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GEOLOGIC APPLICATIONS OF LATE PENNSYLVANIAN ICHTHYOLITHS
FROM THE MIDCONTINENT REGION

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

GEOLOGIC APPLICATIONS OF LATE PENNSYLVANIAN ICHTHYOLITHS FROM THE MIDCONTINENT REGION

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

By

LINDA ELAINE TWAY

Norman, Oklahoma

1982

GEOLOGIC APPLICATIONS OF LATE PENNSYLVANIAN ICHTHYOLITHS

FROM THE MIDCONTINENT REGION

APPROVED BY

DISSERTATION COMMITTEE

ABSTRACT

Ichthyoliths (microscopic fish skeletal debris comprised mainly of teeth, dermal denticles and mucous membrane denticles) are abundant and diverse in a wide range of lithologies and often occur in horizons which are otherwise unfossiliferous. However, very few studies have dealt with Late Paleozoic ichthyoliths due to the problems in identifying them. Through the use of a coded system of identification, I have been able to overcome these taxonomic problems and utilize ichthyoliths. This study was conducted to assess the applicability of Late Pennsylvanian ichthyoliths in geology by comparing their geographic and stratigraphic distributions with those of the conodonts from the Shawnee and Lansing groups.

Ichthyoliths from 16 localities extending from northern Oklahoma to Iowa were examined to determine their geographic and biostratigraphic distributions. Nearly 25,000 ichthyoliths comprising 156 different types were identified and used in the analyses. The results show that the distribution of ichthyoliths closely reflects that of conodonts in the Shawnee and Lansing groups. Different ichthyolith faunas were recovered from rock sequences of different ages, indicating a strong potential of ichthyoliths for biostratigraphic correlations. Initial studies to determine the reactions of ichthyoliths to thermal gradients show that they undergo

not only color changes but structural alterations as well. Their thermal changes suggest an important use of ichthyoliths for hydrocarbon exploration. The results of this study indicate that Late Paleozoic ichthyoliths can provide useful information regarding biostratigraphy, geographic variation and geothermometry.

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PREFACE

Several sections of this dissertation are being submitted for publication. The reader should note which figures I am referring to throughout the text. Appendix A consists of modifications to my earlier identification system (Tway, 1979a). It is part of a manuscript being submitted to Micropaleontology and has its own set of figures. Appendix B is divided into two parts, each of which is part of a manuscript being submitted to the Journal of Vertebrate Paleontology. These parts comprise a catalog of Late Pennsylvanian ichthyoliths and consist of diagnoses and photographs. References are not included in each of these appendices since it would be repetitious. They are given in the main text of the dissertation. The main text refers to the biostratigraphy and geographic variation of the ichthyoliths and will also be submitted for publication. The carbonization work is part of a separate, ongoing project. The initial work for this project has been included in the dissertation.

GEOLOGIC APPLICATIONS OF LATE PENNSYLVANIAN ICHTHYOLITHS FROM THE MIDCONTINENT REGION

INTRODUCTION

Ichthyoliths

General Characteristics

Ichthyoliths are disarticulated microscopic remains of fish. They consist mainly of teeth, shagreen denticles and mucous membrane denticles and are, in general, highly resistant to biological, physical and chemical destruction. Like conodonts, ichthyoliths are phosphatic and range in size from approximately 0.05 to 1mm (Lipps, 1981), although fish teeth and scales can, of course, reach much larger sizes. The major groups of fishes represented by the Late Paleozoic (Virgilian) ichthyoliths are the Chondrichthyes, Acanthodii and Osteichthyes (notably the palaeoniscoids). The osteichthyan remains include conical teeth with sharp, translucent tips (see, for example, Appendix B, Part II, Figs. 1 and 2) and various types of ganoid scales. These scales are typically rhomboid and flat with or without parallel grooves on the crown; in addition a raised keel may be present on the basal side of the element (see, for example, Appendix B, Part I, Figs. 47-50). Chondrichthyan remains include many different types of placoid scales (see, for example, Appendix B, Part

I, Figs.1 and 2) and various single- and multi-cusped teeth with broad bases (see, for example, Appendix B, Part II, Fig. 35). Acanthodians are represented mainly by thick, rhomboid to square scales (see, for example, Appendix B, Part I, Fig. 53). In my samples, the Chondrichthyan remains are by far the most morphologically diverse of the ichthyoliths whereas the palaeoniscoid remains are the most abundant.

Histology

Fish teeth and scales are very similar to other vertebrate hard tissues. The inorganic matrix is made up hydroxyapatite ($Ca_6[PO_4]_{10}[OH]_2$) which, in fossils, later converts to the more stable fluorapatite ($Ca_6[PO_4]_{10}[F]_2$) (Ørvig, 1967). The organization and ratio of the organic and inorganic material varies with the type of hard tissue of the tooth and scale and, indeed, there exists a wide spectrum of hard tissues in the fishes.

Enamel and Enamel-like Substances. True enamel is found in the higher vertebrates (Bhaskar, 1976) and is approximately 96% inorganic and only 4% organic and is consequently very hard. Enamel is ectodermally derived and its matrix is secreted by ameloblasts (Bhaskar, 1976). Because of its hardness, enamel forms a protective layer over other hard tissues. Enameloid is a surface tissue found in fish (Peyer, 1968). It is a very hard, shiny substance which is similar to true enamel, but differs in that it is mesodermally derived. It differs from dentin in that it is more inorganic and therefore much harder. It is believed that enameloid forms under the influence of ameloblasts which themselves do not secrete enamel matrix, but influence in some way the dentin of the odontoblasts so that they secrete enamoloid before secreting dentin (Peyer, 1968). Ganoin is a hard tissue which is also very shiny and hard, but differs from enameloid in that is does not necessarily form in close association with dentin nor with the epithelial tissues. It is also mesodermally derived and therefore cannot be considered a true enamel (Ørvig, 1967).

Dentin. Dentin makes up the bulk of the tooth and is softer than enamel, having an inorganic to organic ratio of 70:30. Dentin is mesectodermally derived and is secreted by odontoblasts. The organic matrix of dentin consists mainly of mucopolysaccharides and collagen fibers along which the apatite crystals align. There are several types of dentin (see Ørvig, 1967). Orthodentin (Ørvig, 1967; Peyer, 1968) is characterized by a very irregular arrangement of dentinal tubules which branch near the dentin surface. Modified dentin (Ørvig, 1967; Peyer, 1968) is harder than orthodentin, but cannot be considered true enamel because it is mesodermally derived. Like enameloid, modified dentin forms under the influence of the ameloblasts that cause the odontoblasts to secrete a modified dentin, which is characterized by having a more tangled or irregular network of dentinal tubules than does ordinary orthodentin. Orthovasodentin (Ørvig, 1967) is characterized by having several vascular canals in the dentinal matrix and fewer dentinal tubules. Vasodentin (Ørvig, 1967) is the extreme case of this condition, with extensive vascularization and no (or very few) dentinal tubules. Plicidentin

(Peyer, 1968) is characterized by the infolding of the orthodentin at the basal portion of the tooth. Trabecular dentin (Peyer, 1968) has many blood and lymphatic vessels passing through it. Dentin is deposited around the vascular canals containing the vessels and eventually forms denteons which look very similar to osteons in bone. Because of its similar appearance to bone, Ørvig (1967) calls this tissue osteodentin.

