fossil record. The advent and subsequent rapid diversification of the angiosperms profoundly altered the composition of the Cretaceous floras. Although pteridophyte-gymnosperm vegetation dominated early Cretaceous floras, by Turonian-Coniacian time the angiosperms were an important component of all Cretaceous floras (Singh, 1975; Herngreen and Chlonova, 1981; Srivastava, 1981).

The first angiosperms had monosulcate pollen superficially similar to that of some monosulcate gymnosperm pollen (Muller, 1970). The earliest accepted angiosperm pollen belong to several form genera including Clavatipollenites, Liliacidites, Stellatopollis, and Retimonocolpites (Muller, 1970; Singh, 1975; Herngreen and Chlonova, 1981).

During the Albian, the first tricolpate pollen appeared in the fossil record. The form genera Tricolpites, Asteropollis, Retitricolpites, and Tricolpopollenites are representative of this group (Muller, 1970; Doyle, 1978). Tricolporate and triporate angiosperm pollen appeared at least by the Cenomanian. The tricolporates include such genera as Nyssapollenites, Tricolporopollenites, Foveotricolporites, and Tricolporites (Muller, 1970; Doyle, 1978; Singh, 1975).

Triporate angiosperm pollen may be divided into two broad groups, the "Normapolles" group and the "non-Normapolles" triporate pollen. Early examples of the Normapolles genera include Complexipollis, Atlantopollis, Turonipollis, and Concavipollis. Late Cretaceous Normapolles genera include Trudopollis, Plicapollis, Oculopollis, and Vacuopollis (Zaklinskaya, 1981; R. H. Tschudy, 1980, 1981). The non-Normapolles triporates characteristic of the Upper Cretaceous include Proteacidites, Triorites, Triporopollenites, and Momipites (Couper, 1964; Muller, 1970; Singh, 1975; Srivastava, 1978, 1981). During the Turonian the distinctive "Aquilapollenites"-type angiosperm pollen appeared in western United States and Siberia. By the Campanian the Aquilapollenites-type pollen was a common palynomorph of terrestrial assemblages in these areas (Srivastava, 1981; B. Tschudy and Leopold, 1970).

Srivastava (1981) recognized only two phytogeoprovinces for the entire Lower Cretaceous. Herngreen and Chlonova (1981) distinguished three pre-Albian phytogeoprovinces. With the beginning of a general world-wide transgression by the Albian (Cooper, 1977), several additional phytogeoprovinces appear. These phytogeoprovinces were distinct by the beginning of the Upper Cretaceous. Brenner (1976), Srivastava (1981), and Muller (1970) recognized four major phytoprovinces during the Upper Cretaceous. Srivastava (1978) and Herngreen and Chlonova (1981) made distinctions between eight phytoprovinces during the Late Cretaceous. The four phytogeoprovinces, following Brenner's (1976) terminology, were the Northern Laurasian, Southern Laurasian, Northern Gondwana, and Southern Gondwana provinces. These roughly correspond to Srivastava's (1981) phytoprovinces that include the Aquilapollenites Province (Northern Laurasian), Normapolles Province (Southern Laurasian), Constantinisporis Province (Northern Gondwana), and the Nothofagidites Province (Southern Laurasian).

WESTERN UNITED STATES

Western United States is included in the Aquilapollenites Province of Srivastava (1981) or the North Laurasian Province of Brenner (1976). The floras in the southern half of this region, which includes the Castle Valley area, indicate a general subtropical vegetation and climate. The floras of the northern part of the province have a more temperate character (R. H. Tschudy, 1980; Norris, Jarzen, and Awai-Thorne, 1975; Batten, 1981; Nichols and Jacobson, 1982; Jarzen and Norris, 1975). The associated marine faunas support these interpretations of climatic trends (Kauffman, 1977, 1984).

During the Middle Cretaceous (Cenomanian to Coniacian), pteridophyte-angiosperm assemblages dominated the flora of the southern part of the Aquilapollenites phytogeoprovince (Srivastava, 1967). The palynoflora of the Middle Cretaceous of the western United States is very similar to that of the late Early Cretaceous. The most notable changes to the palynoflora include the rapid diversification and increased importance of the Schizaeaceae and the conifers Rugubivesiculites, Parvisaccites, and Phyllocladidites, the appearance of reticulate tricolporate angiosperm pollen and early examples of triporate angiosperm pollen (Muller, 1970; Norris, Jarzen, and Awai-Thorne, 1975; Srivastava, 1967, 1981; Herngreen and Chlonova, 1981).

Palynomorphs common to all areas of the western United States during the Middle Cretaceous include, among others: the pteridophytes Appendicisporites, Cicatricosisporites, Stereisporites, Cyathidites, Deltoidospora, Gleicheniidites, Osmundacidites, and Matonisporites; the gymnosperms Rugubivesiculites, Phyllocladidites, Taxodiaceaepollenites, Parvisaccites, Classopollis, and Eucommiidites; and the angiosperms, Liliacidites, Tricolpites, Tricolporopollenites, Nyssapollenites, Retitricolpites, and

Tricolpopollenites (Hedlund, 1966; Jarzen and Norris, 1975; Norris, Jarzen, and Awai-Thorne, 1975; Orlansky, 1971; Nichols and Jacobson, 1982; Herngreen and Chlonova, 1981).

Although it has generally been assumed that gymnosperms, especially saccate gymnosperm pollen were commonly present in the palynofloras of the Northern Hemisphere (Couper, 1964; Herngreen and Chlonova, 1981), this is not entirely true of the Western United States. Many studies have indicated that at various times gymnosperms in general occurred in low frequencies and that bisaccate conifer pollen was rare or absent during the Late Cretaceous. Several of these studies are here summarized.

Rouse, Hopkins, Jr., and Piel (1970) noted the lack of coniferous pollen in the coastal assemblages from the Santonian to the middle Eocene in British Columbia and Alberta, Canada. They also found few conifers in the interior assemblages of Canada from the Santonian to the Danian. Interior assemblages contained high percentages of conifers during the Tertiary.

Crickmay and Pocock (1963) found that saccate gymnosperms were rare in the Upper Cretaceous of British Columbia. Rouse (1962) found that bisaccates, particularly those of Pinus and Podocarpus, were rare in the Upper Cretaceous of Vancouver area, Canada.

Kidson (1971) noted the lack of bisaccate gymnosperms and the low frequency of occurrence of all gymnosperms in general in the Buck Tongue of the Mancos Shale (Upper

Cretaceous) in Utah and Colorado. R. Y. Anderson (1960) and Dickinson, Leopold, and Marvin (1968) noted low percentages of conifer pollen in their Upper Cretaceous samples from New Mexico and Colorado, respectively.

Thiessen and Sprunk (1937) reported a noticeable lack of conifer pollen in the Lower Sunnyside coal of the Blackhawk Formation of Utah (Campanian). Agasie (1969) reported that in the coal swamps of the Dakota Formation (Cenomanian, Arizona) gymnosperms constituted only a minor element of the palynoflora. The coal swamps were composed primarily of ferns, especially of the family Schizaeaceae.

Hedlund (1966) found that cycads and conifers were rare in the Red Branch Member of the Woodbine Formation, Cenomanian of Oklahoma. Pteridophytes and angiosperms dominated the assemblage.

Orlansky (1971) reported that bisaccate gymnosperms were rare in the Smoky Hollow Member of the Straight Cliffs Sandstone and overall, all gymnosperms occurred in low frequencies. More gymnosperms occurred in the Middle and Upper Members of the Straight Cliffs Sandstone, but bisaccate gymnosperms were still rare. He further noted that although Pinuspollenites dominates some samples (greater than 50%), it is rare or absent in coal samples.

Stanley (1965) and Hall and Norton (1967) both noted that bisaccate gymnosperm pollen was more common in the Tertiary than in the Late Cretaceous of South Dakota and Montana, respectively.

P. H. Griggs (1970a) noted that conifers were rare in the palynoflora of the Chuckanut Formation (Late Cretaceous to Middle Eocene, Washington) and absent from the megafossil flora from the same area.

Martinez-Hernandez (1981) noted that angiosperms dominated the Upper Cretaceous palynoflora of the Sand Wash Basin (Colorado). Gymnosperms were the least abundant group of palynomorphs. Two non-bisaccate gymnosperms were found to be abundant, however, in certain environments.

Sarmiento (1957) compared the relative abundances of several palynomorph groups during the deposition of the Upper Cretaceous Mancos Shale in the area of Book Cliffs, Utah. He found that the abundance of monosulcate pollen, tricolpate pollen, and trilete spores did not change significantly throughout the Mancos Shale. The relative abundance of conifer pollen and triporate angiosperm pollen, however, did vary considerably throughout the Mancos Shale. He found terrestrially derived microfossils to be rare in the Middle Cretaceous deposits of the Ferron Sandstone, Tununk Shale, and the Dakota Sandstone. These members of the Mancos Shale contained primarily microforams and marine algal cysts.

Several reasons can be suggested to explain the overall rarity of bisaccate gymnosperms and the general low abundance of most gymnosperms during many parts of the Late Cretaceous throughout much of western North America. These explanations relate to biological, sedimentological, and environmental conditions prevalent in western North America during the Late Cretaceous. Biological factors include both the production and dispersability of gymnosperm pollen. Because gymnosperms and especially conifers tend to produce vast amounts of pollen that are easily transportable by wind or water (Janssen, 1981; Muller, 1959; A. T. Cross, Thompson, and Zaitzeff, 1966), adverse biological factors cannot be considered as a valid explanation for the gymnosperm frequencies observed in the fossil record for the Late Cretaceous of western North America. Indeed, at some times and in some areas gymnosperms dominated the palynofloras. Burgess (1971) and Pierce (1961), among others, found fern-gymnosperm palynofloras in Wyoming and Minnesota, respectively, to be dominant in the Upper Cretaceous. Sarmiento (1957), as mentioned above, found conifers dominating the palynofloras of some levels of the Mancos Shale in Utah.

Sedimentological factors include the differential transportability of the palynomorphs and their differential preservability at their site of deposition. Although gymnosperms, especially conifers, tend to be rare or absent in many of the Upper Cretaceous coal palynofloras of western North America, they are present in coal palynofloras from other areas and different periods of time. Although it is possible for adverse sedimentological factors to effect observed palynomorph frequencies, it is difficult to account for such a large number of palynofloras lacking a notable conifer content due to adverse sedimentological factors.

The common occurrence of Cycadopites and Monosulcites gymnosperm pollen in the Ferron, which are easily destroyed by adverse depositional or preservational factors (Frederiksen, 1980), precludes any adverse sedimentological factors occurring during coal formation.

Rather, it appears more likely that climatic environmental factors are the primary reason for the overall distribution of gymnosperms, particularly the conifers, in western North America during the Late Cretaceous. Whitmore (1975, p. 170) states that conifers, except members of the Podocarpaceae, are "decidedly rare in . . . swampy or seasonally swampy sites . . ." in present day tropical deltas. Herngreen and Chlonova (1981) noted that bisaccate conifer pollen was rare or absent in either the warmer and/or drier environments during the Cretaceous. Today, conifers are mainly temperate to arctic plants of the northern hemisphere (Walter, 1979). Since much of western North America, including the Castle Valley area, was in a subtropical or warm temperate environment during most of the Late Cretaceous (Kauffman, 1984), the rarity of conifers in many of the coastal palynofloras can be seen to further substantiate the environmental conditions of the Late Cretaceous determined from other criteria (Kauffman, 1977, 1984).

DATA COLLECTION

LOCALITIES

Twenty-four sites (13 core and 11 outcrop) were sampled in the Castle Valley area of east-central Utah (Fig. 4, 5; Appendix I). The core samples were obtained from the Branch of Coal Resources, U.S. Geological Survey, Reston, Virginia (U.S.A.). The outcrop samples were collected by Dr. T. A. Ryer of the U.S. Geological Survey (presently with Research Planning Institute, Inc., Boulder, Colorado), and the author in July of 1981.

SAMPLING METHODS

Because of the wide variability and frequent fluctuations of lithologies in deltaic sequences, uniform sampling intervals were not utilized. Instead, the sampling interval was based primarily upon the frequency of lithologic changes and secondarily upon unit thickness. Sandstones were not sampled because they tend to be unproductive for palynological analysis (R. H. Tschudy, 1961). Representative samples were obtained from all major coal zones (A, C, G, I, and J) and from the widest lateral and vertical distribution of the Ferron. Limited sampling of the upper Tununk Shale and the lower Bluegate Shale was made for comparison with

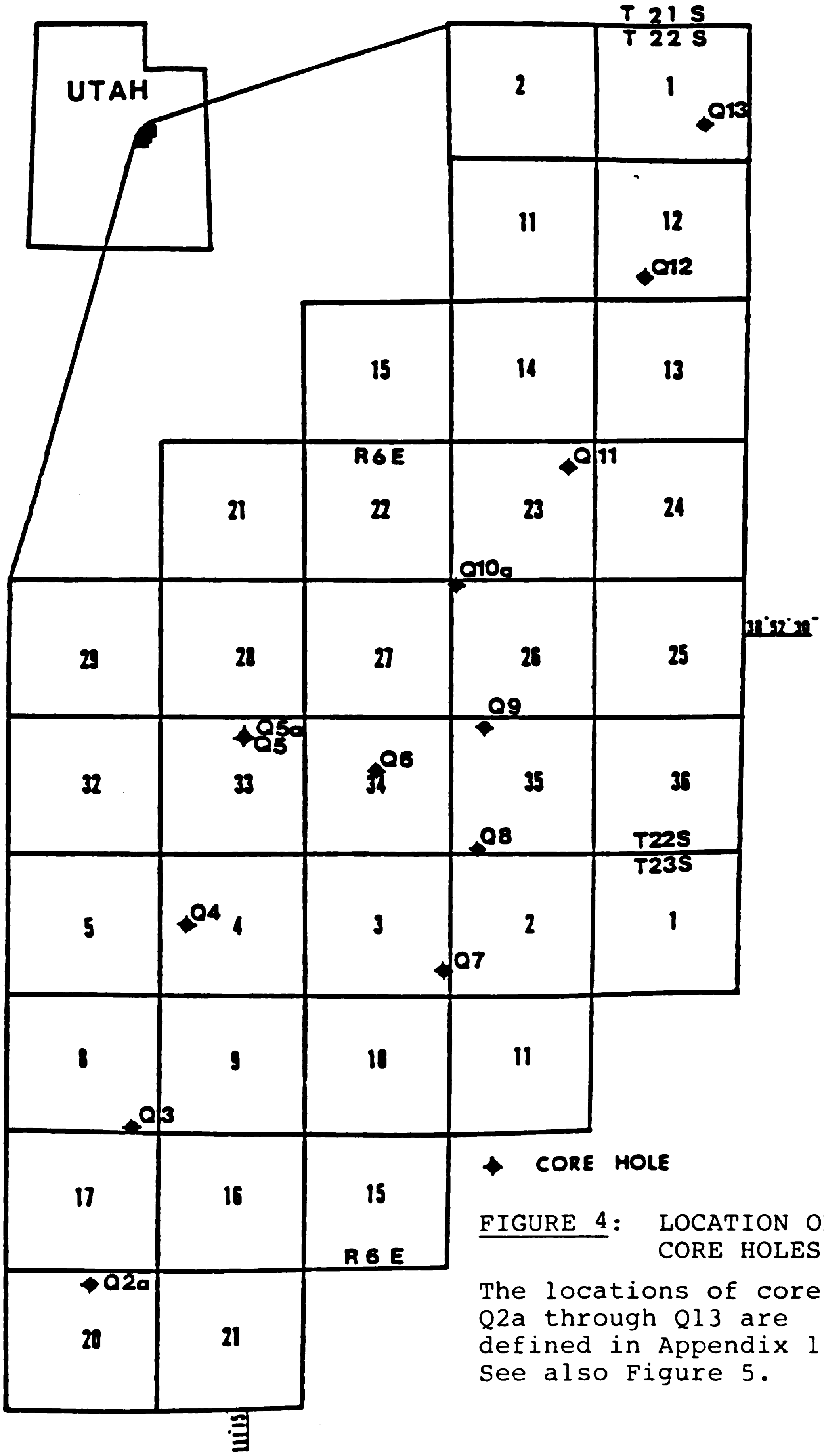
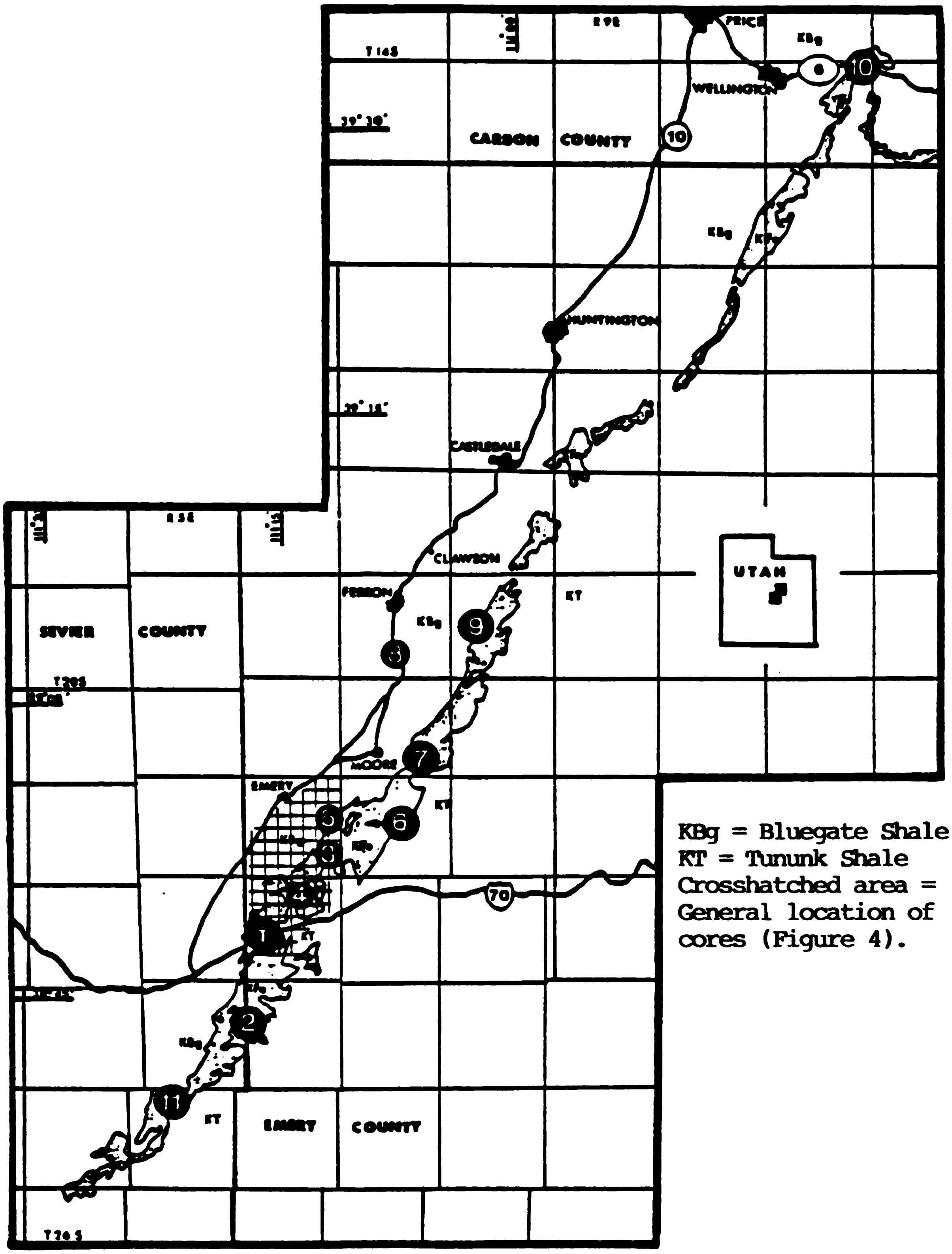


FIGURE 4: LOCATION OF CORE HOLES

The locations of cores Q2a through Q13 are defined in Appendix 1. See also Figure 5.



KBg = Bluegate Shale
KT = Tununk Shale
Crosshatched area = General location of cores (Figure 4).

<u>FIGURE 5</u>: OUTCROP LOCATIONS

The location of outcrop sites is indicated by the numbers 1-11. The stippled area (KFe) is the Ferron Sandstone outcrop.

the Ferron palynoflora. These samples were obtained from dark shales or siltstones located mainly near the Tununk-Ferron contact or the Bluegate-Ferron contact.

Eighty-six outcrop samples were obtained from the Tununk Shale, Ferron Sandstone, and the Bluegate Shale. Eleven outcrop samples were from the upper 100 feet of the Tununk Shale. Five outcrop samples came from the lower one-third of the Bluegate Shale. Seventy outcrop samples were from the Ferron Sandstone. However, not all coal zones and other sample areas of the Ferron Sandstone, Bluegate Shale, or the Tununk Shale contain productive samples. Locations of samples, both barren and productive, are shown in Figure 6 (also, Appendix I). Three localities, F1, F10, and F11, were sampled throughout the entire Ferron. All other outcrop localities represent only small portions of the Ferron, Tununk, or Bluegate. The lithology of the outcrop sections is described by Lupton (1916) for sections F2, F4, F5, F7, and F11. The section at F1 is described by Doelling (1972b), while the F10 section is described by Cotter (1975c). Appendix I contains a listing of outcrop and core sample lithologies and the stratigraphic interval represented by each sample utilized in this study.

All core samples came from the C coal zone and partings of the Ferron. The lithology of the cores is described by Ryer (1981a). The cores were split and crushed by the U.S. Geological Survey, Branch of Coal Resources. Crushed samples were taken from the shale partings, siltstones, and

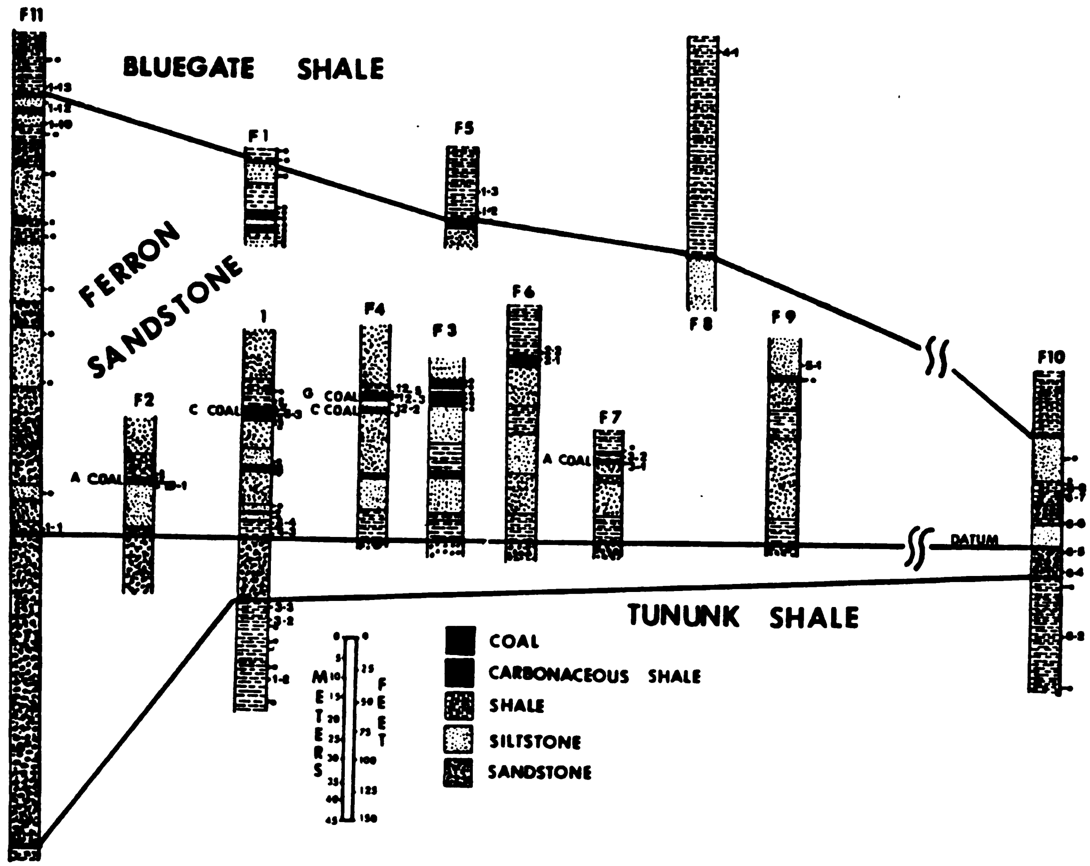


FIGURE 6: LOCATION OF PRODUCTIVE OUTCROP SAMPLES

Datum is defined as the top of the first major sandstone. The distribution of barren samples is indicated by stars. All samples from F3 are barren. Horizontal is not to scale. Refer to Figure 5 and Appendix I for location of sections. References for description of sections are cited in the text.

the top, middle, and bottom of the coal seams. A total of 212 samples were obtained from the cores. The location of the core samples is shown in Figure 7 (also, Appendix I). Barren samples from both cores and outcrops are listed in Appendix II.

CURATORIAL PROCEDURES

Samples obtained from the U.S. Geological Survey are identified by a combination of their project letter, core location number, and the sampling unit number. For example, "Q2-8" represents the Quitchupah core project, the 2nd core drilled, and the 8th sample from the top of the core.

Each outcrop sample was given an accession number, and the sample number for that location. For example, "7-18-81 II-8" represents the 8th sample collected at the IInd locality on 7-18-81. To simplify data handling, each major locality was assigned a field number. For example, "F11" represents all of the samples that came from the Last Chance Creek area.

All samples were assigned a maceration number when processed. All samples obtained were processed and received a maceration number regardless of their ultimate productivity. These numbers are part of the overall curatorial procedures used in the Palynology Laboratory at Michigan State University. Sample and maceration numbers are listed in Appendix I.

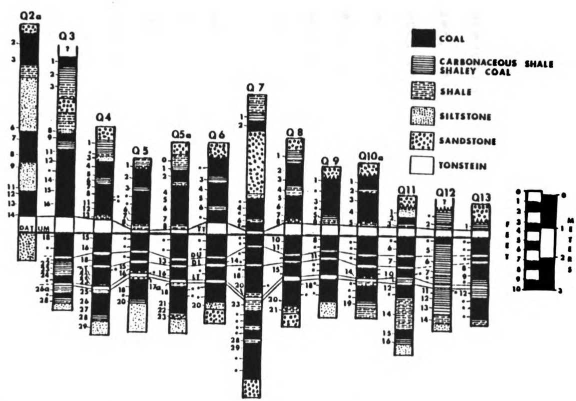


FIGURE 7: LOCATION OF PRODUCTIVE CORE SAMPLES

Datum is taken as the base of the thick tonstein. Core descriptions are based upon Ryer, 1981a. Barren samples are starred. Horizontal is not to scale. An erosional unconformity is present at the top of cores Q6 and Q9-Q13. TT = Thick Tonstein, DU = Upper Doublet Tonstein, DL = Lower Doublet Tonstein, LT = Lower Tonstein

All samples, residues, slides, and maceration schedules are housed in the Herbarium of Fossil Plants at Michigan State University, East Lansing, Michigan (U.S.A.). The original cores are housed with the Branch of Coal Resources, U.S. Geological Survey, Reston, Virginia (U.S.A.).

PREPARATION OF MATERIALS

Maceration Methods

Standard palynological preparation procedures were utilized. All 212 core samples and 86 outcrop samples were processed for palynomorphs. Every attempt was made to treat samples in a similar manner in order to avoid introducing unique biases into the results. Minor modifications of the standard procedure were deemed necessary to adequately process some samples. These modifications primarily involved the timing in a particular step of the overall procedure. Because the chemicals used and the maceration process may destroy some palynomorphs, samples were treated with the minimal chemical treatment necessary in order to retrieve palynomorphs. The following basic procedure was used:

1) Crush to pea size approximately 3/4 of the sample. Core samples were already crushed when received.
2) Obtain 5 gram aliquots of all coal and carbonaceous shale samples, 10 grams of all other shale, and 20 grams of all other lithologies.

3) Process according to one of two schedules. Use schedule A+B for gray shales, siltstones, and tonsteins. Use schedule B for coals and carbonaceous shales or shaley coals.

Schedule A

1) 10% HCl until effervescence stops; stir occasionally and add fresh HCl if necessary.
2) Wash; repeat until neutral.
3) 48% HF for 48 hours; stir occasionally and add fresh HF if necessary.
4) Wash; repeat until neutral.

Schedule B

1) Saturate with Schulze Solution (7.4 parts aqueous reagent grade HNO_3 to 1 part saturated aqueous solution $KClO_3$ for 3-10 minutes in a steam bath.
2) Wash; repeat until neutral.
3) 5% KOH for 3-5 minutes or until humic acids are released.
4) Wash; repeat until neutral.
5) Stain 1/2 of residue with 1% Safranin O in NH_4OH.
6) Wash; repeat until neutral.
7) Sieve into 3 fractions: greater than 250 um, less than 7 um, and greater than 7 um but less than 250 um.
8) Check greater than 250 um fraction for palynomorphs; if none are found, discard. Discard the

less than 7 um fraction if palynomorphs are not present.

9) Place fractions in 1 dram vials and saturate with HEC (hydroxyethylcellulose). Add phenol to the residue in order to retard fungal growth.

The procedure was repeated for unproductive samples. If the second maceration was also unproductive, several modified techniques were tried. These modifications of the basic procedure included using only Schedule A on shales and siltstones, using Schulze solution at room temperature for 3-48 hours, not using KOH, using KOH for 30 minutes, or using Schulze Solution at 10:1 or 5:1 ratios of HNO_3 to $KClO_3$. Only when all of these variants proved ineffective was a sample rejected as barren.

Slide-Making Technique

Slides were made of each residue fraction as follows:

1) Place one drop of residue on a coverslip spreading evenly over the coverslip surface with a toothpick.
2) Allow coverslip to dry on a warming table.
3) Place 2-3 drops of mounting medium on top of the dried residue on the coverslip. Slowly place a slide on top of the coverslip making sure that no air bubbles form in the mounting medium and the mounting medium spreads evenly between the slide and the dried residue on the coverslip.

4) Allow slide to dry on a warming table.

5) Make additional slides of each fraction of a sample residue as needed.

Photography

Photomicrographs of the palynomorphs were obtained using Panatomic X (Asa 32, black and white) film with a Leitz Orthomat Microscope camera mounted on a Leitz Ortholux microscope. Standard film and print processing techniques were used. Photographs were printed at 1000X or 540X by reference to photographs of a standard stage micrometer.

DATA ANALYSIS PROCEDURES

Determination of Sample Productivity

During preliminary screening of the prepared samples, four sample categories, Barren, Poor, Fair, and Excellent, were utilized to indicate quantity or productivity. These categories were based on the number of palynomorphs present. Barren samples contained no palynomorphs. Samples labeled "Poor" contained fewer than 50 palynomorphs per slide and often had either a high cuticular content or represented woody coals. Fair samples contained between 50 and 200 palynomorphs per slide (typically less than 100 palynomorphs per slide). Excellent samples contained greater than 200 palynomorphs per slide.

On the basis of trial counts of randomly selected samples, it was decided that a pollen/spore sum of 500 was necessary for "Excellent" samples in order to obtain a representative sampling of the palynoflora. Similarly, a pollen/spore sum of 300 was deemed sufficient for "Fair" samples. Poor productivity samples did not yield a minimum 200 pollen/spore sum after examining 10 productive slides. The pollen/spore count for these samples was arbitrarily ended after counting 10 slides. "Poor" productivity samples were often from woody coals or had a high cuticular content. Representative sample plots of "Count Number versus Number of Taxa" for a typical "Fair" sample (Q12-12) and a typical "Excellent" sample (Q4-25) are shown in Figure 8. The significance of the variations in sample productivity are discussed later. A total of 133 samples, which include 54 from outcrops and 76 from cores, were barren. These are listed in Appendix II. Barren samples are excluded from this study. Appendix II also lists samples according to their lithology and productivity.

Counting Procedure

In order to further minimize introducing unique biases into the analyses, the slides were systematically scanned. A 22 mm^2 coverslip was divided into equally spaced traverses. There are 49 non-overlapping traverses per coverslip using a 54X objective with a 15X ocular. The counting procedure was as follows:

1) Count from the top to the bottom beginning in the center of the coverslip (traverse line #25).

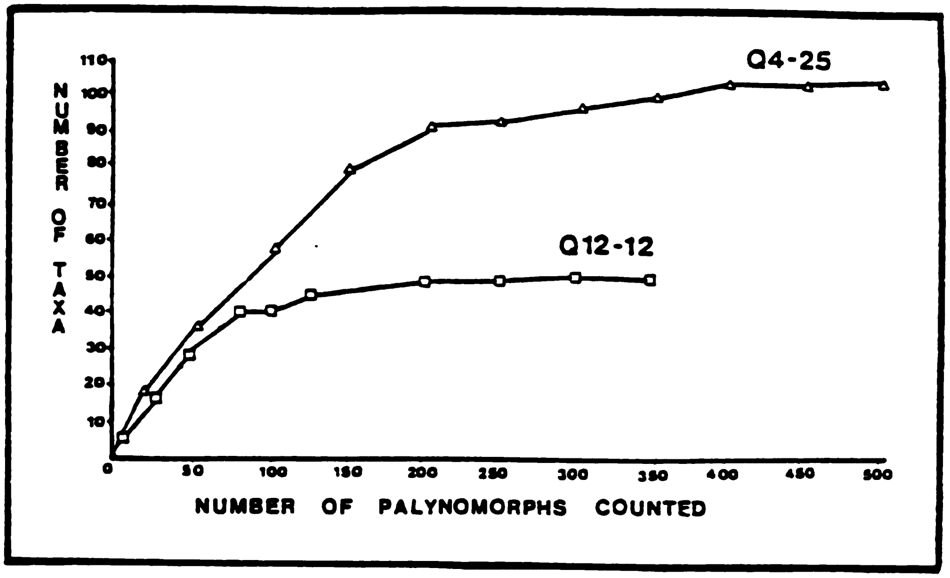


FIGURE 8: DETERMINATION OF SAMPLE COUNTS

Core sample Q4-25 represents a high productivity, high diversity sample. This sample has been termed an "Excellent" sample type and requires a palynomorph count of 500 in order to obtain an adequate representation of the palynoflora.

Core sample Q12-12 represents a medium productivity, average diversity sample. This sample has been termed a "Fair" sample type and requires a palynomorph count of 300 in order to obtain an adequate representation of the palynoflora.

Samples with low productivity and low diversity, the "Poor" sample type, have not been plotted. The relationship between productivity and diversity is discussed in later sections.

2) Scan with the 54X objective counting all grains that have their center in the field of view.

3) When a palynomorph is located, increase the magnification in order to identify the grain. Identify to the smallest taxonomic group possible. Fungal spores were not differentiated into species, but were counted as a single category.

4) Count only those palynomorphs greater than 7 um in diameter.

5) Proceed along traverse lines 25-49 consecutively until the appropriate number of palynomorphs have been counted. Continue counting on traverse lines 24-1.

6) Continue counting procedure, as defined above, on additional slides of the sample if insufficient palynomorphs are present on the first slide. Any sample that contains less than 300 palynomorphs in 10 slides is considered to be a "Poor" sample.

7) Once the appropriate count has been reached, continue to scan the slide(s) and record any other palynomorphs found which were not encountered in the appropriate count.

PALYNOLOGY AND FLORISTIC RELATIONSHIPS

SAMPLE PRODUCTIVITY

A total of 298 samples were processed and palynomorphs recovered from 165 samples. This represents a 55% recovery rate (Table 3). Overall, core sample productivity, defined as a sample that contains palynomorphs, is higher (64%) than that of outcrop samples (34%). Sixty percent of shale and siltstone samples from the outcrop are barren compared to only 12% of core shale and siltstone samples. Seventy-six percent of coal and coaly shale samples from the outcrop are barren compared to only 40% of core coal and coaly shale samples. However, when the location of the samples (core versus outcrop) is ignored, there are no significant differences in the productivity of the various lithologies (Table 4; also, Statistical Calculations, Appendix III). Overall, 59% of all shale and siltstone samples, regardless of source, are productive and 54% of all coals and coaly shales are productive.

Compared to other palynological studies, overall sample productivity is somewhat low although not atypically so. Sarmiento (1957) observed that both the Ferron and the Tununk in Castle Valley tended to be unproductive palynologically. Burgess (1971) found that coal samples of

TABLE 3: SAMPLE PRODUCTIVITY

	OUTCROP SAMPLES		CORE SAMPLES		TOTAL	
PRODUCTIVE	29	(34%)	136	(64%)	165	(55%)
BARREN	57	(66%)	76	(36%)	133	(45%)
TOTAL	86	(100%)	212	(100%)	298	(100%)

LITHOLOGY: SHALE-SILTSTONE

	OUTCROP SAMPLES		CORE SAMPLES		TOTAL	
PRODUCTIVE	21	(40%)	30	(88%)	51	(59%)
BARREN	31	(60%)	4	(12%)	35	(41%)
TOTAL	52	(100%)	34	(100%)	86	(100%)

LITHOLOGY: COAL-COALY SHALE-SHALEY COAL

	OUTCROP SAMPLES		CORE SAMPLES		TOTAL	
PRODUCTIVE	8	(24%)	106	(60%)	114	(54%)
BARREN	26	(76%)	72	(40%)	98	(46%)
TOTAL	34	(100%)	178	(100%)	212	(100%)

TABLE 4: SAMPLE LITHOLOGY VERSUS SAMPLE PRODUCTIVITY

LITHOLOGY	PRODUCTIVITY				
	EXCELLENT	FAIR	POOR	BARREN	TOTAL SAMPLES
COAL	25	39	19	86	169
SHALE	14	16	8	23	61
SILTSTONE	4	5	4	12	25
COALY SHALE-SHALEY COAL	12	9	10	12	43
TOTAL SAMPLES	55	69	41	133	298

PRODUCTIVITY: Excellent = Palynomorph count of 500

Fair = Palynomorph count of 300

Poor = Palynomorph count less than 200

Barren = No recoverable palynomorphs present

No significant difference in the relative productivity of various lithologies, coal, shale, siltstone, or coaly shale/shaley coal, is noted.

the Frontier Formation of Wyoming were usually barren and generally woody. In a study of the Dakota Formation, Agasie (1969) found outcrop coals to be the least productive of the sediments studied. This is also true of the Ferron.

Barren or low productivity samples may result from several factors (Janssen, 1981). Weathering, seen in most outcrop samples, often destroys some or all of the organic matter, including the palynomorphs. In contrast, core samples are generally not weathered to any significant extent. In addition to weathering, the maceration process itself may destroy palynomorphs if the samples are over-treated with harsh chemicals. Because all barren samples were reprocessed, excessive maceration of the samples is probably not a major factor in determining sample productivity.

Barren samples may also result from environmental conditions at the site of deposition. Rapid deposition of clastic sediment can significantly reduce the concentration of palynomorphs per gram of sediment. An oxidizing depositional environment (high Eh) or extensive biodegradation can also destroy organic matter. However, large amount of organic matter may be present in a sample, especially coals, yet palynomorphs may be absent. This is generally due to the large amount of organic detritus, cuticular, woody, or amorphous, in the sample residues, especially coals, which tends to dilute the number of palynomorphs or simply obscures them from view. Riegel (1965) found that relatively dry peat swamp environments often produce cuticular or woody peats that have a low palynomorph content.

In addition to environmental conditions, biological factors also influence the ultimate productivity of a sample (Janssen, 1981). Plants produce spores or pollen in vastly different quantities and with varying degrees of transportability and preservability. Thus, some plant assemblages will leave more diverse palynomorph signatures in the fossil record than others.

Of the 165 productive samples (excellent, fair, and poor productivity) from this study, four samples came from the Tununk Shale and four samples were from the Bluegate Shale. Of the remaining 157 productive samples from the Ferron Sandstone Member, five samples came from the A coal zone, two from the G coal zone, and one each from the I and the J coal zones. Nine productive samples came either from the lowermost or the uppermost Ferron located in unnamed zones. The remaining 139 productive samples were from the C coal zone.

TAXONOMIC LISTING

A total of 170 taxa were differentiated, many to species level (Table 5). This includes 94 genera. Of the identified taxa, 1 is a zygnemataceous algal cyst, 9 are acritarchs, 18 are dinoflagellates, 59 are pteridophytes, 23 are gymnosperms, and 60 are angiosperms. In addition, four

TABLE 5: FERRON-TUNUNK BLUEGATE PALYNOFLORA

TAXONOMIC ENTITY	FERRON	TUNUNK	BLUEGATE
FUNGI			
Fungal Spores	X	X	X
ALGAE			
Zygnemataceae			
Schizosporis sp.	X	X	X
Dinophyceae			
Cleistosphaeridium multifurcatum	X	X	X
Cleistosphaeridium sp.	X	X	X
Cordosphaeridium fibrospinosum. .	X		X
Deflandrea tripartita	X		X
Deflandrea sp.	X	X	X
Exochosphaeridium sp.	X	X	X
Gonyaulacysta sp.	X	X	X
Hexagonifera chlamydata	X		X
Hystrichodinium pulchrum.	X	X	X
Hystrichodinium voigti.	X	X	X
Hystrichosphaeridium ramosa . . .	X	X	X
Nannoceratopsis plegas.	X	X	X
Paleohystrichophora infusorioides	X	X	X
Pareodinia sp.	X		X
Prismatocystis ewengii.	X		X
Scriniodinium sp.	X	X	X
Dinoflagellate Form A	X	X	X
Dinoflagellate Form B	X	X	X
Dinoflagellate Opercula	X		X
Acritarcha			
Ascotomocystis hydria		X	X
Baltisphaeridium sp. 1.		X	X
Baltisphaeridium sp. 2.	X	X	X
Baltisphaeridium sp. 3.	X	X	X
Cymatiosphaera sp.	X		X
Leiosphaeridia sp. 1.	X	X	X
Leiosphaeridia sp. 2.	X	X	X
Micrhystridium inconspicuum . . .	X		X
Micrhystridium sp.			X

TABLE 5 (cont'd)

PTERIDOPHYTES			
Bryophyta			
Sphagnaceae			
Cingutriletes clavus	X	X	
Stereisporites antiquasporites	X		
Stereisporites psilatus	X	X	
Lycophyta			
Lycopodiaceae			
Camarozonosporites sp.	X		
Foveosporis triangulus	X	X	X
Neoraistrickia breviclavata	X		
Perotriletes pannuceus	X		
Perotriletes rugulatus	X	X	
Perotriletes striatus	X		
Selaginellaceae			
Calamospora mesozoica	X		
Cingulatisporites dakotensis	X		
Densoisporites microrugulatus	X		
Pterophyta			
Cyatheaeceae-Dicksoniaceae			
Cyathidites minor	X		
Ischyosporites sp.	X		X
Gleicheniaceae			
Deltoidospora psilostoma	X	X	
Gleicheniidites circiniidites	X		
Gleicheniidites juriensis	X	X	
Gleicheniidites senonicus	X		
Matoniaceae			
Matonisporites conspicuus	X	X	
Matonisporites crassimurus	X		
Matonisporites dorogensis	X	X	
Osmundaceae			
Osmundacidites wellmanii	X	X	
Todisporites major	X	X	

TABLE 5 (cont'd)

Polypodiaceae			
Laevigatosporites haardtii. . .	X	X	
Laevigatosporites irroratus . .	X		
Laevigatosporites ovatus. . . .	X		
Polypodiidites arcus.	X		
Schizaeaceae			
Appendicisporites bifurcatus. .	X		
Appendicisporites bilateralis .	X		
Appendicisporites erdtmanii . .	X		
Appendicisporites potomacensis.	X		
Appendicisporites tricostatus .	X		
Chomotriletes almegrensis . . .	X		
Chomotriletes fragilis.	X		
Cicatricosisporites dorogensis.	X		
Cicatricosisporites hallei. . .	X		
Cicatricosisporites mohrioides.	X		
Cicatricosisporites terminatus.	X		
Cicatricosisporites sp.	X	X	X
Cicatricosisporites potomacensis	X		X
Microfoveolatosporites canaliculatus	X	X	X
Triplanosporites sinuosus . . .	X	X	
Marattiaceae			
Punctatosporites rimosus. . . .	X	X	
Spores *Incertae Sedis*			
Cardioangulina triceps.	X		
Concavisporites rugulatus . . .	X		
Concavisporites sp.	X		
Divisisporites sp.	X		
Extrapunctatosporis oblongius .	X		
Foraminisporites asymmetricus .	X		
Foveosporites sp.	X		
Leptolepidites major.	X		
Leptolepidites verrucatus . . .	X		
Stenozonotriletes stellatus . .	X	X	
Taurocusporites reduncus. . . .	X		
Verirugosisporites sp.	X	X	X
Verucatosporites pseudoreticulatus	X		
Verucosisporites secundus . . .	X		
Monolete Spore Form A	X	X	X

TABLE 5 (cont'd)

GYMNOSPERMS			
Gnetophyta			
Ephedraceae			
Equisetoporites ovatus	X		
Equisetoporites saskatoonensis.	X		
Equisetoporites sp.	X		
Ginkgophyta-Cycadophyta			
Bennettitaeapollenites sp. . . .	X		
Ginkgocycadophytus sp.	X		
Cycadopites minimus	X		
Cycadopites pseudolatus	X	X	X
Cycadopites reticulatus	X	X	X
Coniferophyta			
Cheirolepidiaceae			
Classopollis classoides	X	X	
Araucariaceae			
Araucariacites sp.	X	X	X
Taxodiaceae-Cupressaceae-Taxaceae			
Inaperturopollenites sp. . . .	X	X	
Sequoiapollenites sp.	X	X	
Taxodiaceaepollenites hiatus. .	X	X	X
Pinaceae			
Alisporites similis	X	X	X
Podocarpaceae			
Parvisaccites radiatus.	X	X	
Phyllocladidites mawsoni. . . .	X		X
Rugubivesiculites sp.	X	X	
Incertae sedis			
Confertisulcites fusiformis . .	X		
Monosulcites minimus.	X	X	
Monosulcites perspinosus. . . .	X		
Monosulcites sp.	X	X	
Perinopollenites sp.	X		
Eucommiidites sp.	X	X	X

TABLE 5 (cont'd)

ANGIOSPERMS

Anthophyta

Monocotyledoneae

Arecipites sp.	X		
Clavatipollenites prolatus. . .	X		
Liliacidites clavatus	X	X	
Liliacidites inaequalis	X	X	
Liliacidites peroreticulatus. .	X	X	
Liliacidites textus	X	X	
Liliacidites sp.	X	X	
Monocolpopollenites tranquillus	X		
Monocolpopollenites zievelensis	X	X	
Monocolpopollenites sp. 1 . . .	X	X	
Monocolpopollenites sp. 2 . . .	X		
Monocolpopollenites sp. 3 . . .	X		
Palmaepollenites minusculus . .	X		
Palmaepollenites tranquillus. .	X		
Proxapertites cursus.	X		
Retimonocolpites fragilis . . .	X		
Retimonocolpites sp.	X	X	

Dicotyledoneae

Ajatipollis sp.	X		
Cupaneidites sp.	X		
Cupuliferoidapollenites minutus	X		
Foveotricolpites rhombohedralis	X		
Nyssapollenites albertensis . .	X	X	
Polycolpites sp.	X		
Porocolpopollenites sp.	X		X
Psilatricolpites parvulus . . .	X	X	
Psilatricolpites prolatus . . .	X		
Retitricolpites vulgaris. . . .	X	X	X
Retitricolpites maximus	X		
Retitricolpites sp.	X		
Rousea georgensis	X		
Rousea miculipollis	X		X
Subtriporopollenites reticulatus	X		
Tricolpites aoristus.	X		
Tricolpites crassimurus	X		
Tricolpites foveolatus.	X	X	
Tricolpites hians	X		
Tricolpites psilascabratus. . .	X		
Tricolpites sagax	X	X	
Tricolpites variabilis.	X	X	
Tricolpites sp. 1	X		
Tricolpites sp. 2	X		
Tricolpites sp. 3	X		
Tricolpopollenites distatus . .	X	X	

TABLE 5 (cont'd)

Tricolpopollenites henrici. . .	X		
Tricolpopollenites microscabratus	X		
Tricolpopollenites simplicissimus	X	X	
Tricolpopollenites sp. 1. . . .	X		
Tricolpopollenites sp. 2. . . .	X		
Tricolpopollenites sp. 3. . . .	X	X	
Tricolpopollenites sp. 4. . . .	X	X	
Tricolpopollenites sp. 5. . . .	X	X	
Tricolpopollenites sp. 6. . . .	X		X
Tricolporopollenites aliquantulus	X		
Tricolporopollenites inductorius	X		
Tricolporopollenites intergranulatus	X	X	
Tricolporopollenites platyreticulatus.	X	X	
Tricolporopollenites punctatus.	X		
Tricolporopollenites venustus .	X	X	
Tricolporopollenites sp. . . .	X	X	
Vitipites sp.	X	X	
INCERTAE SEDIS			
Unidentified algae.	X	X	X
Unidentified spores	X	X	X
Unidentified gymnosperm pollen.	X	X	X
Unidentified angiosperm pollen.	X	X	X
Unidentified palynomorphs . . .	X	X	X

dinoflagellate opercula have been observed in the samples. Several types of fungal spores are present, but they have not been differentiated into species.

The flora is arranged according to extant hierarchical relationships (Table 5), but the antiquity of this flora makes precise taxonomic placement in this context very problematical. In some cases reliable taxonomic determinations can be made only at the Division, Class, or Ordinal levels. This is the case with all of the angiosperms and fungal spores and some gymnosperms, ferns, and algae. The palynomorphs of the Ferron Sandstone, Tununk Shale, and the Bluegate Shale are summarized in Table 5.

In order to simplify analysis the palynoflora has been grouped into five categories. These categories include: 1) dinoflagellates and acritarchs, 2) Sphagnaceae and Zygnemataceae, 3) pteridophytes, 4) gymnosperms, and 5) angiosperms. Because of the limited value of fossil fungal spores in ecological and stratigraphic analyses at the present state of the science, the group fungal spores was not utilized in this study. However, fungal spore counts are given in Appendix II. The relative frequencies of occurrence of the five groups are tabulated in Appendix II for all samples. For the C coal of the Ferron, the changes in relative frequencies for these five groups have been plotted in core palynomorph profiles. These core palynomorph profiles are illustrated in Figures 9-21. The

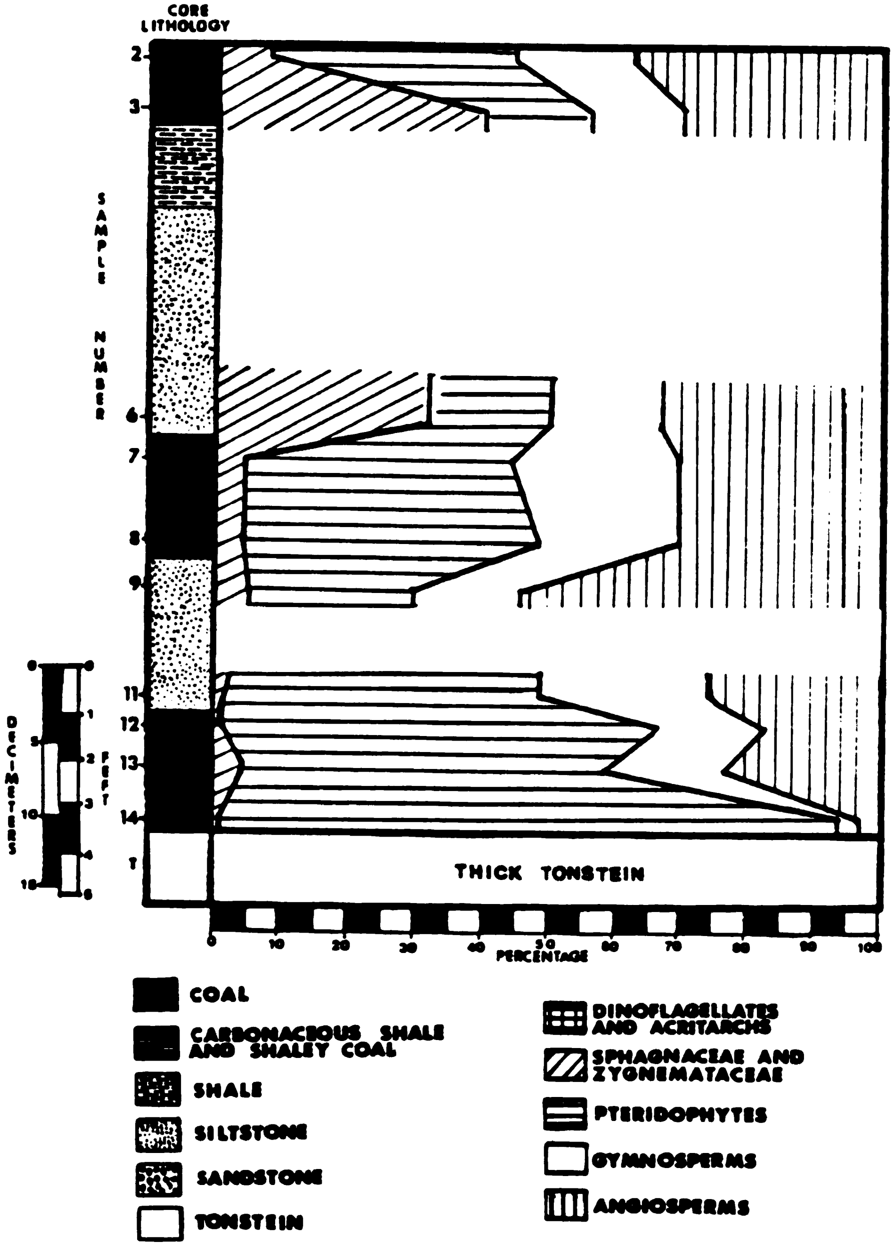


FIGURE 9: CORE Q2a: PALYNOMORPH PROFILE

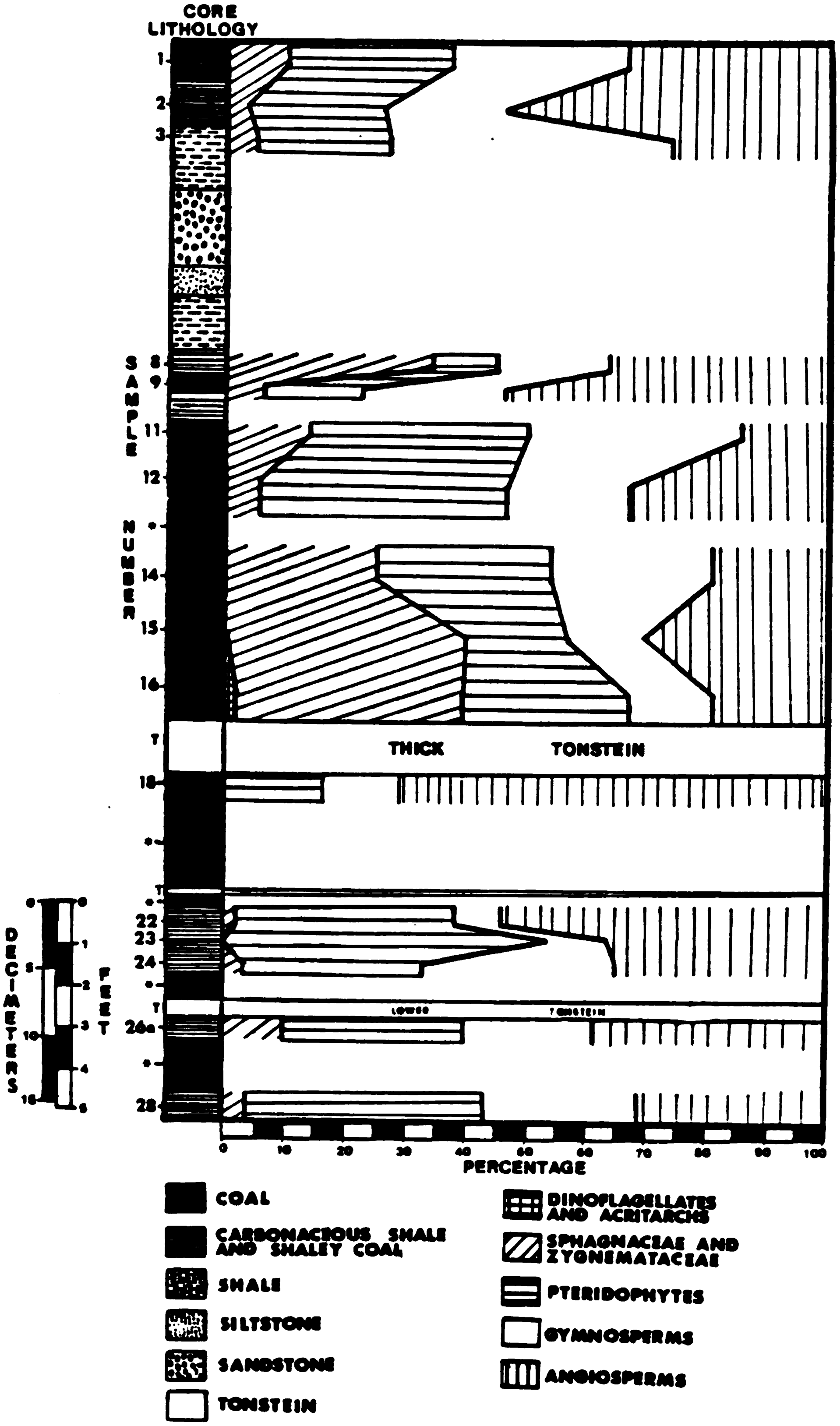


FIGURE 10: CORE Q3: PALYNOMORPH PROFILE

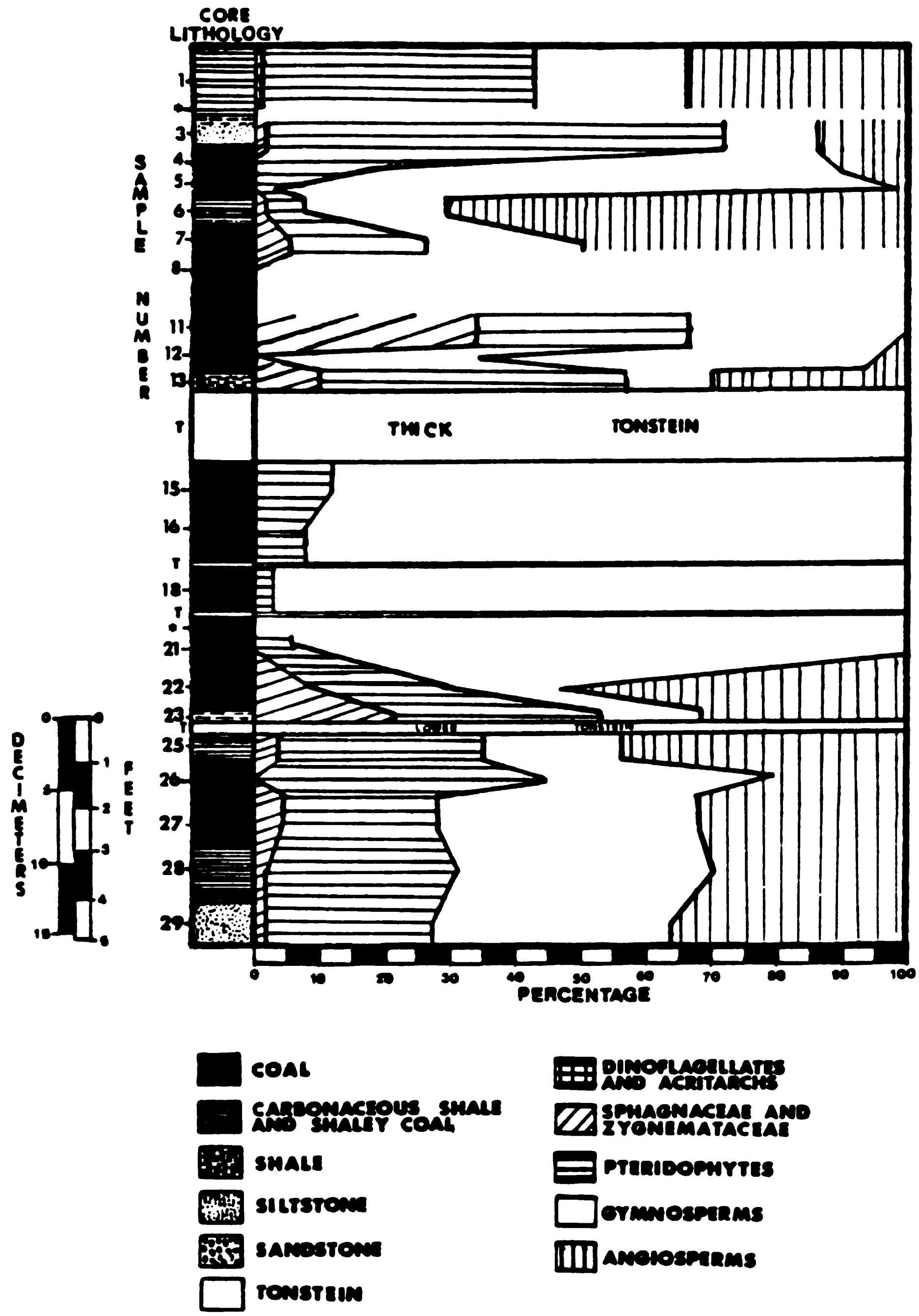


FIGURE 11: CORE Q4: PALYNOMORPH PROFILE

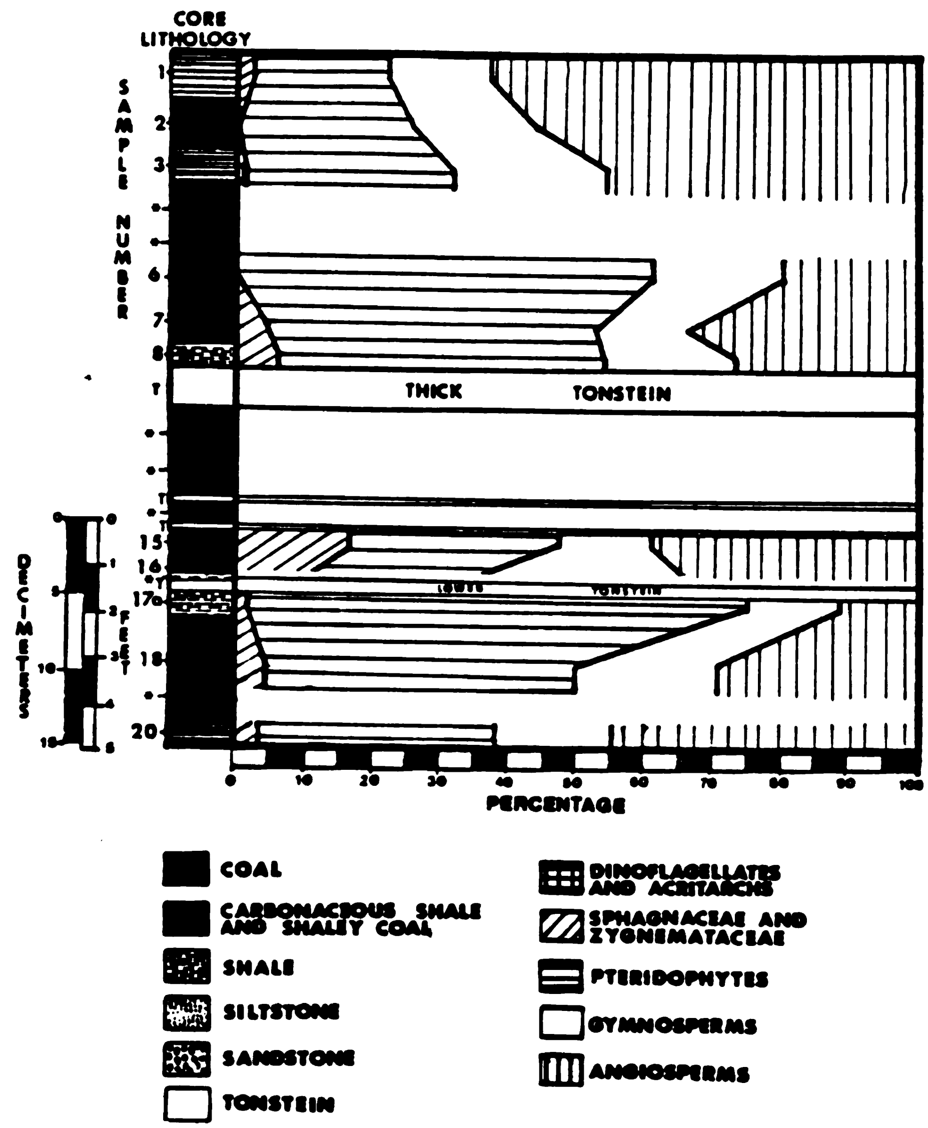
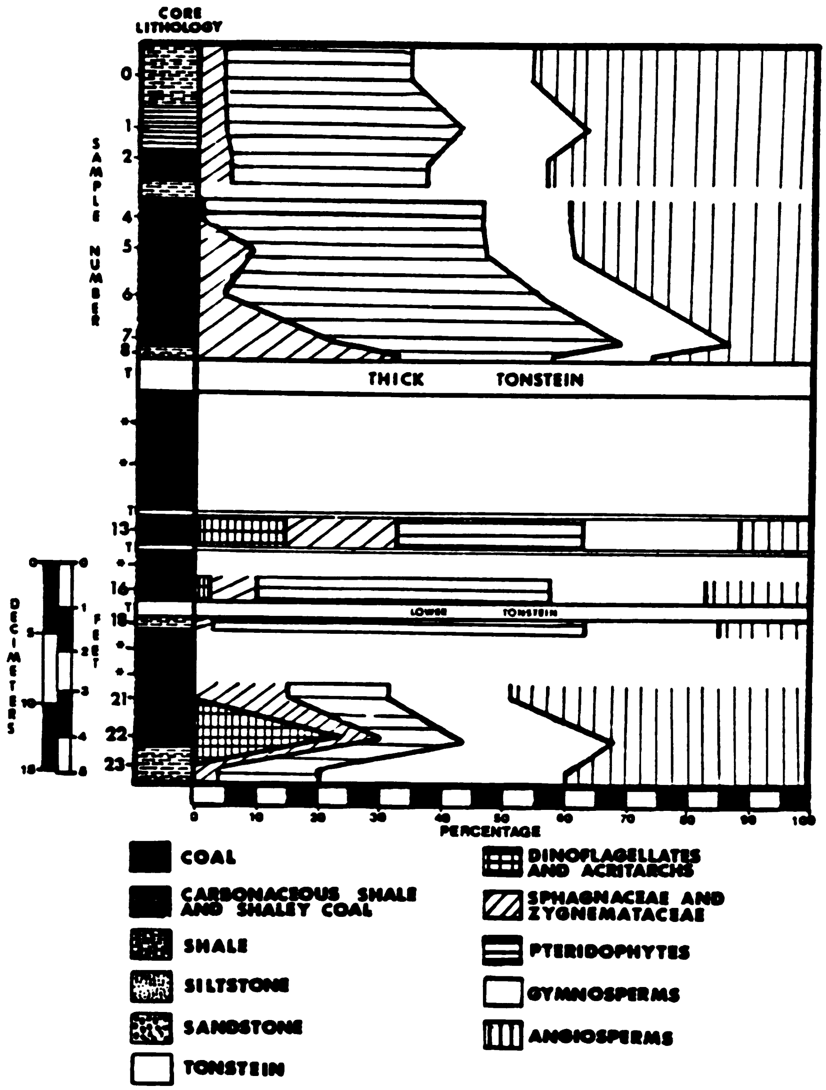


FIGURE 12: CORE Q5: PALYNOMORPH PROFILE



<u>FIGURE 13</u>: CORE Q5a: PALYNOMORPH PROFILE

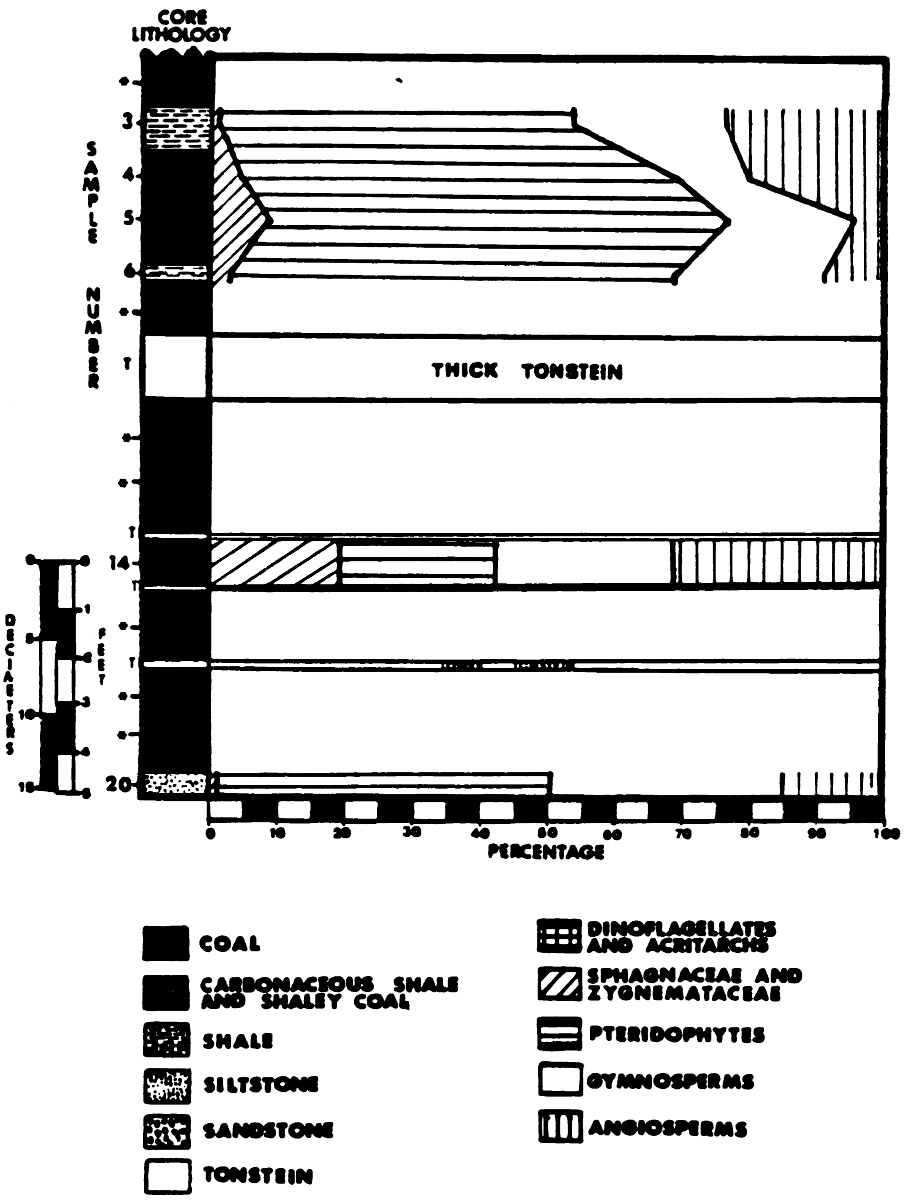


FIGURE 14: CORE Q6: PALYNOMORPH PROFILE

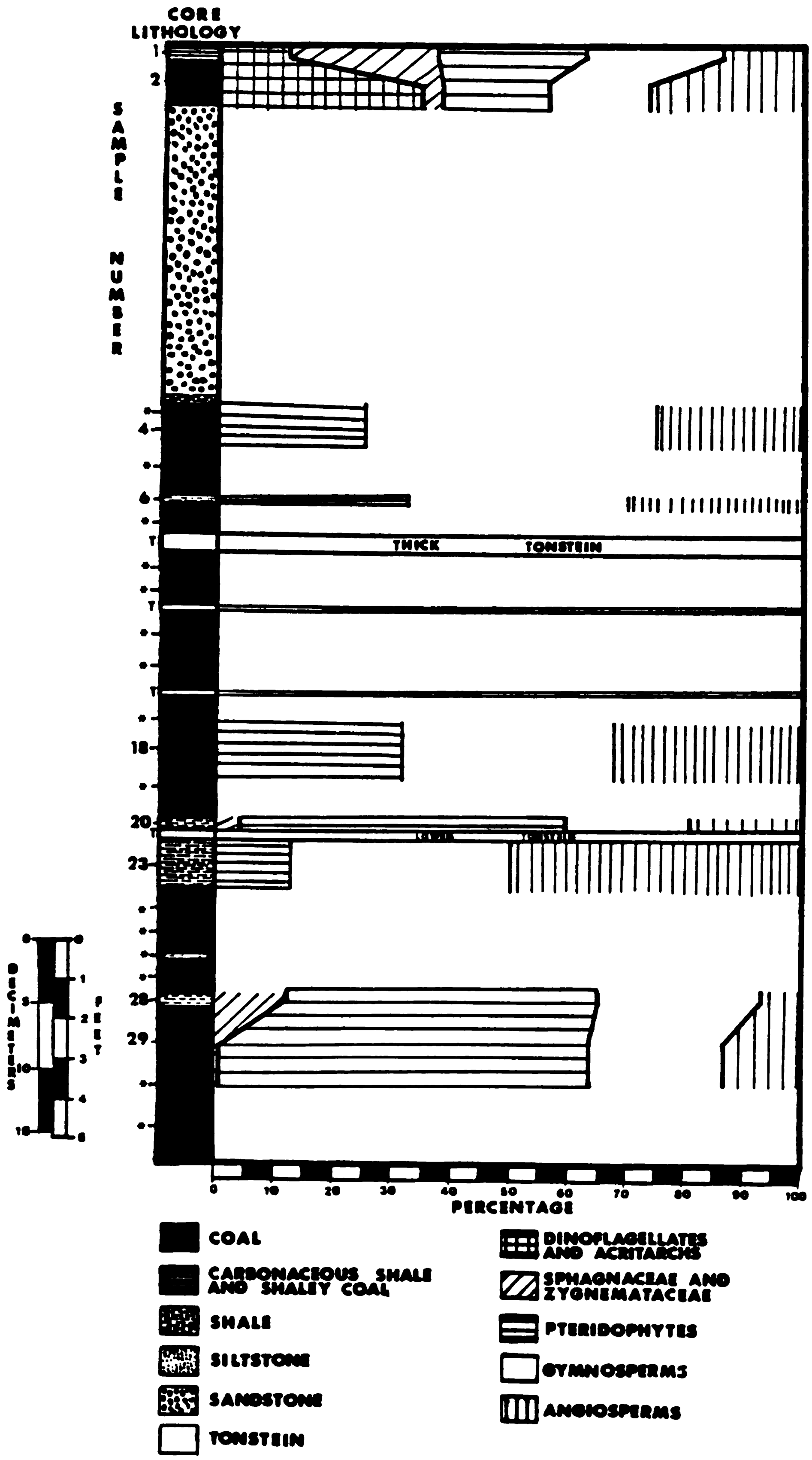


FIGURE 15: CORE Q7: PALYNOMORPH PROFILE

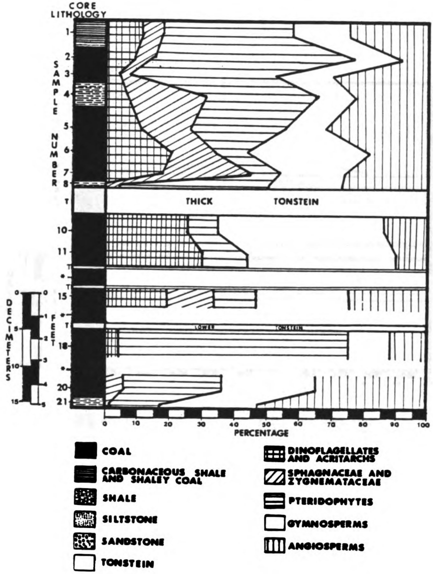


FIGURE 16: CORE Q8: PALYNOMORPH PROFILE

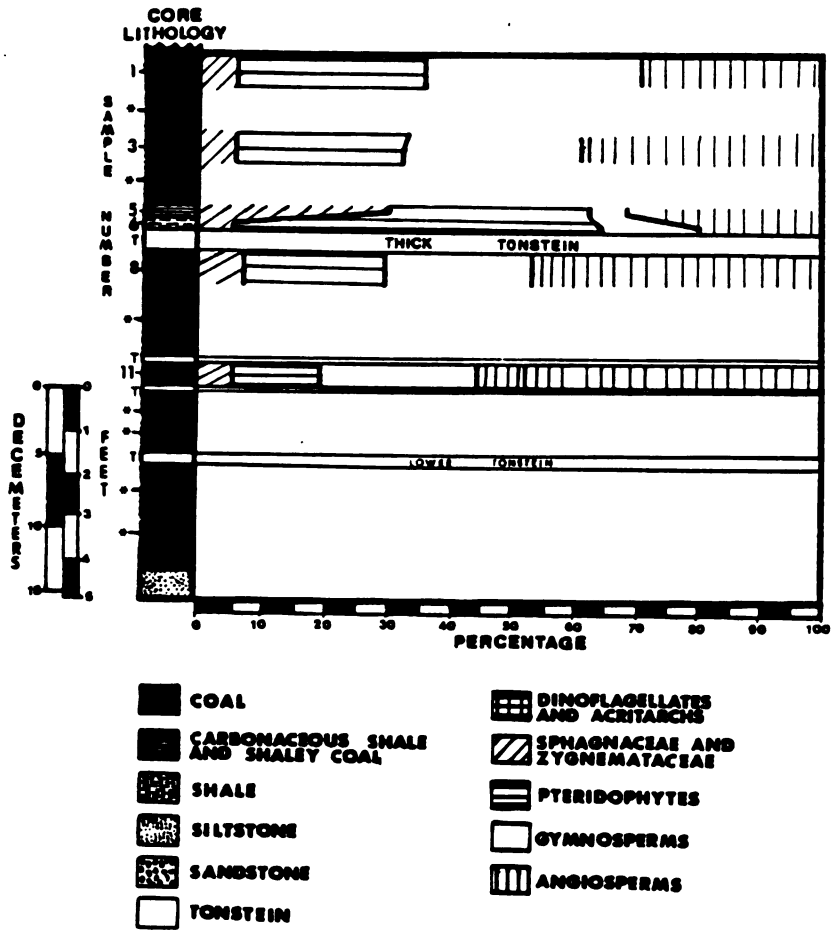


FIGURE 17: CORE Q9: PALYNOMORPH PROFILE

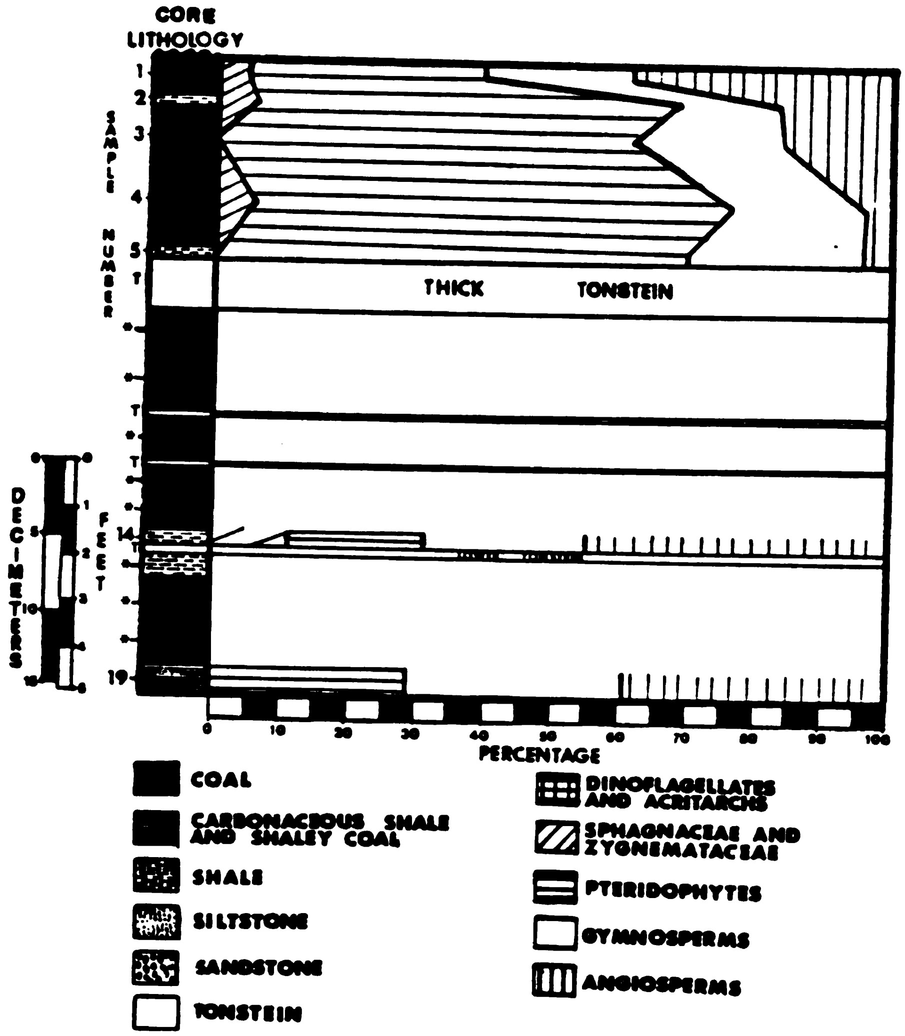
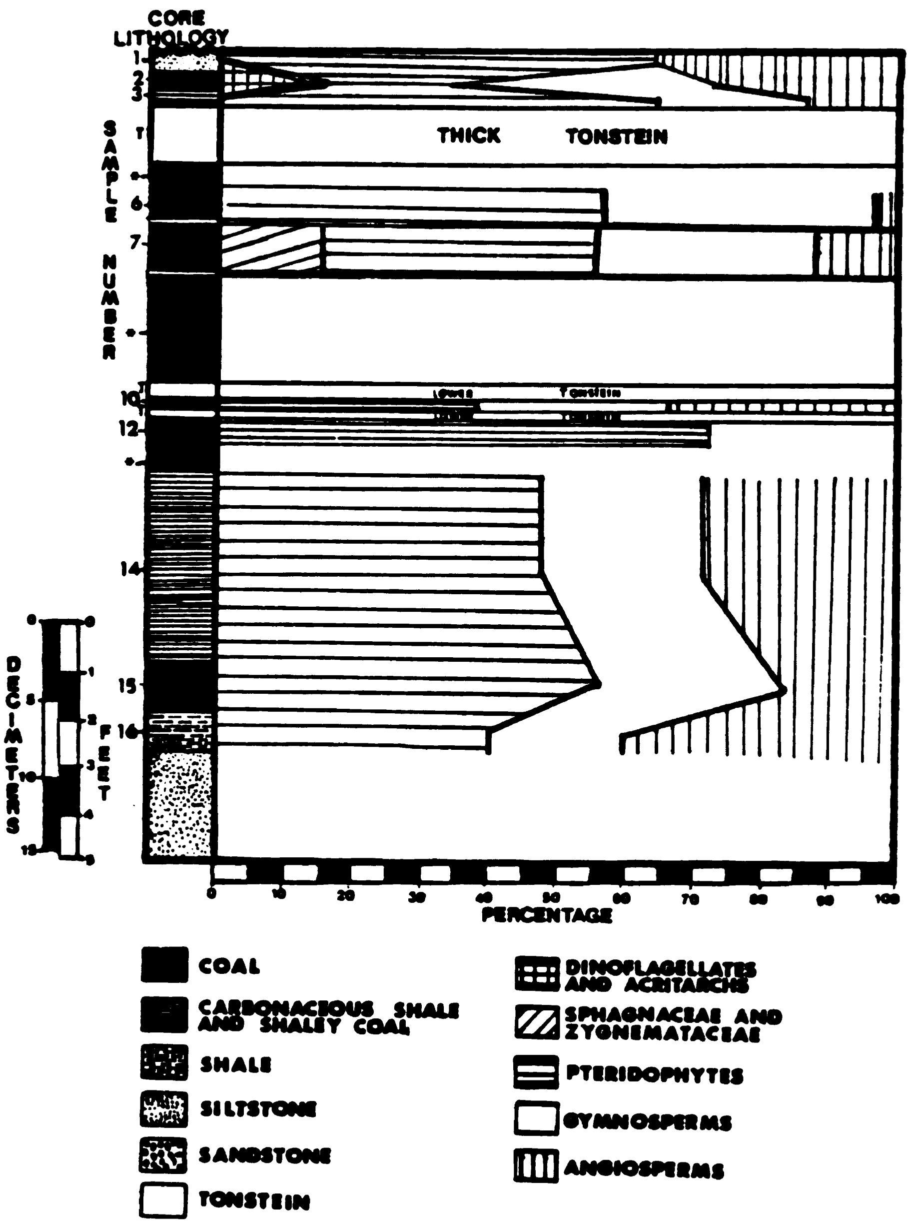


FIGURE 18: CORE Q10a: PALYNOMORPH PROFILE



<u>FIGURE 19</u>: CORE Q11: PALYNOMORPH PROFILE

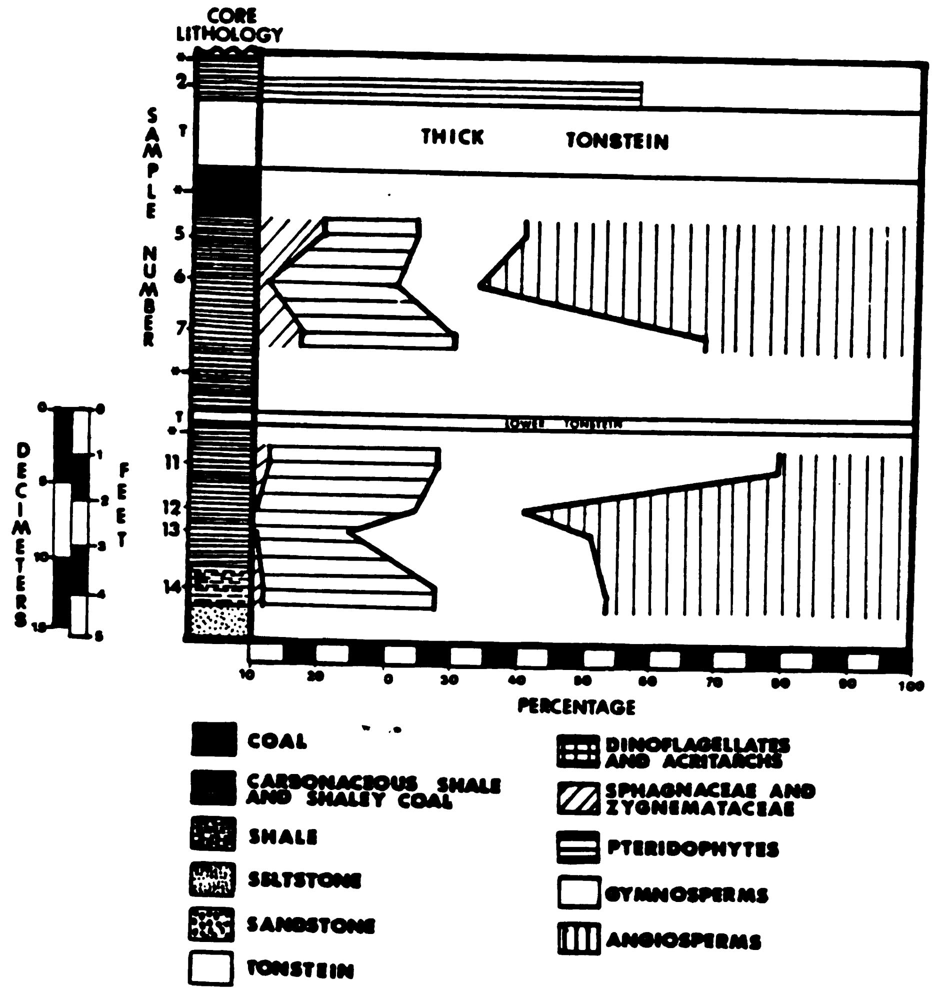


FIGURE 20: CORE Q12: PALYNOMORPH PROFILE

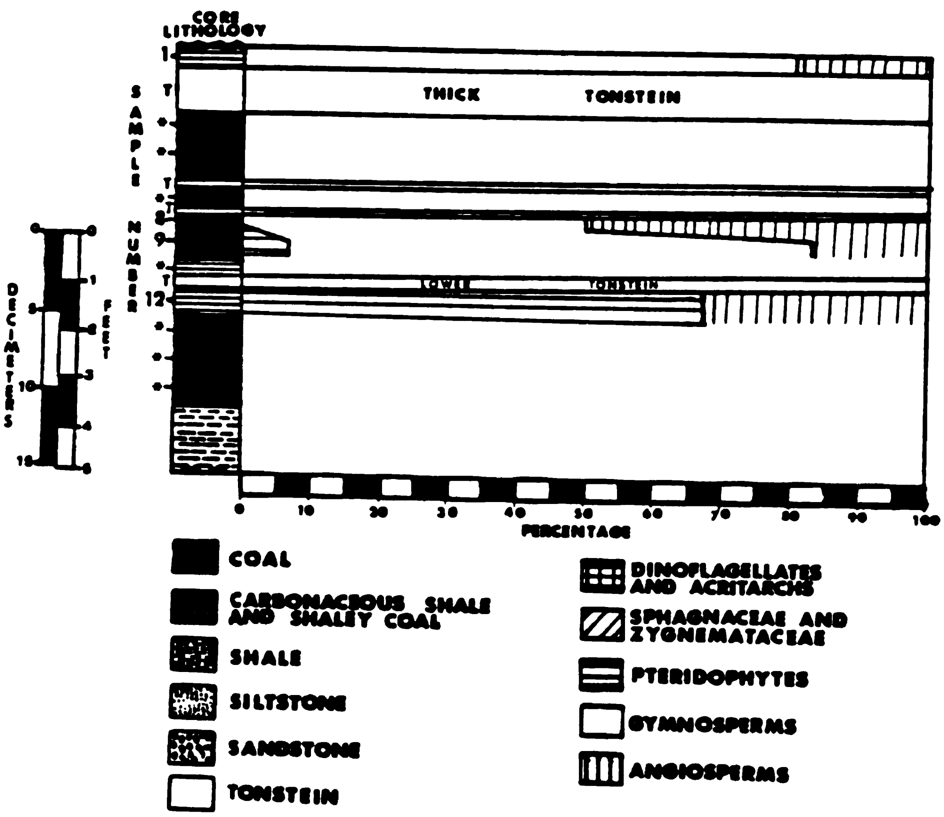


FIGURE 21: CORE Q13: PALYNOMORPH PROFILE

characteristics of the palynoflora for the outcrop samples are summarized in Table 6.

The Tununk Shale palynoflora is based upon only four productive samples. These samples represent different lithologies including shale, mudstone, and siltstone. The content of these samples varies greatly although all represent brackish to marine depositional environments. Overall, the Tununk Shale palynoflora consists of 20 algal cysts, 17 pteridophyte spores, 14 gymnosperms, and 24 angiosperms.

The palynoflora of the Bluegate shale consists of 28 algal cysts, 7 pteridophyte spores, 6 gymnosperms, and 4 angiosperms. The palynoflora is based upon only four productive shale samples. These samples all contained a marine palynoflora.

PALYNOMORPH ABUNDANCE AND DIVERSITY

Due to several factors, such as the differential production, transport, and preservation of palynomorphs, along with varying source plant occurrence in the local communities, the palynomorph taxa are not equally abundant in the samples in either the total number of grains encountered or in the percentage of occurrence in a sample. Some palynomorphs are common in both frequency and relative percentage. Others are abundant in only a few samples. Many are rare in both categories. Twenty-five palynomorphs are found in the majority of samples. This includes twelve

TABLE 6: OUTCROP PALYNOFLORA SUMMARY

SAMPLE	STRATIGRAPHIC POSITION	LITHOLOGY	MARINE (M) D/A*	MARINE (M) %A	S/Z*	TERRESTRIAL (T) FERNS	TERRESTRIAL (T) GYMNO*	TERRESTRIAL (T) ANGIO*	M/T INDEX	TOTAL DIVERSITY
F1-1-2	Tununk Shale	Shale	10%	80%	0%	8%	42%	39%	9.0	40 Taxa
F1-3-2	Tununk Shale	Shale	34	100	1	30	27	8	1.9	33
F1-3-3	Tununk Shale	Siltstone	27	100	0	19	27	27	2.8	12
F10-6-2	Tununk Shale	Siltstone	74	39	1	5	16	4	0.4	28
F10-6-4	Lower Ferron Ss	Siltstone	72%	47%	0%	8%	10%	11%	0.4	46
F10-6-5	Lower Ferron Ss	Shale	20	100	0	11	21	41	2.6	28
F11-1-1	Upper Ferron Ss	Coaly Shale	0%	—	3%	14%	35%	48%	T	65
F1-4-3	Upper Ferron Ss	Siltstone	55	94	0	14	21	10	0.8	15
F1-4-4	Upper Ferron Ss	Coaly Shale	0	—	0	5	55	40	T	40
F1-6-3	Upper Ferron Ss	Coal	0	—	0	33	58	9	T	5
F4-12-2	Upper Ferron Ss	Siltstone	0	—	0	15	58	27	T	10
F2-10-1	Upper Ferron Ss	Coaly Shale	0	—	0	11	46	43	T	67
F7-3-1	Upper Ferron Ss	Coal	42	100	0	10	46	3	1.4	13
F7-3-2	Upper Ferron Ss	Siltstone	0	—	1	40	43	16	T	41
F6-2-1	Upper Ferron Ss	Coaly Shale	15	16	0	37	27	21	5.7	50
F6-2-2	Upper Ferron Ss	Siltstone	84	39	0	2	8	6	0.2	38
F4-12-3	Upper Ferron Ss	Siltstone	0	—	0	56	42	1	T	45
F4-12-5	Upper Ferron Ss	Siltstone	0	—	0	43	51	6	T	40
F9-5-1	Upper Ferron Ss	Siltstone	69	24	0	7	16	8	0.5	45
F5-1-1	Upper Ferron Ss	Coal	45	50	0	16	33	5	1.2	32
F11-1-10	Upper Ferron Ss	Shale	14	76	1	31	23	30	6.1	112
F11-1-12	Upper Ferron Ss	Coal	0	—	0	1	52	47	T	36
F10-6-6	Upper Ferron Ss	Shale	66	1	0	0	10	24	0.5	17
F10-6-7	Upper Ferron Ss	Shale	100	15	0	0	0	0	0.0	11
F10-6-8	Upper Ferron Ss	Siltstone	45	34	0	0	52	3	1.2	15

TABLE 6 (cont'd)

F5-1-2	Bluegate Shale	Shale	98%	21%	0%	0%	0%	2%	0.02	17
F5-1-3	Bluegate Shale	Shale	99	21	0	0	.5	.5	0.01	19
F8-4-1	Bluegate Shale	Shale	97	23	0	3	0	0	0.03	20
F11-1-13	Bluegate Shale	Shale	89	38	0	4	6	1	0.10	43

* D=Dinoflagellates; A=Acritarchs; S=Sphagnaceae; Z=Zygnemataceae; Gymno=Gymnosperms; Angio=Angiosperms; M/T Index=Marine Terrestrial Index (< 1.0=Marine, 1.0-5.5=Very Near Shore, 5.5-10=Lagoonal-Bay, T=Terrestrial); %A=Percentage of D/A that are Acritarchs.

pteridophytes, six gymnosperms, six angiosperms, and one algal cyst. These commonly occurring palynomorphs are listed in Table 7 and are illustrated in Plate I, Appendix III.

Overall, there is little distinction between those taxa found only in coals and those found in other lithologies. Only Tricolpites sp. 3 was not found in the shale or siltstone lithologies while eighteen palynomorphs were not present in the Ferron coals. These eighteen taxa are listed in Table 8. Twelve of the eighteen taxa listed in Table 8 are dinoflagellates and acritarchs and generally not considered to represent part of a typical swamp palynoflora.

The number of taxa identified per sample varied from a low of four taxa to a high of 101 taxa in the C coal horizon of the Ferron cores (Table 9) and from five to 112 in the outcrop samples (Table 6). Many of the low diversity samples had very low overall palynomorph frequency.

The question arises as to whether the diversity of a sample reflects the source plant community or whether it is primarily a product of the nature of the depositional and preservational environment. If, on average, diversity is primarily a facies artifact, then there should be a direct correlation between diversity and the environment of deposition and the lithology of the sample. On the other hand, if sample diversity generally reflects the composition of the parent flora, then palynoflora relative frequencies

TABLE 7: COMMON PALYNOMORPHS IN THE SAMPLES

TAXON	NUMBER OF SAMPLES
G *Eucommiidites* sp.	100
A *Tricolpopollenites simplicissimus*	90
G *Inaperturopollenites* sp. P *Matonisporites conspicuus*	80
P *Triplanosporites sinuosus* G *Classopollis classoides* P *Stereisporites psilatus* P *Cyathidites minor* P *Cicatricosisporites terminatus* Z *Schizosporis* sp. A *Psilatricolpites parvulus* P *Todisporites major*	70
A *Nyssapollenites albertensis* P *Cingulatisporites dakotensis* P *Laevigatosporites ovatus* P *Deltoidospora psilastoma* P *Cicatricosisporites dorogensis* P *Osmundacidites wellmanii* A *Tricolpopollenites* sp. 3 A *Tricolpites variabilis* G *Cycadopites pseudolatus* G *Monosulcites minimus* G *Monosulcites* sp. A *Liliacidites inaequalis* P *Stereisporites antiquasporites*	

Z=Zygnemataceae; P=Pteridophyte; G=Gymnosperm; A=Angiosperm

These taxa are found in the majority of all core samples. Their relative frequency in these samples, however, varies from less than 1% to more than 15% of a sample.