Calcified Tissues of Specific Groups. In general, osteichthyan teeth are characterized by an outer enamel layer, one or more types of dentin, and a central pulp cavity containing numerous nerves and blood vessels (Peyer, 1968). Scales of osteichthyans may be ganoid, cosmoid or secondarily reduced, bony scales of cycloid or ctenoid type. Ganoid scales consist of an outer enamel-like layer of ganoin, a middle dentin layer which is highly vascularized, and a basal layer of lamellar bone (isopedin) which is also highly vascularized (Moy-Thomas and Miles, 1971). With evolution, various groups tended to lose the middle dentin layer and eventually the outer ganoin layer, resulting in the cycloid type of scale which consists of a thin bony plate surrounded by a thin epidermal layer (Hildebrand, 1974). The ganoid and cycloid scales occur in the Actinopterygii. Cosmoid scales consist of an outer layer of cosmine which is made up of an outer shiny enameloid (much like ganoin) and an inner dentin layer with numerous pores and canals. Under the cosmine lies a layer of vascular bone and under this is an inner layer of lamellar bone or isopedin (Moy-Thomas and Miles, 1971). Cosmoid scales occur in the crossopterygians and dipnoans and, like ganoid scales, underwent reduction with evolution. Acanthodians possessed one of two types of scales. The *Nostolepis* type consists of an outer cellular dentin containing vascular canals and a basal cellular bone. The *Acanthodes* type consists of a crown of acellular orthodentin and a thick basal layer of acellular bone (Moy-Thomas and Miles, 1971). Teeth of acanthodians may be single-cusped with broad bases or multicusped tooth whorls. Several types of dentin occur, but true enamel is always absent. Acanthodians evolved toward toothlessness. Elasmobranch teeth generally possess an outer layer of enameloid, a middle orthodentin layer and a central region consisting of osteodentin (Peyer, 1968). Elasmobranch mucous membrane and shagreen denticles are homologous with the dentition and are, therefore, histologically the same.

Previous Work

Ichthyoliths are abundant and widespread in a wide range of lithologies, often occurring where other microfossils are rare or absent. Ichthyoliths may therefore be the only means of correlating such strata (Helms and Riedel, 1971; Doyle et al., 1974). In addition, Late Paleozoic ichthyoliths often exceed conodonts in abundance, and I have recovered ichthyoliths from samples barren of conodonts (Tway, 1977). Moreover, unlike conodonts, ichthyoliths are not restricted to marine depositional environments, further increasing their correlational potential. One may therefore ask why ichthyoliths have been largely ignored. This is apparently due to the difficulties one encounters in trying to identify them. The amount of morphologic variation which occurs within the same species and even within the same individual is overwhelming. Sexual dimorphism, wound healing (Reif, 1978), and ontogenetic development also contribute to this variation. In order to avoid the obvious problems involved with binominal classification, a coded identification system was developed by Doyle et al. (1974) for Cenozoic ichthyoliths. The system makes no implications of zoological affinities. A similar type of utilitarian classification has been proposed by Hughes (1970) for palynomorphs and Riedel (1978) for radiolarians. The key of Doyle et al. (1974) provided a means of effectively handling the ichthyoliths for the purpose of correlating pelagic sediments. It was later modified to describe additional types of elements from both Cenozoic and Mesozoic sediments (Dunsworth et al., 1975; Ramsey et al., 1976; Doyle et al., 1978; Doyle and Riedel, 1979a, 1980; Kozarek and Orr, 1981). I found it necessary to make further major revisions and modifications of the identification system of Doyle et al. (1974) to accommodate the greater diversity and different types of ichthyoliths encountered in Paleozoic samples (Tway, 1979a).

Although ichthyoliths have been largely ignored, their biostratigraphic and paleoecologic importance have been recognized by some workers. One would expect that Paleozoic ichthyoliths would be especially well-suited for biostratigraphy due to the rapid evolution of fishes during that era (Moy-Thomas and Miles, 1971), much of which is reflected in their squamation and dentition. But most studies have been done on ichthyoliths from Cenozoic and Mesozoic sediments. For example, several studies through the Deep Sea Drilling Project have substantiated the utility of ichthyoliths in defining biostratigraphic zones and correlating Cenozoic and Mesozoic pelagic sediments (Helms and Riedel, 1971; Doyle et al., 1974; Dengler et al., 1975; Ramsey et al., 1976; Doyle et al., 1977, 1978; Edgerton et al., 1977; Doyle and Riedel, 1979a, 1979b, 1980; Kaneps et al., 1981; Kozarek and Orr, 1981). Otoliths, which are calcareous spherical deposits in the hearing and balancing organs of teleosts, have long been recognized as useful age indicators in Cenozoic and Mesozoic deposits, particularly for those from the Tertiary. They have also been used for paleoecologic (Abel, 1922) and paleoclimatic (Voight, 1934) studies.

Assemblages of fish remains from the Lower Paleozoic have also been studied more extensively (Claypole, 1894; Dean, 1909; Woodward and White, 1938; Wells, 1944; Harris, 1951; Ørvig, 1969a, 1969b; Thorsteinsson, 1973; Turner and Turner, 1974; Turner and Dring, 1981; Turner et al, 1981) than have those from the Late Paleozoic, which generally have been discussed only briefly in papers dealing with Pennsylvanian conodont faunas (Gunnell, 1931, 1933; Harlton, 1933; Harris and Hollingsworth, 1933; Cooksey, 1933; Perkinson, 1934; cf. Zidek, 1972, 1973, for a review and commentary). Other work dealing with Late Paleozoic ichthyoliths have discussed them in reference to the lepidomorial theory (Ørvig, 1951, 1966; Stensiö, 1961, 1962; Zangerl, 1966, 1968; Peyer, 1968). However, very few papers have dealt exclusively with Late Paleozoic ichthyolith assemblages (Ossian, 1974; Koehler, 1975; Tway, 1977, 1979b), and none of them determined their biostratigraphic applicability. Although my earlier study (Tway, 1977, 1979b) was concerned mainly with the paleoecology of ichthyoliths from the Shawnee Group, it was apparent from their distributions that these Late Paleozoic ichthyoliths might be useful for biostratigraphic correlation. However, because I examined only one section of strata, I could not ascertain this potential. The present study consists of a more detailed examination of the geographic and stratigraphic distribution of ichthyoliths in three members of the Oread Limestone Formation in the Shawnee Group (ascending: the Leavenworth Limestone, the Heebner Shale, and the Plattsmouth Limestone) and three members of the Stanton Limestone Formation in the Lansing Group (ascending: the Captain Creek Limestone, the Eudora Shale, and the Stoner Limestone).