TABLE 8: PALYNOMORPHS NOT FOUND IN COAL SAMPLES

ALGAE

Exochosphaeridium sp.
Gonyaulacysta sp.
Paleohystrichophora infusorioides
Nannoceratopsis plegas
Undifferentiated dinoflagellate opercula
Ascotomocystis hydria
Baltisphaeridium sp. 1
Baltisphaeridium sp. 2
Baltisphaeridium sp. 3
Cymatiosphaera sp.
Micrhystridium inconspicuum
Micrhystridium sp.

PTERIDOPHYTES

Appendicisporites bilateralis
Foveosporis triangulus
Densoisporites microrugulatus

ANGIOSPERMS

Monocolpopollenites tranquillus
Monocolpopollenites sp. 2
Foveotricolpites rhombohedralis

TABLE 9: SAMPLE DIVERSITY

SAMPLE	DIVERSITY	SAMPLE	DIVERSITY	SAMPLE	DIVERSITY
Q2a-2	41	Q5-1	59	Q8-8	42
Q2a-3	34	Q5-2	62	Q8-10	46
Q2a-6	42	Q5-3	77	Q8-11	42
Q2a-7	44	Q5-6	60	Q8-15	33
Q2a-8	53	Q5-7	54	Q8-18	39
Q2a-9	83	Q5-8	57	Q8-20	42
Q2a-11	78	Q5-15	21	Q8-21	47
Q2a-12	70	Q5-16a	53	Q9-1	53
Q2a-13	64	Q5-17a	47	Q9-3	54
Q2a-14	31	Q5-18	38	Q9-5	38
Q3-1	43	Q5-10	88	Q9-6	44
Q3-2	47	Q5a-0	66	Q9-8	42
Q3-3	44	Q5a-1	84	Q9-11	23
Q3-8	39	Q5a-2	55	Q10a-1	63
Q3-9	51	Q5a-4	69	Q10a-2	72
Q3-11	53	Q5a-5	49	Q10a-3	20
Q3-12	43	Q5a-7	46	Q10a-5	20
Q3-14	39	Q5a-7	53	Q10a-5	19
Q3-15	32	Q5a-8	49	Q10a-14	36
Q3-16	25	Q5a-13	49	Q10a-19	36
Q3-18	10	Q5a-16	42	Q10a-19	4
Q3-22	66	Q5a-18	32	Q11-3	15
Q3-23	57	Q5a-21	15	Q11-6	14
Q3-24	67	Q5a-22	89	Q11-7	41
Q3-26a	68	Q5a-23	68	Q11-10	15
Q3-28	70	Q6-3	63	Q11-12	7
Q4-1	78	Q6-4	47	Q11-14	15
Q4-3	41	Q6-5	36	Q11-15	23
Q4-4	30	Q6-6	27	Q11-16	18
Q4-5	16	Q6-14	31	Q12-2	4
Q4-6	82	Q6-20	76	Q12-5	39
Q4-7	80	Q7-1	58	Q12-6	4
Q4-8	10	Q7-2	80	Q12-7	32
Q4-11	20	Q7-4	4	Q12-11	13
Q4-12	15	Q7-6	4	Q12-12	51
Q4-13	88	Q7-18	11	Q12-13	59
Q4-15	20	Q7-20	52	Q12-14	90
Q4-16	16	Q7-23	15	Q13-1	4
Q4-18	13	Q7-28	38	Q13-8	6
Q4-21	21	Q7-29	26	Q13-9	7
Q4-22	74	Q8-1	51	Q13-12	12
Q4-23	28	Q8-2	40		
Q4-25	101	Q8-3	49		
Q4-26	16	Q8-4	36		
Q4-27	78	Q8-5	32		
Q4-28	63	Q8-6	38		
Q4-29	74	Q8-7	31		
Q5-1	59	Q8-8	42		
Q5-2	62	Q8-10	46		

should vary with diversity regardless of the depositional and preservational environment.

In this study the following observations were made:

1) No statistically significant difference exists in the average diversity of the four basic lithologic groups (coal, coaly shale and shaley coal, shale, and siltstone.

2) No statistically significant relationship exists between lithology and productivity.

3) However, if a sample is more productive, it also contains a more diverse palynoflora. High diversity samples tend to have excellent productivity. These samples also tend to be dominated by angiosperms. No particular group of angiosperms dominates high diversity samples.

4) Samples with low productivity and thus low diversity, on average, tend to be dominated by gymnosperms. The primary gymnosperms in these samples include Classopollis classoides, Inaperturopollenites sp., Monosulcites minimus, and Eucommiidites sp. These trends are summarized in Table 10.

In addition to these diversity-palynoflora trends it will be shown later that the different palynomorph assemblages identified in the Ferron C coal represent distinct levels of diversity. Because of these trends it is believed

TABLE 10: SAMPLE LITHOLOGY, PRODUCTIVITY, AND DIVERSITY

LITHOLOGY	PRODUCTIVITY				
	EXCELLENT	FAIR	POOR	BARREN	
COAL	57	43	18	0	
SHALE	59	41	15	0	AVERAGE
SILTSTONE	69	32	12	0	DIVERSITY
COALY SHALE-SHALEY COAL	72	39	15	0	

For each lithology and productivity level the diversity of all outcrop and core samples was averaged, i.e., all coal samples that have an excellent productivity had an average diversity level of 57 taxa.

Productivity: Excellent = palynomorph count of 500
Fair = palynomorph count of 300
Poor = palynomorph count of less than 200
Barren = no recoverable palynomorphs were present

These data indicate that average diversity of these samples is not controlled by lithology, but instead is dependent here upon the level of sample productivity.

PRODUCTIVITY AND DIVERSITY

PRODUCTIVITY	AVERAGE DIVERSITY
EXCELLENT	62
FAIR	40
POOR	14

Average diversity of all samples regardless of lithology for each level of productivity.

LITHOLOGY AND DIVERSITY

LITHOLOGY	OUTCROP DIVERSITY	CORE DIVERSITY
COAL	20	39
SHALE	32	42
SILTSTONE	23	37
COALY SHALE-SHALEY COAL	36	43

Average diversity of all samples in outcrop or core regardless of productivity

Core diversity was higher than outcrop sample diversity, but as shown previously, core productivity was also higher than outcrop productivity.

that in the Ferron C coal swamps, diversity and the corresponding sample productivity are the result of the levels of diversity. Because of these trends it is believed composition of the source community is not primarily an artifact of the preservational environment. Obviously, this relationship does not always exist everywhere, but the peat swamp environments analyzed here provide a closed system that receives little palynomorph contribution from outside environments.

Changes in taxonomic diversity may result from several factors. These variables include latitudinal, environmental, and successional changes. In large-scale analyses, gradual changes in diversity are evident with latitudinal position. High diversity floras characterize tropical latitudes with diversity decreasing poleward (A. G. Fischer, 1960; LaPasha and Miller, 1982). On a local scale, floristic diversity may decrease due to adverse environmental conditions. Poor soil conditions, such as exposed lava rock or sand, serpentine, and limestone soils, and repeated periodic flooding are two of the more common environmental variables leading to a decrease in diversity (A. G. Fischer, 1960).

Decreases in floristic diversity may also characterize both the earliest and the climax stages of succession. Taggart and Cross (1980) suggested that low diversity florules indicate an early successional community in the Miocene Succor Creek flora, which was affected by several periodic volcanic episodes. Similarly, studies of island biogeography (Carlquist, 1974; MacArthur and Wilson, 1967) have shown that the first communities to colonize uninhabited areas contain relatively few species. Although species diversity subsequently increases with time, the increase varies with the distance from the source population. On islands that are fairly distant from the source region, diversity increases slowly and steadily until a relatively stable level of diversity is reached. On the other hand, on islands that are relatively close to the source population, the increase in diversity rapidly overshoots that which the environment is capable of supporting. Thus, on these islands, the climax community actually contains fewer species than earlier successional stages.

In the C coal of the Ferron Sandstone, high diversity palynofloras are defined as containing more than 70 species per sample. This represents the top 10% of all coal samples. By this definition, eleven coal samples contain high diversity palynofloras. All of these high diversity palynofloras are characterized by relatively large numbers of angiosperm taxa. The average high diversity palynoflora contains 46% angiosperms, 25% gymnosperms, and 29% pteridophytes (Table 11). These high diversity palynofloras occur primarily above the thick tonstein (63%). Only 10% of the high diversity palynofloras occur between the thick tonstein and the lower tonstein while 27% occur below the

TABLE 11: DIVERSITY AND SAMPLE PALYNOFLORAS

AVERAGE C COAL DIVERSITY: 41 taxa

AVERAGE C COAL PALYNOFLORA:	PTERIDOPHYTES	GYMNOSPERMS	ANGIOSPERMS
	37%	33%	30%

AVERAGE PALYNOFLORA HIGH DIVERSITY SAMPLES:

	PTERIDOPHYTES	GYMNOSPERMS	ANGIOSPERMS
	29%	25%	46%

AVERAGE PALYNOFLORA LOW DIVERSITY SAMPLES:

	PTERIDOPHYTES	GYMNOSPERMS	ANGIOSPERMS
	34%	47%	19%

High diversity palynofloras contain more than 70 taxa per sample.

Low diversity palynofloras contain less than 20 taxa per sample

High diversity palynofloras are enriched in angiosperms compared to the average C coal palynoflora.

Low diversity palynofloras are enriched in gymnosperms compared to the average C coal palynoflora.

lower tonstein. None of the high diversity palynofloras occur immediately above a tonstein, i.e., do not have basal contact with a tonstein.

Low diversity palynofloras are defined as containing less than 20 species per sample. Twenty-five percent of all Ferron C coal samples contain low diversity palynofloras. In contrast to the distribution of high diversity palynofloras, low diversity palynofloras are fairly evenly distributed throughout the C coal. Thirty-three percent of the low diversity palynofloras occur above the thick tonstein, 38% occur between the lower tonstein and the thick tonstein, and 29% occur below the lower tonstein. Also, in contrast to the high diversity palynofloras, angiosperms are uncommon in low diversity palynofloras. The average low diversity palynoflora contains 47% gymnosperms, 34% pteridophytes, and only 19% angiosperms (Table 11).

DISTRIBUTION IN TIME AND SPACE

Palynomorph Stratigraphic Indicators

Stratigraphic relationships of Cretaceous formations between widely spaced areas in the western United States are based primarily upon an ammonite index fossil chronology. Ammonites as biostratigraphic indicators are well suited to many of the Cretaceous sediment sequences of the Interior Seaway, but cannot be used for terrestrial sediments. Palynomorphs, including terrestrially-derived pollen and spores and brackish-marine dinoflagellates and acritarchs, can be utilized as stratigraphic indicators in and between the terrestrial and marine realms. Terrestrially-derived pollen and spores can be widely dispersed by either wind or water and thus they may also be common in marine sediments.

The establishment of stratigraphic relationship and chronologic age with the use of palynomorphs involves two different approaches. The first method utilizes range data, that is, the first and last appearances of a taxon at either the species or the generic level. The second approach is based upon the general level of evolutionary development seen in the morphology of angiosperm pollen grains. Both approaches have been employed in this study to make a generalized stratigraphic interpretation based on palynological data.

The use of palynomorphs as stratigraphic indicators has two limitations. First, palynomorph zones are, at present, not as precise nor as detailed as zones based upon ammonites. Because of this there is no direct nor comparable palynomorph zone for each of the numerous Cretaceous ammonite zones. The second problem that must be considered is ecological. Because of the possibility of endemism and environmental variables, palynomorph stratigraphic indicators have been taken primarily from western North America.

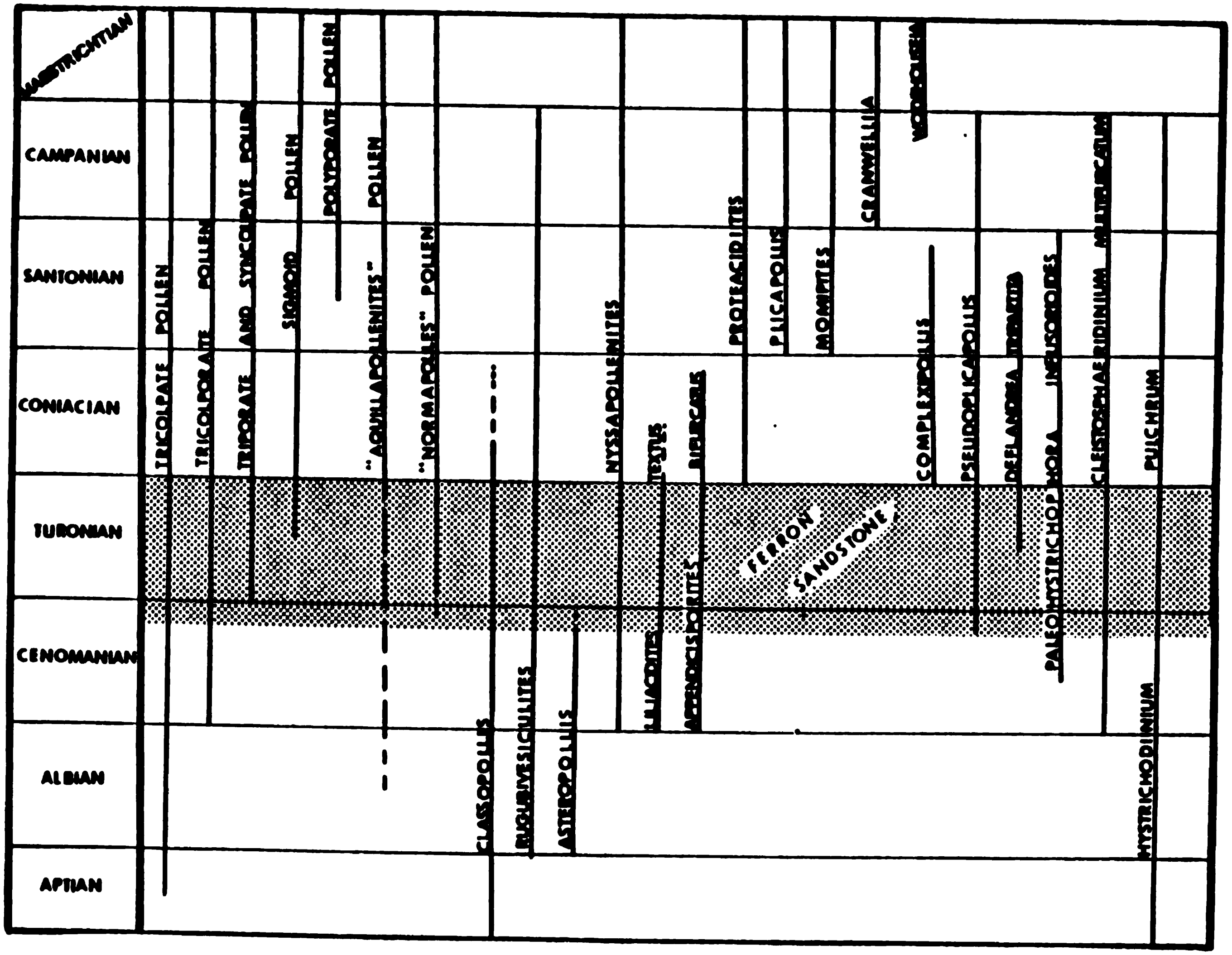
Either the presence of a significant taxon or its absence can be important in correlation. This assumes, of course, that a large enough sample was taken and that several different environments were sampled. Small sample size and a limited number of samples may introduce ecological or diversity biases into the results. The use of a limited number of samples was probably the reason that led May (1972) to conclude that the Ferron was Cenomanian in age. A large number of palynomorphs have been identified in this study, therefore, sample size should not be a serious problem for the Ferron. However, only 48 palynomorphs were identified in the four productive samples of the Bluegate Shale and only 77 palynomorphs were identified in the four productive samples of the Tununk Shale. This represents very limited taxonomic diversity and must be considered in evaluating both the Tununk and Bluegate Shales. These samples contain few terrestrially-derived pollen and spores and, particularly, no significant number of angiosperm pollen.

Certain pollen and spores of stratigraphic significance and distribution of angiosperm pollen morphological levels are tabulated in Table 12. The following references were used to produce the table: Sarmiento (1957), Newman (1965, 1972), Sarjeant (1967), Srivastava (1967, 1981), Ryder and Ames (1970), Jarzen and Norris (1975), Christopher (1978), Nichols and Warner (1978), Alvin (1982), and Nichols and Jacobson (1982).

Monocolpate and tricolpate angiosperm pollen have been found in western North American sediments of Aptian age or younger. Tricolporates appeared in the Cenomanian and triporate and syncolpate pollen appeared by the Turonian.

TABLE 12: PALYNOMORPH RANGE DISTRIBUTION

Ranges of major palynological morphotypes, taxa and several marine microplankton for western North America characteristic of various Cretaceous time zones. References for range data are cited in the text. Shaded area represents the age of the Ferron Sandstone as suggested by the data from this study.



Angiosperm pollen with sigmoid apertures are present from the middle Turonian while polyporate pollen did not appear until the middle Santonian. Records of "Aquilapollenites"-type pollen are sporadic in the Albian through the Turonian in the western United States, but they are significant thereafter. The "Normapolles"-type pollen are present from the late Cenomanian.

The first appearances of four palynomorphs, which are commonly found throughout the western United States, help to establish an age range for the upper Tununk Shale, Ferron Sandstone, and the Bluegate Shale in the Castle Valley area of east-central Utah. Palaeohystrichophora infusoriodes, a dinoflagellate, first appears in the middle Cenomanian. Another dinoflagellate, Deflandrea tripartita, first appears in the late Turonian. Species of Proteacidites and Complexiopollis first appear in the early Coniacian. Additional taxa that are characteristic of the Upper Cretaceous in the western United States are listed in Table 12.

Although palynological data are inadequate for determining the age of the upper Tununk (only four productive samples), the combined presence of Cleistosphaeridium multifurcatum, Paleohystrichophora infusorioides, Classopollis, Rugubivesiculites, Liliacidites textus, and Nyssapollenites albertensis, along with the absence of Deflandrea tripartita and Asteropollis does suggest that the Tununk Shale in this area is no older than the Cenomanian and no younger than the latest Turonian. In the area of

Castle Valley, the ammonite Collignoniceras wollgari and the foraminifera Dentalina utahensis and Vaginulinopsis austinana indicate that the uppermost Tununk is early middle Turonian in age (Cobban, 1976; Maxfield, 1976). However, in the northeastern most areas of the Henry Mountain region the Tununk continues through the earliest late Turonian as indicated by the presence of Inoceramus cuvieri and Prionocyclus macombi (F. Peterson, Ryder, and Law, 1980).

In the Ferron, tricolpate and tricolporate angiosperm pollen are very common and no "Aquilapollenites"-type pollen occurs. In addition only one "Normapolles"-type pollen is present, but it is rare. Further restrictions are placed on the palynologic age by the combined absence of Asteropollis, Proteacidites, and Complexipollis and by the presence of Liliacidites textus, Appendicisporites bifurcatus, Palaeohystrichophora infusorioides, and Deflandrea tripartita. These palynological characteristics suggest a middle Cenomanian through latest Turonian age for the Ferron in the study area. The position of the Ferron within this time frame cannot be determined at this time from palynological data alone.

Age diagnostic invertebrates have been recovered from both the lower Ferron and from the upper Ferron. Katich (1954) reported the presence of the marine ammonites Prionocyclus hyatti in the lower sandstone of the Ferron in Castle Valley. P. hyatti is late middle Turonian in age. The upper Ferron is late Turonian in age based upon the presence of the ammonites Prionocyclus wyomingensis, Scaphites warreni, Inoceramus dimidus, and Ostrea lugubris (Katich, 1954).

Four samples from the Bluegate Shale in the Castle Valley area were productive. The presence of Deflandrea tripartita in the basal one foot thick stratum of the Bluegate (sample F11-1-13) indicates that the Bluegate in the southernmost area of Castle Valley is no older than middle Turonian. D. tripartita ranges from the late Turonian to the middle Santonian. None of the few terrestrially-derived pollen and spores present in the Bluegate Shale samples are indicative of age.

In the Henry Mountains region, the Bluegate is early Santonian in age based upon the presence of the ammonite Inoceramus stantoni. There, most of the late Turonian and all of the Coniacian is absent (F. Peterson, Ryder, and Law, 1980). However, in other areas of the central western interior the late Turonian through Coniacian time is indicated by a regional erosional unconformity. A late Turonian to Coniacian unconformity is present in varying degrees in the Kaiparowits basin of south-central Utah, the Black Mesa basin of northeast Arizona, the San Juan basin of northwest New Mexico and southwest Colorado, and above the Oyster Ridge Sandstone Member of the Frontier Formation in northern Utah and Wyoming (F. Peterson, Ryder, and Law, 1980; Ryer, 1977a). In the Coalville area of north-central Utah the erosional unconformity extends from late middle through late Turonian and possibly into the early Coniacian (Ryer, 1977a).

Relationship to Other North American Floras

Comparisons of the Ferron palynoflora to other Cretaceous floras in North America involve three variables. These factors include ecological differences between areas (environmental-geographic variable), evolutionary change (biologic-stratigraphic variable), and also differences in the degree of preservation of the palynomorphs between areas and lithologies and sample size and number (identification-diversity variable). Because of these three variables no two floras may be identical. The palynofloras that are either closest in geologic age or environment and geographic area will contain the most similarity to the Ferron palynoflora. Comparisons to other floras are made on both the generic and specific levels. Species differences or similarities are more significant on both ecological and time levels than generic differences. A palynoflora was deemed similar to that of the Ferron if more than 50% of its identifiable species were found in the Ferron.

Thirteen palynofloras representing Aptian through Maestrichtian time from both eastern and western United States are compared with the Ferron. Five of these palynofloras are from eastern United States. These include 1) zones 1-3, Aptian to Cenomanian of the Atlantic coastal plain (Doyle and Robbins, 1977); 2) zones 4-5, Middle

Cenomanian to Lower Turonian of the Atlantic coastal plain (Doyle and Robbins, 1977); 3) Coker and Gordo Formations in Alabama, Cenomanian (Leopold and Pakiser, 1964); 4) Eutaw and McShan Formations in Alabama, Coniacian (Leopold and Pakiser, 1964); and 5) Atlantic coastal plain, angiosperms only, Campanian to Maestrichtian (Christopher, 1978). Eight of these palynofloras represent Cretaceous strata in western United States. These are 1) Dakota Sandstone, Arizona, Cenomanian (Agasie, 1969); 2) Dakota Sandstone, Utah, Aptian to Cenomanian (May and Traverse, 1973); 3) Woodbine Formation, Oklahoma, Cenomanian (Hedlund, 1966); 4) Frontier Formation, Cenomanian to Turonian, Wyoming (P. F. Griggs, 1970b); 5) Smoky Hollow Member of the Straight Cliffs Sandstone, Turonian, Utah (Orlansky, 1971); 6) Straight Cliffs Sandstone, Utah, Coniacian to Santonian (Orlansky, 1971); 7) Buck Tongue of the Mancos Shale, Utah and Colorado, Campanian (Kidson, 1971); and 8) Kaiparowits Formation, Utah, Maestrichtian (Lohrengel, 1969).

Little similarity is evident between the palynofloras of the eastern United States and the Ferron (Figure 22). Only the Aptian-Cenomanian zones 1-3 of Doyle and Robbins (1977) show any appreciable similarity to that of the Ferron. Here, 41% of the genera are also present in the Ferron, but only 20% of the species are identical. Unlike other east coast floras, which tend to have only a few pteridophyte genera in common with the Ferron, this Early

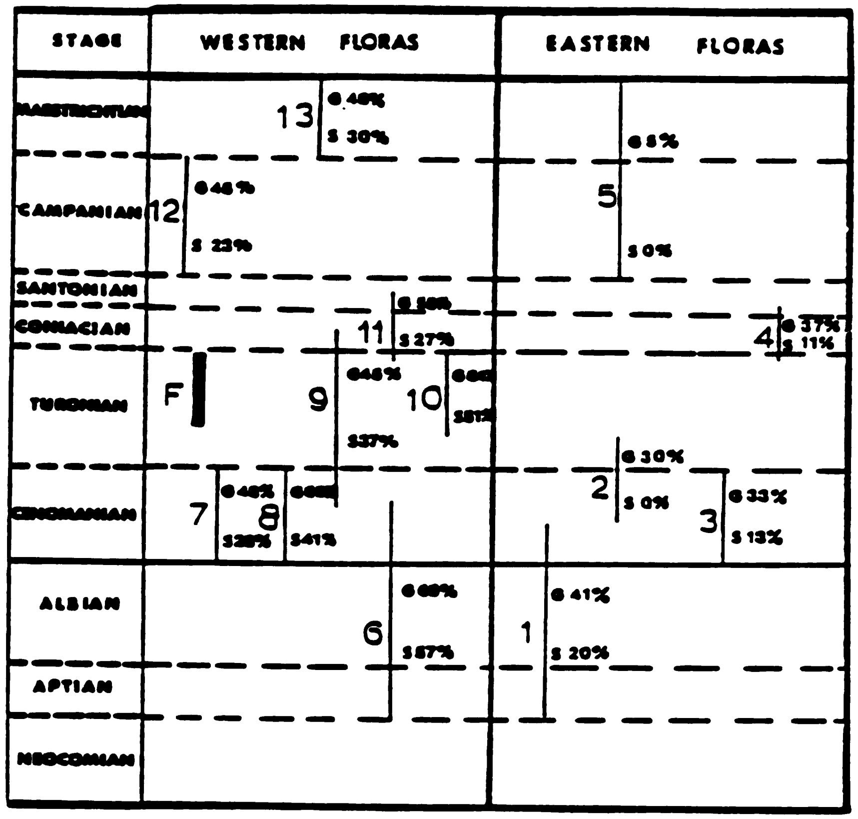


FIGURE 22: FLORISTIC COMPARISON OF THE FERRON PALYNOFLORA TO SEVERAL NORTH AMERICAN CRETACEOUS PALYNOFLORAS

1. Atlantic Coastal Plain, Doyle and Robbins, 1977
2. Atlantic Coastal Plain, Doyle and Robbins, 1977
3. Coker Fm and Gordo Fm, Alabama, Leopold and Pakiser, 1964
4. Eutaw Fm and McShan Fm, Alabama, Leopold and Pakiser, 1964
5. Atlantic Coastal Plain, Christopher, 1978
6. Dakota Ss, Utah, May and Traverse, 1973
7. Dakota Ss, Arizona, Agasie, 1969
8. Woodbine Fm, Oklahoma, Hedlund, 1966
9. Frontier Fm, Wyoming, Griggs, 1970
10. Smoky Hollow Member, Straight Cliffs Fm, Utah, Orlansky, 1971
11. Straight Cliffs Fm, Utah, Orlansky, 1971
12. Buck Tongue of the Mancos Shale, Utah and Colorado, Kidson, 1971
13. Kaiparowits Fm, Utah, Lohrengel, 1969

F=Ferron Ss, This study; G=% Genera Similarity; S=% Species Similarity

Cretaceous flora also has a few angiosperm species in common with the Ferron palynoflora.

All palynofloras examined from western United States showed greater degrees of similarity in both genera and species to the Ferron palynoflora than did any from eastern United States. The palynoflora of the Dakota Sandstone, Aptian to Cenomanian, of Utah (May and Traverse, 1973) closely resembles that of the Ferron palynoflora. Similarities occur primarily in the pteridophytes. The palynoflora of the Turonian portion of the Straight Cliffs Sandstone, the Smoky Hollow Member, also closely resembles that of the Ferron (Orlansky, 1971). Similarities occur between all groups of gymnosperms, pteridophytes, and angiosperms. Both the Dakota Sandstone and the Smoky Hollow Member of Utah have more than 50% of species identical to the Ferron palynoflora. Both also have more than 60% of their genera in common with the Ferron.

Overall, western United States palynofloras closest in age and nearest in geographic location to the Ferron Sandstone are the most similar in palynoflora content. Both ecological conditions and the general evolutionary stage of the floras contribute to this similarity. In addition, it appears that the Western Interior Seaway provided a major physical geographic barrier to floristic dispersability and interchange between eastern and western United States at this time. Although only five Cretaceous palynofloras from eastern United States were compared to the Ferron, all were less similar to the Ferron than any of the western United States palynofloras.

PALEOECOLOGIC ANALYSIS OF PALYNOMORPHS

PALYNOMORPH PALEOECOLOGIC INDICATORS

Because of the antiquity of the Ferron flora, very little is known concerning the ecological implications of the Ferron palynomorphs. This problem is especially pertinent for the angiosperms, which were rapidly evolving at this time and cannot be confidently assigned to most modern families (Muller, 1981). Degree of ecological certainty generally depends upon the degree of taxonomic certainty and the assumed relationships to modern taxa for which ecological data are available. Ecological uncertainties also exist with extinct gymnosperms such as *Eucommiidites* and *Classopollis*. Progress has been made in establishing the ecology of some extinct plants, however, by carefully integrating both the sedimentological data and the ecology of associated plants. Upchurch and Doyle's (1981) study on *Frenelopsis* (*Classopollis*-type pollen) is such an example of detailed ecological study. Recently, Farley and Dilcher (1983) reported preliminary results on the use of sedimentological analysis to assign palynomorphs to one of four depositional environments (levee swale, swamp, marshy lakeside, and distributary margin) in the Dakota Formation of Kansas and Nebraska. Parker's studies (1976a, 1976b) on the Blackhawk macroflora, partly from the Castle Valley area and the remainder from the Wasatch Plateau, established five assemblages of peat-forming Upper Cretaceous plants (arborescent, shrubby understory, herbaceous understory, aquatic community, and swamp conifers) and three bottomland assemblages and a point-bar assemblage. Such studies as these aid in establishing ecological parameters for pollen/spore paleofloras.

Six basic environments can be differentiated palynologically. These environments include a marine environment, open water such as lakes and ponds, a swamp environment, lowland forest, a halophytic or less-mesic environment, and an upland-montane or more distant woodland environment. Table 13 lists the palynomorph indicators for each of these environments. The ecology of the palynomorphs is based primarily on family or division trends for modern taxa and generally not on the ecology of a particular species. Also, it should be noted that several groups have representatives in more than one environment. Groups not listed may have a cosmopolitan distribution, such as the angiosperms, or have undetermined habitats. References used to establish the palynomorph ecological indicators include R. H. Tschudy (1961), Hedlund (1966), Srivastava (1967, 1976), Agasie (1969), Nichols and Traverse (1971), Whitmore (1975), Upchurch and Doyle (1981), Alvin (1982), Rich, Kuehn, and Davies (1982), and Tryon and Tryon (1982).

TABLE 13: SOME FERRON AGE PALYNOMORPH INDICATORS OF CRETACEOUS ENVIRONMENTS

ENVIRONMENT	PALYNOMORPHS
Marine-Brackish Water	Dinoflagellates Acritarchs
Open Water Lakes and Ponds	Sphagnaceae Zygnemataceae
Swamps	Osmundaceae, Polypodiaceae Sphagnaceae, Schizaeaceae Taxodiaceae*
Lowland Forest	Selaginellaceae, Lycopodiaceae, Gleicheniaceae**
Halophytic or Less Mesic Habitats	Ephedraceae, *Classopollis*, Cupressaceae, Araucariaceae*
Upland or More Distant Woodlands	Cyatheaeceae, Pinaceae, Dicksoniaceae, Podocarpaceae, Marattiaceae, Matoniaceae*

* A variety of angiosperms may also characterize these environments.

** A variety of angiosperms and gymnosperms may also characterize this environment.

References for environmental indicators are cited in the text. Groups not mentioned tend to have a cosmopolitan nature or undetermined habitats.

Since none of the six environments is a closed system, many palynological samples are mixtures of several environments (Potter, 1964; Janssen, 1981). This is the result of several factors. First, thanatocoenoses are often comprised of plant remains from several ecological assemblages. This may be due to fluvial, wind, or biological transport of palynomorphs from various environments into a common depositional site (A. T. Cross, Thompson, and Zaitzeff, 1966; Funkhouser, 1969; Janssen, 1981). Sharp boundaries between environments generally do not exist. Rather, environmental conditions change gradually and often occur in a patchwork pattern. Some communities leave excellent records of their existence and floristic composition, e.g., marine assemblages, while others, such as upland or xeric communities are rarely preserved with adequate representation for positive identification (R. H. Tschudy, 1961, 1969, p. 14-25, 87-90, 267; Janssen, 1981).

Palynomorph assemblages also vary in their potential for preservation. Assemblages preserved in fluvial shales or sandstones or nearshore marine lithologies often are derived from many different source-plant communities and usually do not represent an assemblage indigenous to the host rock depositional environment (R. H. Tschudy, 1969, p. 79-85; Raup and Stanley, 1978, p. 24, 296-301; Janssen, 1981). In most depositional environments, there is constant potential for reworking of palynomorphs from other communities or from earlier deposits. This is especially characteristic of fluvial environments and only somewhat evident in modern peats (Wilson, 1964; Riegel, 1965; Muir, 1967; A. T. Cross, Thompson, and Zaitzeff, 1966; Cohen, 1975; Janssen, 1981).

These factors, and others, result in varying degrees of uncertainty in community representation. Some of the more common assumptions used in this study include the following:

1) The ecology of some Cretaceous plants can be correlated to that of modern plants for similar taxonomic groups (R. H. Tschudy, 1961; Cousminer, 1961; Jarzen, 1978).

2) Dinoflagellates and acritarchs are representative of marine or brackish water environments primarily in the Cretaceous and freshwater species are negligible (Evitt, 1969; R. H. Tschudy, 1961). Downie (1973) stated that no pre-Quaternary freshwater acritarchs are known.

3) Reworked palynomorphs and modern contaminants can often be differentiated or identified (Muller, 1959; Wilson, 1964; Muir, 1967).

4) Sedimentologic characteristics and associated trace and invertebrate fossils are often relatively accurate indicators of the general environment or even specific environment of deposition. These are especially useful in combination with floristic analyses (Frey and

Howard, 1982; Dodd and Stanton, 1978, p. 262-298; Ager, 1963, p. 72-74, 123, 201-216.)

5) Exotic communities can often be recognized and defined from palynological study (Nichols and Traverse, 1971).

6) Palynofloras from coals are generally representative of the local vegetation whereas fluvial shale, siltstones, and sandstones often contain palynofloras derived from floral communities of broader regions. This relationship between the lithology of a sample and the vegetation has been reviewed or discussed in numerous studies including those of Muller (1959), Wilson (1964), Riegel (1965), Cohen and Spackman (1972), J. A. R. Anderson and Muller (1975), Dodson (1977), Janssen (1981), and Colhoun et al. (1982).

Muller (1959) in his study of the Orinoco delta (Recent) and Orlansky (1971) in his study of the Upper Cretaceous deltas in the Straight Cliffs Sandstone both stated that the palynofloras of the deltaic sediments consisted primarily of local swamp vegetation. Apparently this resulted from restricted transport of palynomorphs in the delta. Flooding, as evidenced by crevasse splays and overbank muds, however, can introduce palynomorphs of other communities into the delta plain sedimentary environments.

PALEOECOLOGY OF THE MIDDLE CRETACEOUS, EAST-CENTRAL UTAH

General Remarks

During the Middle Cretaceous the lands bordering the Western Interior Seaway were characterized by a mild and equable climate (Kauffman, 1977). The climate has been described as either warm temperate (Lawrence, Kauffman, Fursich, and Ryer, 1982) or subtropical (May, 1972; Kauffman, 1977, 1984). Both the marine invertebrate data and the palynofloras, which are representative of coastal or marine environments, suggest a mild climate at sea level during the Middle Cretaceous in Utah.

Because only twenty-nine outcrop samples were productive in this study and these are widely distributed geographically, and generally represent only stratigraphically proximal strata, only limited ecological analysis can be made for the Tununk Shale, Ferron Sandstone, or the Bluegate Shale in the Castle Valley area of east-central Utah. However, these data are consistent with interpretations based on sedimentological and invertebrate studies of the area.

The relatively large proportion of terrestrially-derived pollen and spores present in three of the four samples from the Tununk Shale (Table 6 and Figure 23) are expected in the case of a shallowing sea located close to the shoreline. The variability seen in the Marine-Terrestrial Indices from the Tununk Shale suggests that the shore line oscillated in position. In addition, northern

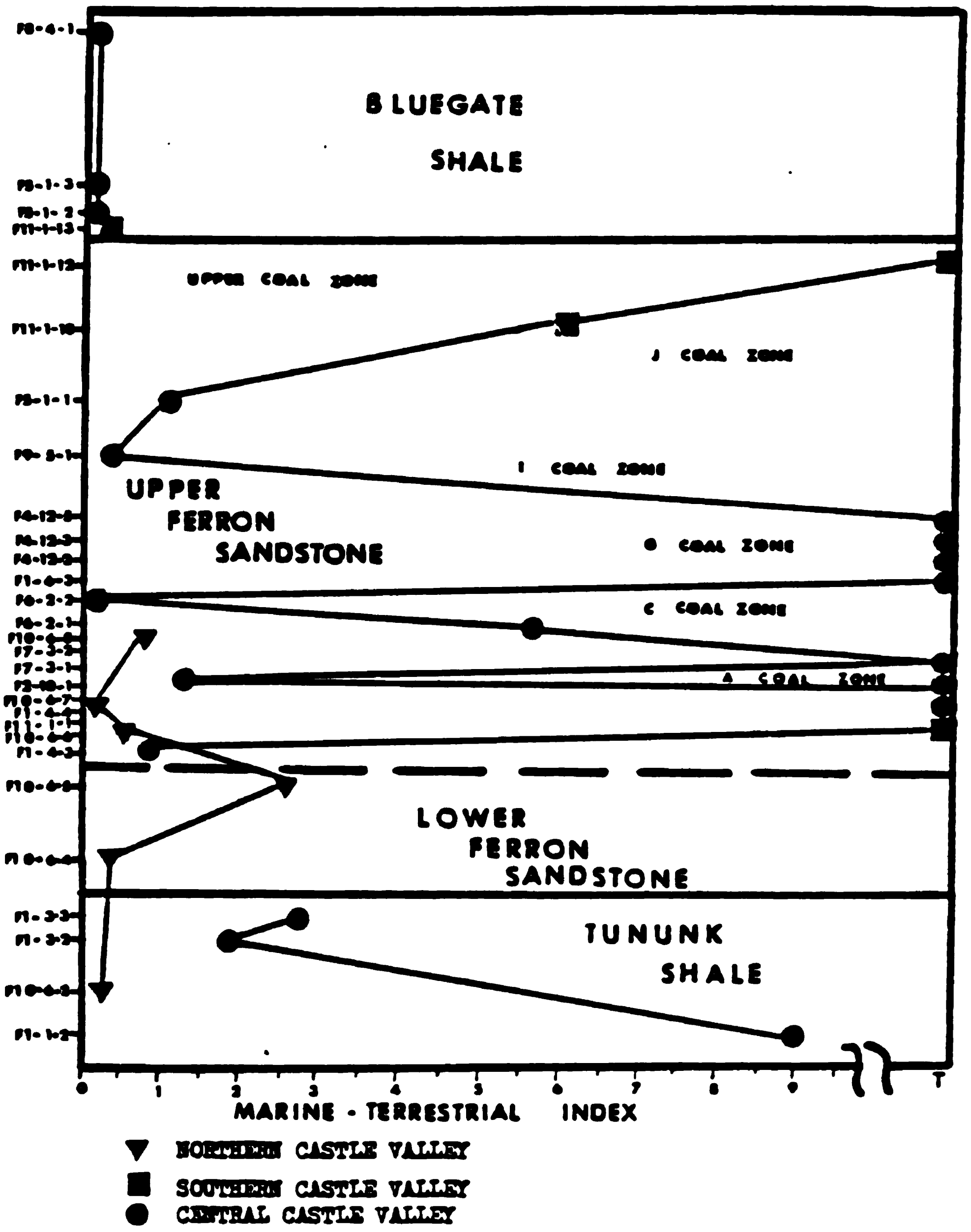


FIGURE 23: PALYNOLOGICAL TRENDS IN OUTCROP SAMPLES

Marine-Terrestrial Index:

less than 1.0	Marine
1.0 - 5.5	Very Near Shore
5.5 - 10.0	Lagoon/Bay Terrestrial

Castle Valley was farther from the prograding Ferron Last Chance Delta than southern Castle Valley.

Compared to the Tununk Shale palynofloras, the four Bluegate Shale samples had a very limited array of terrestrially derived pollen and spores (Table 6, Figure 23). The very low Marine-Terrestrial Indices of the four Bluegate Shale samples suggest a marine environment located far enough from shore to show no nearshore influence on the palynofloras. No significant variation in palynoflora is evident in the few widely scattered samples from the Bluegate Shale.

Productive palynological samples from the Ferron varied considerably in character (Table 6, Figure 23). Both samples from the lower Ferron in northern Castle Valley contained a marine palynoflora. Samples from the upper Ferron Last Chance Delta in southern Castle Valley varied from marine to nonmarine in character. Further palynological work would be required to document the changing scope and character of the paleoflora of the entire Ferron delta during Ferron time.

Tununk Shale

The sediments of the Tununk Shale in the Castle Valley area of east-central Utah represent a gradual shallowing of the Interior Seaway from late Cenomanian through the earliest Late Turonian. Based on foraminiferal ecology, Maxfield (1976) estimated water depths and conditions to be approximately 100-200' (30-60 m), open normal marine for the lower Tununk Shale; about 100' (30 m), open normal marine for the middle Tununk Shale; and less than 75' (23 m), low salinity for the upper Tununk Shale in Castle Valley. The limited palynological evidence from this study also suggests that the upper Tununk was deposited in a shallow sea receiving an abundant supply of sediment from a nearby source.

Studies by Wall (1965) and Tingey (1978) indicate that low phytoplankton diversity was characteristic of a near-shore environment. They also postulated that a high acritarch content along with a low dinoflagellate content indicates a more restricted, brackish habitat. Application of this model to the limited data from the Tununk Shale (Table 6, Figure 23) suggests that the samples from southern Castle Valley were from a more restricted, brackish habitat from a nearshore marine environment as compared to the Tununk sample from northern Castle Valley. The sample from northern Castle Valley (F10-6-2), which contained a normal marine palynoflora, also had the highest phytoplankton diversity and the lowest percentage of acritarchs. Samples from southern Castle Valley (F1-1-2, F1-3-2, and F1-3-3) contained very low phytoplankton diversity and very high acritarch content.

The upper Tununk Shale in the northern half of Castle Valley (sample F10-6-2) contains a typical marine palyno-flora. With 74% of the palynomorphs consisting of dinoflagellates and acritarchs, the Marine-Terrestrial Index of 0.35 is well within the normal marine range. In the southern parts of Castle Valley, the upper Tununk Shale oscillates between lagoon/bay and very nearshore marine environments (samples Fl-1-2, Fl-3-2 and Fl-3-3) based upon Marine-Terrestrial Indices. The stratigraphically lowest productive sample, Fl-1-2, represents lagoon/bay facies (Marine-Terrestrial Index of 9.0). The uppermost productive Tununk Shale samples, Fl-3-2 and Fl-3-3, represent conditions intermediate between the other two Tununk samples. Here the Marine-Terrestrial Indices of 1.9 and 2.8, respectively, indicate a very near-shore marine environment.

Ferron Sandstone

The sediments of the Ferron Sandstone have been divided into two phases of sedimentation, the lower Ferron and the upper Ferron (Davis, 1954; Cotter, 1975b, 1975c). The first phase of sedimentation consisted of marine sands and muds. These sediments contained abundant trace fossils such as Ophiomorpha, Thalassinoides, Teichichnus, Scolicia, and fragments of bivalve and gastropod shells (Cleavinger, 1974; Cotter, 1975b, 1975c). Both the invertebrate data and the sedimentological characteristics of the lower Ferron led Cleavinger (1974) to conclude that the lower Ferron sediments were derived from several barrier island complexes intermixed with lagoonal muds. Ryer (1981b), on the other hand, believes that the lower Ferron sandstones accumulated in the delta-front environment and consist of distal bar and distributary mouth bar subfacies.

Two palynologic samples (F10-6-4 and F10-6-5, Table 6) were productive from the lower Ferron in this study. Both contain a marine palynoflora, which is consistent with the invertebrate and sedimentological interpretations. Sample F10-6-4 had a Marine-Terrestrial Index of 0.4, which is representative of a normal marine environment. Sample F10-6-5 had a Marine-Terrestrial Index of 2.6 representative of a very nearshore facies. The phytoplankton of sample F10-6-5 consists entirely of acritarchs while that of sample F10-6-4 has 47% acritarchs. Based upon the facies model of Wall (1965) and Tingey (1978), the very high acritarch content of sample F10-6-5 is consistent with its higher Marine-Terrestrial Index indicating a facies closer to shore than that of sample F10-6-4.

The second phase of sedimentation, the upper Ferron, consisted primarily of deltaic sediments. Cleavinger (1974) and Ryer (1981a) reported the presence of bivalve and gastropod shell fragments scattered throughout the upper Ferron siltstones. Cleavinger (1974) also reported the presence of echinoid spines and the foraminifera Nodosaria, Frondicularia, and Lenticulina, in the upper shales of the Ferron. Maxfield (1976) considers these formanifera genera to be representative of a benthic community living in stagnant, brackish water of 0-20' depth.

The small number of productive outcrop samples from the upper Ferron makes it difficult to compare and contrast the complex paleoenvironments and paleoflora of the entire Ferron deltaic complex. Only sixteen samples from the upper Ferron outcrop in southern Castle Valley and only three samples from the upper Ferron in northern Castle Valley were productive. The palynological characteristics of these nineteen samples have been summarized in Table 6 and Figure 23. Overall, these samples represent a wide range of stratigraphic and geographic positions and a broad range of environments from nearshore brackish marine siltstones (F1-4-3, F6-2-2, and F10-6-8) and shales (F6-2-1, F10-6-6, and F10-6-7) to brackish coals (F5-1-1 and F7-3-1) to nonmarine siltstones (F4-12-2, F7-3-2, F4-12-3, and F4-12-5), shales (F11-1-10 and F11-1-1), and coals (F11-1-12 and F1-6-3).

Bluegate Shale

The sediments of the Bluegate Shale were deposited in a sea that began transgressing onto the Ferron deltaic sediments during the late Turonian. Based upon the presence of the foraminifera _Planellina_ _kansasensis_ (Maxfield, 1976), the sediments of the lowest Bluegate Shale (0-100 ft/0-30 m) were deposited in open marine waters 75-200 ft (20-60 m) deep. Above 100 ft (30 m) in the Bluegate, which is early Coniacian in age, the Bluegate sea was somewhat deeper, 200-300 ft (60-90 m). This is based upon the presence of the foraminfera _Spirolectammina_ _navarroana_ and _Lituola_ irregulariter and the ammonites Scaphites preventricosus, Scaphites impendicostatus, Baculities marianensis, Forresteria stantoni, and Placenticeras pseudoplacenta (Maxfield, 1976; Cobban, 1976).

All four productive palynologic samples from this study of the Bluegate Shale contain a palynoflora suggestive of a normal marine environment located an appreciable distance from any source of terrestrially-derived palynomorphs. The Marine-Terrestrial Indices at the Bluegate samples ranges from 0.0 to 0.1 (Table 6, Figure 23). Acritarchs accounted for only 21-38% of the total phytoplankton.

LOCAL SWAMP FLORISTIC ASSEMBLAGES OF THE FERRON C COAL

Within the coal of the C coal horizon, seven palynomorph assemblages have been defined. These assemblages are based upon the distribution of the relative percentages of phytoplankton (dinoflagellates and acritarchs), pteridophytes, gymnosperms, angiosperms, and Sphagnaceae/Zygnemataceae present in each sample. Four assemblages contained less than 15% Sphagnaceae/Zygnemataceae and less than 15% dinoflagellates and acritarchs. The 15% level was chosen to differentiate assemblages based upon the occurrence of the largest break in plots of the sample palynomorph distributional trends and in phytoplankton or Sphagnaceae/Zygnemataceae distributional trends. The four assemblages have been called the Angiosperm Assemblage, Herbaceous Fern Assemblage, Gymnosperm Assemblage, and the Mixed Assemblage (Figure 24).

Three assemblages contain greater than 15% Sphagnaceae/ Zygnemataceae or greater than 15% dinoflagellates and acritarchs. These three assemblages have been designated the Wet, Pteridophyte-Gymnosperm Swamp Assemblage, the Wet, Mixed, Swamp Assemblage, and the Brackish, Gymnosperm Swamp Assemblage (Figure 25).

Because, as previously discussed, the palynofloras of coal-swamp samples, especially those associated with deltaic sediments, are believed to represent primarily only the local flora, these seven assemblages are deemed to represent the basic floristic associations that existed within the Ferron C coal. Although the individual taxa may vary somewhat within each of these assemblages, the general character of the assemblages does not change and is of primary concern in this study. The distribution of the floristic assemblages within the C coal are given in Table 14.

The seven palynologic assemblages are defined in Figures 24 and 25. The category "Sphagnaceae/Zygnemataceae" is dominated by the Sphagnaceae in the Wet, Pteridophyte-Gymnosperm Swamp Assemblage and in the Wet, Mixed, Swamp Assemblage. In the Brackish, Gymnosperm Swamp Assemblage, the dominant component of the group "dinoflagellates and acritarchs" is <u>Leiosphaeridia</u>.

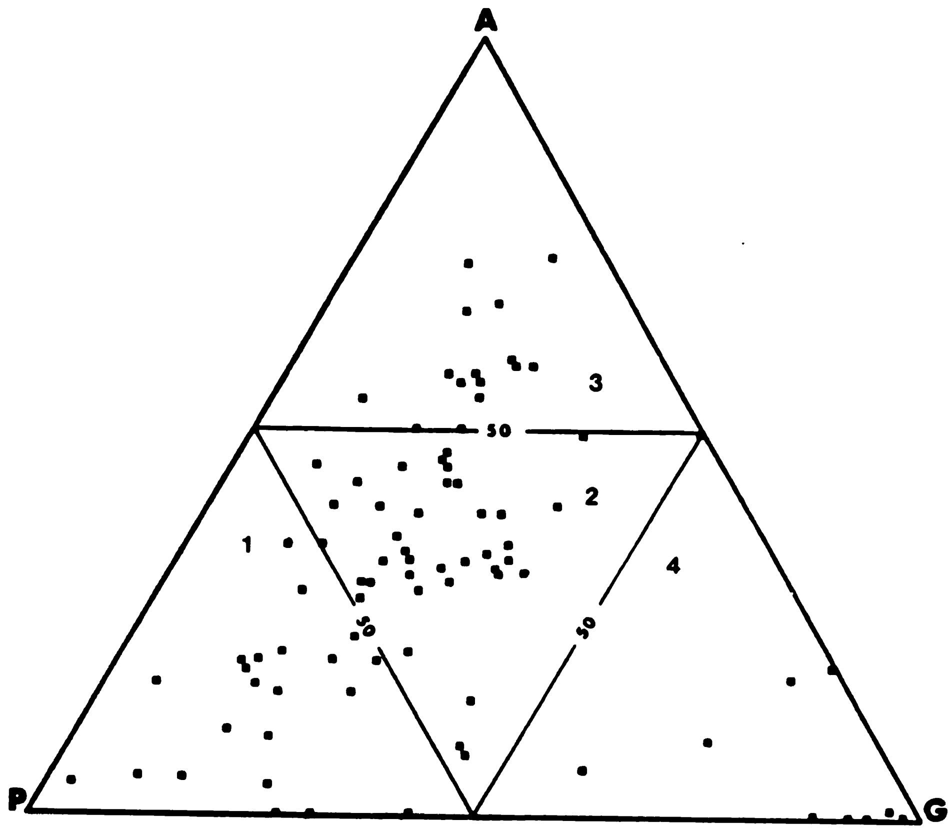


FIGURE 24: RELATIVE ABUNDANCE DISTRIBUTION OF FERRON C COAL SAMPLES

Based upon the relative frequency distribution of pteridophytes, gymnosperms, and angiosperm, four assemblages have been defined. All four assemblages defined here contain less than 15% Sphagnaceae and Zygnemataceae and/or less than 15% dinoflagellates and acritarchs. Assemblages that contain greater than 15% of these two groups are defined in Figure 25.

1) Herbaceous Fern Assemblage: Contains greater than 50% pteridophytes (ferns and fern allies).
2) Mixed Assemblage: Contains less than 50% pteridophytes, less than 50% angiosperms, and less than 50% gymnosperms.
3) Angiosperm Assemblage: Contains greater than 50% angiosperms.
4) Gymnosperm Assemblage: Contains greater than 50% gymnosperms.

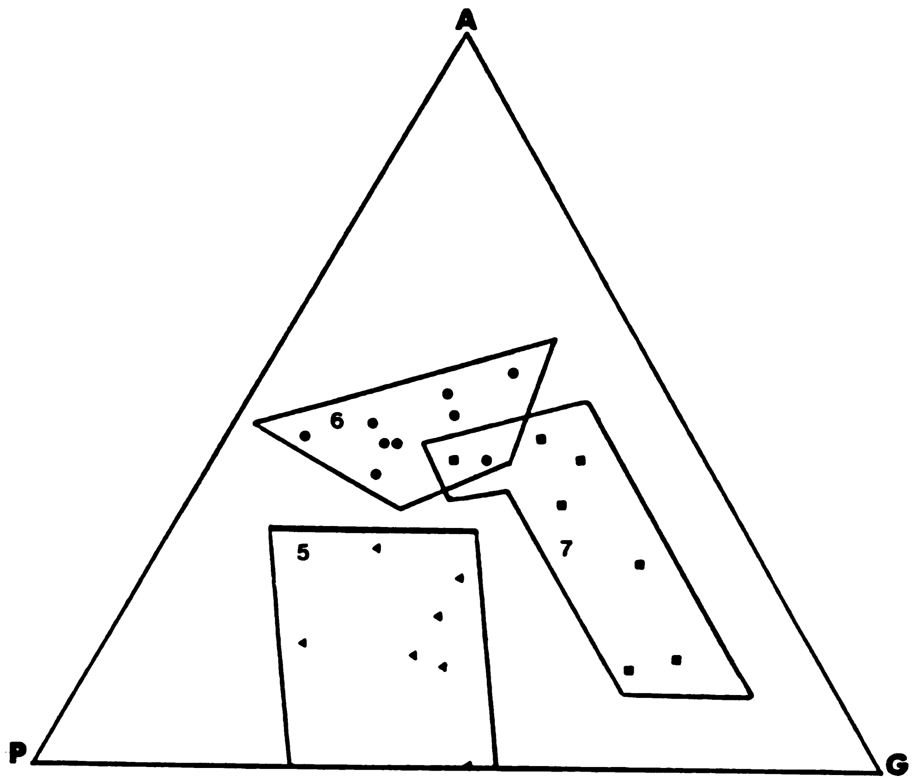


FIGURE 25: RELATIVE ABUNDANCE DISTRIBUTION OF HIGH ALGAL-SPHAGNACEAE COALS

Based upon the relative frequency distribution of pteridophytes, gymnosperms, and angiosperms, three assemblages have been defined. All three assemblages shown above are characterized by containing greater than 15% dinoflagellates and acritarchs or by containing greater than 15% Sphagnaceae and Zygnemataceae. These three assemblages are further characterized by:

5) Wet, Fern-Gymnosperm Swamp Assemblage: Contains less than 30% angiosperms, 20-55% gymnosperms, and 35-60% pteridophytes.
6) Wet, Mixed, Swamp Assemblage: Contains greater than 40% angiosperms, 5-35% gymnosperms, and 15-50% pteridophytes.
7) Brackish, Gymnosperm Swamp Assemblage: Contains 25-70% gymnosperms, 10-45% angiosperms, and 10-40% pteridophytes.

TABLE 14: C COAL PALYNOASSEMBLAGES

SAMPLE	LITHOLOGY	TYPE OF ASSEMBLAGE
Q2a-2	Coal	Mixed Assemblage
Q2a-3	Coal	Wet, Mixed, Swamp Assemblage
Q2a-6	Siltstone	Wet, Mixed, Swamp Assemblage
Q2a-7	Coal	Mixed Assemblage
Q2a-8	Coal	Mixed Assemblage
Q2a-9	Siltstone	Angiosperm Assemblage
Q2a-11	Siltstone	Mixed Assemblage
Q2a-12	Coal	Herbaceous Fern Assemblage
Q2a-13	Coal	Herbaceous Fern Assemblage
Q2a-14	Coal	Herbaceous Fern Assemblage
Q3-1	Coal	Mixed Assemblage
Q3-2	Coaly Shale	Angiosperm Assemblage
Q3-3	Shale	Gymnosperm Assemblage
Q3-8	Shaley Coal	Wet, Mixed, Swamp Assemblage
Q3-9	Coal	Angiosperm Assemblage
Q3-11	Coal	Mixed Assemblage
Q3-12	Coal	Mixed Assemblage
Q3-14	Coal	Wet, Fern-Gymnosperm Swamp Assemblage
Q3-15	Coal	Wet, Mixed, Swamp Assemblage
Q3-16	Coal	Wet, Fern-Gymnosperm Swamp Assemblage
Q3-18	Coal	Angiosperm Assemblage
Q3-22	Coaly Shale	Angiosperm Assemblage
Q3-23	Coaly Shale	Herbaceous Fern Assemblage
Q3-24	Coaly Shale	Mixed Assemblage
Q3-26a	Coaly Shale	Mixed Assemblage
Q3-28	Coaly Shale	Mixed Assemblage
Q4-1	Coaly Shale	Mixed Assemblage
Q4-3	Siltstone	Herbaceous Fern Assemblage
Q4-4	Coal	Gymnosperm Assemblage
Q4-5	Coal	Gymnosperm Assemblage
Q4-6	Coaly Shale	Angiosperm Assemblage
Q4-7	Coal	Angiosperm Assemblage
Q4-8	Coal	Mixed Assemblage
Q4-11	Coal	Wet, Fern-Gymnosperm Swamp Assemblage
Q4-12	Coal	Gymnosperm Assemblage
Q4-13	Shale	Herbaceous Fern Assemblage
Q4-15	Coal	Gymnosperm Assemblage
Q4-16	Coal	Gymnosperm Assemblage
Q4-18	Coal	Gymnosperm Assemblage
Q4-21	Coal	Gymnosperm Assemblage
Q4-22	Coal	Angiosperm Assemblage
Q4-23	Coaly Shale	Wet, Mixed, Swamp Assemblage
Q4-25	Coal	Mixed Assemblage
Q4-26	Coal	Mixed Assemblage
Q4-27	Coal	Mixed Assemblage
Q4-28	Coaly Shale	Mixed Assemblage

TABLE 14 (cont'd)

Q4-29	Siltstone	Mixed Assemblage
Q5-1	Coaly Shale	Angiosperm Assemblage
Q5-2	Coal	Angiosperm Assemblage
Q5-3	Shaley Coal	Mixed Assemblage
Q5-6	Coal	Herbaceous Fern Assemblage
Q5-7	Coal	Herbaceous Fern Assemblage
Q5-8	Shale	Mixed Assemblage
Q5-15	Coal	Wet, Mixed, Swamp Assemblage
Q5-16a	Shale	Mixed Assemblage
Q5-17a	Shale	Herbaceous Fern Assemblage
Q5-18	Coal	Mixed Assemblage
Q5-20	Coaly Shale	Mixed Assemblage
Q5a-0	Shale	Angiosperm Assemblage
Q5a-1	Shaley Coal	Mixed Assemblage
Q5a-2	Coal	Angiosperm Assemblage
Q5a-4	Coal	Mixed Assemblage
Q5a-5	Coal	Mixed Assemblage
Q5a-6	Coal	Mixed Assemblage
Q5a-7	Coal	Wet, Fern-Gymnosperm Swamp Assemblage
Q5a-8	Shale	Wet, Mixed, Swamp Assemblage
Q5a-13	Coal	Wet, Fern-Gymnosperm Swamp Assemblage
Q5a-16	Coal	Herbaceous Fern Assemblage
Q5a-18	Shale	Herbaceous Fern Assemblage
Q5a-21	Coal	Mixed Assemblage
Q5a-22	Coal	Brackish, Gymnosperm Swamp Assemblage
Q5a-23	Shale	Mixed Assemblage
Q6-3	Shaley Coal	Herbaceous Fern Assemblage
Q6-4	Coal	Herbaceous Fern Assemblage
Q6-5	Coal	Herbaceous Fern Assemblage
Q6-6	Shale	Herbaceous Fern Assemblage
Q6-14	Coal	Wet, Mixed, Swamp Assemblage
Q6-20	Siltstone	Mixed Assemblage
Q7-1	Coaly Shale	Wet, Fern-Gymnosperm Swamp Assemblage
Q7-2	Coal	Brackish, Gymnosperm Swamp Assemblage
Q7-4	Coal	Gymnosperm Assemblage
Q7-6	Shale	Mixed Assemblage
Q7-18	Coal	Mixed Assemblage
Q7-20	Shale	Herbaceous Fern Assemblage
Q7-23	Shale	Angiosperm Assemblage
Q7-28	Shale	Herbaceous Fern Assemblage
Q7-29	Coal	Herbaceous Fern Assemblage
Q8-1	Coaly Shale	Mixed Assemblage
Q8-2	Coal	Herbaceous Fern Assemblage
Q8-3	Coal	Mixed Assemblage
Q8-4	Shale	Wet, Mixed, Swamp Assemblage
Q8-5	Coal	Wet, Mixed, Swamp Assemblage

TABLE 14 (cont'd)

Q8-6	Coal	Brackish, Gymnosperm Swamp Assemblage
Q8-7	Coal	Brackish, Gymnosperm Swamp Assemblage
Q8-8	Shale	Mixed Assemblage
Q8-10	Coal	Brackish, Gymnosperm Swamp Assemblage
Q8-11	Coal	Brackish, Gymnosperm Swamp Assemblage
Q8-15	Coal	Brackish, Gymnosperm Swamp Assemblage
Q8-18	Coal	Herbaceous Fern Assemblage
Q8-20	Coal	Mixed Assemblage
Q8-21	Shale	Angiosperm Assemblage
Q9-1	Coal	Mixed Assemblage
Q9-3	Coal	Mixed Assemblage
Q9-5	Coaly Shale	Wet, Mixed, Swamp Assemblage
Q9-6	Shale	Herbaceous Fern Assemblage
Q9-8	Coal	Angiosperm Assemblage
Q9-11	Coal	Angiosperm Assemblage
Q10a-1	Coal	Mixed Assemblage
Q10a-2	Shale	Herbaceous Fern Assemblage
Q10a-3	Coal	Herbaceous Fern Assemblage
Q10a-4	Coal	Herbaceous Fern Assemblage
Q10a-5	Shale	Herbaceous Fern Assemblage
Q10a-14	Shale	Angiosperm Assemblage
Q10a-19	Coaly Shale	Mixed Assemblage
Q11-1	Siltstone	Herbaceous Fern Assemblage
Q11-2	Coal	Mixed Assemblage
Q11-3	Coaly Shale	Herbaceous Fern Assemblage
Q11-6	Coal	Mixed Assemblage
Q11-7	Coal	Wet, Fern-Gymnosperm Swamp Assemblage
Q11-10	Coaly Shale	Mixed Assemblage
Q11-12	Coal	Herbaceous Fern Assemblage
Q11-14	Shale	Mixed Assemblage
Q11-15	Coal	Mixed Assemblage
Q11-16	Coaly Shale	Herbaceous Fern Assemblage
Q12-2	Coaly Shale	Herbaceous Fern Assemblage
Q12-5	Shaley Coal	Angiosperm Assemblage
Q12-6	Shaley Coal	Angiosperm Assemblage
Q12-7	Shaley Coal	Mixed Assemblage
Q12-11	Coaly Shale	Angiosperm Assemblage
Q12-12	Coaly Shale	Angiosperm Assemblage
Q12-13	Coaly Shale	Mixed Assemblage
Q12-14	Shale	Mixed Assemblage
Q13-1	Shaley Coal	Gymnosperm Assemblage
Q13-8	Coal	Gymnosperm Assemblage
Q13-9	Coal	Gymnosperm Assemblage
Q13-12	Coaly Shale	Herbaceous Fern Assemblage

These seven assemblages are further distinguished by their average diversity. The lowest average assemblage diversity is evident in the Gymnosperm Assemblage, where it is only 19 taxa. The highest average diversity of 53 taxa characterizes the Mixed Assemblage. However, as discussed previously, the highest diversity (over 70 taxa per sample) is found in coal samples dominated by angiosperms. An average diversity of 47 and 49 taxa is found in the Angiosperm Assemblage and in the Brackish, Gymnosperm Swamp Assemblage, respectively. An intermediate average diversity of 33 taxa characterizes both the Wet, Mixed, Swamp Assemblage and the Wet, Pteridophyte-Gymnosperm Swamp Assemblage. An average diversity of 37 taxa is found in the Herbaceous Fern Assemblage.

PALEOECOLOGIC HISTORY OF THE C COAL UNIT OF THE FERRON

GENERAL REMARKS

The C coal unit of the Ferron can be subdivided into three general time zones using two of the tonsteins as markers, the "thick tonstein," which is the uppermost tonstein, and the "lower tonstein," which is the oldest tonstein apparent in the C coal cores. These three units are designated the Lower C coal, located below the lower tonstein, the Middle C coal, located between the lower tonstein and the thick tonstein, and the Upper C coal, located above the thick tonstein. The Middle C coal unit can be further subdivided into three units by the presence of two thin tonsteins, the lower doublet tonstein and the upper doublet tonstein. These three subdivisions of the Middle C coal have been designated the Lower Middle C coal unit, the Middle Middle C coal unit, and the Upper Middle C coal unit.

The C coal unit of the Ferron Last Chance Delta was deposited in a coastal peat swamp environment and was developed on lagoon and/or back-barrier beach sediments (Ryer, 1981a). The development and floristic history of this peat swamp was controlled both by hydrologic factors, such as flooding, and by several volcanic eruptions which covered the area with ash.

The duration of the C coal swamp can only be crudely estimated. The inferred duration of the entire Ferron Sandstone sequence places outside limits on this estimate. As noted earlier, the duration of the Ferron has been variously estimated to range from about one-half million (Kauffman, 1977) to one million years (Ryer and McPhillips, 1983). The C coal horizon, which is the main focus of this study, represents only about 5% of the total thickness of sediments of the Ferron Sandstone, but the percentage of Ferron time represented is probably somewhat greater. Five percent of the total Ferron time would represent approximately 25,000 to 50,000 years of development of the C coal horizon. Although this is only a rough estimate of duration and does not take into consideration the numerous erosional unconformities, depositional breaks, and the possibility of varying sedimentation rates throughout the Ferron, this rough duration estimate is within comparable ranges of peat swamp sedimentation rates established in other areas.

J. A. R. Anderson and Muller (1975) estimated that it took 40 years for the deposition of 10 cm of peat (Recent) in southeast Asia. Using peat to coal transformation ratio of 11:1 (Ryer and Langer, 1981), this sedimentation rate would yield a duration of approximately 40,000 years for the C coal horizon (thickness averaged for the coal of all cores). Wing (1980) calculated that 1 cm of lignite (Eocene, Wyoming) represents between 0.5-20 years of deposition based upon floristic analogies to modern hydrologic successional models. Applying Wing's model to the C coal would produce an average duration of 20,000 years. Mehringer, Arnot, and Petersen (1977) determined from radiocarbon dated samples rates of peat deposition varying 5-20 years per cm in post-glacial bogs of Montana. They reported an average peat depositional rate of 5 yr per cm for the past 600 years of the bog's history. Using Mehringer, Arnot, and Petersen's (1977) peat depositional rates produces a duration of 50-200,000 years for the C coal horizon. Ryer (1977b) estimated an average duration of 28,000 years each for a series of 18 cycles present in the Frontier Formation of north-central Utah based upon K-Ar dating of bentonites and faunal zones. One cycle in the Frontier Formation is equivalent to the C coal horizon in Ryer's terminology.

LOWER C COAL UNIT

General Remarks

The lower C coal is defined as all coal and partings located below and including the lower tonstein in the cores (Figures 7, 9-21). During this time period the initial development of the C coal horizon peat swamps in the study area began. However, no peat swamp development, as evidenced by the presence of coal (Ryer, 1981a), is seen south of core Q3 (Figure 6). Total coal thickness, not including partings, varies from zero (core Q2a) to more than 80"

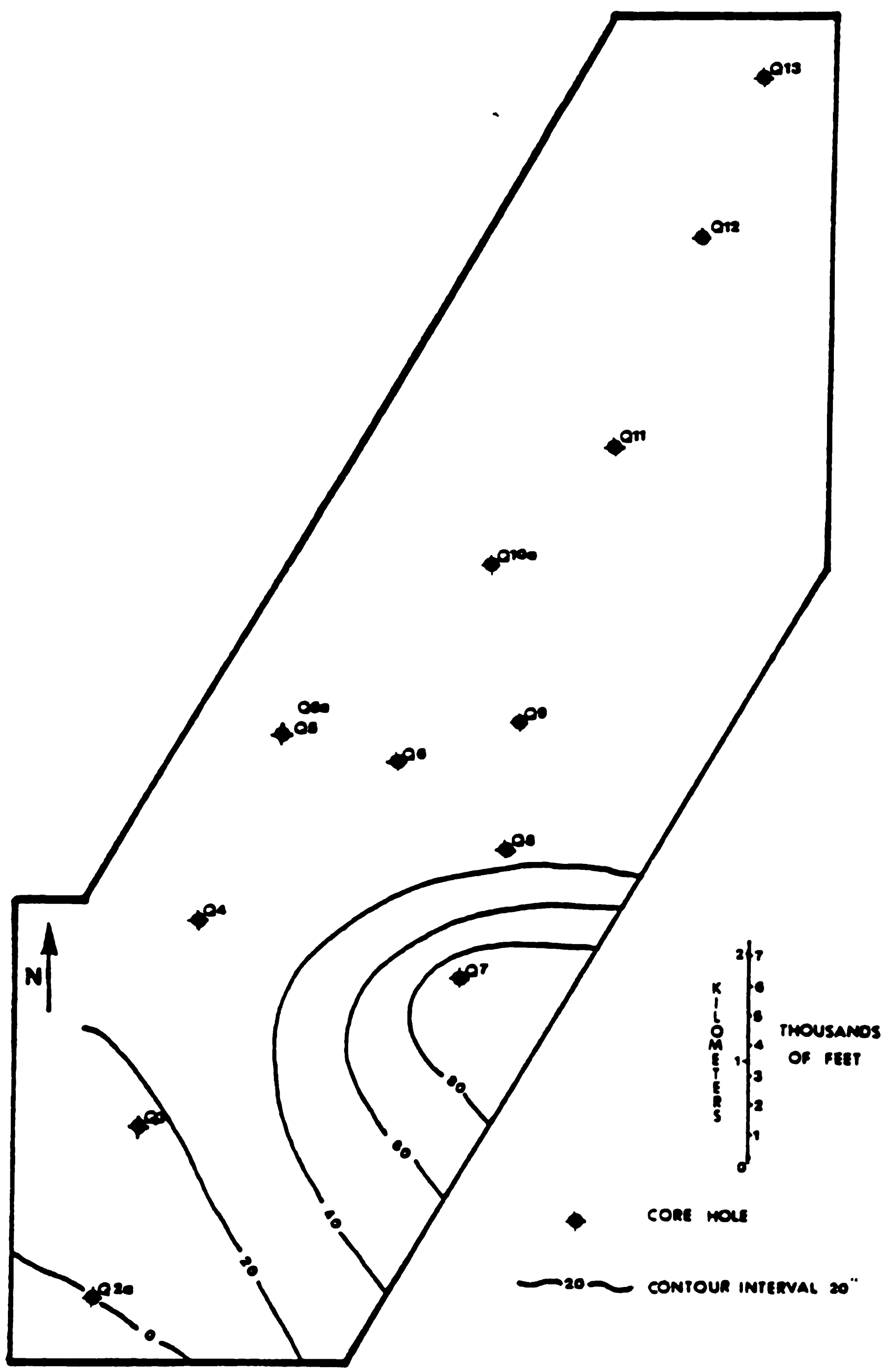


FIGURE 26: THICKNESS OF LOWER C COAL

(core Q7). There is less than 40" of lower C coal (Figure 26) over most of the study area.

The lower C coal can be divided into three time zones. These are 1) Early C Coal, which includes everything prior to time zone 2; 2) Immediately Below the Lower Ash Fall, which includes only the first sample immediately below the lower tonstein; and 3) the Lower Ash Fall. These three time units, however, are not identical in scope. The period "Lower Ash Fall" is a geologically instantaneous time period that can be easily identified and correlated throughout the study area. The time period "Immediately Below the Lower Ash Fall" is represented by core samples of varying lithology and thickness. This time unit could be accurately correlated only if the samples studied represented the first few centimeters of the core immediately below the tonstein. However, this is not the case. The amount of geological time represented by each sample in this time unit is not identical and the palynoflora represents an average palynoflora for an unknown but probably relatively long period of time. The time period "Early C Coal" is the least certain in scope. There are no identifiable nor precise time markers in the lowermost part of the C coal. A general approximation to the overall palynoflora character of the lowermost C coal unit has been obtained by averaging core data throughout the study area over this entire time period.

Time Period One: Early C Coal

During "Early C Coal" time, coal swamps first developed throughout most of the study area. However, no coal is present during this time period in the area of core Q2a. Overall, fifteen coal/coaly shale/shaley coal samples were productive. Nine of these productive samples contain a Mixed Assemblage type palynoflora (Q3-28, Q4-27, Q4-28, Q5-18, Q5-20, Q5a-21, Q8-20, Q10a-19, and Q12-13). Three samples (Q4-26, Q7-29, and Q11-16) contain an Herbaceous Fern Assemblage. The Angiosperm Assemblage is present in core Q12 (Q12-12). Sample Q11-15 contains the Gymnosperm Assemblage. The Brackish, Gymnosperm Swamp Assemblage is present in sample Q5a-22. The distribution of palynologic assemblages (core averaged) is illustrated in Figure 27.

Overall, the average palynoflora of this time period is characteristic of the Mixed Assemblage. The average palynoflora contains 2% phytoplankton, 2% Sphagnaceae/Zygnemataceae, 34% pteridophytes, 29% gymnosperms, and 33% angiosperms. The average diversity of this time period is 47 taxa.

Time Period Two: Immediately Before the Lower Ash Fall

Because of the presence of the lower tonstein, the upper boundary of all samples in this time period are geologic time equivalents. Thus, the various plant communities of the swamps and associated areas, which made up the Ferron C coal area at the moment of the ash fall, may be

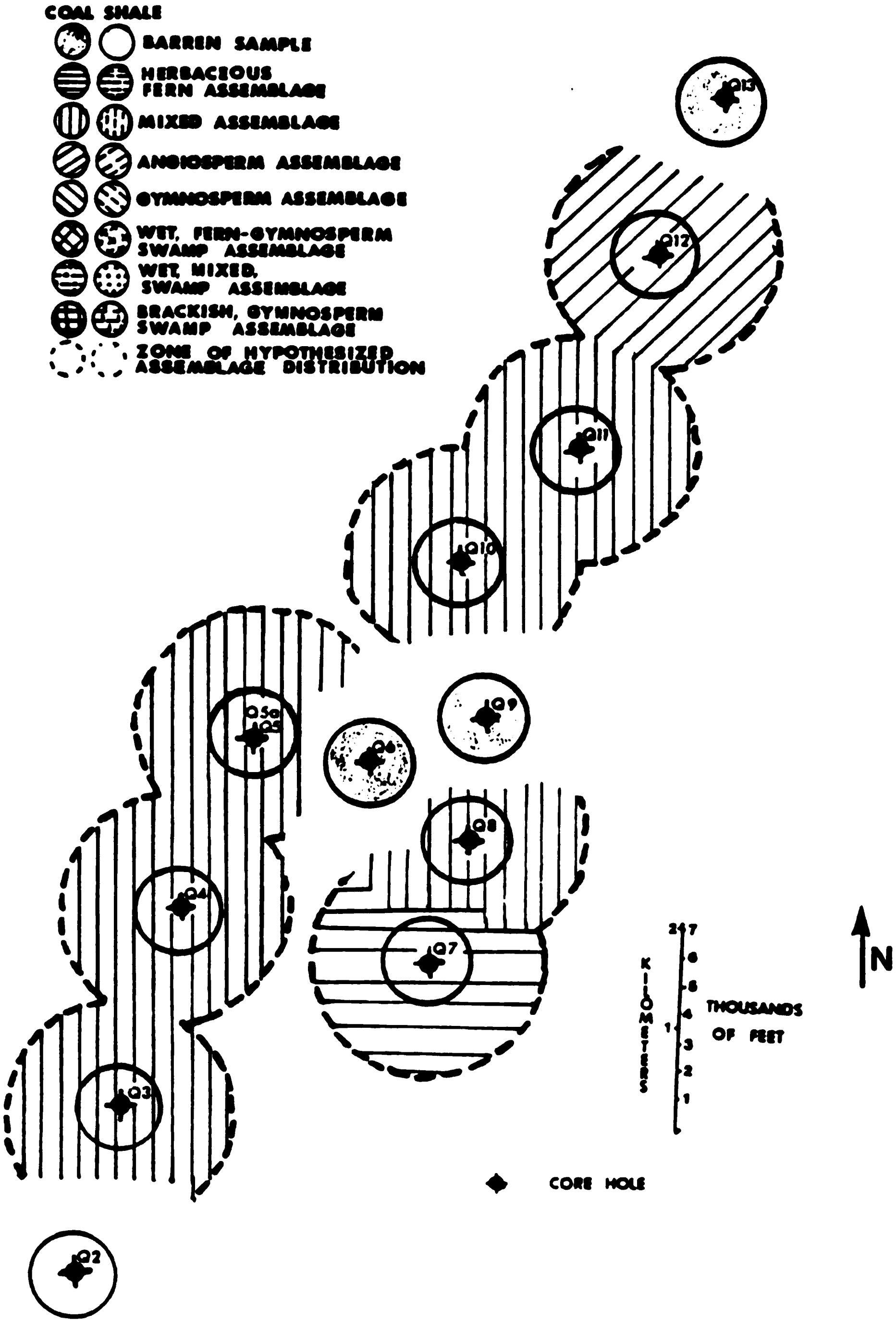


FIGURE 27: PALYNOMORPH ASSEMBLAGE DISTRIBUTION OF THE EARLY C COAL

determinable by palynologic study. However, because of the varying thickness and lithology of the core samples furnished, their respective palynofloras are represented here by an averaged palynological assemblage throughout a long period of time.

Immediately before the lower tonstein ash fall, coal-forming peat swamp was located in the area of cores Q6, Q8, Q9, and Q11 (Figure 28). Coaly shale or shaley coal accumulated in the area of cores Q3, Q4, Q12, and Q13.

Six coal/coaly shale/shaley coal samples were productive from this time period. These included samples Q3-26a and Q4-25, both of which contained a Mixed Assemblage palynoflora. Samples Q8-18, Q11-12, and Q13-12 all contained an Herbaceous Fern Assemblage. Sample Q12-11 contained an Angiosperm Assemblage palynoflora. The distribution of core averaged assemblages is illustrated in Figure 28.

Overall, this time period is characterized by a high pteridophyte or gymnosperm and low angiosperm palynoflora. The average palynoflora of this time period contains 1% phytoplankton, 2% Sphagnaceae/Zygnemataceae, 47% pteridophytes, 25% gymnosperms, and 25% angiosperms. Although the average diversity of this time period is 40 taxa, two distinct regions are present. Cores Q3 and Q4 have an average diversity of 85 taxa, while cores Q8, Q11, Q12, and Q13 have an average diversity of only 18 taxa. The higher diversity average corresponds to the presence of the Mixed

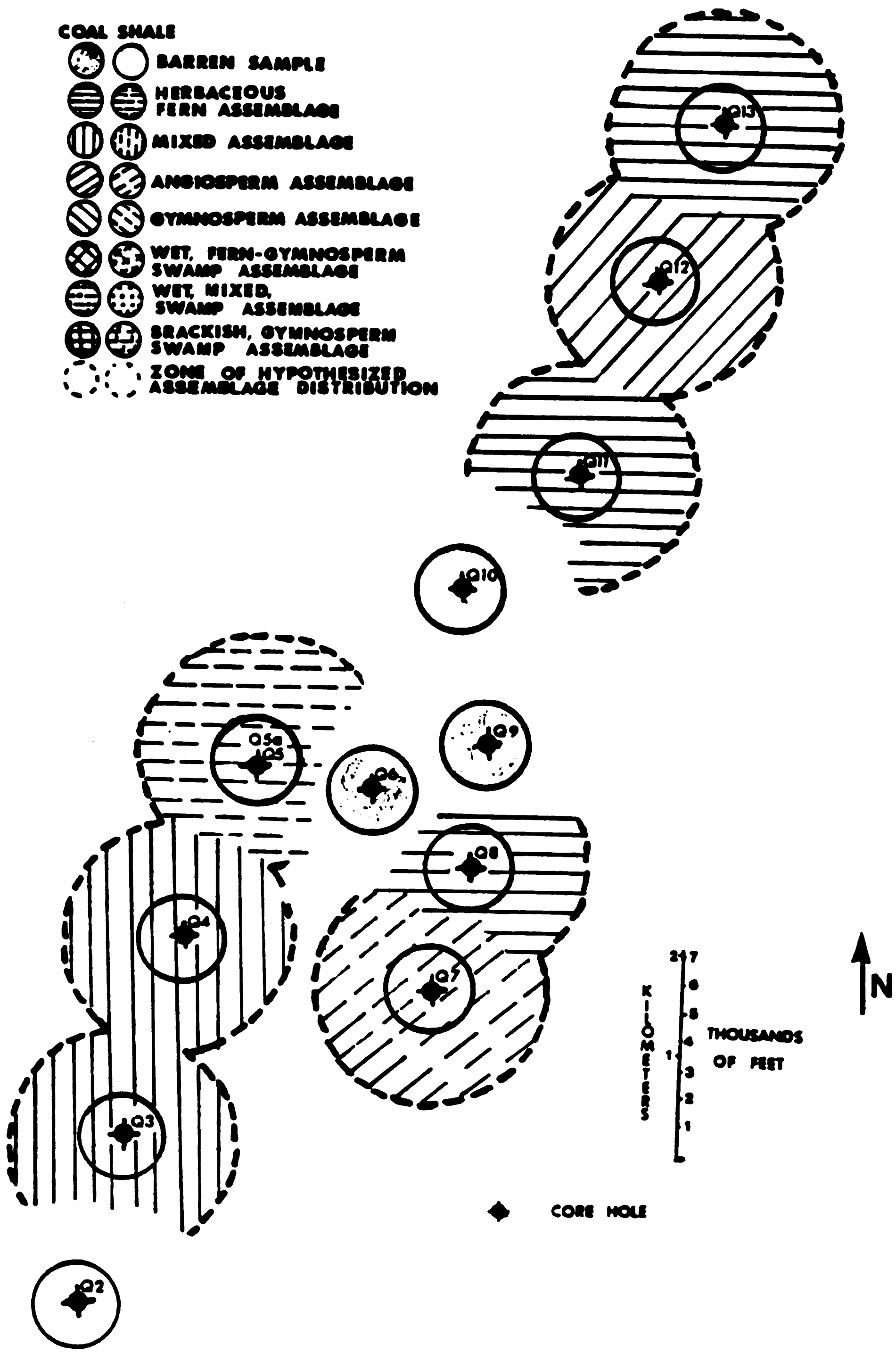


FIGURE 28: PALYNOMORPH ASSEMBLAGE DISTRIBUTION IMMEDIATELY BELOW THE LOWER ASH FALL

Assemblage. The lower diversity corresponds to the presence of the Herbaceous Fern and Gymnosperm Assemblages.

Shale, indicative of either flood deposits or open water, was present in the areas of cores Q5/Q5a, Q7, and Q10a. The precise depositional environment of these shales is not known. In addition, the lower tonstein has not been recognized and may not be distinguishable in the sandstone and shale sediments of core Q2a (Ryer, 1981a).

The palynofloras of the productive shale samples from this time period are found in Q5-17a, Q5a-18, and Q7-23. Both Q5-17a and Q5a-18 contain a pteridophyte dominated palynoflora (67% ferns). Sample Q7-23 contains an angiosperm dominated palynoflora (50% angiosperms). However, as previously discussed, because these samples are not coal swamp, but shale, there is less certainty that their palynofloras are primarily representative of the local vegetation. These non-coal forming areas and their respective palynologic assemblages are shown on Figure 28.

Time Period Three: Lower Ash Fall

The Lower C Coal Unit ended with a geologically instantaneous event. A volcanic eruption deposited a laterally continuous layer of ash over the entire study area. The resulting tonstein is relatively uniform in thickness varying from 2-5" (5-13 cm) thick. The tonstein in core Q11, however, does show an interruption in ash deposition by the presence of a thin coaly shale layer within the lower tonstein. Since this sedimentation break in the lower tonstein does not occur in any other core, it is possible that the sedimentation break in core Q11 resulted from local flooding or some other anomaly during the ash fall. A second reason for the sediment break might be due to differential sinking and compaction of the unconsolidated ash into water-logged sediments. Breakup of ash layers and variable sinking or mixing of ash with uncompacted sediments in lakes have been reported by Anderson, Nuhfer, and Dean (1984) among others. Another reason is that the Lower Ash Fall may have been derived from ash deposited by several eruptions closely spaced in time, geologically. Many ash layers in historic times have been derived from multiple eruptions.

MIDDLE C COAL UNIT

General Remarks

The Middle C Coal unit has been defined as including all coal and partings that lie above the lower tonstein and below the thick tonstein (Figure 7). This unit can be subdivided into three coal zones. The boundaries of the three coal zones are defined by the presence of two tonsteins, the lower doublet tonstein and the upper doublet tonstein (Figure 7). The three coal zones have been designated the Lower Middle-C unit, located between the lower tonstein and the lower doublet tonstein, the Middle Middle-C unit, located between the upper and the lower doublet tonsteins, and the Upper Middle-unit, which is located between the upper doublet tonstein and the thick tonstein.

The coal of the Middle C coal unit in the study area varies from 0" to more than 80" (0-200 cm) in thickness (Figure 29). As in the Lower C Coal unit, no coal swamp developed in the area of core Q2a. Similarly, the thickest accumulation of coal is seen in core Q7, which contains more than 80" of coal. A major part of the study area accumulated between 40-60" (100-150 cm) of coal.

Time Period Four: Lower Middle-C Coal

In order to ascertain the possible effects of an ash fall on the swamp palynoflora, this time period was subdivided into two small zones. These included 1) Immediately Above the Lower Tonstein, and 2) Immediately Below the Lower Doublet Tonstein. The time zone "Immediately Above the Lower Tonstein" includes only the first sample in each core, i.e., the sample that has basal contact with the tonstein. All other samples in the Lower Middle C coal unit belong in the second subperiod.

Coal samples in the first subperiod, "Immediately Above the Lower Tonstein" vary in thickness from 7-8" (18-20 cm). Shale samples vary in thickness from 1-2" (3-5 cm). These samples do not represent identical periods of time, but they do contain an averaged palynoflora representing the plant assemblages that developed or existed in the swamps after the lower tonstein was deposited.

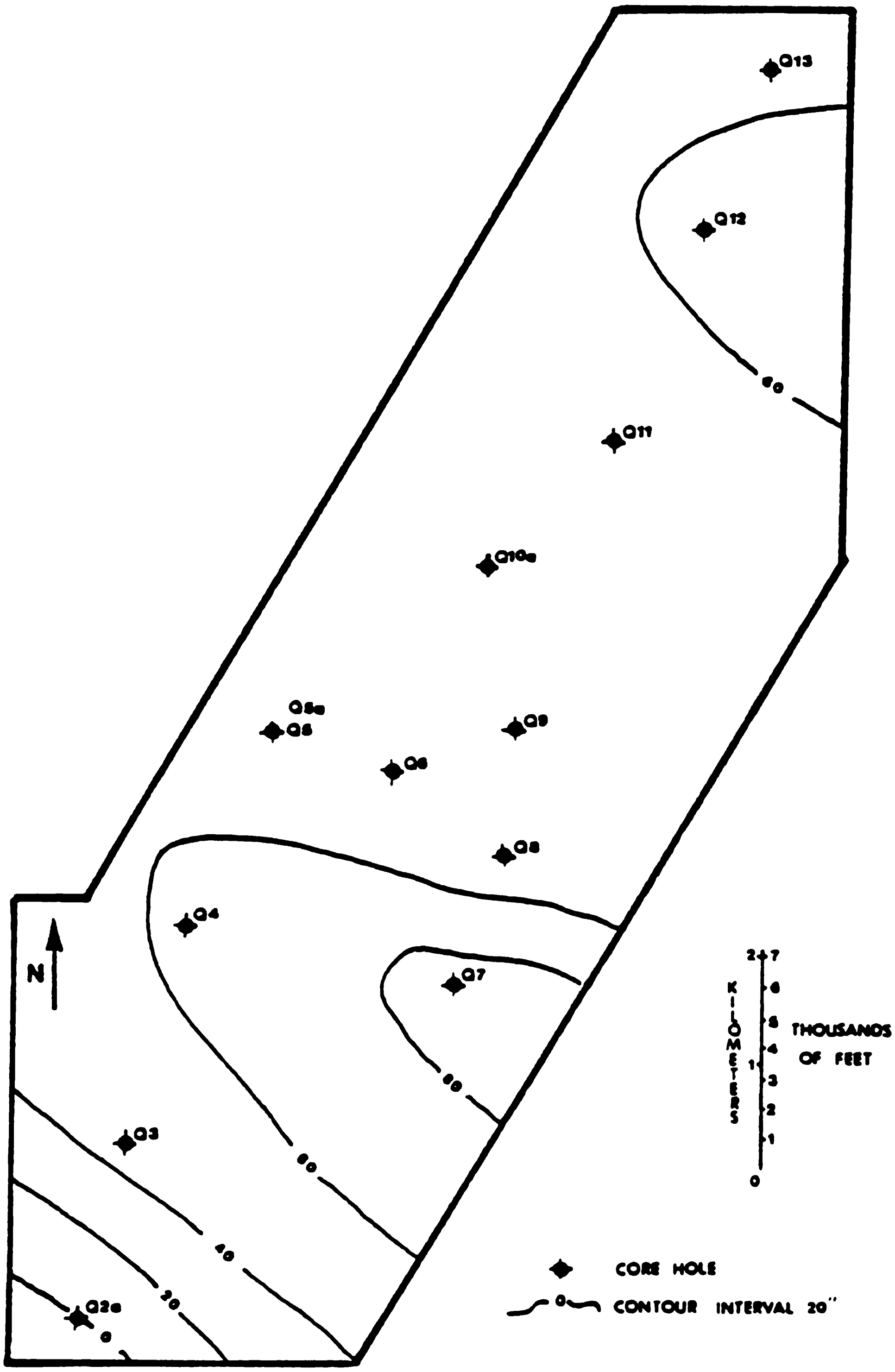


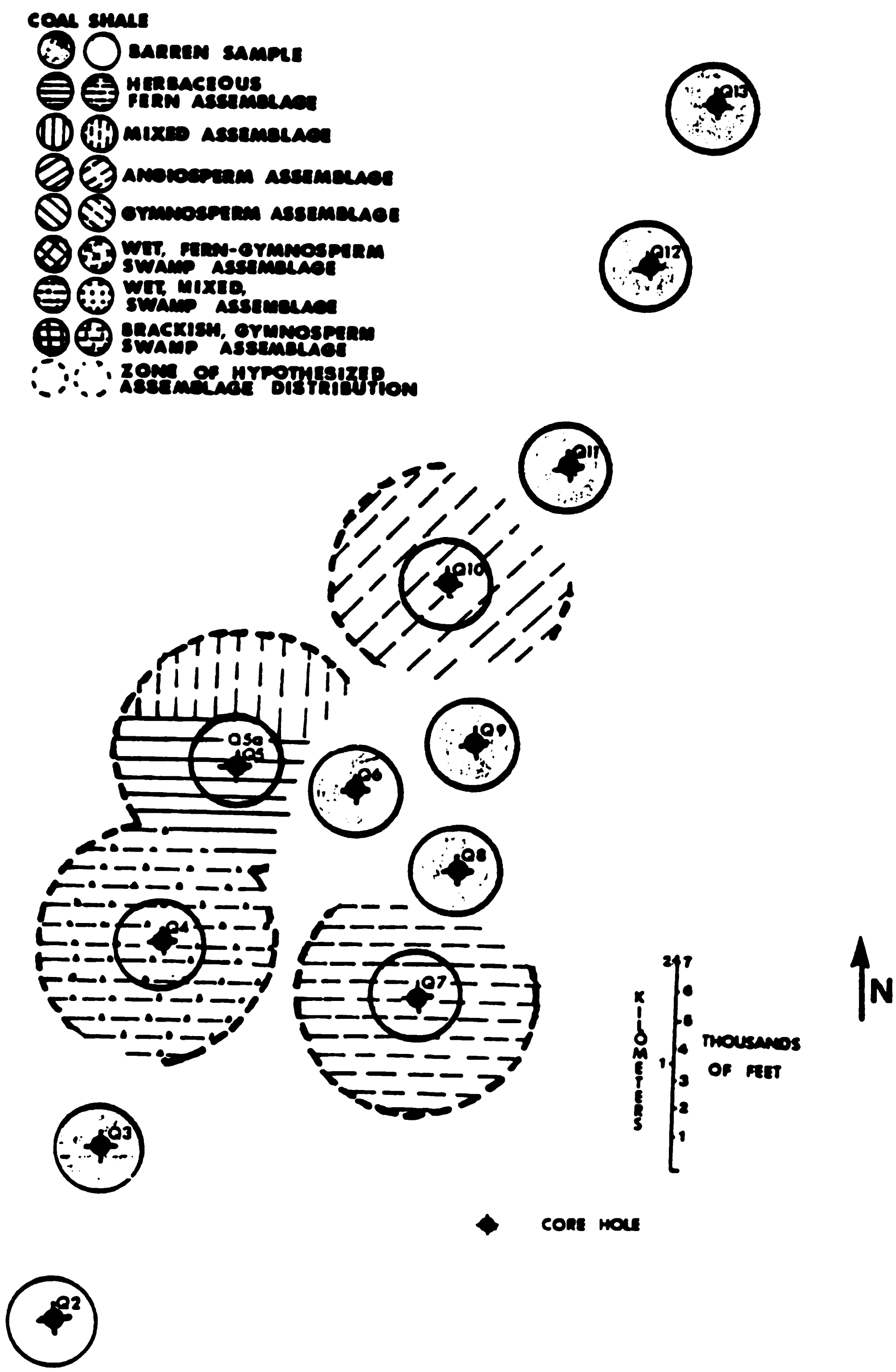
FIGURE 29: THICKNESS OF MIDDLE C COAL

The distribution of coal swamp in the study area is not significantly different from that which occurred immediately prior to the lower tonstein. Shale remains in cores Q5, Q7, and Q10a. Coaly shale or shaley coal is still present in cores Q4, Q12, and Q13 while coal swamp still occurs in cores Q6, Q8, Q9, and Q11. The only sedimentologic changes are seen in cores Q3 and Q5a. Now coal swamp is again present in cores Q3 and Q5a (Figures 7 and 30).

Only one coal and one coaly shale sample from this time period are productive. Sample Q5a-16 (coal) has a diversity of 42 taxa and contains an Herbaceous Fern Assemblage. Samples Q4-23, a coaly shale, has a diversity of 28 taxa and contains a Wet, Mixed, Swamp Assemblage.

Three shale samples were also productive. Sample Q7-20 contains an Herbaceous Fern Assemblage. Sample Q5-16a contains a Mixed Assemblage while Q10a-14 contains an Angiosperm Assemblage. The distribution of all palynoflora assemblages is illustrated in Figure 30.

The average coal/coaly shale palynoflora for this time period consists of 1% dinoflagellates and acritarchs, 14% Sphagnaceae and Zygnemataceae, 39% pteridophytes, 22% gymnosperms, and 24% angiosperms. The average diversity for this time period is 35 taxa. The average shale palynoflora consists of 0% dinoflagellates and acritarchs, 9% Sphagnaceae and Zygnemataceae, 33% pteridophytes, 25% gymnosperms, and 33% angiosperms.



<u>FIGURE 30</u>: PALYNOMORPH ASSEMBLAGE DISTRIBUTION IMMEDIATELY ABOVE THE LOWER TONSTEIN

The remaining samples from the Lower Middle C Coal form a loosely associated group. The upper boundary is the distinct lower doublet tonstein. However, the lower boundary is defined as the top of the first sample above the lower tonstein. The position of the lower doublet tonstein is extrapolated from surrounding cores for cores Q12 and Q3. No data are available for core Q2a. During this time period the entire study area (minus core Q2a) is characterized by coal swamp.