Stratigraphy of the Study Area

Samples from 16 localities in Oklahoma, Kansas, Nebraska, Iowa and Missouri (Text-fig. 1) were used for this study. These localities have been repeatedly sampled by various workers (for example, Toomey, 1966) due to the excellent outcropping of the Shawnee Group in this region. The samples used in this study were collected by Peter von Bitter for his conodont research. After careful examination of the conodont fauna, von Bitter and Heckel (1978) concluded that the two Iowa localities have been misidentified for nearly 50 years and that they belong to the Lansing Group rather than the Shawnee Group. All of the other localities, however, are still considered to represent the Shawnee Group.

Shawnee Group

The Shawnee Group in the midcontinent region is a well-known sequence of megacyclothems. Its cyclic nature was first described by Moore (1931, 1936, 1964) and has since been studied extensively by subsequent workers. Four megacyclothems (ascending: Oread, Lecompton, Deer Creek and Topeka) were deposited during marine transgressions and regressions in Virgilian time (see Text-fig. 2). The epeiric sea was shallow and inundated a stable or slowly subsiding carbonate platform (Toomey, 1969a). The source of clastics for this region is not generally agreed upon. Moore (1929) suggested that sediments were derived from the south (Wichitas, Arbuckles and Ouachitas) and east (Ozark Dome), with which Souter (1966) agreed. However, Toomey (1966, 1969a) stated that the major source of sediments was the ancestral Rockies which resulted in a north-south depositional strike and the remarkable lateral homogeneity of the Leavenworth Limestone. Toomey believed that the stable shield area to the north, the Ozark Dome, the Ouachitas, the Arbuckles and the Wichitas provided only minor amounts of clastics. Just south of this region a rapidly subsiding trough bordered the northern edge of the Arbuckles and Wichitas (Toomey, 1969a).

The Oread Limestone Formation is the oldest megacyclothem of the Shawnee Group. It consists of seven members (ascending): the Toronto Limestone (or Weeping Willow Limestone in Nebraska), the Snyderville Shale, the Leavenworth Limestone, the Heebner Shale, the Plattsmouth Limestone, the Heumader Shale, and the Kereford Limestone. Three of these--the Leavenworth Limestone, the Heebner Shale and the Plattsmouth Limestone--are the most laterally persistent (Troell, 1969) and were included in this study. The outcrop pattern of these members extends from northern Oklahoma (Osage County) through Kansas and part of Missouri into southern Nebraska (Cass County) (see Text-fig. 1). Throughout this extent, these members are fairly consistent in thickness and character. The best example of this is the Leavenworth Limestone which is generally less than three feet (0.915 m) thick (Toomey, 1966), but ranges up to 20 feet (6.1 m) in Oklahoma where it grades into shale (Souter, 1966). The Leavenworth Limestone has been described as "dark bluish-gray, fine-grained, dense, very hard, vertically jointed and moderately fossiliferous" (Toomey, 1969a, p. 1001). Toomey (1966, 1969a), who originally considered the Iowa localities to contain the Leavenworth Limestone, recognized three facies by factor analysis: a skeletal mudstone facies which comprises most of the Leavenworth Limestone sample localities, an aggregate grain facies which includes rock samples at localities #16 in Madison County, Iowa (now known to be the Captain Creek Limestone), and #1 in Osage County, Oklahoma, and a mudstone facies comprising locality #15 in Cass County, Iowa (see Toomey, 1969a, Text-Figure 5, p. 1014). He attributed the facies changes at the northern and southern extremities of the transect to increasing nearness to shore. Toomey has discussed the distribution of algae (Toomey, 1969b), calcareous foraminifera (Toomey, 1972), agglutinated and silicified foraminifera (Toomey, 1974), and miscellaneous microfossils (Toomey et al., 1974). Toomey et al. (1974) briefly discussed the fish remains in the Leavenworth Limestone and indicated that most were palaeoniscoid teeth. They recognized some shark dermal denticles as well, but did not illustrate these (they did illustrate a multicusped shark tooth in Plate 3) and reported that these are generally poorly preserved. Toomey et al. (197[illegible]) stated that fish remains in the Leavenworth Limestone show "very little variability" (p. 1163) and are rare where present. They found no fish remains at localities in Coffey and Franklin counties in Kansas, Buchanan County in Missouri, and Cass and Madison counties in Iowa. Toomey (1969a) suggested that the Leavenworth Limestone was deposited in shallow water on a slowly subsiding carbonate platform during a transgressive phase.

The Heebner Shale overlies the Leavenworth Limestone and is also a very laterally persistent unit, generally varying little from five feet in thickness (Souter, 1966). The lower part of the Heebner Shale is black and platy, and contains phosphatic nodules, plant fragments, pectinoid clams, ichthyoliths, and conodonts. The upper part is gray to green, soft and clayey. Although the base of the upper part is unfossiliferous, it becomes gradually more fossiliferous toward the top (Toomey, 1966; Souter, 1966). Because of its dark, fissile character and high radioactivity, the Heebner Shale provides a good marker unit for subsurface work (Evans, 1966). Although the Heebner Shale is generally five to ten feet (1.525-3.05 m), it thickens abruptly to approximately 60 feet (18.3 m) in Osage County, Oklahoma, where it becomes more bluish-gray in color (Evans, 1966). Although Moore (1936, 1964) suggested shallow water deposition, Evans (1966) believed the Heebner Shale to have been deposited in a relatively deep and poorly oxygenated marine environment during maximum transgression. Subsequent workers have concurred with Evans (e.g. von Bitter, 1972; Heckel et al., 1979).

The Plattsmouth Limestone overlies the Heebner Shale and is considerably thicker than the other two members included in this study, ranging from 15 feet (4.575 m) in southern Nebraska to 40 feet (12.2 m) in northern Oklahoma (Souter, 1966). This limestone is wavy-bedded and dense with local chert nodules, and is fairly fossiliferous, containing brachiopods, bryozoans, fusulinids, corals, molluscs (Moore, 1949, 1951), conodonts (von Bitter, 1972) and ichthyoliths (Tway, 1979b). Thin shale partings are also common (Souter, 1966). The Plattsmouth Limestone was deposited during a regressive phase (Elias, 1966; von Bitter, 1972; Merrill and von Bitter, 1976) in a shallow-water, high-energy environment. In summary, the three members of the Shawnee Group included in this study represent an increasingly transgressive phase (Leavenworth Limestone) and a maximum transgressive phase (Heebner Shale) followed by a regressive phase (Plattsmouth Limestone).

Mendenhall (1951) discussed conodonts and fish remains in the Shawnee Group and noted that the carbonaceous, fissile shales were the most productive horizons. He recognized fish remains representing acanthodians, selachians, and palaeoniscoids. Hutter (1976) studied chitinozoans (probably reworked; Wilson, pers. comm.) in the Leavenworth Limestone and also discussed other palynomorphs present. The paleoecology of conodonts was studied quantitatively by von Bitter (1972), who showed through the use of cluster analysis that the distribution of Pennsylvanian conodonts was environmentally controlled. He recognized six conodont biofacies, five of which

Merrill (1968) had previously recognized based on intuitive, empirical methods. Von Bitter demonstrated the relationship of these six biofacies to five distinct biotopes, thus illustrating the paleoecologic preferences of various groups of conodonts. In a similar type of study (Tway, 1977, 1979b), I used cluster analysis to determine the degree of environmental dependence of ichthyoliths in the Shawnee Group. From my analyses I concluded that, like the conodonts, Late Pennsylvanian ichthyoliths were environmentally controlled to some extent, but that their vertical distributions indicated a potential biostratigraphic usefulness.