Four different plant assemblages were present during this time period. These included the Mixed Assemblage (Q7-18, Q12-7, and the average of Q3-22, Q3-23, and Q3-24), Wet, Mixed, Swamp Assemblage (Q5-15), Gymnosperm Assemblage (average of Q4-21 and Q4-22, and average of Q13-8 and Q13-9), and the Brackish, Gymnosperm Swamp Community (Q8-15). The distribution of these assemblages during this time frame are illustrated in Figure 31.

The average palynoflora of this time period contains 2% phytoplankton, 5% Sphagnaceae/Zygnemataceae, 25% pterido-phytes, 36% gymnosperms, and 32% angiosperms. The average diversity of this time period is 36 taxa. However, two distinct areas of diversity are present. Cores Q3 and Q4 have an average diversity of 57 taxa while cores Q5, Q7, Q8, and Q12 have an average diversity of only 18 taxa. The only significant difference in the average palynofloras from the high diversity and the low diversity areas is evident in the

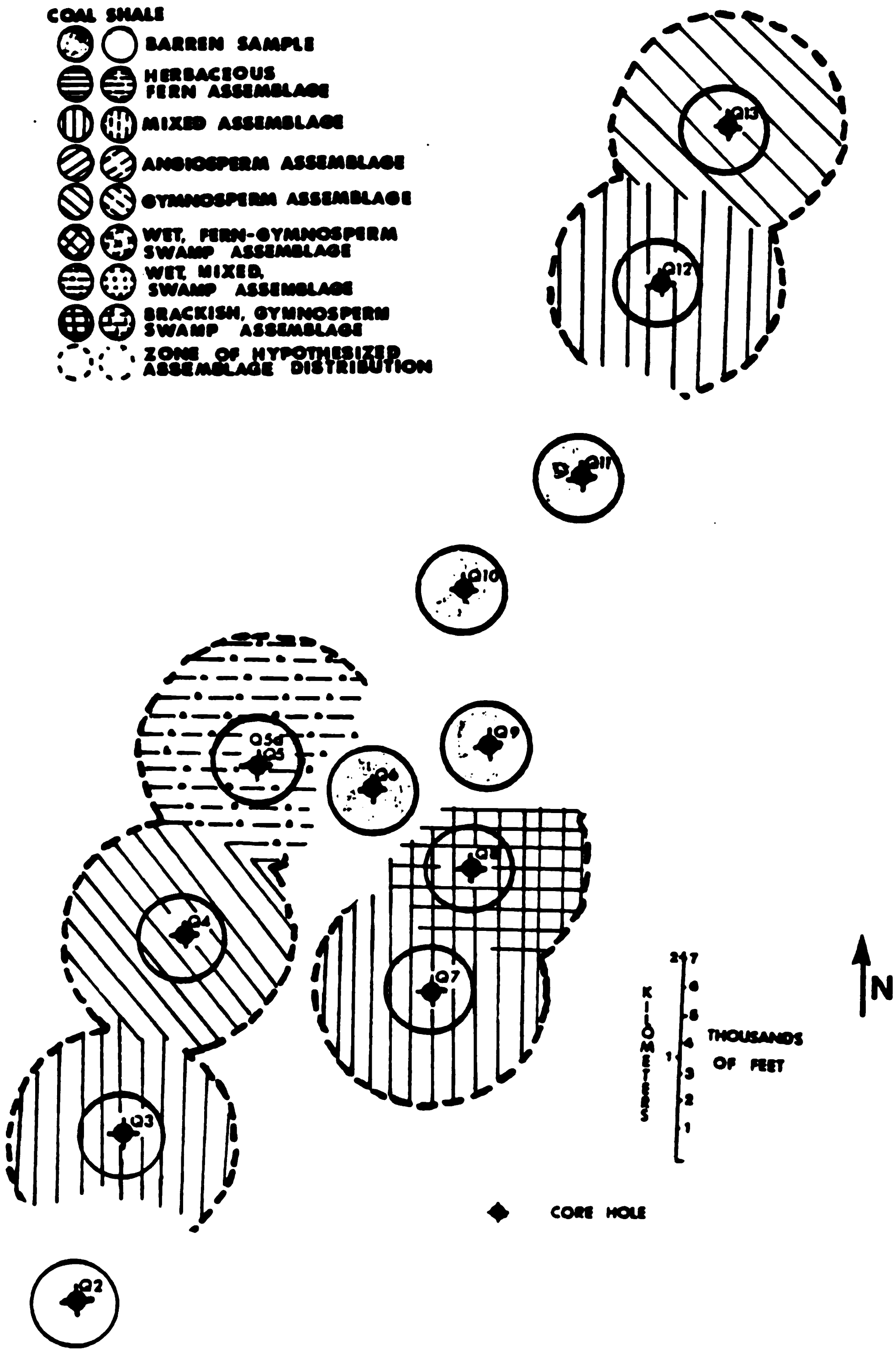


FIGURE 31: PALYNOMORPH ASSEMBLAGE DISTRIBUTION IMMEDIATELY BELOW THE LOWER DOUBLET TONSTEIN

two groups "dinoflagellates and acritarchs" and "Sphagnaceae and Zygnemataceae." The low diversity area contains 4% dinoflagellates and acritarchs and 10% Sphagnaceae and Zygnemataceae. The high diversity area contains only 3% Sphagnaceae/Zygnemataceae and no dinoflagellates and acritarchs.

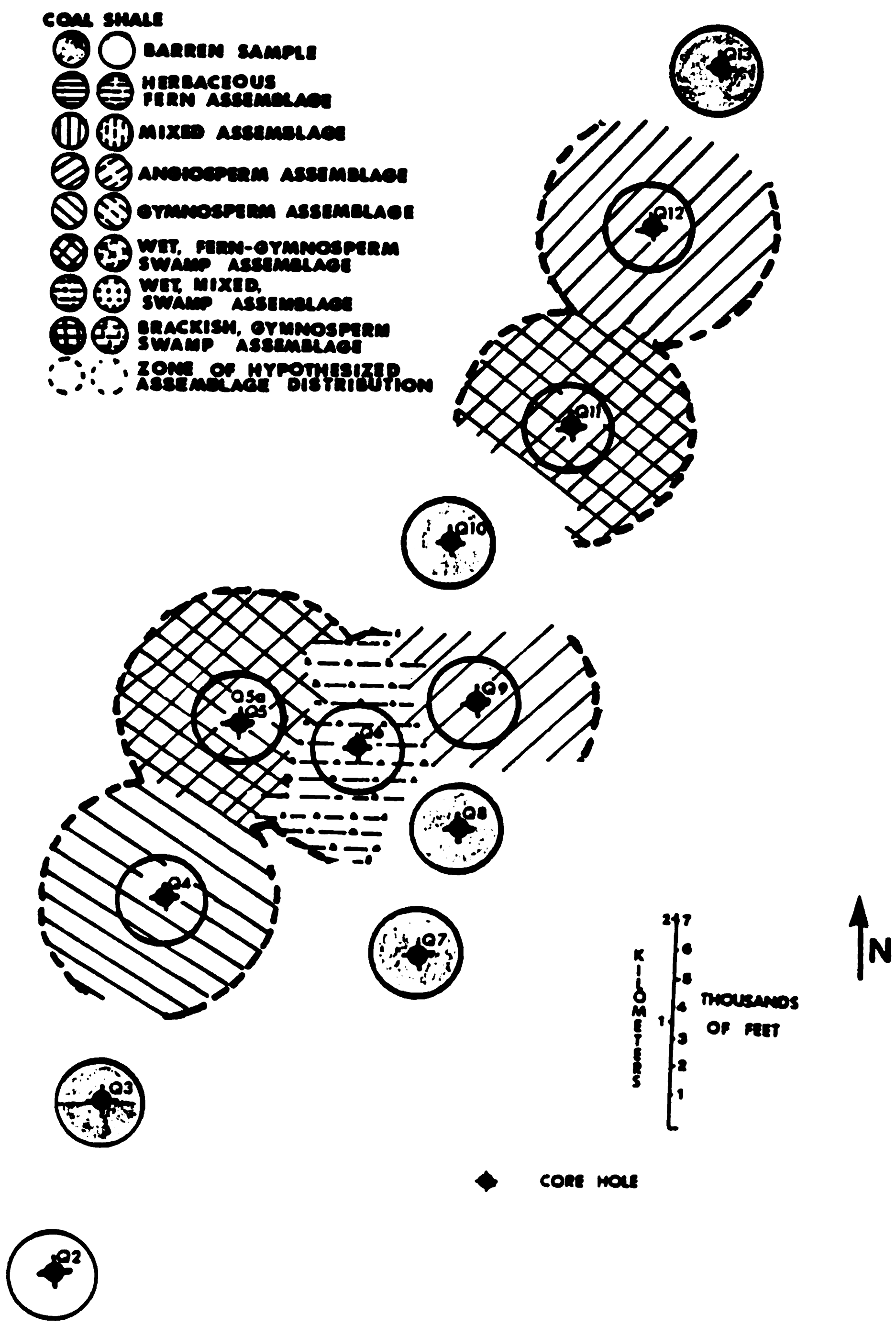
Time Period Five: Lower Doublet Tonstein

Time period five is represented by a geologically instantaneous event. At this time a volcanic ash fall deposited a thin layer of ash over the entire study area. This ash appears as a diffuse band in the coal approximately 1-2" (2-5 cm) thick. This ash, the lower doublet tonstein, cannot be identified in cores Q3 and Q12. Its position has been extrapolated from the position of the ash in surrounding cores. No data is available for core Q2a.

Time Period Six: Middle Middle-C Coal

The Middle Middle-C Coal unit is located between the lower doublet tonstein and upper doublet tonstein. It varies in thickness from 6-22" (15-55 cm). Coal-forming swamp was present in cores Q3 to Q13. No data are available for core Q2a.

Four plant assemblages are present in this interval. They are the Angiosperm Assemblage (Q9-11 and Q12-6), Gymnosperm Assemblage (Q4-18), Wet, Pteridophyte-Gymnosperm Swamp Assemblage (Q5a-13 and Q11-7), and the Wet, Mixed,



<u>FIGURE 32</u>: PALYNOMORPH ASSEMBLAGE DISTRIBUTION OF THE MIDDLE MIDDLE-C COAL

Swamp Assemblage (Q6-14). This distribution of assemblages is illustrated in Figure 32.

This time period has an average palynoflora containing 2% phytoplankton, 10% Sphagnaceae/Zygnemataceae, 22% pteridophytes, 38% gymnosperms, and 28% angiosperms. The average diversity of this time period is 27 taxa. However, two regions of diversity are evident. Cores Q5, Q6, and Q11, all of which had a high Sphagnaceae/Zygnemataceae content, have an average diversity of 40 taxa. Cores Q4, Q9, and Q12, which mainly contain either mainly gymnosperms or angiosperms, have an average diversity of only 13 taxa.

Time Period Seven: Upper Doublet Tonstein

At this time a volcanic event deposited a small layer of ash over the study area. This ash layer, the upper doublet tonstein, is approximately 1-2" (2-5 cm) thick and appears as a diffuse band in the coal. It is not identifiable in core Q12. Its position in core Q12 has been approximated (Figure 7). No data are available for core Q2a.

Time Period Eight: Upper Middle-C Coal

The Upper Middle-C Coal unit is located between the upper doublet tonstein and the thick tonstein. This unit varies in thickness from 10" to 35" (25-90 cm). Eight samples from this unit were productive. Four of the productive samples, Q3-18, Q4-15, Q8-10, and Q9-8 were deposited immediately prior to the thick tonstein. However, the Upper Middle-C Coal unit has not been subdivided into separate subunits because there are no statistically significant differences between the average palynoflora of those samples located immediately prior to the thick tonstein and those samples located elsewhere in the Upper Middle-C Coal.

Four plant assemblages are represented. These are the Angiosperm Assemblage (Q3-18, Q9-8, and Q12-5), Gymnosperm Assemblage (Q4-16, Q4-15), Mixed Assemblage (Q11-6), and the Brackish, Gymnosperm Swamp Assemblage (Q8-10 and Q8-11). The distribution of these plant assemblages is illustrated in Figure 33.

The average palynoflora for this time period contains 7% phytoplankton, 2% Sphagnaceae/Zygnemataceae, 19% pteridophytes, 47% gymnosperms, and 25% angiosperms. Although the average diversity for this time period is 29 taxa, two regions of diversity are evident. Cores Q3, Q4, and Q11 have an average diversity of only 15 taxa. The average diversity of cores Q8, Q9, and Q12 is 42 taxa. The average palynoflora of the low diversity samples consists primarily of gymnosperms (59%) and no dinoflagellates and acritarchs or Sphagnaceae and Zygnemataceae. The higher diversity areas contain 14% dinoflagellates/acritarchs, 4% Sphagnaceae/Zygnemataceae, 17% pteridophytes, 33% gymnosperms, and 32% angiosperms.

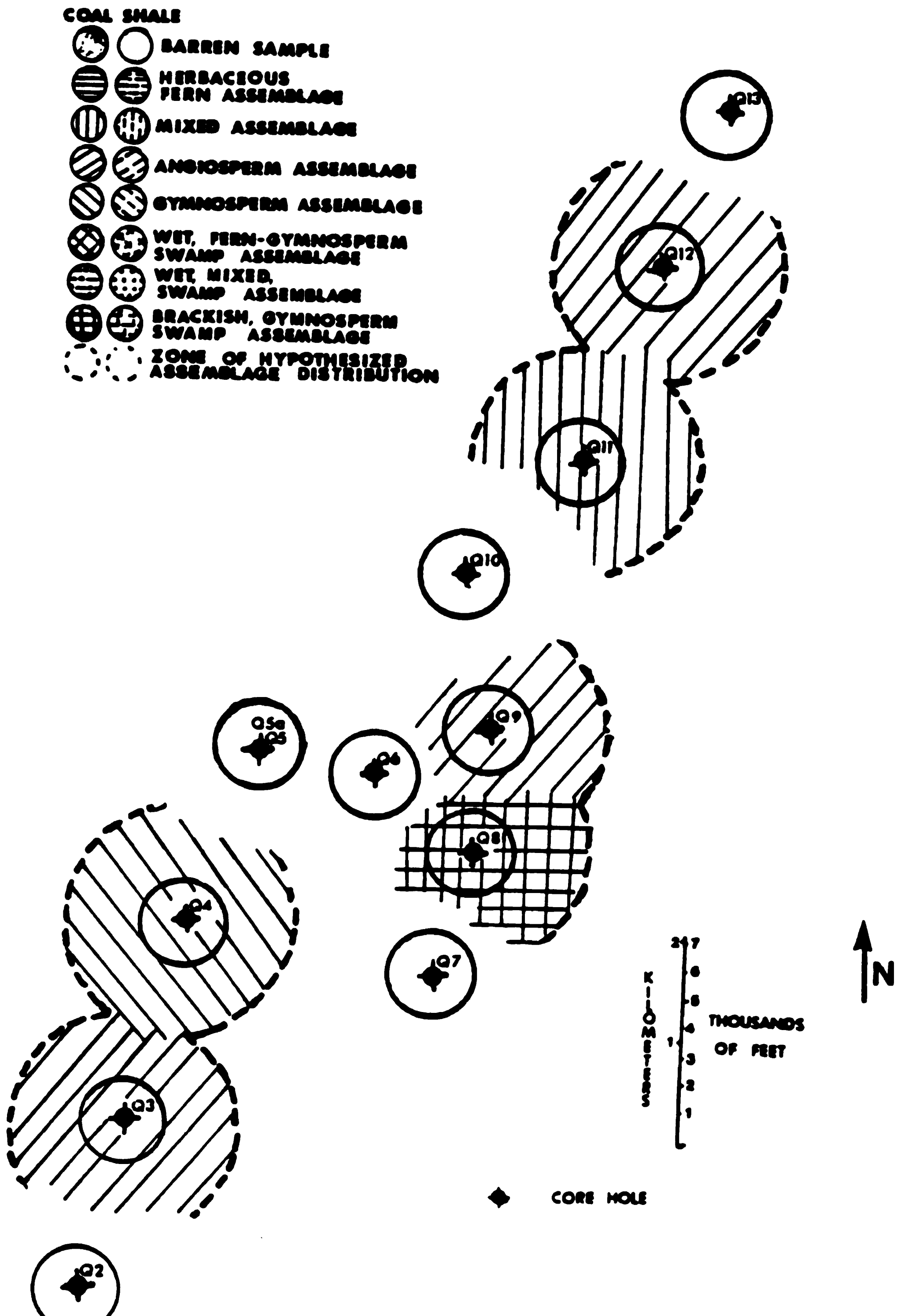


FIGURE 33: PALYNOMORPH ASSEMBLAGE DISTRIBUTION OF THE UPPER MIDDLE-C COAL

UPPER C COAL UNIT

General Remarks

The Upper C Coal unit is defined as all coal and partings located above the base of the thick tonstein, and including the thick tonstein, in the C coal horizon of the cores. Thickness of the coal in the Upper C Coal unit varies from less than 10" (25 cm) in cores Q11, Q12, and Q13 to more than 130" (330 cm) in core Q3. This distribution of coal thickness is mapped in Figure 34. However, several cores including Q6, and Q9-Q13 show an erosional unconformity at the top of the core (Ryer, 1981a). Therefore, the original coal (peat) may have been thicker than presently reported. The distribution of coal greater than 70" thick closely approximates the distribution of peat swamp immediately after the thick tonstein fell (compare Figures 34 and 36). For the first time in the history of the C coal horizon, peat swamp is present in core Q2a. This indicates that the coal-forming peat swamp expanded or migrated southwestward from the location of its general development in the preceding time units.

Time Period Nine: Thick Tonstein

A volcanic eruption deposited a thick layer of ash over the entire study area. The thickness of the resulting tonstein varies from a few inches (cores Q5, Q5a, and Q7) to almost 20" (50 cm) in core Q2a. Tonstein thickness is mapped in Figure 35. Variations in tonstein thickness can

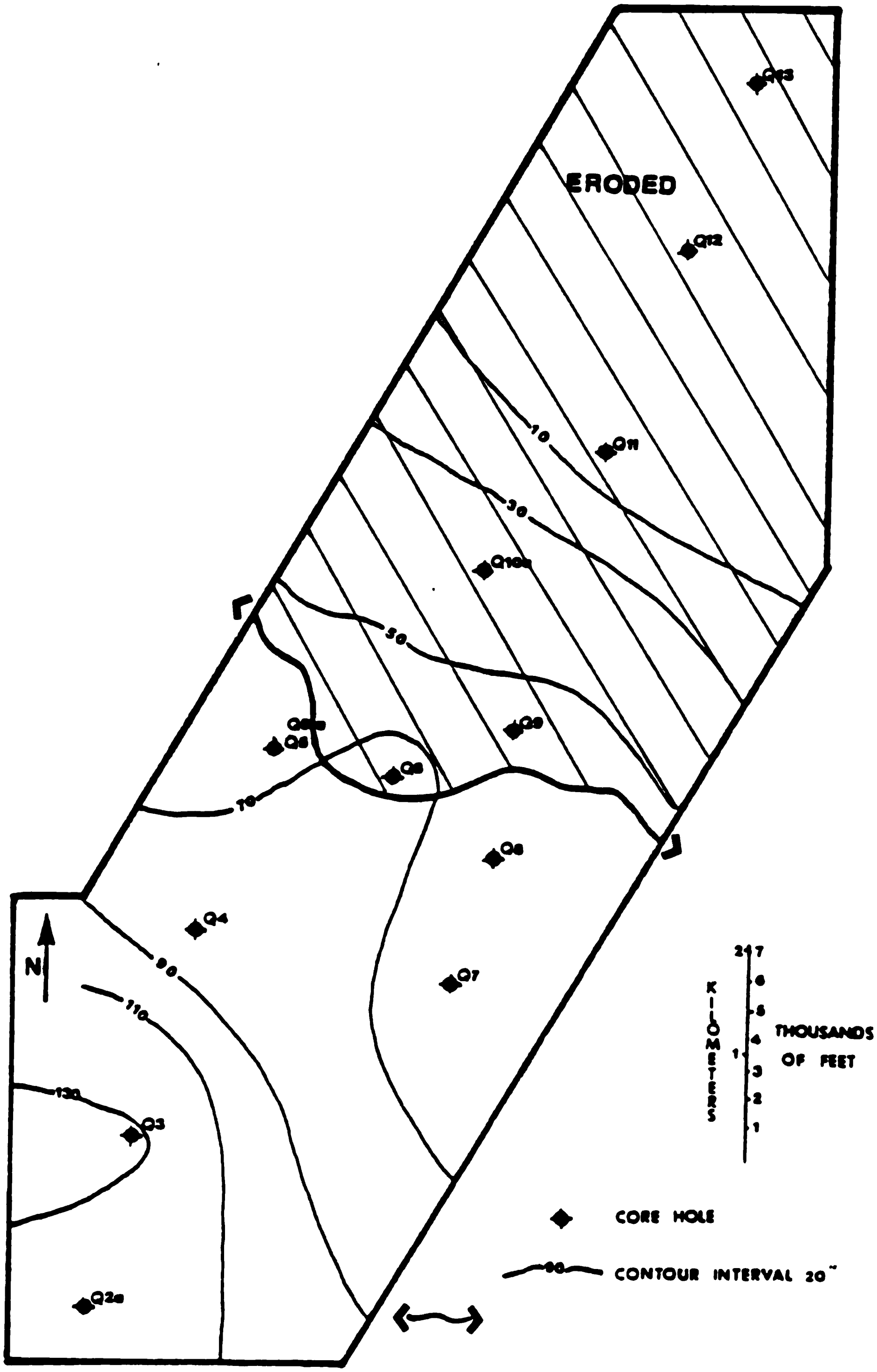


FIGURE 34: THICKNESS VARIATION IN THE UPPER C COAL

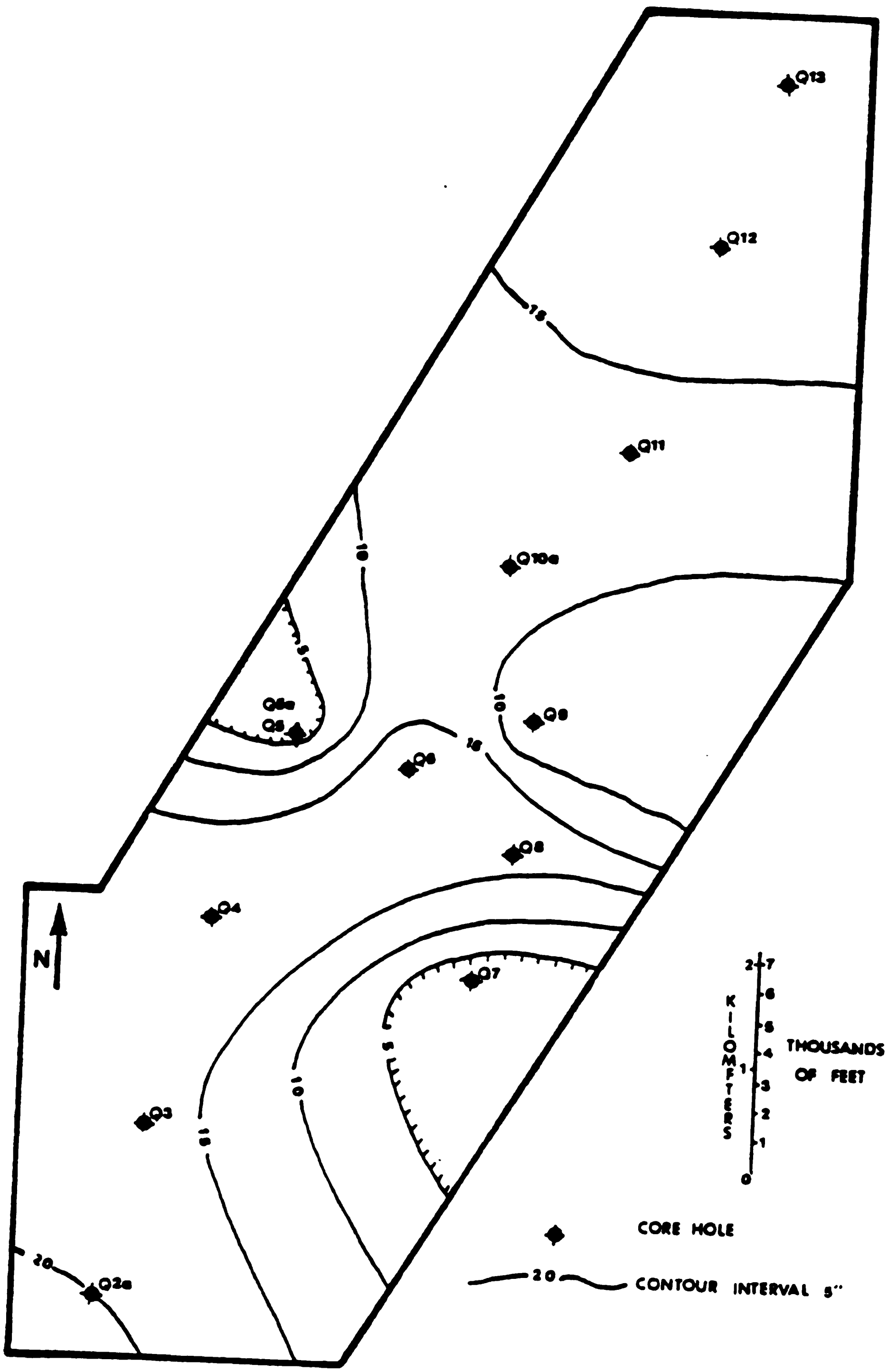


FIGURE 35: THICKNESS OF THE THICK TONSTEIN

be due to either variations in topography, variations in hydrologic conditions, or both.

Time Period Ten: Immediately Above the Thick Tonstein

Time period ten consists of only the first sample immediately above the thick tonstein. The samples made available for study varied in thickness from 3" (7.6 cm) to 19.8" (50.3 cm) for the coals and from 1.8" (4.5 cm) to 4.8" (12.8 cm) for the shales. Similar to other time periods, these samples represent varying degrees of depositional time although they all correlate in time of accumulation at their bases.

The overall palynoflora for all coal/coaly shale/shaley coal samples for this time period contains 50% pteridophytes, 33% gymnosperms, 9% angiosperms, and 8% Sphagnaceae/Zygnemataceae. The average diversity for this time period is only 16 taxa, which is the lowest average diversity of all the time periods. The average palynoflora for all shale samples (Q5-8, Q5a-8, Q8-8, Q9-6, and Q10a-5) contained 49% pteridophytes, 19% gymnosperms, 23% angiosperms, and 9% Sphagnaceae/Zygnemataceae. This time period was dominated by ferns and schizaeaceous ferns constituted the vast majority of all ferns spores present. Spores of <u>Cicatricosisporites</u> were the most prevalent in the coal samples at this time. Sample Q2a-14 contained 93% herbaceous fern spores while sample Q11-3 contained 71% pteridophytes and sample Q12-2 contained 57% pteridophytes.

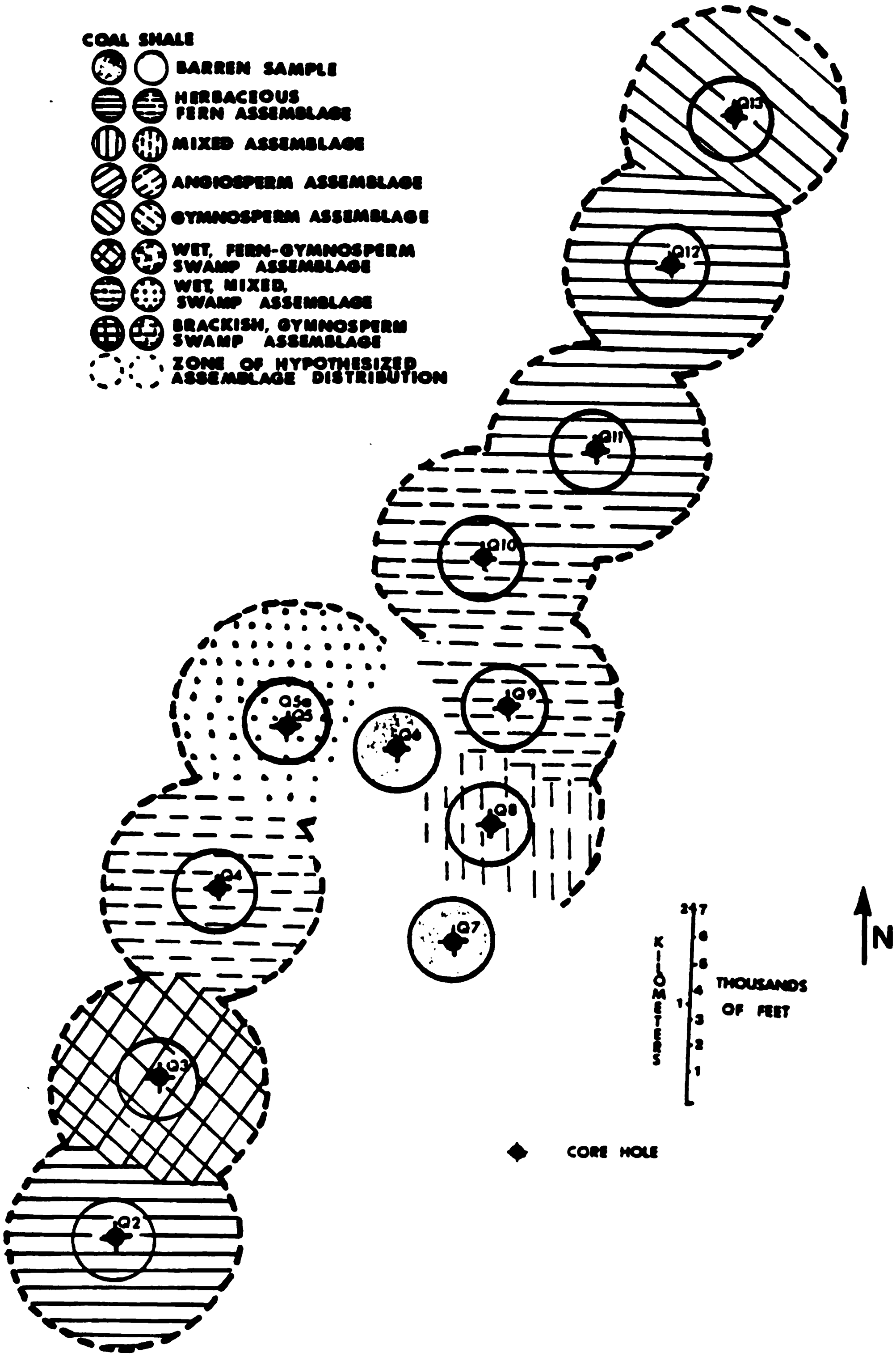


FIGURE 36: PALYNOMORPH ASSEMBLAGE DISTRIBUTION IMMEDIATELY ABOVE THE THICK TONSTEIN

Although pteridophytes dominated most areas of the coal swamp examined, two other floristic assemblages were present at this time. Sample Q3-16 contained a Wet, Mixed, Swamp Assemblage. Sample Q13-1 contained a Gymnosperm Assemblage (80% gymnosperms). The distribution of floristic assemblages is illustrated in Figure 36.

Northern sample palynofloras differ both in content and diversity from those in the southernmost regions of the study area. The northern core samples, Q11-3, Q12-2, and Q13-1 average 49% gymnosperms and 43% pteridophytes. Here, the average diversity is only 8 taxa. The southern coal core samples, Q2a-14 and Q3-16, average 79% pteridophytes. These two coal samples have an average diversity of 28 taxa.

Six shale samples (Q4-13, Q5-8, Q5a-8, Q8-8, Q9-6, and Q10a-5) were productive. The average palynoflora of these shale samples contain 0% dinoflagellates/acritarchs, 10% Sphagnaceae/Zygnemataceae, 48% pteridophytes, 19% gymnosperms, and 23% angiosperms. Individually, however, three assemblages are present in the shale samples. Sample Q10a-5, Q4-13, and Q9-6 contain the Herbaceous Fern Assemblage. The Mixed Assemblage is present in sample Q8-8 while the Wet, Mixed, Swamp Assemblage is present in samples Q5-8 and Q5a-8 (core averaged).

Major hydrological change is evident in the sediments of this time period. Immediately after the deposition of the thick tonstein shale was deposited in the area of cores Q4, Q5, Q5a, Q8, Q9, and Q10a. Peat/coal swamp remains present in the southern and central region of the study area (cores Q3, Q6, and Q7). Coaly shale and shaley coal is now found in cores Q11, Q12, and Q13. Pteridophytes dominated in the cores that contained coal while gymnosperms dominated in areas that contained either shaley coal or coaly shale. For the first time in the history of the C coal horizon, peat swamp is present in the area of core Q2a. This occurred immediately after the deposition of the thick tonstein.

Time Period Eleven: Upper C Coal

All core samples that occur above time period ten are included in this broad time period, Upper C coal. Although this section involves the largest number of productive samples and the thickest section of core, no synchronous markers exist that can be used for reliable correlation of the Upper C Coal section. Because the samples in the Upper C Coal section cannot be correlated, the palynofloras from the coals in each core were averaged to obtain a general palynoflora for that core for this time period.

During this time period, five plant assemblages are evident in the averaged core data (Figure 37). These include the Herbaceous Fern Assemblage in cores Q6, Q10a, and Q11, the Mixed Assemblage in cores Q2a, Q5, and Q5a, and the Gymnosperm Assemblage in cores Q4, Q12, and Q13. In addition to these assemblages, the Wet, Mixed, Swamp Assemblage is present in cores Q3 and Q9 and the Brackish,

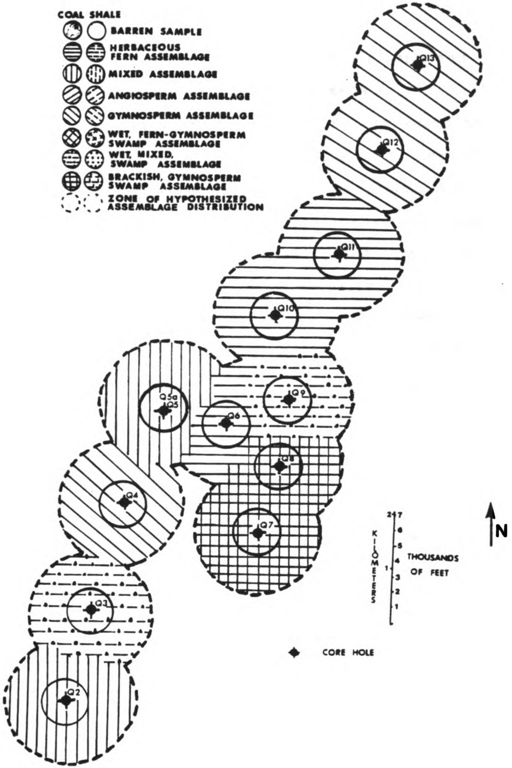


FIGURE 37: PALYNOMORPH ASSEMBLAGE DISTRIBUTION OF THE UPPER C COAL

Gymnosperm Swamp Assemblage is present in cores Q7 and Q8. The average diversity of all core samples for this time period is 45 taxa.

The Upper C Coal time period encompassed numerous hydrological changes in the study area. Initially, this time period began with the return of peat swamp to the entire study area. Throughout this time period several episodes of flooding occurred. These floods involved both inundation by marine waters and by freshwater. Samples Q2a-4 to Q2a-6, samples Q2a-9 to Q2a-11, and samples Q3-3 to Q3-7 represent fluvial flood basin deposits. Samples Q2a-1 is the basal part of an active channel fill (Ryer, 1981a). In addition, the 7.2 feet of sandstone and shale located between samples Q7-3 and Q7-2 represent brackish-water bay fill. Also, the first unlabeled sandstone or shale samples at the top of cores Q4 to Q7 represent brackish bay fill. Delta front or prodelta sandstones are present on top of cores Q8-Q13 (Ryer, 1981a). Several other shale sequences are found throughout the Upper-C Coal, but their depositional environment cannot be determined at this time.

FLORISTIC SUMMARY OF THE C COAL

General Remarks

Geologically, the C coal horizon of the Ferron Sandstone represents a very brief segment of time. Within its short existence, estimated at approximately 25,000 to 50,000 years, the total palynoflora of the study region did not change. There is no evidence for major evolutionary innovations or extinctions in the peat swamps of the Last Chance Delta nor are there any indications for major climatic change during this time. However, although its existence was geologically brief, the overall floristic changes that are evident in the peat swamps of the C coal horizon are ecologically significant. Several events, including numerous floods, both fluvial and marine, and several volcanic eruptions disturbed the normal hydrologic succession of the peat swamp communities.

These events varied in their extent and degree of disturbance. Both volcanic ash falls and storms affect an entire region, but their disruptive effects on the swamp communities may be more apparent in some areas than in others. Also, their degree of disturbance can vary from insignificant changes to major alterations of the flora.

Regional events may be indicated by either progressive or abrupt correlated changes in lithology or in the palynoflora. Regional events are most easily recognized by abrupt changes. Hydrologic succession may be a regional event that can show significant change of palynoflora and possibly significant lithologic changes over relatively long periods of time.

Abrupt changes in either the lithology or in the palynoflora also may be due to local events. Since such changes are seen in only a small fraction of the samples for any given time they do not affect the average trends of the palynoflora. Such events are apparent in the individual core palynomorph profiles (Figures 9 to 21). Very small scale or short-lived palynological changes in the cores cannot always be identified because of the rather large stratigraphic thickness of each sample. Most coal samples made available for this study represent almost one foot (30 cm) or even more of coal. In order to detect small-scale or short-lived floristic changes in coal, a sample interval of one centimeter would be more appropriate.

In the C coal horizon of the Ferron Sandstone statistically significant change is evident between the average palynofloras of the coal units examined. Of the eight coal/coaly shale/ shaley coal units defined in the C coal horizon, three statistically different plant assemblages occur. These three plant assemblages are present in the following coal units: 1) Lower C Coal, Immediately Below the Lower Tonstein, Immediately Above the Lower Tonstein, and Upper C Coal; 2) Immediately Below the Lower Doublet Tonstein, Middle Middle-C Coal, and the Upper Middle-C Coal; and 3) Immediately Above the Thick Tonstein. The average palynoflora of each of these time periods is summarized in Table 15. An average flora typical of the Mixed Assemblage occurs in group 1. Group 2 contains significantly more gymnosperms and less pteridophytes than does group 1. The third group, which consists only of the time period "Immediately After the Thick Tonstein," is dominated by pteridophytes.

TABLE 15: TIME PERIOD PALYNOFLORA AND DIVERSITY SUMMARY

TIME PERIOD	DIVERSITY	D/A	S/Z	P	G	A	
Upper C Coal	45 taxa	2%	9%	36%	26%	27%	*
Immediately Above Thick Tonstein	16	0	8	50	33	9	***
Upper Middle-C Coal	29	7	2	19	47	25	**
Middle Middle-C Coal	27	2	10	22	38	28	**
Immediately Below Lower Doublet Tonstein	36	2	5	25	36	32	**
Immediately Above Lower Tonstein	35	1	14	39	22	24	*
Immediately Below Lower Tonstein	40	1	2	47	25	25	*
Lower C Coal	47	2	2	34	29	33	*

Diversity and palynoflora averaged for all coal/coaly shale/shaley coal samples in each time period.

* The Upper C Coal time period, the Lower C Coal time period, and both Immediately Below the Lower Tonstein, and Immediately Above the Lower Tonstein time periods are statistically indistinguishable palynologically from each other.

** The three time periods Immediately Below the Lower Doublet Tonstein, Middle Middle-C Coal, and the Upper Middle-C Coal are statistically indistinguishable from each other.

*** The time period Immediately Above the Thick Tonstein contains a statistically unique palynoflora.

D/A = Dinoflagellates and Acritarchs; S/Z = Sphagnaceae and Zygnemataceae; P = Pteridophytes; G = Gymnosperms; A = Angiosperms.

It also is depleted in angiosperms and is totally lacking in dinoflagellates and acritarchs.

Differences in diversity are evident between the eight units of the C coal horizon (Table 15). Average time period diversity is highest in the Lower C Coal (47 taxa) and the Upper C Coal (45 taxa) units. Average time period diversity is 40 taxa for the time period "Immediately Below the Lower Tonstein" and 35 taxa for the time period "Immediately Above the Lower Tonstein." Diversity decreases throughout the rest of the time periods. Average diversity for the time period "Immediately Below the Lower Doublet Tonstein" is 36 taxa. The "Middle Middle-C Coal" time period contains an average diversity of 27 taxa while the time period "Upper Middle-C Coal" has an average diversity of 29 taxa. The lowest diversity of any time period is found in the time period "Immediately Above the Thick Tonstein." Here the average diversity is only 16 taxa.

In addition to the differences in diversity between the time periods, average sample diversity is somewhat higher in shale/siltstone lithologies compared to coal/coaly shale/shaley coal lithologies in each of the C coal time units. Average diversity of the shale samples is 63 taxa in the Lower C coal, 39 taxa in the shale samples from the entire Middle C coal zone, and 53 taxa for the shale samples from the entire Upper C coal unit. Higher shale/siltstone diversity often is due to derivation of the palynofloras from broader regions than the coals. Such trends are often evident in flood deposits (Spicer, 1980).

The general trend in floristic change between the average palynoflora of each time period is illustrated in Figure 38. No time scale is implied in the diagram. The floras are based upon the relationship betweeen pteridophytes, gymnosperms, and angiosperms. The two groups dinoflagellates/acritarchs and Sphagnaceae/Zygnemataceae are not illustrated. The overall trend in swamp flora development is for a Mixed Assemblage flora to increase in gymnosperm content. This trend is interrupted once by the deposition of the Thick Tonstein. Following the Thick Tonstein an Herbaceous Fern Assemblage dominates the C coal swamp flora. After this relatively brief phase of development, the flora returns to a Mixed Assemblage flora, which characterized the early history of the C coal swamp.

The floristic history of the Ferron C Coal can be briefly summarized as follows. The "Early C Coal" contained a Mixed Assemblage with a relatively high diversity of 47 taxa. "Immediately Below the Lower Tonstein" pteridophytes increased significantly in the palynoflora while diversity decreased only slightly (40 taxa). Also during this time period, shale was deposited at localities represented by four of the cores (Q5, Q5a, Q7, and Q10a). Although a volcanic eruption deposited the lower tonstein, no discernable effect is measurable on the palynoflora of the C coal

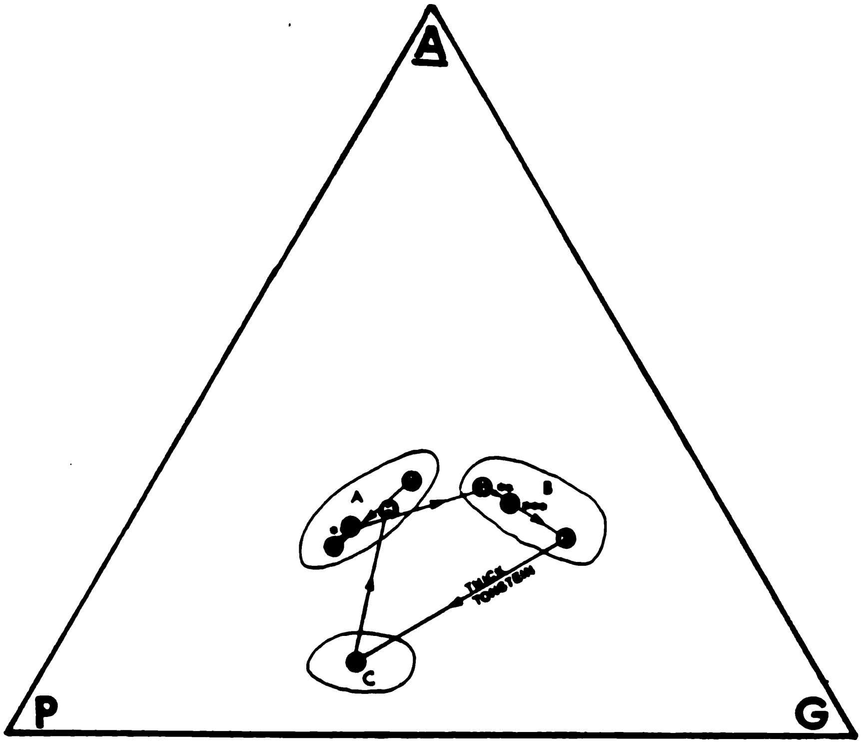


FIGURE 38: TIME PERIOD PALYNOFLORA, RELATIVE ABUNDANCE DISTRIBUTION TREND SUMMARY

A=Angiosperm; P=Pteridophyte; G=Gymnosperm; 1=Lower C Coal; 2=Immediately Below Lower Tonstein; 3=Immediately Above Lower Tonstein; 4=Immediately Below Lower Doublet Tonstein; 5=Middle Middle-C Coal; 7=Immediately Above Thick Tonstein; 9=Upper C Coal.

* Lower Tonstein Occurrence
** Lower Doublet Tonstein Occurrence
*** Upper Doublet Tonstein Occurrence

A,B,C=Statistically unique time period palynofloras. Thick tonstein deposited after time period 6.

The average palynoflora (A, P, and G only) for each time period has been plotted according to sequence of occurrence. The earlier time periods contain an overall Mixed Assemblage type palynoflora. The Middle C Coal shows a general trend to increasing gymnosperm content. No change in trend is seen after the deposition of the Lower Tonstein, Lower Doublet Tonstein, or the Upper Doublet Tonstein. A major break in the palynoflora developmental sequence is evident after the deposition of the Thick Tonstein. The average C coal swamp palynoflora quickly recovers to resemble the Lower C Coal palynofloras in relative frequency composition and in average diversity.

area during the time period "Immediately Above the Lower Tonstein."

Beginning with the Lower Middle-C coal and continuing throughout the Middle Middle-C coal and the Upper Middle-C coal, the relative percentage gymnosperms gradually increased as did the relative percentages of Sphagnaceae and all groups of algae. Corresponding to these increases, diversity decreases to 29 taxa by the Upper Middle-C coal. The lower doublet tonstein and the upper doublet tonstein had no effect on the distribution of coal or the palynofloras of the study area.

The thick tonstein had a profound effect on the flora of the Ferron C coal swamp. After the thick tonstein was deposited, diversity fell to an average of only 16 taxa in the time period "Immediately Above the Thick Tonstein." On average, the entire C coal swamp incurred a 65% reduction in angiosperms, a 30% reduction in gymnosperms, and nearly a 100% reduction in dinoflagellates and acritarchs (primarily Leiosphaeridia). Correspondingly, herbaceous ferns increased 265%.

In addition to the effects of the thick tonstein on vegetation, hydrologic change is also evident immediately after the thick tonstein. Coal-forming peat swamps first developed in the area of core Q2a in the C coal horizon after the thick ash was deposited. Instead of peat swamp, shale was accumulating in the areas of cores Q4, Q5, Q5a, Q8, Q9, and Q10a.

During the Upper-C coal time the average palynoflora of the C coal in the study area increased in diversity (average 45 taxa). All taxonomic groups showed an increase in diversity. The palynoflora of this time period is nearly identical to that of the Early-C coal. It consisted of a Mixed Assemblage with nearly equal proportions of pteridophytes, gymnosperms, and angiosperms.

Effects of Volcanism

The effects of periodic volcanism on plant or animal populations and community structure varies with the type and magnitude of volcanic output (gases, ash, etc.), the distance from the volcanic source, and the population or type of community affected (Malde, 1964). Studies of sites disturbed by thick blankets of volcanic ash show that the amount of "devastation is directly related to the thickness of the ash" (Malde, 1964, p. 9). Volcanic outbursts can affect not only the survivability of plants or animals, but also may alter erosional rates, hydrologic networks, and pedologic conditions because of the vast amount of ejecta deposited and the physical and chemical alteration of the environment that is produced. For example, after the eruption of Paricutin, Mexico, oak trees survived in areas with less than 1.5 meters of tephra while grasses recovered in areas that had accumulated less than 25 cm of ash (Eggler, 1948; Segerstrom, 1950). When Mount Katmai

(Alaska) erupted, a layer of ash 25 cm thick killed off the low vegetation, but most trees survived (R. F. Griggs, 1915, 1919a, 1919b, 1933; Malde, 1964; Kittleman, 1977).

Although volcanic ash soils are often cited as one of the most fertile soils in the world (Walter, 1979, p. 46; Whitmore, 1975, p. 111; Daubenmire, 1978, p. 260), this is not the case immediately after the ash fall. Initially, volcanic ash creates a dry and nutrient-deficient soil. It can take up to several centuries, depending upon the climate, for the ash to weather sufficiently to produce a nutrient-rich soil. In tropical and subtropical climates these "mature" volcanic soils generally support floristic communities different from the communities developed upon non-volcanic soils (Whitmore, 1975; Wilcox, 1959).

Studies on the effects of volcanic ash on paleocommunities are limited. Axelrod (1981) reviewed the general effects of periodic volcanic events on climate and paleocommunity structure. Bagshaw (1977) indicated that in the Tununk Shale (Cenomanian, Utah) the number of foraminifera greatly diminished at the base of ash beds. The benthonic and arenaceous forms that existed prior to the ash falls were replaced primarily by species of calcareous foraminifera.

The effects of periodic volcanic episodes on the Succor Creek flora (Miocene of Oregon and Idaho) have been studied by Taggart and Cross (1980), Cross and Taggart (1983), and Taggart, Cross, and Satchell (1982). They identified several volcanic events that set back the floristic successional cycle to an earlier successional stage. The early successional communities in the Succor Creek flora consisted of an herbaceous-xeric paleoassociation along with some angiosperms of unknown taxonomic affinity.

Mehringer, Blinman, and Petersen (1977) and Mehringer, Arnot, and Petersen (1977) reported that there were no major effects on the flora of Lost Trail Pass Bog (Recent, Montana) by either the Mazama Ash or the Glacier Peak Ash Falls. These ash falls were all less than 10 cm thick. However, they indicated that the pollen of xeric or steppe genera increased briefly after an ashfall and lake algae decreased in numbers.

The four ash deposits in the C coal of the Ferron had varying effects on the plant communities of the coal swamps. The extent of community disruption appears to be related to the thickness of the ashfall. This is consistent with the observation of the effects of ash on modern plant communities (Eggler, 1948; R. F. Griggs, 1915, 1919a; Malde, 1964; Sigurdson, 1982; Decker and Decker, 1981).

Two minor tonsteins are present in the C coal. These are the lower doublet tonstein and the upper doublet tonstein. The palynoflora of the study area immediately after the lower doublet tonstein, the middle Middle-C coal palynoflora, is not statistically different from the palynoflora of the time period "Immediately Before the Lower Doublet Tonstein." The palynoflora immediately after the upper doublet tonstein, the "Upper Middle C Coal" palynoflora is not statistically different from the palynoflora that precedes the tonstein. In addition, no apparent effect on the hydrology of the study area after either of these tonsteins, lower and upper doublet tonsteins, is apparent. All coal swamp areas and their coal plant assemblages appear to have survived these ash falls with little change in extent or character.

The lower tonstein is slightly thicker than either of the doublet tonsteins. It is 2-6" (5-25 cm) thick. No significant change in the percentages of the five major plant groups examined (dinoflagellates and acritarchs, Sphagnaceae and Zygnemataceae, pteridophytes, gymnosperms, and angiosperms) is evident in the coal after the lower tonstein was deposited. However, a compositional change in the palynoflora is noted. Prior to the lower tonstein, monosulcate angiosperm pollen were the dominant angiosperm pollen present in the coal swamps. After the lower tonstein accumulated, dicotyledonous angiosperms dominated the angiosperm portion of the palynoflora. Similarly, prior to the lower tonstein Classopollis was the primary gymnospermous pollen present while after the lower tonstein no single gymnospermous-type pollen dominated the gymnosperm portion of the palynoflora. In the pteridophytes, schizaeaceous ferns dominated the pteridophyte portion of the palynoflora after the ash fall, whereas, prior to the lower tonstein, no particular pteridophytic group dominated the flora. The dominance of schizaeaceous ferns after an ash fall is believed to be a primary indicator of floristic community disturbance in the Ferron C coal horizon.

Little hydrologic change is evident after the deposition of the lower tonstein. Immediately after the lower ash fall, coal swamp spread into the area of core Q5a, while shale was concurrently deposited in the area of core Q4. Both this change in the hydrology of the region along with some effects of volcanic ash on the flora would explain the change in floristic character evident in the palynoflora after the lower tonstein accumulated.

Unlike the first three ash falls, the thick tonstein caused pronounced hydrologic, pedologic, and floristic change throughout the swamps of the C coal. The thick tonstein varies from 5-20" (23-50 cm) thick. It is immediately after this ash fall that coal swamp is present in core Q2a for the first time in the history of the C coal horizon.

The primary hydrologic change associated with the thick tonstein is flooding. Prior to the ash fall all areas of the study region, except for core Q2a, were coal swamp. However, immediately after the ash fall, shale was deposited in the area of cores Q4, Q5, Q5a, Q8, Q9, and Q10a. Coal swamp is present in cores Q2a, Q3, Q6, and Q7, and coaly shale or shaley coal in cores Q11, Q12, and Q13. This hydrologic change probably resulted from ash and debris clogging the deltaic distributaries. Ash- and debris-filled rivers and streams are often associated with modern volcanic eruptions (Gadow, 1930; Wilcox, 1959; Malde, 1964; Rosenfeld, 1980; Decker and Decker, 1981).

The palynoflora of the coal swamp changed dramatically after the accumulation of the thick tonstein. The first coal/coaly shale/shaley coal samples located immediately above the thick tonstein have an average diversity of only 16 taxa, which is the lowest diversity of any time period. This low diversity is statistically different from the overall C coal average of 41 taxa per sample. This low diversity is believed to be one of the important indicators of the presence of an early successional community. Other major changes in the palynoflora also occurred. Immediately prior to the thick tonstein, dinoflagellates and acritarchs comprised an average of 7% of the palynoflora in the Upper Middle-C coal. After the thick tonstein, phytoplankton represented less than 0.5% of the palynoflora of the C coal.

In addition to the changes cited above, 50% of the palynoflora after the ash fall consisted of herbaceous ferns compared to 19% that was present prior to the ash fall. The herbaceous ferns primarily belong to the genus Cicatricosisporites in the family Schizaeaceae. In core Q2a (sample Q2a-14) 93% of the palynoflora consist of herbaceous ferns. Of the total ferns in this sample, 45% belong to the family Schizaeaceae. Overall, over 60% of all angiosperms and 30% of all gymnosperms disappeared from the palynoflora immediately after the thick tonstein was deposited compared to the palynoflora immediately prior to the thick tonstein. The largest number of gymnosperms in the palynoflora after the thick tonstein were located in cores Q12 and Q13. All other core samples contained a reduced number of gymnosperms compared to the average palynoflora prior to the ash fall. In addition, only core Q3 (sample Q3-16) contain spores of the Sphagnaceae and Zygnemataceae.

The total C coal palynoflora immediately above the thick tonstein is statistically different from any other time period examined in the C coal horizon. The differences between the post-thick-tonstein palynoflora and the rest of the C coal horizon is summarized in Table 16. The great reduction of angiosperms, gymnosperms, and phytoplankton indicates that this ash fall destroyed most of the original vegetation. Plant destruction may have been due to smothering by the thick layer of ash, severe flooding, volcanic gases, or a combination of all three conditions. Because of the thickness of this ash fall in comparison to the other three C coal horizon ash falls and the great difference in the effects of the ash falls, smothering by ash is most likely the dominant cause of change of constituent plants and plant communities in the Ferron C coal swamps.

Plant recovery to a more normal community structure is evident by the time of the second sample taken above the top of the thick tonstein in most cores. It is recognized, though, that the interval is very unequal in the different

TABLE 16: EFFECTS OF THE THICK TONSTEIN ON THE COAL FLORA OF THE C COAL

	A	B	C COAL AVERAGE
DIVERSITY	29 taxa	16 taxa	41 taxa
DINOFLAGELLATES-ACRITARCHS	7%	0%	2%
SPHAGNACEAE-ZYGNEMATACEAE	2%	8%	7%
PTERIDOPHYTES	19%	50%	34%
GYMNOSPERMS	47%	33%	30%
ANGIOSPERMS	25%	9%	27%

A = Palynoflora immediately before accumulation of the thick tonstein.
B = Palynoflora immediately following accumulation of the thick tonstein.

cores and that the times represented by these intervals is quite varied. However, herbaceous fern-dominated palynofloras continue in cores Q2a and Q6 for several feet of sediment accumulation above the thick tonstein. However, these later samples are not dominated by schizaeaceous ferns, but a more diverse assemblage of ferns is present. Overall, the average C coal palynoflora is almost identical to that of the "Early C Coal" palynoflora both in compositional character and in diversity. This indicates that the palynoflora of the "Upper C Coal" returned to a type of successional community structure found in the earliest C coal. Although the history of the C coal zone ends, it is assumed that the successional trend might continue as it did during the Middle C coal, that is, increasing gymnosperms and, correspondingly, decreasing in all other groups.

The early colonization of ash or otherwise disturbed sites by ferns is seen today. Ferns were the first to recolonize Krakatoa (Went, 1949; Richards, 1952; Francis and Self, 1983) after that volcano exploded violently in 1883. In tropical rainforests ferns are the first to colonize sites disturbed by fire or flood (Walter, 1979, p. 46; Tryon and Tryon, (1982). Tryon and Tryon (1982) reported that some members of the Schizaeaceae today prefer disturbed sites or dry soils.

Prehistorically, recolonizing floras dominated by ferns have been reported from the Ravenscrag Formation of Saskatchewan, Canada (Nichols et al., 1986). Here, the dominant spore species after the K-T boundary event is Laevigatosporites haardtii. Ferns remained the dominant element of the palynoflora through 15 cm of sediment accumulation after the K-T boundary event.

Recolonizing floras dominated by ferns also have been reported from the Raton Formation of Colorado and New Mexico after the K-T boundary event (R. H. Tschudy et al., 1984; Pillmore et al., 1984; Gilmore et al., 1984; and Orth et al., 1981). In the Raton Formation up to 100% of the initial post-disturbance flora was pteridophytic. Fern dominance was evident within the first 10 cm of post-disturbance sedimentation. Complete recovery was evident in samples above that point. Floristic change due to any of several small volcanic ash falls, approximately 5 cm thick each, located near the K-T boundary event was not evident in those studies. The small volcanic ash falls in the K-T boundary studies are comparable to the lower tonstein of 2-6" (5-15 cm) in this study in both thickness and lack of significant floristic modification. However, the thick tonstein (5-20", 13-15 cm) did induce floristic changes of considerable magnitude and similar in character to those changes seen in the studies of floristic change at the K-T boundary event. One major difference is apparent between the floristic changes caused by the K-T boundary event and the thick tonstein of this study. The accumulation of the thick tonstein did not apparently result in the extinction of any plants, whereas several taxa became extinct soon after the K-T boundary event (Muller, 1970; Srivastava, 1981; R. H. Tschudy *et al*., 1984).

Swamp Succession

The concept of plant community succession is widely used in ecological studies. It implies a process whereby one community type replaces another over time until some kind of steady-state situation is reached in which the final or "climax" community is in equilibrium with the environment and is self-perpetuating (Walter, 1979, p. 330-335). However, communities and the environment are dynamic (Walter, 1979, p. 334; Shugart and West, 1981). Disturbances are common and generally disrupt the "successional process" (Taggart and Cross, 1980; Cross and Taggart, 1983). These disturbances are of several types including both small and large scale thermal oscillations, periodic flooding, drought, fire, disease, volcanism, and today, human intervention. Except for volcanism, these physical disturbances are evident today in the coastal swamps of North America (Odum, McIvor, and Smith, 1982).

Because the normal successional process is often disrupted or modified by external events, several types of succession have been recognized. Primary succession, which is the colonization of bare rock or new mineral sediment surface and the subsequent development of successional plant communities through time, is very important in considering recovery of plants over new regional, volcanic-extrusive surfaces. Secondary succession, another form of succession, is the result of a disturbance to the environment that is geologically instantaneous, such as fire, flooding, human intervention, and sometimes volcanism, which removes or otherwise destroys the original plant cover. A third form of succession is hydrologic succession. As its name implies, hydrologic succession is the process by which plant communities change through time in response to changing surface or ground water levels. Hydrologic succession is evident in the infilling of lakes or ponds or in the normal development of swamps.

In the C coal of the Ferron both hydrologic and secondary succession are evident. The principal development of the C coal swamps is that of hydrologic succession. However, periodic ash falls and several episodes of flooding disrupted the normal hydrologic successional scheme. This resulted in the development of a secondary successional process following a major flood or a major ash fall.

In order to arrive at an approximation to the successional relationships between the seven floristic assemblages in the C coal of the Ferron Sandstone, the sequence and frequency of floristic assemblage transitions in the coal were identified (Table 17). A transition is defined as a change in community type from one sample to the next younger sample in each core. A transition does not occur between cores. For example, sample Q12-5 and sample Q12-6 both contain the Angiosperm Assemblage. Therefore, no floristic

TABLE 17: OBSERVED PALYNOFLORA ASSEMBLAGE TRANSITIONS

OLDER ASSEMBLAGE	YOUNGER ASSEMBLAGE: 1	2	3	4	5	6	7
1	x	8	1	7	1		1
2	5	x	6	1		3	1
3	1	2	x	2	1	2	
4	1			x	1		1
5		3			x	1	
6		2	2		1	x	
7		2			1		x

Number of Observed Transitions

x = denotes non-transitional sequence

Floristic Assemblages:
1) Herbaceous Fern Assemblage
2) Mixed Assemblage
3) Angiosperm Assemblage
4) Gymnosperm Assemblage
5) Wet, Fern-Gymnosperm Swamp Assemblage
6) Wet, Mixed, Swamp Assemblage
7) Brackish, Gymnosperm Swamp Assemblage

An insufficient number of transitions are present in this study to comprise a statistically valid group for analysis. A sampling of 200-250 transitions would be needed for statistical analyses of transitional data for a matrix of seven assemblages.

transition occurs between these two assemblages. Sample Q12-7 contains the Mixed Assemblage. Thus, a floristic transition does occur between Q12-7 and Q12-6, where the Angiosperm Assemblage is seen to successionally replace the Mixed Assemblage.

Because seven assemblages were used in this study, there exist 42 possible transitional sequences of one plant community replacing an earlier, different assemblage. Twenty-five of these transitions occur at least once in the Ferron C coal cores of this study (Table 17). One-fourth of all observed transitions involve only two assemblages, the Herbaceous Fern Assemblage and the Mixed Assemblage replacing each other. This is seen, for example, when Q4-23 (Mixed Assemblage) is followed by the Herbaceous Fern Assemblage of Q4-22 or when Q11-16 (Herbaceous Fern Assemblage) is replaced by the Mixed Assemblage of Q11-15.

Thirty percent of all transitions involve any of the seven assemblages being followed by either the Wet, Mixed, Swamp Assemblage, the Wet, Fern-Gymnosperm Swamp Assemblage, or the Brackish, Gymnosperm Swamp Assemblage. Examples of this type of transition include Q4-12 (Wet, Mixed, Swamp Assemblage) replacing Q4-25 (Mixed Assemblage), Q4-11 (Wet, Fern-Gymnosperm Swamp Assemblage) replacing Q4-12 (Gymnosperm Assemblage), or Q7-2 (Brackish, Gymnosperm Swamp Assemblage) replacing Q7-4 (Gymnosperm Assemblage). However, these three "wet" assemblages (Wet, Fern-Gymnosperm Swamp Assemblage, Wet, Mixed, Swamp Assemblage, and

Brackish, Gymnosperm Swamp Assemblage) are replaced by only the Mixed Assemblage or the Angiosperm Assemblage. For example, Q2a-2 (Mixed Assemblage) replaces Q2a-3 (Wet, Mixed, Swamp Assemblage) or Q4-22 (Angiosperm Assemblage) Q4-23 (Wet, Mixed, Swamp Assemblage). This type of transitional sequence accounts for an additional 15% of all observed transitions in the C coal cores.

An additional 15% of all transitions involve only the Mixed Assemblage replacing the Angiosperm Assemblage or the Angiosperm Assemblage replacing the Mixed Assemblage. This type of transition is seen when samples Q5-2 (Angiosperm Assemblage) follows Q5-3 (Mixed Assemblage) and Q3-1 (Mixed Assemblage) replaced Q3-2 (Angiosperm Assemblage).

The remaining 15% of all observed transitions involve the Angiosperm Assemblage or the Gymnosperm Assemblage being replaced by the Herbaceous Fern Assemblage and replacing either the Herbaceous Fern Assemblage, the Mixed Assemblage, or the Angiosperm Assemblage. Examples of this type of transition include Q12-5 (Angiosperm Assemblage being replaced by the Mixed Assemblage (Q12-2), sample Q4-13 (Herbaceous Fern Assemblage) being followed by Q4-12 (Gymnosperm Assemblage), and sample Q4-8 (Mixed Assemblage) replacing Q4-7 (Angiosperm Assemblage). It is recognized, however, that in a number of instances these transitions may not represent the true changes but some are probably 2 or 3 step changes which cannot be recognized due to unproductive intervening samples.

Hydrologic succession is the main successional feature of all coals swamps including the Ferron C coal horizon. However, because floristic communities can change quickly in a swamp with only modest changes of water levels, swamps cannot be said to consist of "climax" communities in the usual sense of the term. However, the general trend from the Early C coal through the Upper Middle C coal time does show a general, gradual increase in gymnosperms with a corresponding decrease in diversity. The palynoflora of the earliest C coal time period, the Early C Coal, has a relatively high diversity and contains a Mixed Assemblage palynoflora. This suggests that the normal early successional palynoflora would resemble the Mixed Assemblage while the normal later successional palynoflora would resemble the Gymnosperm Assemblage (Figure 39).

Both hydrologic and pedologic factors and any external disturbances, such as fire and flood, determine to a large extent, which successional sequence will develop in any particular area of the peat swamp. Brackish inundations or standing water lead to the development of the Brackish, Gymnosperm Swamp Assemblage. This is seen after core Q7 was inundated with brackish, bay-fill sediments. The subsequent sample, Q7-2, contained the Brackish, Gymnosperm Swamp Assemblage. On the other hand, after fluvial flood basin sediments were deposited in core Q2a, the subsequent sample, Q2a-3, contains a Wet, Mixed, Swamp Assemblage. Hydrologic change especially if associated with a volcanic event, can

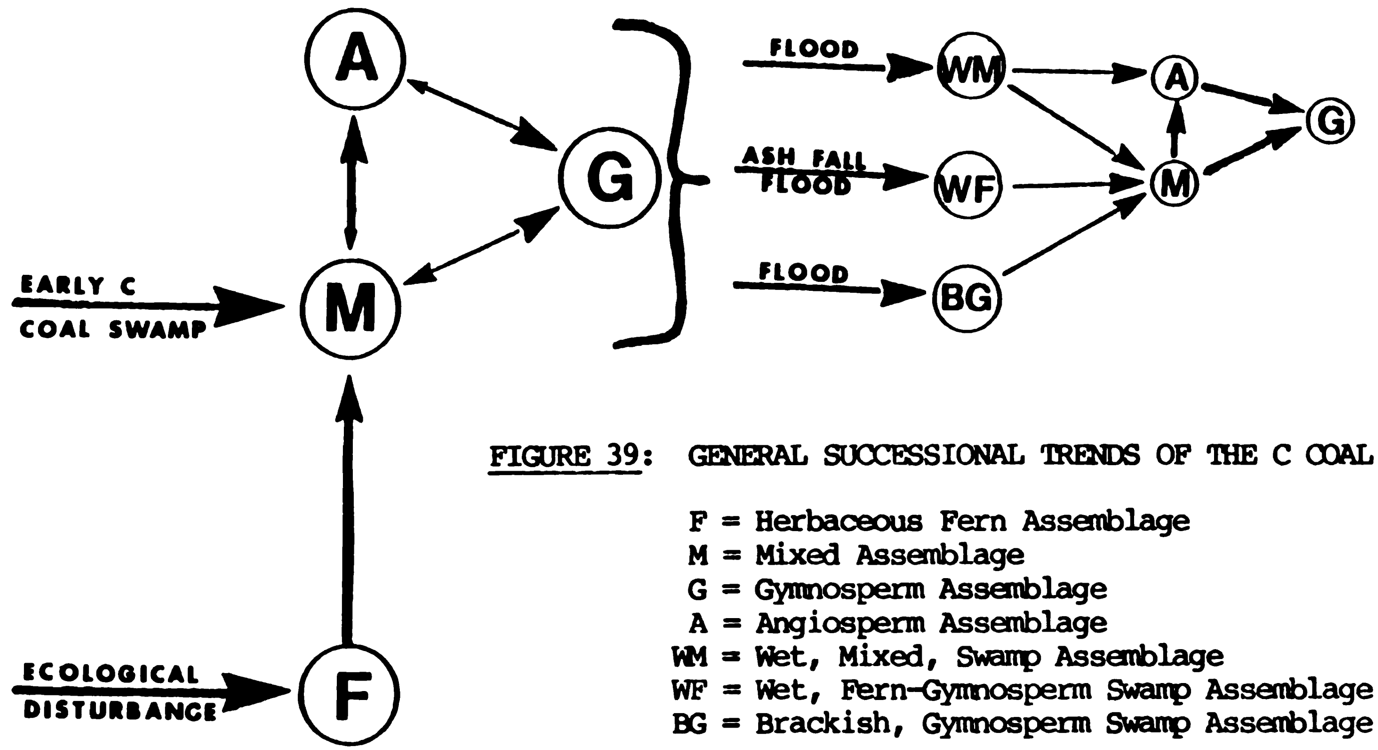


FIGURE 39: GENERAL SUCCESSIONAL TRENDS OF THE C COAL SWAMPS

F = Herbaceous Fern Assemblage
M = Mixed Assemblage
G = Gymnosperm Assemblage
A = Angiosperm Assemblage
WM = Wet, Mixed, Swamp Assemblage
WF = Wet, Fern-Gymnosperm Swamp Assemblage
BG = Brackish, Gymnosperm Swamp Assemblage

The earliest flora found in the C coal deltaic swamps of the Ferron Sandstone is represented predominantly by the Mixed Assemblage. The Mixed Assemblage is followed by either the Angiosperm Assemblage or the Gymnosperm Assemblage. The general overall trend is toward the Gymnosperm Assemblage. Flooding, either brackish or freshwater, which increases the ground water level, can occur at any time. This flooding leads to the Wet, Mixed, Swamp Assemblage if a freshwater flood and to the Brackish, Gymnosperm Swamp Assemblage if a brackish water flood. An ash fall and a flood occurring together lead to the Wet, Fern-Gymnosperm Swamp Assemblage in most cases. All "flood" assemblages return to the main swamp successional sequence. A major environmental disturbance, such as a devastating volcanic ash fall, destroys much of the existing vegetation. The swamps are then recolonized by a low diversity Herbaceous Fern Assemblage. This early successional assemblage was followed by the Mixed Assemblage in the Ferron C coal.

lead to the development of the Wet, Fern-Gymnosperm Swamp Assemblage. This is seen after the deposition of the thick tonstein in core Q3. Sample Q3-16 contains the Wet, Fern-Gymnosperm Swamp Assemblage and is located immediately after the thick tonstein.

The relatively large increase in ferns during the time period "Immediately Below the Lower Tonstein" and continuing through the time period "Immediately Above the Lower Lower Tonstein" also corresponds to the deposition of shale, coaly shale, and shaley coal, in nine of the twelve cores. This indicates that the coal swamp floristic communities were disturbed in some manner. Although the sedimentary result of this disturbance indicates that a hydrologic change occurred in the swamps, the primary cause of the disturbance that led to the hydrologic change may have been a fire or a storm that swept through the swamps of the study area. The actual reason for this increase in ferns during these two time periods cannot be determined at this time.

Secondary succession (or possibly primary succession) follows the deposition of the thick tonstein. As discussed previously, the accumulation of the thick tonstein devastated the swamp flora. This disturbance reset the successional sequence to an earlier successional stage (or to a primary stage of succession). New peat swamp developed in the southernmost part of the C coal study area for the first time. Here, core Q2a first developed an Herbaceous Fern Assemblage. Other areas also showed a high pteridophyte content but to a lesser degree than core Q2a. Some gymnosperms remained dominant in core Q13, however. Although gymnosperms and a few angiosperms remained in the C coal swamps after the thick tonstein accumulated, overall diversity was very low averaging only 16 taxa per sample.

After this early successional palynoflora, the recovery palynoflora shows both an increase in diversity and in angiosperm and gymnosperm content. The Mixed Assemblage, such as found in samples Q2-8 or Q3-12, is the most common assemblage type seen after the early successional Herbaceous Fern Assemblage and typifies the average palynoflora of the Upper C coal. Diversity increases rapidly after the time period "Immediately After the Thick Tonstein." However, diversity decreases again toward the very top of most of the cores. The highest diversity corresponds to a phase of high angiosperm content in the palynofloras (samples Q3-9, Q4-7 or Q5-2, for example). In core Q4, the Angiosperm Assemblage was followed by the Gymnosperm Assemblage (sample Q4-5). This transitional sequence along with the fact that the average Upper C coal palynoflora is indistinguishable from the average Early C coal palynoflora both in content and in diversity, leads to possibility that if the C coal swamp had continued in existence, the subsequent successional trends would continue to follow the pre-thick tonstein sequence. However, if pedologic and hydrologic conditions were indeed sufficiently altered by the thick tonstein, this assumption may not be valid. Today volcanic soils in tropical and subtropical environments support quite different floristic communities from that of other types of soils (Whitmore, 1975). The importance of pedologic differences in the determination of the secondary successional cycle has also been emphasized by Gomez-Pompa _et_ _al_. (1974). Unfortunately, there is no record of the C coal swamp beyond this point due to inundation by brackish bay sediments. The successional patterns as suggested by the data in this study are illustrated Figure 39.

SUMMARY OF FINDINGS

1. A total of 170 taxa (94 genera) were differentiated in samples from the Tununk Shale, Ferron Sandstone, and the Bluegate Shale Members of the Mancos Shale of east-central Utah. These palynomorphs consist of 1 zygnemataceous algal cyst, 9 acritarchs, 18 dinoflagellates, 59 pteridophytes, 23 gymnosperms and 60 angiosperms.
2. Sample productivity, defined as the presence or absence of palynomorphs, was almost twice as great in samples from unweathered cores as from outcrop samples. Palynomorphs were recovered from 55% of the 298 samples processed. Eighty-six of the samples came from outcrop sites in Castle Valley and 212 samples came from the Ferron C coal cores.
3. It was found that in these samples taxonomic diversity paralleled the degree of productivity of the sample and not the lithology of the sample. Diversity also appears to be related to the type of palynomorph assemblage present in the sample. Diversity, on average, is highest in angiosperm-dominated palynofloras. It is lowest in gymnosperm-dominated palynofloras and in early successional herbaceous fern-dominated palynofloras.

4. Most palynomorphs have a low frequency of occurrence in the samples. Only 25 types of palynomorphs were generally present in the samples. These 25 palynomorphs were found in at least one-half of all core samples.
5. The limited palynoflora obtained in this study from the upper Tununk Shale in Castle Valley is characteristic of the Cenomanian-Turonian. The palynoflora indicates that the environment of deposition varied from normal marine conditions to lagoon/bay environments. The transition to the Ferron deltaic deposits was gradual.
6. The palynoflora of the Ferron is characteristic of late Cenomanian through Turonian palynofloras of western North America. The lower Ferron in northern Castle Valley contains a marine palynoflora. Lagoonal to marine conditions existed throughout the Turonian in the northern part of Castle Valley. Productive samples of the upper Ferron Last Chance Delta includes palynofloras from marine shales and siltstones, lagoon/bay deposits, freshwater and brackish water coals, and fluvial flood deposits.
7. The palynoflora of the lower Bluegate Shale suggests that it is latest Turonian or younger in age. All four productive samples are from normal marine environments as indicated by the palynomorphs. The palynoflora of the Bluegate Shale shows an abrupt change to a normal

marine palynoflora immediately at the Ferron-Bluegate contact as expected from a transgressive sea.

8. Seven floristic assemblages were differentiated in the C coal swamps of the Ferron Sandstone. Like modern swamps these assemblages were distributed in a mosaic pattern. Some assemblages are sharply defined and limited in extent. These seven assemblages include the Herbaceous Fern Assemblage; Mixed Assemblage; Angiosperm Assemblage; Gymnosperm Assemblage; Wet, Fern-Gymnosperm Swamp Assemblage; Wet, Mixed, Swamp Assemblage; and the Brackish, Gymnosperm Swamp Assemblage.

9. The seven assemblages of the C coal were arranged in a general successional model based on the observed palyno-assemblage transitions. Early successional assemblages were fern-dominated. Diversity was lowest in these early successional assemblages. Taxonomic diversity was highest in the intermediate angiosperm-dominated assemblages. The mature or stable swamp community appears to be represented by the Gymnosperm Assemblage.

10. The presence of four tonsteins in the C coal permitted a gross time zonation of the coal. The four tonsteins divide the C coal into five basic, grossly-correlative time zones. This general time zonation provided a base on which to compare lateral (geographic) floristic variation and vertical (successional) trends throughout the C coal in the study area.

11. The effects of four volcanic ash falls on the flora of the C coal swamp are in some ways related to the thickness of the ash fall. The thicker the tonstein, the more devastating the effect the original ash fall had on the swamp communities. The thick tonstein affected the hydrologic, pedologic, and floristic environment of the coal swamps. Overall, over 60% of the angiosperm pollen and 30% of the gymnosperm pollen disappeared from the coal swamp pollen flora in the sediment that accumulated early after the deposition of the volcanic ash, which altered to the thick tonstein. The ash fall of the lower tonstein had only minor effects on the hydrology and flora of the C coal swamps. The lower and the upper doublet tonsteins had no measurable effect on the C coal swamps.
12. Herbaceous ferns, mainly of the family Schizaeaceae, were the first to repopulate the volcanic soils after a volcanic ash fall. The flora recolonizing the C coal peat swamp showed an increase in herbaceous ferns of about 265% after the thick tonstein accumulated. Eventually the flora of the C coal peat swamp recovered and again contained a diverse palynoflora similar to that seen in the earliest C coal swamps.

APPENDICES

APPENDIX I: SAMPLE DESCRIPTIONS

TABLE 18: SITE LOCATIONS

CORE SITE NUMBER	LOCATION
Q2a	NE 1/4 Sec. 20, T. 23 S., R. 6E., Emery County, Utah
Q3	SE 1/4 Sec. 8, T. 23 S., R. 6 E., Emery County, Utah
Q4	NW 1/4 Sec. 4, T. 23 S., R. 6 E., Emery County, Utah
Q5/Q5a	NE 1/4 Sec. 33, T. 22 S., R. 6 E., Emery County, Utah
Q6	NW 1/4 Sec. 34, T. 22 S., R. 6 E., Emery County, Utah
Q7	SE 1/4 Sec. 3, T. 23 S., R. 6E., Emery County, Utah
Q8	SW 1/4 Sec. 35, T. 22 S., R. 6E., Emery County, Utah
Q9	NW 1/4 Sec. 35, T. 22 S., R. 6 E., Emery County, Utah
Q10a	NW 1/4 Sec. 26, T. 22 S., R. 6E., Emery County, Utah
Q11	NE 1/4 Sec. 23, T. 22 S., R. 6 E., Emery County, Utah
Q12	SW 1/4 Sec. 12, T. 22 S., R. 6 E., Emery County, Utah
Q13	SE 1/4 Sec. 1, T. 22 S., R. 6 E., Emery County, Utah

FIELD SITE NUMBER	LOCATION
F1	Along north side of I-70, 5.5 miles east of the I-70/HWY 10 junction; Sec. 20, T. 23 S., R. 6 E., Emery County, Utah
F2	Willow Springs Wash, Sec. 13, T. 24 S., R. 6 E., Sevier County, Utah
F3	Miller Canyon, Sec. 26, T. 22 S., R. 6 E., Emery County, Utah
F4	Quitchupah Creek Canyon, Sec. 4, T. 23 S., R. 6 E., Emery County, Utah
F5	Williams Mine, Muddy Creek Canyon, Sec. 13, T. 22 S., R. 6 E., Emery County, Utah
F6	5 miles SE of Moore, 3.5 miles N of I-70, Sec. 15, T. 22 S., R. 7 E., Emery County, Utah
F7	Dry Wash, Sec. 34, T. 21 S., R. 7 E., Emery County, Utah
F8	Along east side of HWY 10, 4 miles south of Ferron, Sec. 34, T. 20 S., R. 7 E., Emery County, Utah

<u>TABLE 18</u> (cont'd)

F9	5 miles east of Ferron, Sec. 16, T. 20 S., R. 8 E., Emery County, Utah
F10	Along north side of HWY 6, 6 miles east of Wellington, Sec. 1, T. 15 S., R. 11 E., Carbon County, Utah
F11	Along Last Chance Creek, Sec. 4, T. 25 S., R. 5 E., Sevier County, Utah

TABLE 19: SAMPLE DESCRIPTIONS

SAMPLE NUMBER	MACERATION NUMBER	LITHOLOGY	SAMPLE THICKNESS
Q2a-2	Pb12757	coal	14.4" (36.6 cm)
Q2a-3	Pb12758	coal	9.6" (24.4 cm)
Q2a-6	Pb12761	siltstone	3.6" (9.1 cm)
Q2a-7	Pb12762	coal	19.2" (48.7 cm)
Q2a-8	Pb12763	coal	21.6" (54.9 cm)
Q2a-9	Pb12764	siltstone	14.4" (36.6 cm)
Q2a-11	Pb12766	siltstone	14.4" (36.6 cm)
Q2a-12	Pb12767	coal	9.6" (24.4 cm)
Q2a-13	Pb12768	coal	14.4" (36.6 cm)
Q2a-14	Pb12769	coal	7.2" (18.3 cm)
Q3-1	Pb12771	coal	7.2" (18.3 cm)
Q3-2	Pb12772	coaly shale	7.2" (18.3 cm)
Q3-3	Pb12773	shale	9.6" (24.4 cm)
Q3-8	Pb12778	shaley coal	4.8" (12.8 cm)
Q3-9	Pb12779	coal	9.6" (24.4 cm)
Q3-11	Pb12781	coal	16.2" (41.1 cm)
Q3-12	Pb12782	coal	12.0" (30.5 cm)
Q3-14	Pb12784	coal	18.0" (45.7 cm)
Q3-15	Pb12785	coal	12.6" (32.0 cm)
Q3-16	Pb12786	coal	19.8: (50.3 cm)
Q3-18	Pb12788	coal	13.8" (35.1 cm)
Q3-22	Pb12792	coaly shale	6.0" (15.2 cm)
Q3-23	Pb12793	coaly shale	6.0" (15.2 cm)
Q3-24	Pb12794	coaly shale	6.0" (15.2 cm)
Q3-26a	Pb12797	coaly shale	3.6" (9.1 cm)
Q3-28	Pb12799	coaly shale	8.4" (21.3 cm)
Q4-1	Pb12801	coaly shale	16.8" (42.7 cm)
Q4-3	Pb12803	siltstone	4.8" (12.8 cm)
Q4-4	Pb12804	coal	3.0" (7.6 cm)
Q4-5	Pb12805	coal	9.0" (22.9 cm)
Q4-6	Pb12806	coaly shale	8.4" (21.3 cm)
Q4-7	Pb12807	coal	12.0" (30.5 cm)
Q4-8	Pb12808	coal	7.2" (18.3 cm)
Q4-11	Pb12811	coal	4.8" (12.8 cm)
Q4-12	Pb12812	coal	9.6" (24.2 cm)
Q4-13	Pb12813	shale	2.4" (6.1 cm)
Q4-15	Pb12815	coal	10.8" (27.4 cm)
Q4-16	Pb12816	coal	16.8" (42.7 cm)
Q4-18	Pb12818	coal	12.0" (30.2 cm)
Q4-21	Pb12821	coal	9.6" (24.4 cm)
Q4-22	Pb12822	coal	5.4" (13.7 cm)
Q4-23	Pb12823	coaly shale	1.8" (4.6 cm)
Q4-25	Pb12825	coaly shale	2.4" (6.1 cm)
Q4-26	Pb12826	coal	13.8" (35.1 cm)
Q4-27	Pb12827	coal	11.4" (29.0 cm)
Q4-28	Pb12828	coaly shale	4.2" (10.7 cm)
Q4-29	Pb12829	siltstone	21.6" (54.9 cm)

TABLE 19 (cont'd)

Q5-1	Pb12831	coaly shale	13.2" (33.5 cm)
Q5-2	Pb12832	coal	12.0" (30.5 cm)
Q5-3	Pb12833	shaley coal	2.4" (6.1 cm)
Q5-6	Pb12836	coal	13.2" (33.5 cm)
Q5-7	Pb12837	coal	7.2" (18.3 cm)
Q5-8	Pb12838	shale	4.8" (12.8 cm)
Q5-15	Pb12845	coal	12.0" (30.5 cm)
Q5-16	Pb12846	shale	0.8" (2.0 cm)
Q5-17a	Pb12849	shale	3.0" (7.6 cm)
Q5-18	Pb12850	coal	11.4" (29.0 cm)
Q5-20	Pb12852	coaly shale	2.4" (6.1 cm)
Q5a-0	Pb12855	shale	9.0" (22.9 cm)
Q5a-1	Pb12856	shaley coal	8.4" (21.3 cm)
Q51-2	Pb12857	coal	9.6" (24.4 cm)
Q5a-4	Pb12859	coal	10.8" (27.4 cm)
Q5a-5	Pb12860	coal	10.8" (27.4 cm)
Q5a-6	Pb12861	coal	12.6" (32.0 cm)
Q5a-7	Pb12862	coal	15.0" (38.1 cm)
Q5a-8	Pb12863	shale	1.8" (4.6 cm)
Q5a-13	Pb12868	coal	4.8" (12.8 cm)
Q5a-16	Pb12871	coal	8.4" (21.3 cm)
Q5a-18	Pb12873	shale	1.8" (4.6 cm)
Q5a-21	Pb12876	coal	7.2" (18.3 cm)
Q5a-22	Pb12877	coal	3.6" (9.1 cm)
Q5a-23	Pb12878	shale	12.0" (30.5 cm)
Q6-3	Pb12882	shaley coal	18.0" (45.7 cm)
Q6-4	Pb12893	coal	12.0" (30.5 cm)
Q6-5	Pb12884	coal	18.0" (45.7 cm)
Q6-6	Pb12885	shale	1.8" (4.6 cm)
Q6-14	Pb12893	coal	4.2" (10.7 cm)
Q6-20	Pb12899	siltstone	2.4" (6.1 cm)
Q7-1	Pb12900	coaly shale	1.2" (3.1 cm)
Q7-2	Pb12901	coal	14.4" (36.6 cm)
Q7-4	Pb12904	coal	1.8" (4.6 cm)
Q7-6	Pb12906	shale	1.8" (4.6 cm)
Q7-18	Pb12918	coal	10.8" (27.4 cm)
Q7-20	Pb12920	shale	1.2" (3.1 cm)
Q7-23	Pb12923	shale	1.8" (4.6 cm)
Q7-28	Pb12928	shale	3.0" (7.6 cm)
Q7-29	Pb12929	coal	19.2" (48.7 cm)
Q8-1	Pb12931	coaly shale	12.0" (30.5 cm)
Q8-2	Pb12933	coal	10.8" (27.4 cm)
Q8-3	Pb12934	coal	10.8" (27.4 cm)
Q8-4	Pb12935	shale	14.2" (36.6 cm)
Q8-5	Pb12936	coal	15.6" (39.6 cm)
Q8-6	Pb12937	coal	12.6" (32.0 cm)
Q8-7	Pb12938	coal	9.0" (22.9 cm)
Q8-8	Pb12939	shale	2.4" (6.1 cm)
Q8-10	Pb12941	coal	10.8" (27.4 cm)
Q8-11	Pb12942	coal	15.0" (38.1 cm)

TABLE 19 (cont'd)

Q8-15	Pb12946	coal	8.4" (21.3 cm)
Q8-18	Pb12949	coal	13.2" (33.5 cm)
Q8-20	Pb12951	coal	12.0" (30.5 cm)
Q8-21	Pb12952	shale	4.8" (12.8 cm)
Q9-1	Pb12953	coal	13.2" (33.5 cm)
Q9-3	Pb12955	coal	9.0" (22.9 cm)
Q9-5	Pb12957	coaly shale	2.4" (6.1 cm)
Q9-6	Pb12959	shale	3.6" (9.1 cm)
Q9-8	Pb12960	coal	10.8" (27.4 cm)
Q9-11	Pb12963	coal	3.6" (9.1 cm)
Q10a-1	Pb12971	coal	4.2" (10.7 cm)
Q10a-2	Pb12972	shale	5.4" (13.7 cm)
Q10a-3	Pb12973	coal	15.6" (39.6 cm)
Q10a-4	Pb12974	coal	18.0" (45.7 cm)
Q10a-5	Pb12975	shale	3.0" (7.6 cm)
Q10a-14	Pb12984	shale	1.8" (4.6 cm)
Q10a-19	Pb12989	coaly shale	6.0" (15.2 cm)
Q11-1	Pb12990	siltstone	6.6" (16.8 cm)
Q11-2	Pb12991	coal	4.2" (10.7 cm)
Q11-3	Pb12992	coaly shale	3.0" (7.6 cm)
Q11-6	Pb12995	coal	13.2" (33.5 cm)
Q11-7	Pb12996	coal	14.4" (36.6 cm)
Q11-10	Pb12999	coaly shale	1.2" (3.1 cm)
Q11-12	Pb13000	coal	9.6" (24.4 cm)
Q11-14	Pb13003	shale	43.2" (109.7 cm)
Q11-15	Pb13004	coal	9.6" (24.4 cm)
Q11-16	Pb13005	coaly shale	14.4" (36.6 cm)
Q12-2	Pb13008	coaly shale	3.6" (9.1 cm)
Q12-5	Pb13011	shaley coal	10.8" (27.4 cm)
Q12-6	Pb13012	shaley coal	10.8" (27.4 cm)
Q12-7	Pb13013	shaley coal	15.6" (39.6 cm)
Q12-11	Pb13017	coaly shale	15.6" (39.6 cm)
Q12-12	Pb13018	coaly shale	3.6" (9.1 cm)
Q12-13	Pb13019	coaly shale	13.2" (35.5 cm)
Q12-14	Pb13020	shale	9.6" (24.4 cm)
Q13-1	Pb13022	shaley coal	7.2" (18.3 cm)
Q13-8	Pb13029	coal	12.6" (32.0 cm)
Q13-9	Pb13030	coal	14.4" (36.6 cm)
Q13-12	Pb13033	coaly shale	8.4" (21.3 cm)
F1 1-2	Pb12742	shale (gypsum)	1.5" (3.8 cm)
F1 3-2	Pb12747	shale	2.0" (5.1 cm)
F1 3-3	Pb12748	siltstone	1.5" (3.8 cm)
F1 4-3	Pb12751	siltstone	2.0" (5.1 cm)
F1 4-4	Pb12752	coaly shale	1.5" (3.8 cm)
F1 6-3	Pb13045	coaly shale	2.0" (5.1 cm)
F2 10-1	Pb13059	coaly shale	1.5" (3.8 cm)
F4 12-2	Pb13070	siltstone	1.5" (3.8 cm)
F4 12-3	Pb13071	siltstone	2.0" (5.1 cm)
F4 12-5	Pb13225	siltstone	2.0" (5.1 cm)
F5 1-1	Pb13072	coal	1.0" (2.5 cm)

TABLE 19 (cont'd)

F5 1-2	Pb13074	shale	1.5" (3.8 cm)
F5 1-3	Pb13075	shale	1.5" (3.8 cm)
F6 2-1	Pb13076	coaly shale	1.0" (2.5 cm)
F6 2-2	Pb13077	siltstone	2.5" (6.4 cm)
F7 3-1	Pb13078	coal	1.0" (2.5 cm)
F7 3-2	Pb13079	siltstone	2.5" (6.4 cm)
F8 4-1	Pb13081	shale	2.0" (5.1 cm)
F9 5-1	Pb13082	siltstone	2.0" (5.1 cm)
F10 6-2	Pb13085	siltstone	2.0" (5.1 cm)
F10 6-4	Pb13087	siltstone	3.5" (8.9 cm)
F10 6-5	Pb13088	shale	4.0" (10.9 cm)
F10 6-6	Pb13089	shale	2.5" (6.4 cm)
F10 6-7	Pb13090	shale	1.5" (3.8 cm)
F10 6-8	Pb13104	siltstone	3.0" (7.6 cm)
F11 1-1	Pb13226	coaly shale	2.5" (6.4 cm)
F11 1-10	Pb13235	shale	3.0" (7.5 cm)
F11 1-12	Pb13237	coal	1.0" (2.5 cm)
F11 1-13	Pb13224	shale	1.5" (3.8 cm)

APPENDIX II: DISTRIBUTION OF PALYNOMORPH TAXA

TABLE 20: BARREN CORE SAMPLES

SAMPLE	LITHOLOGY	SAMPLE	LITHOLOGY
Q3-13	Coal	Q8-13	Coal
Q3-19	Coal	Q8-16	Coal
Q3-21	Coal	Q8-19	Coal
Q3-25	Coal	Q9-2	Coal
Q3-27	Coal	Q9-4	Coal
Q4-2	Shale	Q9-9	Coal
Q4-9	Coal	Q9-13	Coal
Q4-10	Coal	Q9-14	Coal
Q4-20	Coal	Q9-16	Coal
Q5-4	Coal	Q9-17	Coal
Q5-5	Coal	Q10a-7	Coal
Q5-10	Coal	Q10a-8	Coal
Q5-11	Coal	Q10a-10	Coal
Q5-13	Coal	Q10a-12	Coal
Q5-16a	Shale	Q10a-13	Coal
Q5-19	Coal	Q10a-16	Shale
Q5a-10	Coal	Q10a-17	Coal
Q5a=11	Coal	Q10a-18	Coal
Q5a-15	Coal	Q11-5	Coal
Q5a-19	Coal	Q11-8	Coal
Q5a-20	Coal	Q11-13	Coal
Q6-2	Coal	Q12-1	Shaley Coal
Q6-8	Coal	Q12-4	Coal
Q6-11	Coal	Q12-8	Shaley Coal
Q6-12	Coal	Q12-10	Shaley Coal
Q6-16	Coal	Q13-3	Coal
Q6-18	Coal	Q13-4	Coal
Q6-19	Coal	Q13-6	Coal
Q7-3	Coal	Q13-10	Coaly Shale
Q7-5	Coal	Q13-13	Coal
Q7-7	Coal	Q13-14	Coal
Q7-9	Coal	Q13-15	Coal
Q7-10	Coal		
Q7-12	Coal		
Q7-14	Coal		
Q7-15	Coal		
Q7-17	Coal		
Q7-19	Coal		
Q7-24	Coal		
Q7-25	Shale		
Q7-26	Coal		
Q7-27	Coal		
Q7-30	Coal		
Q7-31	Coal		

TABLE 21: BARREN OUTCROP SAMPLES

SAMPLE	LITHOLOGY	SAMPLE	LITHOLOGY
7-14-81 1-1	Shale	7-14-81 8-3	Tonstein
7-14-81 1-3	Shale	7-14-81 9-1	Siltstone
7-14-81 2-1	Shale	7-14-81 10-2	Coal
7-14-81 2-1	Shale	7-14-81 10-3	Siltstone
7-14-81 3-1	Shale	7-14-81 10-4	Coal
7-14-81 4-1	Coaly Shale	7-14-81 11-1	Siltstone
7-14-81 4-2	Siltstone	7-14-81 11-2	Coal
7-14-81 4-5	Shale	7-14-81 11-3	Coaly Shale
7-14-81 4-6	Coal	7-14-81 11-4	Coal
7-14-81 5-1	Coal	7-14-81 11-5	Coal
7-14-81 5-2	Coal	7-14-81 11-6	Coaly Shale
7-14-81 5-3	Coal	7-14-81 12-1	Coaly Shale
7-14-81 5-4	Shale	7-14-81 12-4	Coal
7-14-81 6-1	Coaly Shale	7-15-81 5-2	Siltstone
7-14-81 6-2	Shale	7-15-81 6-1	Shale
7-14-81 6-4	Tonstein	7-15-81 6-3	Shale
7-14-81 6-5	Coal	7-15-81 6-9	Siltstone
7-14-81 6-6	Tonstein	7-15-81 6-10	Siltstone
7-14-81 6-7	Coaly Shale	7-16-81 1-2	Siltstone
7-14-81 6-8	Coal	7-16-81 1-3	Shale
7-14-81 6-9	Siltstone	7-16-81 1-4	Coal
7-14-81 7-1	Siltstone	7-16-81 1-5	Shale
7-14-81 7-2	Coal	7-16-81 1-6	Shale
7-14-81 7-3	Coaly Shale	7-16-81 1-7	Coaly Shale
7-14-81 7-4	Coal	7-16-81 1-8	Shale
7-14-81 7-5	Shale	7-16-81 1-9	Shale
7-14-81 8-1	Coal	7-16-81 1-11	Shale
7-14-81 8-2	Shaley Coal	7-14-81 1-14	Shale