Lansing Group

Like the Shawnee Group, the Lansing Group consists of a series of cyclothems with alternating limestones and shales deposited during marine transgressions and regressions. The Lansing Group is made up of three megacyclothems or formations (ascending: Plattsburg, Vilas and Stanton) and is Missourian in age (see Text-fig. 3). The uppermost Stanton Limestone Formation contains five members (ascending): the Captain Creek Limestone, the Eudora Shale, the Stoner Limestone, the Rock Lake Shale, and the South Bend Limestone. The lower three members (Captain Creek, Eudora and Stoner) outcrop in Cass and Madison counties, Iowa, and were also included in this study (Text-fig. 1). Their inclusion is due to the fact that these members were mistaken for nearly 50 years for the Leavenworth, Heebner and Plattsmouth members of the Shawnee Group. This misidentification has been due to the nearly identical lithologies of the members of the two groups and the structural complexities which occur in Iowa, such as domes and synclines (Welp et al., 1968). Consequently, these members have been collected along with the Shawnee Group members, resulting in confusion and somewhat erroneous conclusions when trying to relate conodont distributions in Iowa with those in the rest of the midcontinent region.

The misidentification of the members at the Iowa localities was first suspected by von Bitter (1976) based on the conodont fauna. The change in the typical assemblage of conodonts at the Iowa localities led von Bitter (1973) to originally interpret this an as indication of geographic variation of the conodonts. However, after an extensive re-examination of these localities, von Bitter and Heckel (1978) concluded that the three members at the Iowa localities belong to a different stratigraphic sequence and are the Captain Creek Limestone, Eudora Shale, and Stoner Limestone members of the Lansing Group. It is now apparent that the northernmost aggregate grain and mudstone facies in Iowa defined by Toomey (1966) is an artifact resulting from comparing different stratigraphic sequences rather than an indication of a different environment.

Geothermometry

Previous Work

Carbonization is the change in the characteristics of organic material related to temperature, depth of burial, pressure, associated chemical constituents and radioactivity (Wilson, 1971). During such alterations, volatiles are driven off and the relative amount of carbon increases. Rogers (1860) was the first to recognize that Pennsylvanian coals from the Appalachian Basin change characteristics with the varying geologic structure of the area. Hilt (1873) observed that the amount of volatile material decreases with increasing depth of burial. This relationship later became known as "Hilt's Law" and was elaborated upon by White (1915) in his Carbon Ratio Theory which basically states that with increasing metamorphism hydrocarbons become lighter until they reach the "oil deadline". At this point oil is replaced by wet gas which is in turn replaced by dry gas with increasing organic alteration. The carbon ratio is the amount of volatile hydrocarbons and fixed carbon which remain after the volatiles have been driven off.

Much of the early work done with organic metamorphism dealt with coal and there was therefore a problem when trying to determine the degree of carbonization in regions without coal. This problem was resolved by Wilson (1961) who showed that palynomorphs from coal seams in the Arkoma Basin underwent color and preservation changes and that these changes varied with the geologic structure. He compared the palynomorph changes with the percentage values of fixed carbon, thus producing a scale which could be used when looking at palynomorphs to determine the amount of fixed carbon, and he suggested its application to hydrocarbon exploration. Wilson pointed out the importance of using the same genus and, if possible, species in assessing carbonization because different spore and pollen types undergo carbonization at somewhat different rates.

Gutjahr (1966) studied spore translucency and concluded that as spores undergo increasing metamorphism, they become more opaque to transmitted light; this observation provided a quantitative means for measuring the amount of carbonization. He measured spore translucency in the Gulf Coast region of Texas and related his measurements to oil and gas occurrences. Another quantitative method was developed by van Gijzel (1963) who measured the amount of autofluorescence of palynomorphs. With increasing alteration, their autofluorescence shifts from the blue-green series to the red-brown series. Staplin (1969) related palynomorph color, geochemistry, and oil and gas occurrences in western Canada. He noted that scales should be constructed for each type of organic material since they may differ in their responses to carbonization.

The past decade has seen refinements of methodology and utilization of new groups for carbonization studies. Epstein et al. (1977) found that with increasing temperatures the color of conodonts changes from light amber to brown to black to gray to opaque white and finally clear. The change to black accompanies an increase in fixed carbon which is eventually driven off, producing an opaque white color. With recrystallization and possibly the driving off of water, the conodont becomes clear. Observations of conodonts collected from rocks in the Appalachian Basin confirm that conodonts alter comparably _in situ_ as they do in simulated laboratory heating experiments. Epstein et al. (1977) concluded that conodonts alter mainly in response to temperature. Pressure had little or no effect, but when conodonts were heated in wet, sealed systems with water and argon or methane, carbonization was considerably retarded. The advantage of conodonts over palynomorphs is that conodonts alter at much higher temperatures and are therefore useful in sequences containing dry gas.

Alteration Ranges of Specific Groups

Vitrinite is an organic maceral which increases its reflectance with increasing organic metamorphism. Urban and Allen (1975) discussed vitrinite reflectance values. Vitrinite is useful mainly for nonmarine and shallow water marine sequences and is used widely by oil companies. Quantitative reflectance values are quickly and easily measured, but may vary with rock type. Epstein et al. (1977) noted lower reflectance values in carbonate rocks than in shales. Thus, vitrinite reflectance is best used in lacustrine, fluvial, and shallow water marine sequences and in those rocks which have been exposed to temperatures in excess of 80°C (176°F).

Wilson (1961, 1971) discussed the useful ranges of plant palynomorphs, plant cuticles, and wood. Plant cuticles tend to behave in a manner similar to palynomorphs. Wood tissue tends to turn black early, but its delicate structures remain discernible at a relatively high fixed carbon value. The alteration of palynomorphs is dependent on factors such as temperature, pressure, geologic age, associated chemicals, weathering, and radioactivity (Wilson, 1971). The rapidity with which palynomorphs change depends on the thickness of the exine and the presence of saccate structures, spines or other delicate ornamentation. Palynomorphs with thin walls and delicate ornamentation alter more quickly than do spherical palynomorphs with thick walls and no ornamentation. Certain associated chemicals or radioactivity may influence their alteration. For example, Sanders (1967) noted that the presence of pyrite (and bacteria) destroys palynomorphs in a reducing environment, and would therefore cause an earlier alteration. Radioactivity also causes palynomorph alteration, but the presence of copper in the original depositional environment has the opposite effect, retarding alteration (Wilson, 1971). Palynomorphs range from Precambrian to Recent but are most useful for floral and faunal thermal maturation comparison in Devonian sequences because that was the earliest time in which both occurred in abundance in the same sedimentary deposits (Wilson, pers. comm.). Plant material has a lower threshhold to carbonization than do some groups of "faunal" palynomorphs whose composition is chitinaceous. Palynomorphs are best used in rocks which have undergone temperatures less than 160°C (320°F).