TABLE 22: PRODUCTIVITY AND LITHOLOGY OF SAMPLES

LITHOLOGY: COAL

1. Excellent Productivity (Palynomorph Count = 500)

Sample

Q2-2	Q3-1	Q5-3	Q6-5
Q2-3	Q3-11	Q5-6	Q7-2
Q2-7	Q4-7	Q5a-1	Q8-7
Q2-12	Q4-22	Q5a-6	Q8-20
Q2-12	Q4-27	Q5a-7	
Q2-13	Q5-1	Q5a-22	
Q2-14	Q5-2	Q6-4	

2. Fair Productivity (Palynomorph Count = 300)

Sample

Q3-8	Q5-7	Q5a-13	Q8-3	Q9-1	Q11-2
Q3-9	Q5-15	Q5a-16	Q8-5	Q9-3	Q11-7
Q3-12	Q5-16	Q6-3	Q8-6	Q9-8	
Q3-14	Q5-18	Q6-14	Q8-10	Q9-11	
Q3-15	Q5a-2	Q6-28	Q8-11	Q10a-1	
Q3-16	Q5a-4	Q6-29	Q8-15	Q10a-3	
Q4-11	Q5a-5	Q8-2	Q8-18	Q10a-4	

3. Low Productivity (Palynomorph Count less than 200)

Sample

Q3-18	Q4-15	Q5a-21	Q11-15
Q4-4	Q4-16	Q7-4	Q13-8
Q4-5	Q4-18	Q7-18	Q13-9
Q4-8	Q4-21	Q11-6	7-15-81 1-1
Q4-12	Q4-26	Q11-12	7-15-81 3-1

LITHOLOGY: SILTSTONE

1. Excellent Productivity (Palynomorph Count = 500)

Sample

Q2-6 Q2-9 Q4-29 Q6-20

2. Fair Productivity (Palynomorph Count = 300)

Q4-3 7-14-81 12-3 7-15-81 2-2 7-15-81 3-2
7-15-81 6-4

3. Low Productivity (Palynomorph Count less than 200)

Sample

Q11-1 7-14-81 3-3 7-14-81 4-3 7-15-81 6-8

TABLE 22 (cont'd)

LITHOLOGY: COALY SHALE/SHALEY COAL

1. Excellent Productivity (Palynomorph Count = 500)

Sample

Q2-11	Q3-24	Q4-6	Q7-1
Q3-2	Q3-28	Q4-25	Q9-5
Q3-22	Q4-1	Q5-20	7-14-81 10-1

2. Fair Productivity (Palynomorph Count = 300)

Sample

Q3-23	Q4-28	Q10a-19	Q12-7	7-15-81 5-1
Q4-23	Q8-1	Q12-5	7-14-81 12-5	

3. Low Productivity (Palynomorph Count less than 200)

Sample

Q11-3	Q11-16	Q12-6	Q13-1	7-14-81 6-3
Q11-10	Q12-2	Q12-11	Q13-12	7-15-81 6-2

LITHOLOGY: SHALE

1. Excellent Productivity (Palynomorph Count = 500)

Sample

Q3-3	Q7-20	Q11-14	7-16-81 1-10
Q5-8	Q8-8	Q12-14	7-16-81 1-13
Q5a-0	Q8-21	Q5-17a	
Q5a-8	Q10a-2	Q4-13	

2. Fair Productivity (Palynomorph Count = 300)

Sample

Q3-26a	Q8-4	Q12-12	7-15-81 1-2
Q5a-18	Q9-6	Q12-13	7-15-81 1-3
Q5a-23	Q10a-5	7-14-81 1-2	7-15-81 2-1
Q6-6	Q10a-14	7-14-81 3-2	

3. Low Productivity (Palynomorph Count less than 200)

Sample

Q7-6	7-14-81 12-2	7-15-81 6-5	7-15-81 6-7
Q7-23	7-15-81 4-1	7-15-81 6-6	

TABLE 23: CORE SAMPLE PALYNOFLORA SUMMARY

SAMPLE	D/A*	S/Z**	PTERIDOPHYTES	GYMNOSPERMS	ANGIOSPERMS
Q2a-2	0%	8%	38%	17%	37%
Q2a-3	0	40	16	15	29
Q2a-6	0	32	18	17	33
Q2a-7	0	4	40	26	30
Q2a-8	0	4	44	22	30
Q2a-9	0	5	24	17	54
Q2a-11	0	2	45	29	24
Q2a-12	0	2	64	17	17
Q2a-13	0	5	53	19	23
Q2a-14	0	1	92	3	4
Q3-1	0	10	27	27	36
Q3-2	0	3	22	22	53
Q3-3	0	5	22	47	26
Q3-8	0	34	11	19	36
Q3-9	0	7	15	23	55
Q3-11	0	14	36	36	14
Q3-12	0	6	41	21	32
Q3-14	0	25	28	28	19
Q3-15	0	40	16	14	30
Q3-16	2	37	27	15	19
Q3-18	0	0	16	13	71
Q3-22	0	2	36	9	53
Q3-23	0	0	53	11	36
Q3-24	0	3	34	28	35
Q3-28	0	3	38	29	30
Q4-1	0	1	41	25	33
Q4-3	0	2	69	16	13
Q4-4	0	0	19	71	10
Q4-5	0	0	3	96	1
Q4-6	0	2	6	21	71
Q4-7	0	5	21	22	52
Q4-8	0	0	30	36	34
Q4-11	0	34	32	34	0
Q4-12	0	0	35	59	6
Q4-13	0	10	46	14	30
Q4-15	0	0	12	88	0
Q4-16	0	0	9	91	0
Q4-21	0	0	6	94	0
Q4-22	0	8	20	19	53
Q4-23	0	21	31	16	32
Q4-25	0	3	30	23	44
Q4-26	0	0	47	32	21
Q4-27	0	4	31	33	32
Q4-28	0	2	28	40	30
Q4-29	0	2	24	38	36
Q5-1	0	0	18	17	63
Q5-2	0	0	25	18	57
Q5-3	0	1	30	23	46
Q5-6	0	0	61	19	20

TABLE 23 (cont'd)

Q5-7	0	4	48	14	34
Q5-8	0	6	47	20	27
Q5-15	0	17	31	13	39
Q5-16	0	11	25	30	34
Q5-17a	0	2	74	13	11
Q5-18	0	4	40	28	28
Q5-20	0	3	30	23	44
Q5a-0	0	3	30	18	49
Q5a-1	0	3	37	20	40
Q5a-2	0	4	32	18	46
Q5a-4	0	1	45	14	40
Q5a-5	0	8	38	15	39
Q5a-6	0	3	29	25	43
Q5a-7	0	21	47	18	14
Q5a-8	0	32	24	17	27
Q5a-13	13	18	30	27	12
Q5a-16	2	7	47	27	17
Q5a-18	0	3	60	22	15
Q5a-21	0	7	34	23	36
Q5a-22	23	6	13	26	32
Q5a-23	0	3	23	34	40
Q6-3	0	1	52	24	23
Q6-4	0	5	63	13	19
Q6-5	0	8	78	10	4
Q6-6	0	2	70	20	8
Q6-14	0	19	21	26	34
Q6-20	0	1	49	35	15
Q7-1	11	24	28	24	13
Q7-2	33	3	19	18	27
Q7-4	0	0	25	50	25
Q7-6	0	0	33	34	33
Q7-18	0	0	32	36	32
Q7-20	0	4	55	22	19
Q7-23	0	0	13	37	50
Q7-28	0	12	53	28	7
Q7-29	0	1	62	24	13
Q8-1	11	6	40	18	25
Q8-2	9	7	61	14	9
Q8-3	4	3	44	20	29
Q8-4	6	26	33	12	23
Q8-5	11	16	27	14	32
Q8-6	21	21	9	27	26
Q8-8	0	4	44	25	27
Q8-10	25	0	10	51	14
Q8-11	30	0	16	44	10
Q8-15	18	15	14	29	24
Q8-18	4	0	64	20	12
Q8-20	0	6	29	30	35
Q8-21	0	2	15	31	52
Q9-1	0	6	30	35	29

TABLE 23 (cont'd)

Q9-3	0	5	21	36	38
Q9-5	0	29	32	7	32
Q9-6	0	5	58	17	20
Q9-8	0	7	25	22	46
Q9-11	0	5	14	27	54
Q10a-1	0	4	35	23	38
Q10a-2	0	6	61	16	17
Q10a-3	0	0	64	20	16
Q10a-4	0	0	80	15	5
Q10a-5	0	0	68	22	10
Q10a-14	0	13	20	22	45
Q10a-19	0	0	28	33	39
Q11-1	0	0	63	0	37
Q11-2	12	1	18	42	27
Q11-3	0	0	71	25	4
Q11-6	0	0	47	44	9
Q11-7	0	15	41	32	12
Q11-10	0	0	34	33	33
Q11-12	0	0	71	29	0
Q11-14	0	0	47	25	28
Q11-15	0	0	46	40	14
Q11-16	0	0	55	16	29
Q12-2	0	0	57	43	0
Q12-5	0	10	17	14	59
Q12-6	0	0	24	20	56
Q12-7	0	7	23	38	32
Q12-11	0	0	24	20	56
Q12-12	0	0	17	24	59
Q12-13	0	0	14	37	49
Q12-14	0	1	26	27	46
Q13-1	0	0	0	80	20
Q13-8	0	0	0	50	50
Q13-9	0	0	6	77	17
Q13-12	0	0	77	33	0
Q3-26a	0	10	29	23	33

* D/A = Dinoflagellates and Acritarchs
** S/Z = Sphagnaceae and Zygnemataceae

TABLE 24: SAMPLE PALYNOFLORAS

List of Palynomorphs*

1. Fungal Spores
2. Schizosporis sp
3. Cleistosphaeridium multifurcatum
4. Cleistosphaeridium sp.
5. Deflandrea tripartita
6. Deflandrea sp.
7. Exochosphaeridium sp.
8. Gonyaulacysta sp.
9. Hexagonifera chlamydata
10. Hystrichodinium pulchrum
11. Hystrichodinium voigti
12. Hystrichosphaeridium ramosa
13. Nannoceratopsis plegas
14. Paleohystrichophora infusorioides
15. Pareodinia sp.
16. Prismatocystis ewengii
17. Scriniodinium sp.
18. Dinoflagellate Form A
19. Dinoflagellate Form B
20. Dinoflagellate Opercula
21. Ascotomocystis hydria
22. Baltisphaeridium sp. 1
23. Baltisphaeridium sp. 2
24. Baltisphaeridium sp. 3
25. Cymatiosphaera sp.
26. Leiosphaeridia sp. 1
27. Leiosphaeridia sp. 2
28. Micrhystridium inconspicuum
29. Michrystridium sp.
30. Cingutriletes clavus
31. Stereisporites psilatus
32. Stereisporites antiquasporites
33. Camarozonosporites sp.
34. Foveosporis triangulus
35. Perotriletes pannuceus
36. Perotriletes rugulatus
37. Perotriletes striatus
38. Calamospora mesozoica
39. Cingulatisporites dakotensis
40. Densoisporites microrugulatus
41. Cyathidites minor
42. Ischyosporites sp.
43. Deltoidospora psilostoma
44. Gleicheniidites circiniidites
45. Gleicheniidites juriensis
46. Gleicheniidites senonicus
47. Matonisporites conspicuus
48. Matonisporites crassimurus
49. Matonisporites dorogensis
50. Osmundacidites wellmanii
51. Todisporites major
52. Laevigatosporites haardtii
53. Laevigatosporites irroratus
54. Laevigatosporites ovatus
55. Polypodiiidites arcus
56. Appendicisporites bifurcatus
57. Appendicisporites bilateralis
58. Appendicisporites erdtmanii
59. Appendicisporites potomacensis
60. Appendicisporites tricostatus
61. Chomotriletes almegrensis
62. Chomotriletes fragilis
63. Cicatricosiporites dorogensis
64. Cicatricosisporites hallei
65. Cicatricosisporites mohrioides
66. Cicatricosisporites potomacensis
67. Cicatricosisporites sp.
68. Microfoveolatosporites canaliculatus
69. Triplanosporites sinuosus
70. Punctatosporites rimosus
71. Cardioangulina triceps
72. Concavisporites rugulatus
73. Divisisporites sp.
74. Extrapunctatosporites oblongius
75. Foraminisporites asymmetricus
76. Foveosporites sp.
77. Leptolepidites major
78. Leptolepidites verrucatus
79. Stenozonotriletes stellatus
80. Taurocusporites reduncus
81. Verirugosisporites sp.
82. Verucatosporites pseudoreticulatus
83. Vericosisporites secundus
84. Monolete Spore Form A
85. Equisetoporites ovatus
86. Equisetoporites saskatoonensis

TABLE 24 (cont'd)

87. Equisetoporites sp.
88. Bennettitaeapollenites sp.
89. Ginkgocycadophytus sp.
90. Cycadopites minimus
91. Cycadopites pseudolatus
92. Cycadopites reticulatus
93. Classopollis classoides
94. Araucariacites sp.
95. Inaperturopollenites sp.
96. Sequoiapollenites sp.
97. Taxodiaceaepollenites hiatus
98. Alisporites similis
99. Parvisaccites radiatus
100. Phyocladidites mawsoni
101. Rugubivesiculites sp.
102. Confertisulcites fusiformis
103. Monosulcites minimus
104. Monosulcites perspinosus
105. Monosulcites sp.
106. Perinopollenites sp.
107. Eucommiidites sp.
108. Arecipites sp.
109. Clavatipollenites prolatus
110. Liliacidites clavatus
111. Liliacidites inaequalis
112. Liliacidites peroreticulatus
113. Liliacidites textus
114. Liliacidites sp.
115. Monocolpopollenites tranquillus
116. Monocolpopollenites zievelensis
117. Monocolpopollenites sp. 1
118. Monocolpopollenites sp. 2
119. Monocolpopollenites sp. 3
120. Palmaepollenites minusculus
121. Palmaepollenites tranquillus
122. Proxapertites cursus
123. Retimonocolpites fragilis
124. Retimonocolpites sp.
125. Ajatipollis sp.
126. Cupaneidites sp.
127. Cupuliferoidapollenites minutus
128. Foveotricolpites rhombohedralis
129. Nyssapollenites albertensis
130. Polycolpites sp.
131. Porocolpopollenites sp.
132. Psilatricolpites parvulus
133. Psilatricolpites prolatus
134. Retitricolpites vulgaris
135. Retitricolpites maximus
136. Rousea georgensis
137. Rousea miculipollis
138. Subtriporopollenites reticulatus
139. Tricolpites aoristus
140. Tricolpites crassimurus
141. Tricolpites foveolatus
142. Tricolpites hians
143. Tricolpites psilascabratus
144. Tricolpites sagax
145. Tricolpites variabilis
146. Tricolpites sp. 1
147. Tricolpites sp. 2
148. Tricolpites sp. 3
149. Tricolpopollenites distatus
150. Tricolpopollenites henrici
151. Tricolpopollenites microscabratus
152. Tricolpopollenites simplicissimus
153. Tricolpopollenites sp. 1
154. Tricolpopollenites sp. 2
155. Tricolpopollenites sp. 3
156. Tricolpopollenites sp. 4
157. Tricolpopollenites sp. 5
158. Tricolpopollenites sp. 6
159. Tricolporopollenites aliquantulus
160. Tricolporopollenites inductorius
161. Tricolporopollenites intergranulatus
162. Tricolporopollenites platyreticulatus
163. Tricolporopollenites punctatus
164. Tricolporopollenites venustus
165. Tricolporopollenites sp.
166. Vitipites sp.
167. Neoraistrickia briviclavata
168. Cicatricosisporites terminatus
169. Concavisporites sp.
170. Retitricolpites sp.
171. Unidentified algae
172. Unidentified trilete spores
173. Unidentified gymnospermous pollen

TABLE 24 (cont'd)

174. Unidentified angiospermous pollen
175. Unidentified palynomorphs

* This numbered listing of palynomorph taxa corresponds to the numbered listing in the Palynomorph Table 25 that follows.

TABLE 25: PALYNOFLORA DISTRIBUTION TABLE

	CB-2	CB-3	CB-6	CB-7	CB-8	CB-9	CB-11	CB-12	CB-13	CB-14	CD-1	CD-2	CD-3	CD-8	CD-9	CD-11	CD-12	CD-14	CD-15	CD-16	CD-18	CD-22	CD-23	CD-24	CD-26a	CD-28	CH-1	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-11	CH-12	CH-13	CH-15	CH-16	CH-18	CH-21	CH-22	CH-23	CH-25	CH-26	CH-27	CH-28
1.	88	72	90	20	30	30	20	27	37	22	151	102	88	19	25	110	13	27	24	19	4	14	33	41	32	33	51	5	2	1	14	37	4	50	0	6	2	2	1	4	22	5	17	5	4	16
2.	12	0	0	6	6	1	0	1	24	6	36	10	10	39	0	40	0	6	26	10	0	0	7	42	13	10	2	0	0	0	2	6	0	45	2	2	1	0	0	0	2	1	0	0	11	2
3.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.	0	96	99	0	0	0	0	6	0	0	0	0	4	0	0	2	0	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	2	2
31.	0	39	33	12	0	16	2	3	0	0	0	0	2	36	9	2	1	14	44	68	2	0	0	0	0	4	0	4	2	0	1	14	3	26	16	20	1	0	0	0	6	38	6	0	2	0
32.	22	69	27	0	4	6	0	1	0	0	0	0	0	17	2	9	7	30	37	16	3	0	0	2	0	0	0	2	1	0	5	4	0	10	2	21	0	0	0	0	23	16	0	0	0	0
33.	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
34.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
35.	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
36.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37.	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	6	0	4	0
38.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39.	0	0	0	4	4	0	6	3	0	0	0	0	12	0	3	0	0	0	4	2	0	0	7	3	0	2	9	12	3	0	2	4	0	0	0	13	0	0	1	0	11	20	2	0	4	6
40.	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41.	26	10	5	30	30	10	27	73	30	26	6	27	3	2	6	32	3	14	0	2	0	17	11	7	4	11	14	41	0	0	4	0	0	0	0	9	2	0	0	0	6	0	43	0	2	7
42.	6	0	0	0	0	0	0	4	0	0	3	0	0	0	0	4	0	0	0	0	0	0	4	0	0	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
43.	47	4	4	26	45	12	14	37	0	9	4	5	0	4	0	30	7	0	6	3	0	18	24	16	10	6	4	17	6	0	1	1	0	5	0	1	0	0	0	0	2	19	6	0	0	2
44.	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	4	1	2	0	0	2	0	0	0	3	0
45.	0	0	0	6	10	0	2	7	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	2	17	19	0	0	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0	4	2
46.	26	21	22	20	16	11	12	16	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	0	0	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0
47.	0	4	0	6	6	11	0	4	4	24	23	6	0	0	0	0	1	4	10	0	0	0	0	0	0	2	0	0	2	0	0	0	0	10	5	22	2	3	0	3	3	0	4	0	1	5
48.	0	0	6	0	0	0	1	1	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	17	15	2	17	7	0	3	6	1	0	0	10	0	0	0	0	0	0	1	0	0	0
49.	0	0	3	0	0	1	13	0	0	2	0	0	0	0	0	0	0	2	6	0	0	0	0	0	0	1	0	0	6	0	1	0	0	7	0	0	0	0	0	0	2	0	4	0	0	2
50.	0	6	2	12	2	4	0	0	0	15	0	2	4	0	0	17	0	4	6	12	0	6	4	2	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51.	6	0	0	4	4	0	1	12	6	1	11	4	0	0	0	13	0	7	4	14	0	4	4	1	0	0	2	0	0	0	0	4	0	7	0	7	0	1	1	2	10	0	6	0	0	0
52.	15	0	0	2	11	10	4	1	0	1	3	0	0	6	0	4	0	0	0	2	0	0	2	0	3	2	2	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	4	0	0	2
53.	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2
54.	6	6	5	10	10	5	1	0	0	11	0	0	0	2	0	4	0	0	0	0	0	0	10	0	0	2	4	0	0	0	3	2	0	0	0	4	0	0	0	0	0	0	4	0	4	5
55.	0	0	0	0	0	0	2	2	0	3	3	2	4	0	0	10	6	4	2	0	0	2	2	4	11	12	2	0	0	0	0	0	0	0	0	6	0	0	0	0	4	0	0	1	12	5

TABLE 25 (cont'd)

	04-29	05-1	05-2	05-3	05-6	05-7	05-8	05-15	05-16	05-17a	05-18	05-20	05a-0	05a-1	05a-2	05a-4	05a-5	05a-6	05a-7	05a-8	05a-13	05a-16	05a-18	05a-21	05a-22	05a-23	06-3	06-4	06-5	06-6	06-14	06-28	07-1	07-2	07-4	07-6	07-18	07-20	07-23	07-28	07-29	08-1	08-2	08-3	08-4	08-5
1.	12	18	10	13	4	6	22	93	28	2	23	25	33	36	0	2	4	11	16	18	13	14	2	4	18	20	30	15	28	15	35	0	11	22	0	3	6	13	6	19	11	43	42	11	25	34
2.	11	6	1	6	0	0	4	0	15	4	7	0	0	11	1	2	2	4	6	0	13	5	1	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	1	21	4	21	26	7	60	41
3.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
5.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
6.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	2	6	0	0	0	0	0	0	1	0	0	1	0	0
7.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
10.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
13.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
16.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
17.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0
18.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
19.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	4	0	0	31	0	0	0	0	0	0	24	67	0	0	0	0	0	0	0	1	0	0	0	0	0
26.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	14	0	0	0	0	0	0	11	16	0	0	0	0	0	0	0	20	31	32	6	11	16
27.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	15	5	3	6	13
28.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.	0	2	0	0	0	2	4	0	0	6	0	3	0	2	0	0	2	7	41	25	0	0	7	0	2	0	0	0	14	0	6	0	31	3	0	0	0	0	0	2	0	0	0	0	0	0
31.	0	0	1	0	0	8	9	29	14	0	4	0	0	0	0	4	16	12	13	28	21	3	0	6	18	9	0	11	23	7	32	4	34	0	0	0	0	0	0	7	0	4	4	0	15	0
32.	0	0	0	0	0	3	7	0	0	0	0	3	11	2	0	0	2	0	33	88	10	0	0	3	6	0	1	3	0	0	9	2	49	1	0	0	0	15	0	2	0	0	0	0	0	0
33.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
34.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35.	0	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	2	0	5	0	0
36.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
37.	0	2	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38.	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
39.	3	4	0	0	0	4	9	0	2	6	0	12	5	12	0	4	7	4	3	0	0	0	5	0	4	0	6	0	0	5	0	4	0	6	0	0	0	12	2	0	0	0	4	0	0	9
40.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41.	6	2	3	6	9	15	21	19	7	39	22	11	19	22	17	28	7	22	46	11	7	0	36	0	9	1	6	52	22	0	0	12	17	10	0	0	0	15	6	17	34	8	7	16	9	0
42.	4	3	0	0	23	0	20	0	0	4	0	0	3	1	0	1	0	0	9	0	0	0	2	0	0	0	4	4	3	0	0	0	5	0	0	0	2	0	0	0	0	4	5	7	2	0
43.	2	6	2	10	4	20	21	14	2	119	2	13	10	4	14	15	9	46	4	0	0	0	14	0	1	1	7	3	12	22	6	8	2	2	1	0	0	9	0	0	23	12	2	6	0	0
44.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45.	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	5	0	0	0	0	0	0
46.	5	0	2	0	0	0	0	13	0	0	0	2	0	2	0	0	5	10	16	4	0	9	0	0	2	5	0	4	0	2	5	0	4	0	0	0	4	10	5	4	0	3	6	0	0	0
47.	16	0	0	0	62	14	10	0	6	36	11	9	1	9	13	0	6	0	0	0	1	4	16	0	0	7	13	43	67	23	0	28	21	3	0	0	0	0	2	7	28	17	26	10	13	0
48.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	14	18	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49.	0	0	4	0	27	4	0	0	1	44	2	0	1	0	6	15	0	4	4	0	0	0	2	0	0	3	4	5	9	5	0	10	2	0	0	0	0	0	0	5	3	8	4	2	0	2
50.	0	4	6	2	0	0	0	0	3	0	7	10	0	2	2	13	3	7	0	0	0	4	21	0	4	0	0	0	0	0	0	6	0	4	0	0	5	11	4	3	8	0	6	0	0	0
51.	0	10	4	2	4	10	32	0	9	2	2	1	0	6	5	10	4	0	1	21	0	16	0	0	2	12	0	12	0	0	17	41	0	0	0	0	0	16	0	19	34	0	4	6	2	12
52.	6	2	12	5	5	3	0	0	0	10	2	12	0	0	0	0	0	0	0	6	0	0	18	0	0	0	0	4	0	17	6	0	0	0	0	0	0	0	0	0	0	10	2	0	1	2
53.	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54.	1	0	4	4	11	3	0	7	5	12	7	6	4	7	0	6	6	0	0	15	3	0	8	0	4	4	2	0	0	0	0	8	0	1	0	1	0	4	1	0	0	2	19	0	10	11
55.	3	0	2	0	0	2	5	0	0	13	0	4	6	9	3	5	0	0	11	0	0	4	8	0	2	0	2	0	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 25 (cont'd)

	O8-6	O8-7	O8-8	O8-10	O8-11	O8-15	O8-18	O8-20	O8-21	O9-1	O9-3	O9-5	O9-6	O9-8	O9-11	O10a-1	O10a-2	O10a-3	O10a-4	O10a-5	O10a-14	O10a-19	O11-1
1.	32	46	0	31	43	14	34	84	44	11	6	26	12	10	38	16	19	5	2	0	12	4	1
2.	7	30	4	0	0	0	0	11	4	0	0	56	2	20	2	2	6	0	0	3	15	0	0
3.	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	3	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17.	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19.	2	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26.	27	47	0	36	30	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27.	8	24	0	7	18	21	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28.	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.	2	0	0	0	1	2	0	0	0	1	2	11	4	0	0	2	0	0	0	0	2	0	0
31.	0	52	2	0	0	20	0	10	4	15	0	43	15	0	7	6	21	3	5	5	16	0	1
32.	0	0	0	0	0	11	2	2	0	0	12	18	0	0	3	0	2	0	0	0	4	0	0
33.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
35.	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
36.	0	0	0	0	0	0	0	13	0	0	0	5	0	0	0	0	74	15	4	4	0	0	0
37.	0	0	0	0	0	10	0	3	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
38.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39.	0	0	7	0	7	6	0	2	0	7	5	0	0	0	0	0	0	0	0	0	0	4	0
40.	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41.	0	3	4	0	2	0	41	0	0	5	0	10	15	5	2	14	0	0	6	1	7	25	0
42.	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	2	1	0	0	0	0	0	0
43.	0	0	0	2	0	9	0	0	0	7	12	4	0	5	2	2	22	4	5	1	2	0	0
44.	0	0	0	0	0	0	2	0	0	0	0	22	0	0	0	0	3	0	0	0	0	0	0
45.	0	0	1	0	0	0	0	0	0	1	2	0	3	0	0	0	4	0	0	0	0	0	0
46.	0	0	2	0	2	5	27	9	0	5	2	0	2	9	0	3	3	0	1	3	0	0	0
47.	0	0	12	0	2	0	36	0	4	3	5	2	7	0	0	13	12	2	4	2	0	4	4
48.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49.	0	0	0	0	0	0	12	0	0	2	0	0	2	0	0	2	7	5	5	0	0	0	0
50.	0	0	2	0	0	0	0	4	0	2	2	0	2	11	2	2	23	5	3	9	20	4	0
51.	0	2	2	3	0	7	2	0	4	5	7	13	17	7	0	9	17	2	5	11	0	12	0
52.	0	18	4	0	0	0	0	0	0	0	3	1	0	0	0	2	4	0	0	0	0	0	0
53.	0	0	0	0	0	0	0	0	0	2	2	11	0	0	0	0	0	0	0	0	0	0	0
54.	0	0	3	4	0	0	0	0	0	0	0	0	2	0	2	10	6	0	0	0	0	0	0
55.	0	0	0	0	0	0	0	0	5	0	0	0	2	0	0	0	2	0	0	3	0	10	0

	O11-2	O11-3	O11-6	O11-7	O11-10	O11-12	O11-14	O11-15	O11-16	O12-2	O12-5	O12-6	O12-7	O12-11	O12-12	O12-13	O12-14	O13-1	O13-8	O13-9	O13-12	7-14-81 1-2	7-14-81 3-2
1.	16	0	3	12	0	0	10	0	0	0	14	4	27	4	11	20	18	0	6	3	0	0	2
2.	0	0	0	10	0	0	0	0	0	0	21	2	14	0	0	0	0	0	0	0	0	0	0
3.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
5.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
11.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
15.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26.	25	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	66
27.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	13
28.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0
31.	2	7	0	11	0	0	2	3	3	0	0	0	0	0	0	0	2	0	1	3	0	5	0
32.	0	0	0	0	0	0	0	0	0	0	5	4	4	0	0	0	0	0	0	0	0	0	0
33.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34.	0	0	0	7	0	0	4	0	0	0	4	0	0	2	0	0	0	0	0	0	0	2	1
35.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36.	3	0	0	16	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39.	0	0	0	7	1	0	3	0	4	3	5	0	0	1	0	0	0	0	0	0	0	0	0
40.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41.	0	0	0	12	1	0	44	11	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0
42.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43.	5	4	3	14	1	0	17	4	0	0	0	0	0	0	4	0	1	0	0	0	1	2	6
44.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46.	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	5	0	0	0	0	0	0	0
47.	0	5	3	11	0	0	23	0	3	0	0	0	0	3	6	0	10	0	0	0	2	6	10
48.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49.	0	0	0	2	2	10	0	0	15	1	0	0	2	3	4	0	4	0	0	0	0	2	0
50.	5	3	6	2	0	0	10	3	3	0	6	0	13	0	0	6	6	0	0	0	0	0	0
51.	5	10	3	5	4	0	12	4	0	0	2	3	53	4	0	2	14	0	0	0	0	0	2
52.	0	0	0	0	0	0	4	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	6
53.	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	5	0	0	0	0	0	0
54.	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55.	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0

TABLE 25 (cont'd)

	7-14-01 3-3	7-14-01 4-3	7-14-01 4-4	7-14-01 6-3	7-14-01 10-1	7-14-01 12-2	7-14-01 12-3	7-14-01 12-5	7-15-01 1-1	7-15-01 1-2	7-15-01 1-3	7-15-01 2-1	7-15-01 2-2	7-15-01 3-1	7-15-01 3-2	7-15-01 4-1	7-15-01 5-1	7-15-01 6-2	7-15-01 6-4	7-15-01 6-5	7-15-01 6-6	7-15-01 6-7	7-15-01 6-8	7-16-01 1-1	7-16-01 1-10	7-16-01 1-12	7-16-01 1-13
1.	2	5	6	1	42	4	26	2	0	6	3	23	4	7	0	4	4	14	11	6	1	3	1	11	1	6	0
2.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	0	7
3.	1	1	0	0	0	0	0	0	4	7	0	0	4	0	0	9	0	1	2	0	6	5	0	0	0	0	19
4.	0	0	0	0	0	0	0	0	1	53	56	0	0	0	0	5	3	0	0	0	2	2	0	0	0	0	31
5.	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	1	0	5	0	1	2	1	0	0	0	7
6.	3	0	0	0	0	0	0	0	0	0	2	0	2	0	0	1	0	0	3	0	0	0	0	0	0	0	0
7.	0	0	0	0	0	0	0	0	0	5	19	5	11	0	0	11	1	4	7	0	1	5	2	0	1	0	3
8.	0	0	0	0	0	0	0	0	0	0	9	0	9	0	0	1	3	2	1	0	0	0	0	0	0	0	2
9.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
10.	0	0	0	0	0	0	0	0	2	28	12	0	11	0	0	5	4	2	2	0	1	0	0	0	0	0	39
11.	0	0	0	0	0	0	0	0	2	0	2	2	0	0	0	9	0	6	0	0	0	0	0	0	0	0	20
12.	0	0	0	0	0	0	0	0	6	99	20	6	33	0	0	15	13	10	1	0	3	0	1	0	0	0	54
13.	0	0	0	0	0	0	0	0	6	0	4	0	2	0	0	0	0	1	4	0	0	0	0	0	0	0	1
14.	0	0	0	0	0	0	0	0	0	4	4	0	15	0	0	4	6	3	0	0	3	6	2	0	0	0	36
15.	0	0	0	0	0	0	0	0	0	4	7	0	5	0	0	1	0	0	2	0	0	0	0	0	0	0	2
16.	0	0	0	0	0	0	0	0	2	2	0	0	1	0	0	0	1	0	2	0	1	0	0	0	0	0	2
17.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	4	4	0	0	0	0	0	7	0	5
18.	0	0	0	0	0	0	0	0	0	42	65	0	18	0	0	7	0	5	9	0	1	2	0	0	0	0	35
19.	0	0	0	0	0	0	0	0	0	30	20	0	22	0	0	3	0	10	11	0	5	0	2	0	5	0	69
20.	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	10
21.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
22.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	9
23.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	4	0	0	0	0	0	0	0	1
24.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	1	0	0	0	0	0	15
25.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	6
26.	0	10	0	0	0	0	0	0	19	49	53	15	77	15	0	31	37	30	87	53	1	4	4	0	44	0	41
27.	0	5	0	0	0	0	0	0	11	17	14	10	16	13	0	2	0	5	36	0	1	2	1	0	9	0	20
28.	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
29.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
30.	0	0	0	0	0	0	0	23	0	0	0	0	0	0	6	0	0	3	0	0	0	0	0	2	4	0	0
31.	0	0	0	0	0	0	0	11	0	0	0	2	0	0	4	0	0	0	0	1	0	0	0	4	0	0	0
32.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
33.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
34.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
35.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0
37.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38.	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
39.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6	0	0
40.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41.	0	1	2	0	10	0	17	0	0	0	0	19	0	0	0	0	2	0	0	0	0	0	0	5	12	0	0
42.	0	0	0	0	0	0	7	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
43.	1	0	0	0	12	0	27	1	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	2	18	0	0
44.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
45.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	2	4	0	0
46.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
47.	2	0	0	0	0	3	9	0	0	0	0	6	3	0	0	0	2	0	0	0	0	0	0	3	0	0	0
48.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49.	0	1	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	2	13	0	0
50.	0	0	0	0	0	0	4	4	9	0	0	21	0	0	11	0	0	0	0	13	0	0	0	2	2	0	0
51.	0	1	0	0	2	1	2	0	0	0	0	18	0	0	2	0	0	0	0	3	0	0	0	4	0	0	0
52.	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	2	1	0	0
53.	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
54.	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	4	5	0	0
55.	0	0	0	0	0	0	13	2	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0

TABLE 25 (cont'd)

	08-2	08-3	08-6	08-7	08-8	08-9	08-11	08-12	08-13	08-14	03-1	03-2	03-3	03-8
56.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58.	0	0	0	0	0	0	0	3	0	0	0	0	0	0
59.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61.	0	0	0	0	0	0	0	16	0	0	0	0	0	0
62.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63.	0	0	0	19	33	4	11	0	19	197	4	2	0	0
64.	0	0	0	0	0	0	2	2	17	36	0	0	0	0
65.	0	0	0	0	0	0	13	1	10	20	0	0	0	0
66.	0	0	0	10	6	0	0	0	0	18	0	3	0	0
67.	0	0	0	0	4	1	0	7	0	20	0	1	0	0
68.	0	0	0	0	0	0	0	0	0	0	0	1	0	0
69.	4	0	0	0	0	2	18	26	1	0	20	4	18	0
70.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71.	0	0	0	0	0	0	3	0	4	0	0	0	0	0
72.	0	0	0	0	0	4	2	1	0	0	0	0	0	0
73.	0	2	2	0	0	0	4	7	2	2	0	2	0	0
74.	0	0	0	0	0	0	12	14	0	0	0	0	4	0
75.	0	0	0	0	0	0	0	12	18	0	0	0	0	0
76.	0	0	0	0	0	0	0	9	0	0	0	0	0	0
77.	0	0	0	0	0	0	2	0	1	0	0	0	0	0
78.	0	0	0	0	0	0	0	0	0	0	0	0	0	2
79.	0	0	2	0	1	0	0	0	0	0	0	0	0	0
80.	0	0	1	0	0	0	0	0	0	0	0	0	0	0
81.	0	0	0	0	0	0	0	0	24	0	14	2	2	0
82.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83.	0	0	0	0	0	2	0	0	1	2	0	0	0	0
84.	0	0	0	0	0	0	0	0	0	1	0	0	0	0
85.	4	0	0	20	27	0	17	6	18	4	7	0	6	2
86.	0	0	0	2	5	5	4	0	0	0	0	0	0	0
87.	0	0	0	12	1	1	0	0	0	0	1	6	6	0
88.	12	13	2	4	0	0	0	18	15	1	0	0	7	0
89.	0	0	1	0	0	0	0	0	0	0	0	0	0	0
90.	4	12	0	6	7	2	0	4	9	7	0	0	1	2
91.	0	2	4	2	0	0	0	0	0	0	0	0	0	0
92.	0	0	0	0	0	0	0	7	0	0	0	0	0	0
93.	1	1	0	0	0	0	0	0	0	0	21	0	4	0
94.	0	0	0	0	0	0	0	0	0	0	5	0	0	1
95.	31	13	16	18	9	1	2	10	21	5	25	10	12	2
96.	0	5	1	2	2	1	0	0	0	0	0	0	0	0
97.	6	0	1	0	0	0	0	0	0	0	0	0	0	0
98.	0	0	4	0	0	0	0	4	6	0	0	0	2	0
99.	0	0	0	0	13	3	0	0	2	0	0	0	0	0
100.	1	0	7	0	0	0	0	0	6	0	5	0	0	0
101.	17	0	0	0	0	0	0	3	0	0	0	0	2	0
102.	0	6	0	6	5	0	0	1	2	0	0	0	0	0
103.	13	6	6	20	13	1	0	15	6	1	7	2	2	0
104.	0	0	0	2	0	0	0	0	0	0	0	4	0	0
105.	10	14	0	0	3	1	0	14	4	0	3	0	6	0
106.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107.	14	0	0	0	0	5	3	21	20	2	3	4	4	2
108.	0	0	0	0	0	0	0	2	2	0	0	0	4	0
109.	0	2	0	4	0	1	0	0	14	6	0	0	0	0
110.	0	1	0	0	0	0	0	0	2	4	7	0	0	0

	03-9	03-11	03-12	03-14	03-15	03-16	03-18	03-22	03-23	03-24	03-26	03-28	04-1	04-3	04-4
56.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
57.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
58.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59.	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0
60.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63.	11	0	32	6	0	0	0	6	4	0	0	0	0	15	6
64.	0	0	6	0	0	0	0	0	0	0	14	2	0	4	1
65.	0	0	13	0	0	0	0	2	2	1	0	0	0	2	2
66.	0	0	0	0	0	7	0	0	0	0	0	0	2	29	2
67.	2	0	2	17	0	0	0	0	0	0	0	0	0	0	0
68.	4	0	0	0	0	7	0	13	0	0	0	0	12	5	1
69.	0	12	6	0	0	10	0	45	9	33	6	50	42	10	4
70.	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
71.	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0
72.	0	0	0	0	0	0	0	4	6	0	0	0	2	14	1
73.	0	2	0	0	0	0	0	0	11	0	0	0	0	0	0
74.	0	0	0	0	0	0	0	0	0	3	2	1	0	0	0
75.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
76.	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0
77.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78.	0	0	0	0	0	0	0	0	6	0	9	4	0	0	0
79.	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1
80.	0	0	0	0	0	0	0	2	6	0	0	0	0	0	0
81.	2	4	6	0	0	0	0	1	0	0	3	2	9	0	0
82.	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83.	0	7	0	0	0	0	4	12	0	0	0	2	0	0	0
84.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85.	2	0	0	3	0	0	0	2	0	0	3	9	2	0	0
86.	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
87.	7	0	0	6	0	0	0	0	0	0	0	0	0	0	0
88.	0	0	0	0	0	0	0	2	3	4	0	0	0	1	9
89.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
90.	0	0	3	2	0	0	0	6	10	3	0	2	0	0	0
91.	0	0	0	3	0	4	0	0	2	0	10	11	6	0	0
92.	0	0	0	12	0	12	0	13	7	0	0	0	0	0	0
93.	2	0	3	6	0	6	3	9	0	0	22	20	0	0	2
94.	0	0	0	0	0	0	0	3	0	4	0	0	0	0	0
95.	1	1	0	4	0	14	0	5	4	0	4	4	20	19	11
96.	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
97.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
98.	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
99.	0	0	0	0	0	2	0	4	2	0	0	0	4	2	0
100.	0	0	0	0	0	0	0	4	2	0	0	0	0	0	2
101.	0	0	0	0	0	0	0	6	10	0	1	1	0	0	0
102.	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0
103.	0	0	0	24	2	0	3	32	19	16	7	14	16	14	16
104.	0	0	0	0	0	0	0	0	4	4	0	0	0	1	1
105.	0	0	0	0	0	5	0	10	4	4	4	0	0	0	4
106.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
107.	1	4	6	4	2	7	7	1	7	6	9	4	21	14	14
108.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109.	0	0	0	0	0	10	0	14	3	6	0	0	2	12	6
110.	0	0	0	1	0	2	4	6	2	0	0	0	0	0	0

	04-5	04-6	04-7	04-8	04-11	04-12	04-13	04-15	04-16	04-18	04-21	04-22	04-23	04-25	04-26	04-27	04-28
56.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
57.	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
58.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
59.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
60.	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	5	0
61.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63.	0	0	14	6	24	0	13	0	0	0	0	0	0	6	0	24	5
64.	0	0	0	0	9	0	14	0	0	0	0	5	0	0	0	0	9
65.	0	1	10	1	9	0	0	0	0	0	0	4	22	2	1	0	2
66.	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2
67.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	0
68.	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0
69.	2	1	0	2	0	2	21	0	0	0	0	6	6	12	2	5	2
70.	0	0	4	0	0	0	6	0	0	0	0	0	0	0	0	11	4
71.	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
72.	0	1	5	0	0	0	4	1	0	0	0	2	0	2	0	0	2
73.	0	0	0	0	0	2	7	0	0	0	0	0	0	4	0	0	9
74.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76.	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0
77.	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
78.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	6	0
79.	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0
80.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
81.	0	1	1	0	0	2	7	0	0	0	0	0	0	4	0	0	0
82.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	10	0
84.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85.	1	3	0	1	0	0	1	0	0	0	0	1	25	0	0	11	16
86.	0	3	5	0	0	0	0	11	0	0	0	2	1	0	0	11	0
87.	0	0	1	0	0	0	0	3	0	0	0	10	0	0	5	0	17
88.	6	2	0	2	2	0	15	4	7	0	4	0	4	0	0	0	1
89.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90.	0	2	0	10	2	15	7	21	14	2	16	4	3	3	0	1	0
91.	13	2	2	2	9	6	0	0	0	0	0	0	0	0	0	4	12
92.	0	6	0	0	0	0	4	3	9	0	1	5	0	0	4	0	1
93.	21	1	14	0	12	0	26	0	10	26	0	26	21	41	0	2	2
94.	1	23	0	0	0	0	10	0	1	0	1	5	0	0	0	5	2
95.	11	4	0	1	11	0	29	5	1	37	4	4	2	0	0	0	6
96.	0	2	0	0	0	0	2	0	0	2	0	1	0	0	0	2	0
97.	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2	0
98.	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0
99.	10	2	2	1	0	0	10	0	0	3	1	2	0	0	0	1	0
100.	10	0	1	0	0	0	0	0	0	0	9	0	2	0	0	0	0
101.	0	0	0	0	0	0	0	0	0	28	0	0	0	0	0	3	0
102.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
103.	0	7	1	0	23	24	4	11	11	0	0	6	0	0	0	0	1
104.	0	0	2	0	0	0	2	0	0	2	1	0	0	0	0	0	0
105.	2	0	12	0	0	0	0	2	2	2	10	5	0	0	0	6	0
106.	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0
107.	5	14	16	0	27	17	0	1	10	16	0	0	36	2	0	8	3
108.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
109.	6	2	4	0	16	0	6	0	0	0	0	0	0	0	0	9	12
110.	0	0	0	0	0	0	0	0	11	0	19	0	0	0	0	3	4

TABLE 25 (cont'd)

	04-29	05-1	05-2	05-3	05-6	05-7	05-8	05-15	05-16	05-17a	05-18	05-30	05a-0	05a-1	05a-2	05a-4	05a-5	05a-6	05a-7	05a-8	05a-13	05a-16	05a-18	05a-21	05a-22	05a-23	06-3	06-4	06-5	06-6	06-14	06-30	07-1	07-2	07-4	07-6	07-18	07-10	07-23	07-28	07-29	08-1	08-2	08-3	08-4	08-5
56.	0	0	3	2	7	0	3	0	3	5	0	2	2	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
59.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
60.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0
61.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63.	0	0	0	28	10	7	9	0	2	6	33	0	0	0	2	42	13	0	0	0	2	0	20	0	11	9	102	93	87	53	5	15	6	0	0	0	0	14	0	16	0	0	84	12	0	0
64.	0	0	0	0	0	0	0	0	0	19	0	0	0	9	4	4	2	11	0	0	3	3	4	0	1	1	15	14	19	10	0	25	10	0	0	0	0	11	0	7	0	0	34	7	0	0
65.	0	2	1	4	4	0	0	0	5	9	1	0	0	0	0	12	0	14	0	0	2	8	0	0	0	0	4	6	0	2	0	6	6	1	0	0	0	11	0	0	0	0	0	0	10	0
66.	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	7	3	0	3	0	4	0	3	0	0	0	0	0	0	0	11	0	0	3	0
67.	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	3	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
68.	4	6	1	0	13	7	17	0	0	2	2	3	6	9	3	4	1	0	0	0	0	0	0	4	0	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	13	1	3	1	0
69.	1	2	0	2	0	12	21	0	1	3	2	5	23	16	7	12	0	17	23	6	10	22	2	0	13	4	2	6	24	11	4	14	4	13	0	0	0	15	1	5	0	22	8	2	0	0
70.	3	0	0	21	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	10	6	4	0	0	0	0	0	0	0	0	0	0	0	3	11	9	15	10
71.	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	3	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72.	3	0	0	2	0	2	0	0	0	0	0	3	0	3	0	0	0	0	0	0	2	5	0	0	0	0	0	0	2	0	2	4	0	0	0	0	0	0	0	13	0	0	0	0	0	0
73.	7	0	3	0	0	0	0	0	0	0	0	2	2	3	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	2	0	2	0	0	0	0	0	0	0	0	4	0	0	0
74.	0	4	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1
75.	1	3	0	0	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	17	2	0	2	0	0	0	0	0	0	0	9	0	0	0	0	0	0
76.	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	6	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
77.	4	0	2	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	12	7	0	0	0	0	0	0	0	0	7	0	0	0	0	2	0	0	0	23	0	0	0	0	0	9	0	0
78.	6	3	5	5	25	4	13	0	3	0	0	3	0	11	0	1	3	0	0	0	5	0	0	3	0	2	6	0	0	0	0	2	0	2	0	0	0	0	0	2	0	0	0	0	11	14
79.	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	3	2	0	0	0	0	0	0	0	2	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0
80.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81.	14	2	7	7	11	3	0	0	0	4	0	0	0	7	0	4	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	7	0	9	0	0	0	2	0	0
82.	1	0	0	0	0	0	4	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	12	0	0	0	0	0	6	0	0
83.	0	3	0	5	0	0	2	0	0	0	0	0	14	9	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0
84.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
85.	24	4	9	0	0	0	0	0	0	3	9	0	9	0	0	0	9	11	2	2	3	0	2	0	14	2	10	0	0	19	2	14	6	0	0	0	0	14	0	10	0	0	0	5	0	0
86.	18	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	6	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87.	29	2	15	0	4	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0
88.	6	11	6	10	0	0	4	3	0	0	5	16	1	0	4	0	4	11	4	2	0	0	0	0	6	4	3	12	4	0	0	4	6	20	0	0	0	7	0	0	0	4	13	0	9	1
89.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90.	9	2	4	0	0	0	0	0	0	3	6	6	14	4	0	0	0	0	4	0	2	1	0	0	9	10	2	4	0	0	0	4	12	11	0	0	0	1	0	0	7	0	0	0	0	0
91.	6	11	22	6	0	0	0	0	0	4	14	3	0	9	0	3	10	9	0	0	7	7	0	0	10	13	15	0	5	0	5	0	4	1	0	0	0	0	0	0	0	11	3	0	0	0
92.	0	4	6	7	9	0	0	0	0	1	0	6	0	1	4	12	0	9	4	0	7	1	1	0	1	0	0	0	2	2	0	1	0	0	3	0	0	0	0	0	0	0	0	0	6	0
93.	0	0	2	0	0	0	0	3	3	0	0	0	7	2	4	6	0	0	9	0	0	4	0	0	7	6	11	2	0	17	31	10	15	14	1	0	0	2	0	9	13	27	29	6	0	13
94.	7	2	0	0	2	2	0	0	5	0	0	2	2	0	0	0	0	4	0	0	7	0	0	0	0	2	0	0	0	0	0	4	0	2	0	0	0	0	0	0	1	11	3	0	5	7
95.	6	0	9	16	0	3	6	0	19	11	12	4	1	5	5	0	1	13	12	19	19	26	0	2	22	4	0	0	15	0	0	55	19	3	0	0	4	0	6	7	19	0	3	0	0	5
96.	0	0	0	0	5	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	7
97.	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	2	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	3	0	0
98.	1	0	0	4	4	3	4	0	5	3	1	0	0	0	2	0	0	9	0	0	3	0	2	5	5	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0
99.	0	0	0	2	0	0	0	0	5	0	0	0	3	4	1	2	0	0	7	4	0	4	0	0	4	1	0	0	5	0	0	0	0	0	0	0	0	2	0	24	0	0	0	0	2	0
100.	2	4	0	4	0	0	0	0	0	0	2	2	0	7	3	0	1	0	0	0	0	0	0	0	0	7	0	4	0	0	1	0	2	0	0	0	0	0	0	1	0	4	0	0	0	0
101.	11	0	0	0	30	10	0	0	0	19	0	0	2	0	0	0	0	4	0	0	5	0	17	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
102.	1	0	2	0	0	0	0	15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
103.	16	12	0	5	15	7	17	0	0	4	2	21	31	32	1	5	0	13	18	25	1	11	9	0	7	9	12	2	3	4	5	33	36	11	0	0	2	44	0	5	16	0	3	0	0	0
104.	15	2	0	1	12	0	0	0	0	7	0	1	0	0	0	1	0	0	0	0	0	0	6	0	0	0	7	2	0	0	0	1	0	0	0	0	0	0	0	5	0	0	3	0	0	0
105.	2	0	5	0	0	6	11	0	7	5	13	6	3	15	5	6	6	13	11	2	0	0	9	0	20	6	5	11	0	0	0	12	6	2	0	0	0	0	0	2	0	8	3	14	13	0
106.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	1	0	0
107.	14	11	1	21	4	0	6	0	1	0	5	17	5	1	0	1	0	0	0	0	2	3	0	3	0	13	0	0	5	9	0	2	0	6	1	1	3	3	0	0	0	9	0	2	0	1
108.	3	1	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109.	1	12	4	20	0	0	0	0	0	2	0	11	3	4	2	0	2	0	0	5	0	0	0	0	4	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
110.	0	14	0	7	0	4	0	2	0	4	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 25 (cont'd)