Another group of palynomorphs are the chitinozoans. These are an extinct group of organisms which are generally considered to have ranged from Ordovician to Devonian (Hutter, 1976, reported on Pennsylvanian chitinozoans from the Shawnee Group but these were probably recycled, according to Wilson, pers. comm.). Recent work by Wilson (1971, and pers. comm.) has shown that they undergo alteration with metamorphism. They have a higher extinction point than plant palynomorphs and change from brown to black. At a point when they are black they can still be bleached, but if heated beyond this point they can no longer be bleached even though they are still black. This, then, is their extinction point. (The term "extinction point" in carbonization work refers to the point at which all of the organic material has volatilized.) Since this work is still in its initial stages, precise ranges of chitinozoan alterations have not yet been published. An advantage of chitinozoans is that they could be used beyond the range of plant palynomorphs and that they are abundant and useful stratigraphic markers. However, they are limited to rock sequences from Ordovician to Devonian (and possibly Carboniferous).

The color changes undergone by conodonts have been given color alteration index (CAI) numbers by Epstein et al. (1977). Conodonts begin to alter at higher temperatures than palynomorphs and continue to alter beyond the extinction point for palynomorphs, being useful for temperatures up to 500°C (932°F). The advantage of conodonts, therefore, is that they are useful at temperatures beyond those withstood by palynomorphs. However, conodonts are restricted to marine sequences and to rocks which range in age from Cambrian to Triassic and are not generally abundant.

Multivariate Methods

Geographic Variation

Cluster analysis and principal components analysis have been commonly employed in geographic variation and paleoecologic studies of most major groups of Recent and fossil flora and fauna. Analyses using presence-absence data have been most common (Kaesler, 1966; Maddocks, 1966; Orloci, 1966; Valentine and Peddicord, 1967; Mello and Buzas, 1968; Brown, 1969; Cairns and Kaesler, 1969; Kaesler et al., 1971; Hocutt et al., 1974; MacDonald, 1975; Keen, 1977; Strahler, 1978). The use of relative abundance data is rare (Rucker, 1967;

Gevirtz et al., 1971; Tanabe, 1979; Haack and Kaesler, 1980) and, even when relative abundance data are available, they are often reduced to presence-absence data, thereby ignoring a great deal of information regarding distributions. Orloci (1966) stated that when using ordination techniques, little information is lost by presenting the data as presence-absence variables. Valentine and Peddicord (1967) indicated that the use of relative abundance data resulted in "weighting" the data. Gill and Tipper (1978) used a rather unique form of presence-absence data. The mean values of abundances were calculated; if an object or species was present at a value above the mean, it was considered present; if it occurred at a value below the mean, it was regarded as absent. However, most authors who use presence-absence data regard a species to be present even if only one specimen is found.

In working with Late Pennsylvanian ichthyoliths (Tway, 1977; 1979b), I have found a considerable amount of variation in the clusters resulting from the two types of data. This is to be expected since presence-absence data ignore a considerable amount of ecological information that the abundance data provide. For example, in samples containing acanthodian and palaeoniscoid remains, there is generally a difference in the abundances of each group depending on the lithology. Although both groups of ichthyoliths are generally present in all lithologic types, the acanthodian scales tend to be abundant in dark shales where the palaeoniscoid remains are less common. The palaeoniscoid remains, on the other hand, are abundant in fine-grained limestones where acanthodian remains are less common. This information regarding geographic variation is potentially very important and certainly of interest, but is unfortunately lost when using presence-absence data. I would even contend that the use of presence-absence data is a form of weighting in that the very rare forms are given equal weight to those forms which are abundant. Since abundance data are more sensitive to environmental fluctuations, they can provide more information regarding geographic variation.

Biostratigraphy

Multivariate techniques have been utilized in biostratigraphic studies to correlate stratigraphic sequences and determine zonations (Cheetham and Deboo, 1963; Cheetham and Hazel, 1969; Hazel, 1970, 1971, 1977; Christopher, 1978). The advantages of using these methods is that they provide a more objective means of quantifying the biostratigraphic data, resulting in less subjectivity. Repeatability by different workers is therefore more likely. In the range-through method, introduced by Cheetham and Deboo (1963), a species is considered to be present in a particular horizon if it is found both above and below that horizon even if it is not found in that horizon. Use of the range-through method and presence-absence data avoids some of the effects of environmental control and are therefore more suitable for studies of the stratigraphic distributions of organisms.

Purpose of Investigation

Although ichthyoliths are well preserved, abundant and widespread in virtually all lithologic types, they have been one of the most ignored groups of microfossils. Ichthyoliths often occur in deposits that are otherwise unfossiliferous and may exceed conodonts in abundance. Furthermore, ichthyoliths are not restricted to marine depositional environments as are conodonts, and have a much longer stratigraphic range (Cambrian to Recent) than do conodonts (Cambrian to Triassic). As a further indication of their potential importance, ichthyoliths undergo color changes with increasing temperatures. Although Mesozoic and Cenozoic ichthyoliths have been studied and shown to be useful in biostratigraphy, the Late Paleozoic elements have been virtually ignored with regard to their utility in various geologic applications.

This study was conducted to answer the following questions:

1. Is there geographic variation of Late Paleozoic ichthyoliths?

2. Does the ichthyolith fauna at the Iowa localities (#15 and #16) differ from that at all the other localities? In other words, is there a change in the ichthyolith fauna stratigraphically?

3. How similar is the ichthyolith distribution to that of the conodonts?

4. How do ichthyoliths react to thermal gradients?

5. Based on the above would Late Paleozoic ichthyoliths be useful in geology?

Of primary interest was an examination of the relationship of localities #15 and #16 with all the other localities because the rocks sampled here are now known to be of a different age. The conodont distributions at the northern and southern ends of the outcrop belt have been carefully studied (Merrill and von Bitter, 1976; von Bitter, 1973, 1976; von Bitter and Heckel, 1978; von Bitter and Merrill, 1980). Although the results regarding the conodont distributions at most of the localities in the central portion of the outcrop belt have not yet been published, it is apparent that the conodont fauna at the central localities is uniform and monotonous, dominated by Streptognathodus, Idiognathodus, and Idioprioniodus (von Bitter, pers. comm.). However, the conodont distributions at some of the localities in the central outcrop belt have been discussed by Ellison (1941) and von Bitter (1972). The conodonts therefore provided an important control for comparing the ichthyolith distributions, both geographically and stratigraphically. In addition, work done by Toomey (1966, 1969a) provided information regarding lithologic variability of the Leavenworth Limestone, and was used as a comparison for the ichthyolith distributions.