	Q8-6	Q8-7	Q8-8	Q8-10	Q8-11	Q8-15	Q8-18	Q8-20	Q8-21	Q9-1	Q9-3	Q9-5	Q9-6	Q9-8	Q9-11	Q10-1	Q10-2	Q10-3	Q10-4	Q10-5	Q10-14	Q10-19	Q11-1
56.	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
57.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
59.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
60.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	14	0	0	0	0	0
63.	0	4	15	0	6	0	16	0	0	2	0	4	16	5	0	0	0	0	2	2	0	0	0
64.	0	0	0	0	0	0	4	0	0	5	0	0	0	2	0	0	0	0	0	0	2	0	0
65.	0	2	13	0	0	0	6	4	4	2	1	12	10	0	0	5	0	0	0	0	0	0	0
66.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.	0	0	6	0	2	0	0	0	0	0	0	0	1	5	0	0	2	0	0	0	0	0	0
68.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
69.	0	0	33	2	0	0	0	32	0	6	7	35	0	0	0	17	2	0	0	0	4	15	0
70.	0	0	0	1	1	7	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
71.	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2	0	0	0	0	0	0	0	0
72.	0	0	2	0	0	0	0	0	0	3	1	0	0	5	0	0	1	0	0	0	0	0	0
73.	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0
74.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
76.	0	2	0	0	0	0	0	0	0	0	0	0	0	9	0	2	0	0	0	0	0	0	0
77.	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
78.	0	0	0	0	2	2	0	4	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0
79.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0
80.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81.	0	0	2	0	0	0	0	0	7	0	0	0	12	7	0	4	1	0	0	1	0	0	0
82.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83.	0	0	0	0	0	0	0	0	5	2	0	0	4	0	0	2	0	0	0	0	2	0	0
84.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
85.	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
86.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
88.	20	6	0	2	3	2	0	27	6	20	11	0	5	0	5	6	0	0	1	2	0	9	0
89.	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
90.	0	6	2	0	3	7	2	0	0	0	0	0	0	0	0	0	0	4	0	0	6	0	0
91.	0	0	6	0	0	0	0	0	43	0	0	0	0	15	3	5	3	0	0	0	0	13	0
92.	6	0	2	18	27	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	1	0	0
93.	6	27	11	4	9	16	0	6	4	9	7	0	0	0	7	0	2	0	3	6	0	5	0
94.	14	0	0	0	7	0	7	0	0	9	0	0	2	3	0	4	5	2	0	0	0	0	0
95.	16	0	13	0	10	10	0	3	5	10	16	0	10	13	7	6	38	8	2	5	19	10	0
96.	0	4	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97.	1	0	0	6	2	0	9	0	0	5	21	0	0	0	0	0	2	0	0	0	0	9	0
98.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
99.	9	0	0	17	0	7	0	3	0	2	0	0	4	0	0	2	0	0	0	1	0	0	0
100.	0	0	0	0	0	2	4	0	0	0	0	0	0	0	20	0	2	0	0	0	0	0	0
101.	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102.	0	0	0	3	2	2	0	0	5	0	0	0	0	3	0	0	2	0	0	0	0	0	0
103.	0	16	4	12	6	7	7	44	38	12	13	12	7	9	6	7	2	0	0	0	25	5	0
104.	0	0	2	0	1	13	9	3	0	0	0	0	0	0	0	0	1	0	0	0	0	5	0
105.	0	0	10	16	0	1	4	0	0	2	9	0	0	3	0	6	6	3	2	0	18	9	0
106.	0	41	0	14	9	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	4	0
107.	2	6	34	6	0	2	0	3	4	0	0	0	0	0	17	12	0	0	0	0	5	6	0
108.	0	0	0	0	0	0	0	2	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
109.	0	0	0	0	0	0	0	0	0	2	0	0	4	0	0	0	0	0	0	0	0	0	0
110.	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0

	Q11-2	Q11-3	Q11-4	Q11-7	Q11-10	Q11-12	Q11-14	Q11-15	Q11-16	Q12-2	Q12-5	Q12-6	Q12-7	Q12-11	Q12-12	Q12-13	Q12-14	Q13-1	Q13-8	Q13-9	Q13-12	7-14-81 1-2	7-14-81 3-2
56.	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0
57.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58.	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0
64.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
65.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0
66.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
67.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	9
68.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4
69.	9	4	0	4	0	3	11	0	2	0	2	0	6	0	7	0	6	0	0	0	3	0	19
70.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	1	0	2	0
71.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
74.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	7	0	0	0	0	0	0
76.	0	0	0	2	0	0	2	0	0	0	0	0	2	0	6	1	0	0	0	0	2	0	0
77.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0
78.	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	6	0	0	0	0	1	2	2
80.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81.	0	0	0	0	0	0	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4
82.	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
84.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
85.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
88.	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	10	0	0	0	0	0	0
89.	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
90.	0	0	0	0	0	0	0	0	0	0	0	0	4	0	5	0	4	1	0	0	2	12	0
91.	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	10	0	0	0	0	0	0
92.	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	1	0	0	0	0	4	0
93.	26	5	4	21	5	1	0	0	0	2	9	4	20	6	20	14	6	0	0	0	1	8	0
94.	0	0	2	15	0	1	4	2	0	0	2	0	0	2	2	2	4	0	1	3	0	17	2
95.	31	0	3	18	4	1	30	6	4	0	10	0	20	7	0	15	25	2	0	0	3	3	7
96.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	19
97.	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	1	1	0	2	11	0	21	0
98.	3	0	0	1	0	0	4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	5
99.	0	0	0	4	0	0	13	1	0	0	2	0	0	0	5	6	0	0	0	0	0	4	6
100.	0	0	0	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
101.	0	0	0	5	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	9
102.	0	0	0	0	0	0	0	0	0	0	0	0	7	0	4	0	0	0	0	0	0	17	0
103.	0	2	5	2	0	0	6	0	0	0	0	4	4	0	7	11	13	0	0	0	0	15	11
104.	0	0	0	6	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105.	13	0	0	0	0	0	14	3	1	0	0	0	7	0	4	5	11	0	0	0	0	13	2
106.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
107.	2	6	0	10	5	3	3	6	0	1	21	0	26	4	15	6	3	1	0	0	0	13	9
108.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0
110.	0	0	0	0	0	0	4	0	0	0	2	0	0	0	5	0	0	0	0	0	0	2	0

TABLE 25 (cont'd)

	7-14-01 3-3	7-14-01 4-3	7-14-01 4-4	7-14-01 6-3	7-14-01 10-1	7-14-01 13-2	7-14-01 13-3	7-14-01 13-5	7-15-01 1-1	7-15-01 1-2	7-15-01 1-3	7-15-01 2-1	7-15-01 2-2	7-15 01 3-1	7-15-01 3-2	7-15-01 4-1	7-15-01 5-1	7-15-01 6-2	7-15-01 6-4	7-15-01 6-5	7-15-01 6-6	7-15-01 6-7	7-15-01 6-8	7-16-01 1-1	7-16-01 1-10	7-16-01 1-12	7-16-01 1-13
56.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
58.	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
61.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
62.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63.	0	0	0	0	0	0	0	12	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	17	0	0
64.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
65.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
66.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	5
67.	0	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
68.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
69.	0	0	6	0	7	0	0	2	7	0	0	0	0	0	4	0	0	0	0	0	0	0	0	2	7	0	0
70.	0	0	0	0	0	0	13	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
71.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
72.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
74.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
75.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
76.	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0
77.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79.	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	2	1	0	0
80.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
82.	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	5	0	0
83.	0	1	2	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
84.	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
85.	0	0	6	0	11	0	10	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
86.	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
87.	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88.	0	0	0	0	11	0	0	4	4	0	0	0	0	0	2	0	2	0	0	3	0	0	0	0	5	0	0
89.	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	5	0
90.	0	0	0	0	1	0	0	0	0	0	0	2	0	0	1	0	2	1	0	4	0	0	12	2	2	4	0
91.	0	0	13	0	0	0	6	0	0	0	1	14	1	1	0	0	0	5	0	0	0	0	0	0	0	0	0
92.	0	0	1	0	5	0	7	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	5	10	0	2
93.	1	1	2	0	0	0	0	0	2	0	0	15	4	2	11	0	9	7	4	4	0	0	0	5	0	2	0
94.	0	1	9	1	0	2	4	5	2	0	0	2	0	1	0	0	2	0	2	3	0	0	0	5	0	12	2
95.	0	1	25	5	30	1	16	64	6	0	0	4	0	3	18	0	0	1	6	0	0	0	0	27	32	29	0
96.	0	1	0	0	0	0	2	5	4	0	0	4	0	0	10	0	0	0	0	2	0	0	0	3	3	0	0
97.	1	0	31	0	9	1	0	5	0	0	0	6	2	0	7	0	0	0	0	0	0	0	0	0	1	0	4
98.	0	0	0	0	2	0	0	0	2	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	2	2
99.	0	0	0	0	2	0	0	4	0	0	0	4	0	0	0	0	1	0	0	0	0	0	1	3	0	5	0
100.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
101.	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	0	2	0	0	0	0	0	1	4	3	3	0
102.	0	0	1	0	7	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0
103.	1	0	0	0	12	0	4	4	0	0	0	4	0	0	3	0	0	0	5	6	0	0	0	10	0	5	0
104.	0	0	4	0	1	0	0	2	0	0	0	6	0	0	4	0	1	0	0	0	0	0	0	0	3	0	0
105.	1	2	2	0	0	1	4	4	0	0	0	6	2	0	3	0	11	0	1	0	0	0	1	12	2	10	0
106.	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0
107.	0	0	21	0	53	3	17	0	9	4	0	0	4	0	6	0	4	0	0	0	0	0	0	6	9	10	12
108.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
109.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	0
110.	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	1	0

TABLE 25 (cont'd)

	Q3B-2	Q3B-3	Q3B-6	Q3B-7	Q3B-8	Q3B-9	Q3B-11	Q3B-12	Q3B-13	Q3B-14	Q3-1	Q3-2	Q3-3	Q3-8	Q3-9	Q3-11	Q3-12	Q3-14	Q3-15	Q3-16	Q3-18	Q3-22	Q3-23	Q3-24	Q3-26b	Q3-28	Q4-1	Q4-3	Q4-4	Q4-5	Q4-6	Q4-7	Q4-9	Q4-11	Q4-12	Q4-13	Q4-15	Q4-16	Q4-18	Q4-21	Q4-22	Q4-23	Q4-25	Q4-26	Q4-27	Q4-28
111.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	12	0	2	0	0	3	2	0	1	0	6	0	0	0	16	0	0	0	0	1	0	0	0	0	6	0	0	7	7	9
112.	0	0	0	0	0	0	1	1	0	0	0	0	0	3	0	0	0	0	0	0	0	4	12	0	0	0	2	0	0	0	0	0	0	0	0	6	0	0	0	0	9	0	4	0	2	0
113.	0	0	0	0	0	1	0	0	0	0	1	0	10	0	0	2	14	0	0	0	0	4	16	2	15	0	2	0	0	0	12	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
114.	0	0	0	0	0	0	1	0	2	0	0	0	2	7	4	0	6	0	0	0	0	0	0	0	6	0	0	0	0	0	4	0	0	0	0	3	0	0	0	0	0	0	4	0	21	1
115.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
116.	4	0	0	10	0	4	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	5	10	4	1	3	2	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	6	0	5	2
117.	12	2	0	0	2	14	2	2	2	0	3	0	0	0	0	6	0	0	0	0	0	10	11	1	2	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	6	10	0	1	0
118.	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	2
120.	0	0	0	0	0	0	0	0	0	0	0	0	9	0	1	0	0	0	0	0	0	0	0	27	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
121.	2	0	0	4	2	0	3	0	0	4	0	0	4	0	7	0	0	0	1	0	0	0	2	13	0	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
122.	4	0	0	0	0	0	4	0	2	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	4	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	1
123.	0	2	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125.	0	1	1	6	0	0	0	2	6	0	4	0	0	0	3	2	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	4	2
126.	10	0	4	6	4	4	2	2	0	0	0	19	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	4	11	2	0	0	0
127.	24	10	12	4	6	0	6	0	0	0	0	10	0	0	0	0	0	0	0	0	0	2	0	0	0	4	13	0	0	0	11	6	0	0	0	6	0	0	0	0	3	1	0	0	5	0
128.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
129.	0	21	7	0	6	10	2	0	6	0	21	17	2	16	10	0	19	23	20	12	0	23	0	0	0	11	10	0	0	0	11	19	0	0	0	0	0	0	0	0	26	37	0	1	4	3
130.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	16	0	0	0	0	0	2	1	0	0	0
131.	0	0	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	4	0	0	0	5	0	0	0	0	1	0	0	0	0	0
132.	36	26	34	21	20	21	13	0	22	3	24	24	4	0	3	3	0	0	0	0	0	22	7	19	17	21	10	17	4	0	20	13	2	0	0	3	0	0	0	0	0	3	14	0	3	0
133.	6	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	6	4	0	0	0	1	0	0	0	0	0	0	2	0	0	0
134.	0	0	0	0	0	0	0	0	0	0	0	0	0	9	17	0	2	10	0	12	0	0	0	0	2	3	0	0	0	1	3	1	0	0	0	3	0	0	0	0	1	1	2	0	1	5
135.	0	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	16	0	0	0	0	0
136.	0	0	0	0	0	0	0	2	0	0	0	4	0	0	4	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	17	0	0	0	0	0	0	0	0	0	4	0	0	0	0	2
137.	0	0	0	0	0	1	0	0	1	0	0	0	0	5	0	0	0	0	0	0	0	4	0	0	0	2	3	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
138.	0	0	0	0	0	1	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4	7	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	0	1	3
139.	0	0	0	0	0	1	1	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	2	2	0	0	0	0	0	1	4	0	0	0	6	0	0	0	0	1	0	4	0	1	0
140.	4	0	0	1	4	0	0	0	1	0	0	4	0	0	0	4	0	0	0	0	0	2	0	2	2	2	4	0	0	0	0	1	2	0	0	3	0	0	0	0	0	0	0	0	0	0
141.	0	0	0	0	0	6	4	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	3	0	6	0	2	2
142.	0	0	0	0	0	2	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6	0	6	0	0	0
143.	0	0	0	0	0	4	6	2	1	0	0	0	0	0	0	0	0	0	6	0	0	21	0	0	2	2	1	0	0	0	1	1	0	0	0	10	0	0	0	0	6	0	0	0	1	2
144.	0	0	0	0	0	0	2	2	0	0	0	0	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	4	0	2	0	0	0
145.	0	0	0	0	0	2	0	0	9	0	0	12	2	19	0	2	0	2	0	1	0	6	4	13	10	9	14	5	3	0	27	21	0	0	0	4	0	0	0	0	27	6	0	0	7	9
146.	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
147.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
148.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0
149.	0	12	0	0	0	6	7	9	2	0	12	11	0	0	16	0	0	0	1	0	0	0	0	2	2	0	0	0	0	0	2	2	0	0	0	2	0	0	0	0	1	0	0	0	0	1
150.	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	1	0	10	0	2	1
151.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	1	1	0	0	0	0	0	6	12	0	0	0	0	0	0	0	0	4	0	0	0	4	0
152.	22	14	14	8	14	10	16	15	12	10	17	13	2	3	0	6	2	4	0	0	0	14	0	21	23	2	14	1	2	0	23	34	4	0	0	9	0	0	0	0	13	0	15	0	5	0
153.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
154.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
155.	6	6	12	7	0	13	0	11	13	0	4	11	0	0	11	0	0	0	1	0	0	4	2	4	4	1	7	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	2	0	4	0
156.	0	6	6	11	10	9	0	3	0	1	4	1	0	2	0	0	0	0	0	0	0	21	0	13	16	7	0	0	0	0	6	3	0	0	0	1	0	0	0	0	6	0	0	0	0	0
157.	0	4	10	0	0	10	0	0	3	0	0	4	0	0	12	0	0	0	1	0	0	19	0	4	3	16	11	0	0	0	4	2	0	0	0	5	0	0	0	0	3	0	0	0	2	2
158.	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	7	0	0	0	3	0	0	0	0	5	1	2	0	3	0
159.	0	0	0	0	0	10	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	7	4	3	2	7	4	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
160.	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161.	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0
162.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	5	0	6	0	0	0	0	0	6	12	0	0	0	2	0	0	0	0	0	0	0	1	6	4
163.	0	0	4	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	5	0	0	10	0	0	0	2	2	0	0	0	2	3	0	0	0	2	0	0	0	0	4	0	2	0	0	0
164.	0	4	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	2	0	0	0	0	1	0	6	0	0	0
165.	0	0	0	0	0	6	0	2	0	0	3	4	0	5	7	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0

TABLE 25 (cont'd)

	G4-29	G5-1	G5-2	G5-3	G5-6	G5-7	G5-8	G5-15	G5-16	G5-17a	G5-18	G5-30	G5a-0	G5a-1	G5a-2	G5a-4	G5a-5	G5a-6	G5a-7	G5a-8	G5a-13	G5a-16	G5a-18	G5a-21	G5a-22	G5a-23	G6-3	G6-4	G6-5	G6-6	G6-14	G6-30	G7-1	G7-2	G7-4	G7-6	G7-18	G7-20	G7-23	G7-28	G7-29	G8-1	G8-2	G8-3	G8-4	G8-5
111.	10	28	13	13	11	5	4	0	3	11	10	7	0	4	1	1	0	0	0	4	0	0	23	0	6	7	4	0	0	0	0	4	0	0	0	0	7	2	0	0	0	0	0	0	14	0
112.	0	8	6	0	4	4	0	0	0	0	0	0	7	2	1	0	0	0	0	7	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
113.	0	60	34	4	13	0	12	0	7	0	11	10	11	2	6	11	0	4	4	0	5	0	0	0	2	6	0	10	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	6	0	0
114.	2	15	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	14	0	0	0	0	0	0	1	12	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	3	2	6
115.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
116.	5	7	14	0	0	0	0	0	0	0	0	0	6	10	3	4	7	11	0	0	0	0	0	4	0	1	0	0	0	0	3	4	0	1	0	0	0	6	0	0	9	3	0	7	2	4
117.	1	6	10	4	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5	0	9	5	4
118.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
120.	0	0	0	2	0	0	0	0	0	0	7	14	0	0	0	0	0	0	0	0	0	0	0	0	4	12	0	0	0	0	5	5	0	17	0	0	0	19	0	0	0	0	0	0	0	0
121.	0	0	4	0	2	2	0	2	0	0	13	7	2	0	0	0	0	2	0	0	0	0	5	0	0	0	1	21	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122.	2	1	0	2	4	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0
123.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124.	0	0	0	0	0	0	0	11	0	0	0	13	0	3	0	0	0	0	0	0	0	0	0	0	4	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125.	0	10	0	0	4	5	6	0	0	0	0	1	0	0	0	0	0	6	0	2	2	0	0	0	10	11	5	0	0	0	0	1	3	9	0	0	0	8	0	0	0	3	0	0	0	0
126.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127.	0	4	0	0	0	0	0	0	0	0	0	0	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
129.	6	11	16	14	0	0	0	0	5	3	3	5	0	2	7	0	10	3	0	0	4	7	0	3	14	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	26	16	0	0	0	34
130.	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
131.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
132.	9	1	0	7	0	0	0	0	0	3	6	3	19	14	0	7	9	15	12	12	3	6	0	0	15	0	0	1	0	0	0	0	5	0	0	0	2	0	2	0	4	11	20	3	1	2
133.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134.	9	12	2	0	13	0	6	4	1	0	0	9	2	4	2	11	0	5	0	2	3	2	0	0	6	2	4	4	0	0	0	0	1	2	0	0	0	0	0	0	0	2	0	2	5	6
135.	0	5	2	6	0	0	0	0	0	0	0	2	0	10	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	6	0	0
136.	0	0	7	2	0	0	0	0	0	0	0	5	0	0	6	3	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	16	0	0
137.	6	4	6	3	0	0	0	4	0	0	0	0	0	1	2	1	0	10	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	5	0	0
138.	0	6	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
139.	0	0	17	2	4	6	0	0	0	4	0	2	0	0	1	5	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0
140.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	1	2	0	5	0	0	1	2	5	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
141.	4	6	4	6	0	0	0	0	0	0	0	0	7	1	5	1	4	2	4	5	0	0	0	0	0	1	4	6	0	0	0	0	4	5	0	0	0	7	0	0	0	0	0	0	0	0
142.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143.	1	0	0	4	0	0	9	0	0	0	0	5	1	0	1	3	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
144.	4	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
145.	15	14	18	11	16	19	22	3	0	3	15	19	23	6	17	34	2	2	0	7	4	4	0	0	11	0	1	0	0	0	0	0	6	5	0	0	0	0	0	0	0	19	0	0	0	0
146.	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147.	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
148.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149.	6	2	21	4	0	0	6	0	0	0	0	10	2	0	6	4	2	16	9	2	0	0	0	0	2	2	2	0	0	0	2	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0
150.	1	0	0	0	0	0	0	0	0	0	0	2	6	4	0	0	6	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
151.	3	2	1	2	0	0	0	0	0	0	0	4	1	10	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152.	18	20	13	17	0	10	12	0	6	7	6	10	9	11	23	21	19	26	7	0	0	10	17	8	11	12	15	6	0	9	11	2	6	6	0	0	3	12	0	4	0	9	2	9	16	0
153.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
154.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155.	10	4	4	9	0	0	2	7	0	0	0	7	12	0	6	7	6	4	3	6	1	0	0	0	18	4	1	0	0	0	0	2	4	1	0	0	0	0	1	0	7	3	6	0	0	0
156.	0	1	7	0	0	0	0	5	0	0	0	3	11	12	2	1	0	0	0	1	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	2	3	0	0	0	0	1	0	0
157.	0	0	1	0	0	0	0	4	0	0	0	1	17	11	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158.	3	0	0	0	0	0	0	0	0	0	0	17	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
159.	0	0	0	0	0	2	4	0	2	2	0	2	6	2	8	1	2	7	0	13	0	0	0	0	0	4	3	0	0	0	8	6	2	1	0	0	0	0	0	0	0	4	0	0	0	2
160.	0	0	0	5	0	0	0	0	0	0	0	2	2	4	1	0	0	2	0	7	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161.	4	9	6	2	0	0	1	0	0	0	0	6	12	11	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
162.	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163.	4	2	1	0	0	0	4	0	0	0	0	3	5	9	0	9	6	3	3	8	0	1	0	0	2	2	1	6	0	8	5	2	0	2	0	0	0	0	0	0	0	1	0	0	0	8
164.	0	0	2	2	0	4	8	0	1	0	0	2	2	4	0	0	3	4	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	8	0	0	0	6	0	0	0	0	8	0	4	0
165.	0	0	0	0	0	0	12	0	6	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	8	0	0	9	0	0	0	1	6	7	0	0	0	0	0	0	0	1	0	0	0	0

TABLE 25 (cont'd)

	Q8-6	Q8-7	Q8-8	Q8-10	Q8-11	Q8-15	Q8-18	Q8-20	Q8-21	Q9-1	Q9-3	Q9-5	Q9-6	Q9-8	Q9-11	Q10B-1	Q10B-2	Q10B-3	Q10B-4	Q10B-5	Q10B-14	Q10B-19	Q11-1	Q11-2	Q11-3	Q11-6	Q11-7	Q11-10	Q11-12	Q11-14	Q11-15	Q11-16	Q12-2	Q12-5	Q12-6	Q12-7	Q12-11	Q12-12	Q12-13	Q12-14	Q13-1	Q13-8	Q13-9	Q13-12	7-14-01 1-2	7-14-01 3-2
111.	7	0	0	1	0	32	5	0	11	0	0	4	3	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	24	0	0	0	17	3	0	0	0	0	0	21	0
112.	0	0	0	6	0	6	0	4	0	2	0	4	2	0	0	2	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	1	0	0	0	0	4	0
113.	4	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	15	4	2	0	0	14	0	5	0	0	0	0	0	2	2	0	0	6	2	0	0	3	0	2	0	0	0	0	2	0
114.	2	0	0	8	2	4	0	0	0	0	0	0	0	13	0	0	3	6	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6	0	0	0	0	0	0	1	0
115.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
116.	0	0	0	0	0	0	2	0	6	2	2	0	0	5	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	2	5	0	0	0	0	2	0
117.	0	0	0	0	0	0	13	0	0	0	0	0	0	2	0	5	0	0	0	0	11	0	0	0	0	0	0	0	0	10	0	0	0	6	0	0	0	6	0	2	0	0	0	0	4	0
118.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	6	0	0	0	0	0	0
119.	0	0	0	0	0	0	2	0	0	0	0	0	0	9	0	2	2	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
120.	0	0	0	0	0	0	5	0	0	0	0	0	0	0	3	4	0	0	0	0	2	6	0	2	2	0	0	0	0	0	0	3	0	1	0	2	0	2	0	10	0	0	0	0	0	0
121.	0	0	0	0	0	0	0	0	0	5	2	4	0	0	3	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7	0	0	0	0	0	0
122.	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
123.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	8	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124.	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0	7	0	0	0	0	0	4	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2	2
125.	0	0	11	2	0	0	0	0	2	0	2	11	2	0	0	0	9	0	0	0	0	3	0	5	0	0	0	0	0	7	0	2	0	0	0	2	0	2	1	11	0	0	0	0	0	0
126.	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
127.	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
128.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
129.	2	42	4	6	0	0	0	4	4	3	6	63	0	0	0	16	0	0	0	0	2	0	0	7	0	0	3	0	0	6	0	0	0	0	4	0	0	4	0	2	0	2	1	0	4	0
130.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
131.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132.	2	2	9	0	1	0	0	12	19	0	0	17	0	2	5	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	17	11	0	2	1	0	0	0	0	0	0	13	0
133.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
134.	0	9	0	1	0	0	0	0	0	2	5	0	0	11	9	0	0	2	0	0	1	15	0	0	0	0	3	0	0	6	5	1	0	0	0	0	0	0	6	1	0	0	0	0	4	0
135.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	9	1	0	0	0	2	3	0	0	0	0	0	0	13	1	5	0	0	0	0	0	0	13	0	0	0	0	0	0	0
136.	6	0	6	0	5	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	4	3	0	0	4	3	0	0	4	24	0	0	0	0	0	0	0
137.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0
138.	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
139.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
140.	0	0	12	0	0	0	0	3	4	1	5	0	0	0	0	0	0	0	0	0	0	7	0	5	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
141.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	7	0
142.	0	0	0	0	0	0	0	0	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	11	0	0	0	0	0	0	0	0	0	13	2	2	0	0	0	0	0	0
143.	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
144.	0	0	0	0	0	2	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	5	17	1	0	0	0	12	3
145.	0	0	0	0	7	0	0	0	0	3	12	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	23	0	0	0	0	9	0	0	0	0	0	7	0
146.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
147.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
148.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149.	0	0	2	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	11	1	0	0	0	0	0	0	0
150.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	4	0	0	0	0	0	0
151.	0	0	0	0	0	0	0	6	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
152.	1	36	15	0	0	0	0	25	43	11	11	16	7	17	9	4	5	0	0	0	7	14	0	9	0	0	0	0	0	8	0	0	0	13	0	3	2	9	20	19	0	0	0	0	0	15
153.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
154.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
155.	0	5	0	0	0	0	0	1	23	0	2	0	1	5	0	14	0	0	0	5	2	0	0	3	0	0	0	0	0	9	0	1	0	2	2	3	0	2	0	4	0	0	0	0	0	1
156.	0	2	0	0	1	0	0	31	9	0	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	14	8	0	0	0	0	1	0	0	0	0	2	0
157.	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0	1	0	0	0	0	9	0
158.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	4	0	0	0	0	0	0
159.	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	1	0	0	0	0	0	14	0	5	0	0	0	6	0	0	0	0	0	2	2	0	0	13	2	7	0	0	0	0	0	0
160.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161.	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	11	1	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	2
162.	0	0	0	0	0	0	0	0	2	0	0	6	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
163.	0	0	2	0	0	0	3	0	4	0	1	0	0	4	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
164.	0	0	8	0	0	0	0	0	21	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	2	0
165.	0	13	12	4	2	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	2	7	0	0	0	0	0	0

TABLE 25 (cont'd)

	7-14-01 3-3	7-14-01 4-3	7-14-01 4-4	7-14-01 6-3	7-14-01 10-1	7-14-01 13-2	7-14-01 13-3	7-14-01 13-5	7-15-01 1-1	7-15-01 1-2	7-15-01 1-3	7-15-01 2-1	7-15-01 2-2	7-15-01 3-1	7-15-01 3-2	7-15-01 4-1	7-15-01 5-1	7-15-01 6-2	7-15-01 6-4	7-15-01 6-5	7-15-01 6-6	7-15-01 6-7	7-15-01 6-8	7-16-01 1-1	1-16-01 1-10	7-16-01 1-12	7-16-01 1-13
111.	0	0	17	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0
112.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	10	0	0	7	2	17	0
113.	0	0	25	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
114.	1	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	0	10	0	3	0
115.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
116.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	12	0
117.	0	0	9	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	2	0
118.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0
119.	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0
120.	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
121.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
122.	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
123.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124.	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0
125.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	0	0	7	0	0	0	0	0	0	0
126.	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127.	0	1	0	0	14	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
129.	0	0	0	0	0	6	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0
130.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
131.	0	0	10	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0
132.	0	0	0	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	12	0	6	0
133.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134.	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	2	0	0	0	0	0	0	0	6	2	0
135.	0	0	12	0	0	0	0	0	0	0	0	2	0	0	4	0	0	0	0	17	0	0	0	4	0	0	0
136.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	4	0	0
137.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	11	0	4
138.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
139.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	3	0	0
140.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0
141.	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	9	0	0	0	4	0	0	0
142.	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	1	1	0	0
143.	0	0	0	0	11	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
144.	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	4	2	2	0	0	0	6	6	0	0
145.	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	7	0
146.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147.	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
148.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149.	1	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0
150.	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
151.	0	0	0	0	11	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
152.	0	0	0	0	15	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	9	12	13	0
153.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
154.	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
155.	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
156.	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1	7	0
157.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
158.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2
159.	0	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
160.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
161.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	1	0
162.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
163.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
164.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165.	1	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	5	0	0

TABLE 25 (cont'd)

	Q[illegible]-2	Q[illegible]-3	Q[illegible]-4	Q[illegible]-7	Q[illegible]-8	Q[illegible]-9	Q[illegible]-11	Q[illegible]-12	Q[illegible]-13	Q[illegible]-14	Q3-1	Q3-2
166.	0	0	4	0	4	1	4	2	4	0	0	1
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	0	0	0	0	0	2	12	10	13	15	0	4
169.	0	1	2	0	0	11	0	0	0	0	0	0
170.	0	0	0	0	0	1	0	0	0	0	0	2
171.	0	0	0	0	0	0	0	0	0	0	0	0
172.	10	12	11	0	15	15	14	11	17	5	2	5
173.	12	6	10	0	2	0	11	7	3	2	5	12
174.	16	0	10	26	34	0	5	6	10	4	5	22
175.	11	17	67	57	31	50	47	13	15	26	4	39

	Q3-3	Q3-8	Q3-9	Q3-11	Q3-12	Q3-14	Q3-15	Q3-16	Q3-18	Q3-22	Q3-23	Q3-24
166.	2	3	3	0	0	2	0	0	0	10	0	2
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	10	0	5	0	17	4	0	9	0	0	0	1
169.	0	0	0	0	2	0	2	0	0	2	0	0
170.	3	0	0	0	0	0	0	0	0	0	0	0
171.	0	0	0	0	0	0	0	5	0	0	0	0
172.	9	0	6	14	0	0	1	0	0	5	6	4
173.	25	3	0	6	12	0	0	2	0	0	1	17
174.	42	5	7	12	0	0	34	15	0	20	0	16
175.	60	8	4	22	4	16	1	0	1	1	0	0

	Q3-26a	Q3-28	Q4-1	Q4-3	Q4-4	Q4-5	Q4-6	Q4-7	Q4-8	Q4-11	Q4-12	Q4-13
166.	2	13	0	0	0	0	4	4	0	0	0	2
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	3	1	4	27	0	0	3	4	3	9	0	14
169.	0	0	2	0	0	0	0	0	0	0	0	0
170.	0	0	10	17	4	0	28	13	2	0	0	15
171.	0	0	0	0	0	0	0	0	0	0	3	0
172.	30	27	51	2	0	0	9	16	0	2	0	2
173.	13	4	7	2	0	0	2	9	0	0	2	2
174.	5	23	0	15	0	0	0	21	32	0	0	0
175.	46	3	20	2	16	1	0	13	1	13	9	23

	Q4-15	Q4-16	Q4-18	Q4-21	Q4-22	Q4-23	Q4-25	Q4-26	Q4-27	Q4-28
166.	0	0	0	0	0	0	10	0	2	0
167.	0	0	0	0	0	0	0	0	2	0
168.	0	0	0	0	13	18	2	0	11	4
169.	1	0	0	0	0	0	0	0	0	0
170.	0	0	0	0	15	0	1	0	0	4
171.	0	0	0	0	0	0	0	0	0	0
172.	0	11	0	0	0	3	7	2	0	12
173.	0	0	0	0	0	0	18	0	12	5
174.	0	0	0	0	0	21	17	33	0	13
175.	2	2	2	2	62	0	61	2	39	11

	Q4-30	Q[illegible]-1	Q[illegible]-2	Q[illegible]-3	Q[illegible]-4	Q[illegible]-7	Q[illegible]-8	Q[illegible]-15	Q[illegible]-16	Q[illegible]-17a	Q[illegible]-18	Q[illegible]-20
166.	0	1	1	0	0	0	4	0	2	0	0	0
167.	0	0	0	11	0	0	0	0	0	0	0	0
168.	0	10	10	15	11	4	0	0	5	17	9	2
169.	2	0	0	4	0	4	0	0	0	0	0	2
170.	0	0	0	3	0	0	4	0	0	0	0	2
171.	0	0	0	0	0	0	0	0	0	0	0	0
172.	0	5	19	28	25	47	3	25	0	9	12	2
173.	4	2	10	2	6	3	9	2	15	2	5	11
174.	14	26	34	26	20	16	20	2	27	19	0	0
175.	37	6	0	72	38	0	42	34	2	0	16	25

	Q[illegible]-30	Q[illegible]-1	Q[illegible]-2	Q[illegible]-4	Q[illegible]-5	Q[illegible]-6	Q[illegible]-7	Q[illegible]-8	Q[illegible]-13	Q[illegible]-16	Q[illegible]-18	Q[illegible]-21
166.	0	7	1	2	3	4	0	4	0	0	0	0
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	1	0	0	0	0	0	0	0	0	0	0	0
169.	3	2	0	13	14	10	9	0	14	19	4	0
170.	13	0	0	0	5	0	0	0	0	1	0	0
171.	0	0	0	0	0	0	0	0	0	0	1	0
172.	14	34	21	3	0	0	14	0	0	5	9	0
173.	3	3	0	0	2	4	7	2	5	2	0	0
174.	0	22	21	0	23	6	0	12	7	0	18	0
175.	34	12	43	50	31	49	31	57	6	15	12	0

	Q[illegible]-22	Q[illegible]-23	Q6-1	Q6-4	Q6-5	Q6-6	Q6-14	Q6-20	Q7-1	Q7-2	Q7-4	Q7-6
166.	0	0	0	0	0	0	0	0	0	0	0	0
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	0	0	0	0	0	0	0	2	11	0	0	0
169.	4	5	30	19	33	24	0	16	20	0	0	0
170.	0	0	0	0	0	0	0	2	3	0	0	0
171.	0	0	6	0	0	0	0	0	1	4	0	0
172.	2	2	7	6	6	2	0	4	10	0	4	2
173.	3	14	28	17	4	2	0	7	9	7	0	0
174.	10	0	2	27	22	0	0	40	21	22	17	0
175.	2	0	27	20	20	9	11	24	4	53	6	3

	Q7-10	Q7-20	Q7-23	Q7-28	Q7-29	Q8-1	Q8-2	Q8-3	Q8-4	Q8-5
166.	0	0	0	0	0	0	0	0	0	0
167.	0	0	0	0	0	0	0	0	0	0
168.	0	0	0	0	0	0	0	0	0	0
169.	0	51	0	9	0	33	21	23	0	0
170.	0	0	0	4	0	0	0	0	0	0
171.	0	0	0	0	0	0	0	0	0	0
172.	0	0	13	2	0	3	0	0	10	6
173.	0	15	0	3	4	7	4	5	4	0
174.	0	0	0	0	0	0	1	21	0	0
175.	9	30	3	12	0	47	24	19	0	3

	Q[illegible]-6	Q[illegible]-7	Q[illegible]-8	Q[illegible]-10	Q[illegible]-11	Q[illegible]-15	Q[illegible]-18	Q[illegible]-20	Q[illegible]-21	Q[illegible]-1	Q[illegible]-2	Q[illegible]-3
166.	2	0	0	0	0	3	0	0	0	6	4	4
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	0	0	31	0	5	0	2	10	0	10	4	4
169.	0	0	0	2	0	0	0	0	0	5	3	0
170.	0	0	0	0	0	0	0	0	0	0	0	0
171.	0	0	0	0	1	0	0	0	0	0	0	0
172.	7	9	4	10	4	0	5	7	16	0	0	25
173.	2	1	32	12	6	4	9	19	8	15	0	2
174.	0	24	11	0	37	0	9	11	0	15	20	22
175.	40	24	31	21	17	41	7	24	28	34	20	33

	Q[illegible]-4	Q[illegible]-8	Q[illegible]-11	Q10-1	Q10-2	Q10-3	Q10-4	Q10-5	Q10-14	Q10-19	Q11-1	Q11-2
166.	2	0	0	2	0	0	0	0	0	0	0	0
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	30	0	0	2	1	0	0	0	12	0	0	10
169.	1	0	0	0	6	0	0	0	0	0	0	0
170.	0	0	0	0	2	0	0	0	0	0	0	0
171.	0	0	0	0	0	0	0	0	0	0	0	2
172.	4	0	20	0	1	0	0	0	0	0	0	0
173.	5	13	2	4	9	2	3	3	2	4	0	17
174.	26	0	26	14	103	16	0	0	0	0	44	11
175.	26	3	10	10	11	0	0	0	7	22	0	5

	Q11-3	Q11-4	Q11-7	Q11-10	Q11-12	Q11-14	Q11-15	Q11-16	Q12-2	Q12-3	Q12-4	Q12-7
166.	0	0	0	0	0	2	0	0	0	0	0	0
167.	0	0	0	0	0	0	0	0	0	0	0	0
168.	6	0	11	7	0	0	0	0	0	0	0	0
169.	0	0	0	0	0	6	0	0	0	0	0	0
170.	0	0	0	0	0	3	0	0	0	0	0	0
171.	0	0	0	0	0	2	0	0	0	0	0	0
172.	0	0	2	4	0	0	0	0	0	0	2	2
173.	0	3	14	0	0	0	0	0	0	0	0	16
174.	0	13	3	2	10	0	0	0	0	0	0	23
175.	0	0	4	1	0	17	3	0	0	23	0	25

	Q12-11	Q12-12	Q12-13	Q12-14	Q13-1	Q13-8	Q13-9	Q13-12	7-14-Q1 1-2	7-14-Q1 3-2
166.	0	0	0	0	0	0	0	0	7	0
167.	0	0	0	0	0	0	0	0	0	0
168.	0	0	0	15	0	0	0	3	1	17
169.	0	0	0	2	0	0	0	0	0	0
170.	0	0	7	0	0	0	0	0	0	0
171.	0	0	0	1	0	0	0	0	0	3
172.	0	4	1	1	0	0	0	0	0	0
173.	5	2	0	21	1	1	3	0	0	0
174.	19	0	0	0	9	5	0	5	0	0
175.	2	26	7	53	0	0	0	0	1	11

	7-14-Q1 3-3	7-14-Q1 4-3	7-14-Q1 4-4	7-14-Q1 6-3	7-14-Q1 10-1	7-14-Q1 12-2	7-14-Q1 12-3	7-14-Q1 13-5	7-15-Q1 1-1	7-15-Q1 1-2	7-15-Q1 1-3	7-15-Q1 2-1	7-15-Q1 2-2	7-15-Q1 3-1
166.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
167.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
168.	0	0	0	0	0	0	2	0	0	0	0	0	0	0
169.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
171.	0	0	0	0	0	0	0	0	6	0	9	0	2	0
172.	0	0	0	0	0	0	1	0	0	0	0	17	0	0
173.	0	0	4	1	28	0	23	23	12	1	6	4	7	21
174.	0	0	0	0	0	0	2	0	0	0	0	2	0	0
175.	0	2	28	0	31	0	26	30	3	1	0	15	14	2

	7-15-Q1 3-2	7-15-Q1 4-1	7-15-Q1 5-1	7-15-Q1 6-2	7-15-Q1 6-4	7-15-Q1 6-5	7-15-Q1 6-6	7-15-Q1 6-7	7-15-Q1 6-8	7-16-Q1 1-1	7-16-Q1 1-10	7-16-Q1 1-12	7-16-Q1 1-13
166.	0	0	0	0	0	0	0	0	0	0	0	9	0
167.	0	0	0	0	0	0	0	0	0	0	1	0	0
168.	0	0	0	0	0	0	0	0	2	0	0	0	0
169.	0	0	0	0	0	0	0	0	0	0	0	0	0
170.	0	0	0	0	0	0	0	0	0	3	0	0	0
171.	0	0	3	0	12	0	2	1	2	3	4	0	0
172.	12	0	2	0	0	7	0	0	0	7	15	3	19
173.	3	0	4	0	6	12	0	0	1	13	9	17	8
174.	4	0	6	0	3	0	0	0	0	2	1	2	0
175.	60	1	26	0	21	4	0	0	0	0	0	0	0

APPENDIX III: PLATE 1

THE TWENTY-FIVE MOST COMMON FERRON TAXA

PLATE 1

TWENTY-FIVE MOST COMMON FERRON TAXA

1. Schizosporis sp., 1000x. Slide Location: Q4-25 m2, 42.5 x 114.9.

2. Monosulcites sp., 1000x. Slide Location: 7-14-81 10-1 b, 41.5 x 124.6

3. Classopollis classoides, 1000x. Slide Location: Q4-25 m3, 38.6 x 126.6

4. Inaperturopollenites sp., 1000x. Slide Location: 7-14-81 10-1 a, 47.8 x 116.0

5. Eucommiidites sp., 1000x. Slide Location: Q4-25 m3, 34.8 x 113.4.

6. Cycadopites pseudolatus, 1000x. Slide Location: 7-14-81 10-1 a, 60.7 x 123.0.

7. Monusulcites minimus, 1000x. Slide Location: 7-14-81 10-1 b, 30.8 x 121.4.

8. Liliacidites inaequalis, 540x. Slide Location: 7-16-81 1-10 b, 36.3 x 114.1.

9. Tricolpites variabilis, 1000x. Slide Location: 47.8 x 126.0.

10. Nyssapollenites albertensis, 1000x. Slide Location: Q4-25 d, 28.3 x 125.7.

11. Tricolpopollenites sp. 3, 1000x. Slide Location: 7-16-81 1-10 d, 24.1 x 110.2.

12. Tricolpopollenites simplicissimus, 1000x. Slide Location: Q4-25 m3, 45.4 x 118.0.

13. Psilatricolpites parvulus, 1000x. Slide Location: Q4-25 m2. 43.4 x 117.7.

14. Cingulatisporites dakotensis, 1000x. Slide Location: 7-16-81 1-10 d, 47.5 x 121.0.

15. Stereisporites psilatus, 1000x. Slide Location: 7-16-81 1-10 d, 27.9 x 123.5.

16. Stereisporites antiquasporites, 1000x. Slide Location: 7-16-81 1-10 b, 26.8 x 120.4.

PLATE 1 (cont'd)

17. *Cicatricosisporites terminatus*, 540x. Slide Location: Q4-25 m2, 32.7 x 114.1

18. *Cicatricosisporites dorogensis*, 1000x. Slide Location: Q4-25 m3, 41.9 x 122.6.

19. *Laevigatosporites ovatus*, 1000x. Slide Location: Q4-25 m3, 39.5 x 119.2.

20. *Deltoidospora psilostoma*, 540x. Slide Location: 7-16-81 1-10 d, 31.8 x 111.5.

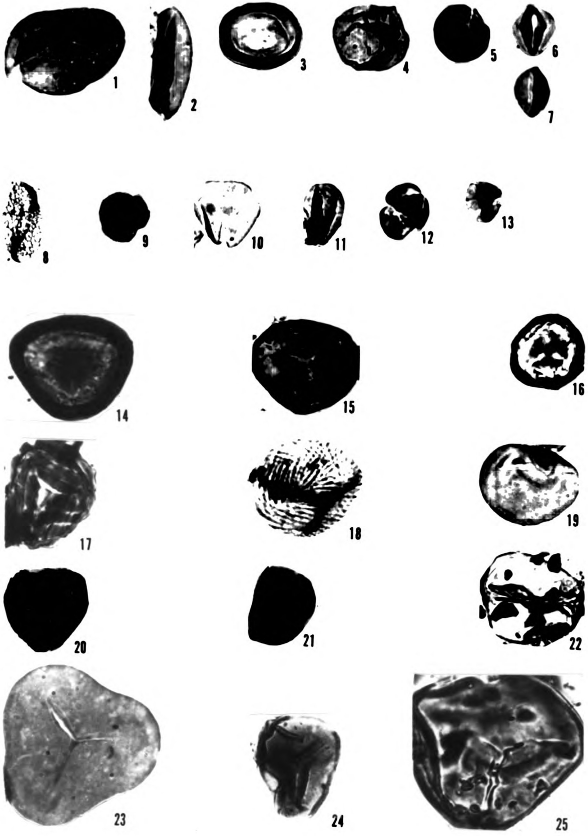
21. *Osmundacites wellmanii*, 540x. Slide Location: 7-16-81 d, 34.1 x 110.4.

22. *Triplanosporites sinuosus*, 1000x. Slide Location: 7-16-81 d, 34.1 x 110.4.

23. *Cyathidites minor*, 1000x. Slide Location: Q4-25 m2, 34.1 x 121.1.

24. *Matonisporites conspicuus*, 1000x. Slide Location: Q4-25 m2, 26.5 x 120.5.

25. *Todisporites major*, 1000x. Slide Location: Q4-25 a, 32.9 x 117.0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