MATERIALS AND METHODS

Sampling

Samples from 16 localities (Text-fig. 1) were collected by Peter H. von Bitter of the Royal Ontario Museum for his conodont research. Not all localities contained a good exposure of each member. Therefore several sublocalities near the main localities were also sampled in order to collect all three members. Von Bitter followed the procedure of channel sampling (Collinson, 1965), whereby the selected outcrop was sampled perpendicular to the bedding plane. The samples collected were continuous from base to top of the exposed outcrop. He collected an average of 1,600 to 2,000 grams of rock sample from each horizon. Due to the small thickness and lithologic homogeneity of the Leavenworth Limestone (and Captain Creek Limestone), only one horizon was sampled at each of 13 localities. In general, at least two horizons were sampled in the Heebner Shale (and Eudora Shale) due to the different natures of the upper and lower parts. Many more horizons were sampled in the Plattsmouth Limestone (and Stoner Limestone) due to the greater thickness and lithologic variability. The 132 sampled horizons, their localities, and their ROM accession numbers are listed in Appendix C. Brief descriptions of each locality (and sublocality) are included in Appendix F.

Processing

The limestone samples were broken down using acetic acid or formic acid and the shale samples were broken down using Stoddard Solvent, Quaternary "O" and/or sodium hypochlorite. The resulting muds were then sieved through mesh sizes of 20 or 25 and 170. Tetrabromoethane was used to separate the heavy and light portions, the heavy portions of which were then separated using a magnetic separator. Von Bitter recovered the conodonts from these residues and then loaned them to me for recovery of the fish remains. Although most of the ichthyoliths were found in the non-magnetic heavy residues, I also sorted through the magnetic portions and recovered numerous ichthyoliths.

Photography and Ichthyolith Analysis

Most of the ichthyoliths were examined and photographed using an ETEC Autoscan scanning electron microscope, with a few being photographed with a JEOL JSM-2 scanning electron microscope. Several different types of mounting media were used, but I found the optimum type to be envelope glue since it is water soluble and allows easy removal of the ichthyoliths. After mounting, the ichthyoliths were sputter-coated with approximately 150 to 200 Å of gold and examined under the scanning electron microscope at 20 KV. A disadvantage of using the SEM was that several of the palaeoniscoid teeth have translucent tips and this characteristic could not be observed in the SEM micrographs (see, for example, Appendix B, Part II, Fig. 6a). Therefore, these ichthyoliths were also photographed in reflected light using a Wild binocular microscope and camera with 32 ASA Panatomic film with a Wratten 59 filter (see Appendix B, Part II, Fig. 6b). The color photographs of the altered ichthyoliths were also taken using the Wild microscope and camera. In addition, an ultraviolet filter was used with 50 ASA Ektachrome film to achieve the truest colors possible.

Classification

The ichthyoliths were identified according to the key for Paleozoic ichthyoliths (Tway, 1979a). Several new ichthyoliths were encountered which were not identifiable by this system, necessitating the addition of several categories. These are listed in Appendix A.

Curation of Samples and Ichthyoliths

The sample residues are deposited in the Department of Invertebrate Paleontology of the Royal Ontario Museum in Toronto, Canada. All ichthyoliths are deposited in the Department of Vertebrate Paleontology of the Royal Ontario Museum.

Geothermometry

For the initial carbonization work, ichthyoliths were heated in open air in a Lindberg muffle furnace. The times and temperatures at which they were heated were those specified by Epstein et al. (1977) for conodonts. These ranged from 500°C for 0.5 h to 950°C for 4.0 h. Five replicate samples were run for each time and temperature. The ichthyoliths used in these experiments were from several shallow marine limestones of the Shawnee Group. Ichthyoliths from units with a high carbon content were not used in order to avoid some of the possible darkening effects of the carbon. Palaeoniscoid teeth were used in most of the experiments due to their abundance and general consistency of size and shape. However, other types of ichthyoliths were also included in some of the heating experiments to determine whether or not different ichthyolith types would respond differently to thermal gradients.

Sections were made of larger elasmobranch teeth (Cretaceous) in order to determine if any internal structural alterations were taking place in addition to the color changes. The larger teeth facilitated the making of sections. Comparisons were made between teeth which had not been heated (control) and those which had been thermally altered (experimental). The teeth were first heated in the muffle furnace. They were then embedded in epoxy, cut and ground longitudinally, and polished with aluminum oxide powder. The polished surfaces were etched for 15-20 sec in 2N HCl (see Barnes et al., 1970). The sections were then examined and photographed with the scanning electron microscope. The temperatures used in these experiments are necessarily much higher than those which would have occurred in the original matrix. The higher temperatures at shorter time periods is the only way to satisfactorily simulate lower temperatures for very long peroids of time (geologically). The reader is referred to Figure 3 of Epstein et al. (1977) for the time and temperature relationships through an Ahrrenius plot.

Multivariate Analyses

Geographic Variation Analysis

For the present study, I was not interested in a detailed analysis of the paleoecology but rather in an examination of the geographic variation of the ichthyoliths and a comparison of their distribution with that of the conodonts from the study area. I used abundance data since these tend to provide more information regarding the more subtle ecological trends and geographic variation. The absolute abundances of the ichthyoliths were divided by the quantity of rock sample (in kilograms) which yielded the ichthyoliths (see Appendix D), resulting in abundance values of the number of ichthyoliths per kilogram (no. ichthyoliths/kg). I performed Q-mode cluster analysis and principal components analysis to determine the relationship of the localities. R-mode cluster analysis was also performed on the ichthyoliths but did not provide any useful information regarding the geographic variation. No missing values were used and the data were not standardized (since a type of standardization was initially done by calculating the no. ichthyoliths/kg). In the cluster analysis, the average taxonomic distance coefficient was used (Sneath and Sokal, 1973). A cophenetic correlation coefficient (Sokal and Rohlf, 1962) was calculated for each dendrogram to measure the amount of distortion resulting from presenting the data in the form of a dendrogram.

It is especially important in studies of geographic variation to also perform an ordination on the data. Ordination techniques provide better indications of global (between group) relationships and can be used to determine if the clusters resulting from cluster analysis are real or simply an artifact of that type of analysis. For the ordination method, I employed the principal components analysis using the product-moment correlation coefficient. The Numerical Taxonomy System of Multivariate Statistical Programs (NT-SYS; Rohlf et al., 1979) and the Statistical Analysis System (SAS; Helwig and Council, 1979) were used. The raw data of the no. ichthyoliths/kg used in the geographic variation analyses are listed in Appendix E, Part I.

Biostratigraphic Analysis

I was interested in quantitatively determining if the Iowa localities would be segregated from all the other localities based on the ichthyolith fauna. Since it has been shown (von Bitter and Heckel, 1978) that the samples from these localities are older than those from the other localities (but essentially the same environmentally), I was interested in determining if there are any differences in the ichthyolith faunas of the two stratigraphic sequences. I analyzed each member separately but combined the corresponding members in the Iowa localities with those from the other localities. Thus, when I analyzed the Leavenworth Limestone member, the Captain Creek Limestone member was included since I wanted to evaluate whether the Captain Creek and Leavenworth limestones could be distinguished based on the ichthyoliths. The other corresponding members were combined in the same way.

For the biostratigraphic analyses, I used presence-absence data and the range-through method since these tend to ignore some of the effects of environmental control. In addition, since several horizons were sampled for the Plattsmouth/Stoner members and the Heebner/Eudora members at each locality, I combined these horizons so that only one sample from each locality was used in the analyses. This further avoided effects of geographic variation. I then used cluster analysis with the Dice coefficient as suggested by Cheetham and Hazel (1969). Principal coordinates analysis was achieved by performing a Gower transformation on the results of the Dice coefficient among localities. Since factor loadings are not provided by principal coordinates analysis, a product-moment correlation coefficient was calculated between the ichthyolith types and the first seven factors. This provided information regarding the relationships of the ichthyoliths to each factor. The tables of these correlations provided information regarding the relationships of the ichthyoliths to the locality clusters and therefore provided similar information to R-mode cluster analysis. No missing values were included and the NT-SYS package was used. The presence-absence and range-through data used in the biostratigraphic analyses are listed in Appendix E, Part II.

RESULTS

General Observations

A total of 24,670 ichthyoliths, comprising 156 different types, were recovered and identified from the 132 samples. These ichthyoliths are illustrated and described in Appendix B. Although the average relative abundance for all the members was 114.15 ichthyoliths/kg, the abundances and diversities varied considerably in each member (Table 1). Of the three Shawnee Group members, the Plattsmouth Limestone contained the most numerous and diverse ichthyolith fauna, and the Stoner Limestone contained the most numerous and diverse ichthyolith fauna of the Lansing Group members. Since both of these members represent an increasingly transgressive phase, it is apparent that the abundant and diverse fauna is a result of a more ecologically suitable environment.

Text-figures 4 and 5 illustrate the change in the average ichthyolith abundances and diversities in the members along the sampled transect. The Leavenworth and Captain Creek limestones contained the sparsest ichthyolith fauna along most of the transect. However, the ichthyolith abundance in the Leavenworth Limestone changed abruptly from 1.06 ichthyoliths/kg at locality #2 to 367.72 ichthyoliths/kg at locality #1 a short distance away. The diversity also increased from two different types at locality #2 to 43 different types at locality #1. There is also an increase in abundance and diversity at locality #16 (Captain Creek Limestone), but the change is not as pronounced. Although Toomey et al. (1974) found no ichthyoliths in the Leavenworth Limestone at his sample localities in Coffey and Franklin counties in Kansas, Buchanan County in Missouri, and Cass and Madison counties in Iowa, I recovered several ichthyolith types, some in high numbers, from sample localities in these counties. There appears to be no distinct patterns in the ichthyolith abundances in the Heebner and Eudora shales and the Plattsmouth and Stoner limestones. The abundances fluctuate considerably throughout the transect but generally decrease at the northern and southern edges. The diversities, however, tend to increase in a northward direction. Both the ichthyolith diversity and abundance increase abruptly in the Heebner Shale at locality #14 (Johanneson Quarry) in Cass County, Nebraska.

An unusual ichthyolith assemblage was recovered from the Stoner Limestone in Cass County, Iowa (locality #15). The ichthyoliths are variously colored, ranging from an unaltered off-white to nearly black (see Plate 1). These color differences were observed even among ichthyoliths of the same type and size (for example, palaeoniscoid teeth). However, the conodonts from this sample do not vary in color which poses a problem when trying to explain the variously-colored ichthyoliths (see Discussion section). There were several ichthyolith types (#236, #237, #239, #240, #242, and #245) which occur only in the Stoner Limestone in Cass and Madison counties, Iowa (localities #15 and 16), and nowhere else.

Another unusual ichthyolith assemblage occurred in the Leavenworth Limestone (Sample Le-4-1) at locality #1 in Osage County, Oklahoma. Generally, there was very low ichthyolith abundance and diversity in the Leavenworth Limestone at other localities (the average was 10 ichthyoliths/kg) but at locality #1 there were 368 ichthyoliths/kg. von Bitter (field notes) observed that the Leavenworth Limestone at this locality did not have its "regular lithology" and he was "somewhat skeptical that this is really Leavenworth". He also recovered an atypical conodont assemblage from this locality. In general, he found greater conodont abundances and diversities.

Geothermometry

Ichthyoliths heated in open-air heating experiments undergo irreversible color alterations similar to those of conodonts and palynomorphs. Basically, they become darker going from an off-white in an unaltered state (see Plate 2a) to increasingly darker shades of brown (see Plate 2b) and eventually to a chalk-white (see Plate 2c). At higher temperatures, the translucent tip becomes opaque (see Plate 2c). These changes are both time and temperature dependent. The results of this study indicate that ichthyoliths alter at lower temperatures than conodonts but at higher temperatures than palynomorphs. I have also observed that different ichthyolith types undergo slightly different changes.

Not only does the color of ichthyoliths change but their internal structure is affected as well. Plate 3 shows a cross-section of a shark's tooth. The outer edge of the tooth is on the left, and toward the right is the central pulp region. The parallel-fibered structure on the outer edge is the orthodentin and the osteodentin (or trabecular dentin) comprises the central pulp region of the tooth where most of the organic matrix is contained. Plate 4 shows a higher magnification of the orthodentin in a control tooth and in one which has been thermally altered (experimental). Plate 5 shows higher magnifications of the osteodentin in a control tooth and an experimental tooth. The orthodentin did not undergo significant alteration, but in the osteodentin there has been a substantial change.

Geographic Variation

Leavenworth Limestone/Captain Creek Limestone

Cluster analysis of the Leavenworth and Captain Creek members based on the ichthyolith fauna produced a dendrogram with a very distinctive sample (Le-4-1 from locality #1 in Oklahoma) and a very tight cluster of the other samples (see Text-fig. 6). Samples Le-16-1 and Le-7-1 show a lower similarity to the other localities. Within the tight cluster, the more southern localities (#5, #8, #2 and #7) are the most similar. The remaining northern localities joined this cluster at increasingly higher values. The principal components analysis resulted in a somewhat different distribution of the localities (see Text-fig. 7). Locality #15 is not significantly different from the main cluster of Leavenworth localities in cluster analysis. However, in the principal components analysis, Le-15-1 shows very little similarity with the other localities in terms of the third principal components axis. The three-dimensional diagram of the first three principal axes illustrates that Le-4-1, Le-16-1 and Le-15-1 are highly dissimilar to the other samples with respect to the first, second and third axes, respectively. Le-7-1 does not appear to be significantly different from the other localities in the principal components analysis. Within the tight cluster of the principal components analysis, a progressive separation again occurs from the southern localities to the northern localities as was present in the dendrogram.

Heebner Shale/Eudora Shale

The dendrogram of the cluster analysis shows a tight clustering of most of the samples but a low similarity of four samples: He-11-4, He-14-2, He-13-3, and He-14-3 (see Text-fig. 8). The tight cluster contains mainly southern localites (#5, #2, #7, #6 and #3) and a few northern localites (#13, #15 and #16). In general, these samples contained fewer ichthyoliths than the more northern localities which joined this cluster at increasingly higher levels. He-11-4, He-14-2, He-13-3 and He-14-3 contained many ichthyoliths (as was seen in Text-figs. 4 and 5). The dendrogram indicates a similar relationship in which an increasing diversity occurs in a northerly direction but drops abruptly at localities #15 and #16. A similar relationship resulted from the principal components analysis. In general, localities #15 and #16 do not appear to be significantly different from most of the other localities based on the ichthyoliths and clustered in tightly with them. In addition, no distinct clustering of the Iowa localities occurred in either analysis.

Plattsmouth Limestone/Stoner Limestone

Three distinct groups resulted from the cluster analysis. P-4-2 and P-9-3 form one group and join the other two groups at a very low similarity value (see Text-fig. 9). The uppermost cluster contains mainly the most northern localities (except for localities #5 and #7). The middle cluster contains samples of all the other localities with no apparent pattern to their relationship. A similar distribution resulted from the principal components analysis.

Biostratigraphy

Leavenworth Limestone/Captain Creek Limestone

Cluster analysis of the presence-absence and range-through data resulted in three distinct clusters (Text-fig. 10). The lowest cluster contains Le-4 and Le-16, and has a very low similarity with the other samples. Sample Le-15 clustered with the middle group and did not, therefore, show a high similarity with Le-16.

Text-figure 11 illustrates the relationship of the localities relative to the first seven principal coordinates axes. Table 2 shows that the percentage of variation explained by the seven factors extracted by principal coordinates analysis is 83.97%. The first factor shows a similar relationship of the localities as did cluster analysis. However, localities #16 and #1 are not as distinct with respect to the first factor in principal coordinates analysis, and locality #15 is less similar to the cluster of northern localities than it was in cluster analysis. From Table 3 it is apparent that only three ichthyolith types (#035, #038 and #056) correlate highly with the first factor. The correlation of the other ichthyolith types with this factor is low.

The second factor shows a separation of localities #16, #1 and #15 from the other localities in that they lie on the upper edge of the axis and are not separated from each other by other localities. This also shows a closer relationship of localities #16 and #1 than #16 and #15 (see Discussion section). From Table 3 it is apparent that many ichthyolith types correlate highly and positively with this factor, particularly those which are common (for example, #006, #035, #038, #072 and #091). Thus, what distinguishes these localities from the others is the greater diversity of ichthyoliths present at localities #1, #15 and #16.

Although von Bitter (pers. comm.) also noted a difference in the typical conodont fauna at locality #1, he believed this change to be a reflection of the environment rather than a difference in age since the Oklahoma locality represents a much shallower marine environment. If this is the case, there is enough environmental effect to show up in the biostratigraphic analysis. von Bitter (field notes) also noted that the Leavenworth Limestone at locality #1 did not look the same as it did elsewhere. The ichthyolith distribution is very similar to that of the conodonts. I found a much higher diversity and abundance of ichthyoliths at locality #1 (368 ichthyoliths/kg versus an average of 10 ichthyolith/kg at the other localities; see Appendix E, Part II). This may be a reflection of drastic environmental change (for example, the approach to a shoreline) but the atypical conodont assemblage and different appearance of the Leavenworth Limestone warrants a reexamination of this locality.

No apparent pattern of the localities is seen with the third factor and localities #15, #16 and #1 are separated from each other along this axis. Factor IV shows a high similarity of localities #15 and #16. Two ichthyolith types (#012 and #057) correlate highly and negatively with the fourth factor (Table 3). Type #057 was absent at both localities whereas #012 was present at locality #16 but absent at locality #15. This factor also resulted in the distinction of locality #5 in Chautauqua County, Kansas, and the ichthyolith which correlate highly with this factor were both present at locality #5.

Factor V shows no distinct pattern of the localities. Factor VI separated locality #6 (Elk County, Kansas) from the other localities and ichthyolith type #169 (which was absent at locality #6) correlates highly and negatively with this factor. However, this ichthyolith type was absent at most localities, so it is the other ichthyolith types which do not correlate highly with this factor which were responsible for the distinction of locality #6. In addition, localities #15 and #1 were shown to be very similar relative to this factor and ichthyolith type #169 was absent at both localities.

The seventh factor shows a segregation of locality #16 and all of the ichthyolith types which correlate highly and negatively with this factor were present at this locality. No relationship is apparent between localities #1, #15 and #16 along this factor.

Heebner Shale/Eudora Shale

Cluster analysis resulted in two distinct groups (Text-fig. 12). Within the uppermost group, He-14, He-15 and He-16 cluster tightly together. Although these three samples do not form a group which was separate from all the other localities, they are more similar to each other than they are to all the other localities. This relationship is seen in the scatter diagram of the first and seventh axes of principal coordinates analysis (Text-fig. 13). The amount of variation explained by each axis is shown in Table 2. Table 4 shows the correlations of the ichthyoliths to the first seven factors of the principal coordinates analysis, and the relationship of the localities to each other with respect to these factors is illustrated in Text-fig. 14.

The first factor was responsible for a generally even distribution of most of the southern localities while the northern localities (#12, #14, #13, #16 and #11) formed a tight group at the upper edge of this factor. From Table 4, it is seen that many ichthyolith types correlate highly and positively with this factor. These ichthyoliths were very common and this factor constitutes a diversity factor.

Factors II and III did not result in any characteristic pattern of the localities but with both factors, locality #3 (Osage County, Oklahoma) was distinctly different. Ichthyolith types #038, #007 and #145 correlate highly and positively with these factors and all were absent at this locality, even the very common ichthyolith types #007 and #038. Ichthyolith type #193 has a high negative correlation with the second factor and was present at locality #3. The third and seventh factors resulted in a closer relationship of localities #15 and #16 than occurred with the other factors. Locality #14 is also similar to locality #16 with respect to the third factor.

The fourth factor groups most of the localities closely together at the center of the axis. Locality #7 is distinct from this group and lies at the upper edge of the axis. Localities #2 and #5 were also distinct and are on the bottom of the axis. The ichthyoliths which correlate highly with this factor are #035 (which has a positive association) and #214 and #217 (which are negatively correlated). Type #035 was absent in the Heebner Shale at both localities #2 and #5, even though it is a very common ichthyolith. Type #217 was present only at locality #2. However, most of the localities were similar to each other based on their ichthyolith fauna.

No distinct pattern of the localities is seen relative to factors V and VI, although locality #4 is distinct from the other localities relative to the sixth factor. Both ichthyolith types #141 and #157 correlate highly and negatively with this factor and were absent at most localities but present at locality #4. Ichthyolith type #208, although generally common, was absent at locality #4.

The seventh factor was responsible for the separation of locality #8 but no distinct pattern of the other localities can be seen. As noted earlier, localities #15 and #16 show a closer relationship to each other with respect to this factor.

Plattsmouth Limestone/Stoner Limestone

Two main clusters are apparent in the cluster analysis of the Plattsmouth and Stoner limestones (Text-fig. 15). Localities #15 and #16 are clustered within Shawnee Group samples, but do show a higher similarity to each other than to the other localities. Text-figure 16 shows the relationship of the localities with respect to the first seven principal coordinates axes. The first factor shows a very high similarity of most of the localities. Locality #4, #7 and #6 are not within this cluster and locality #3 (Osage County, Oklahoma) is very distinct, lying at the bottom of the axis. The ichthyoliths which correlate highly with this factor (see Table 5) also correlated positively, indicating that most of the localities contained these ichthyoliths. Locality #3, however, was barren of all of these ichthyoliths, even though most are very common. This locality represents the southernmost extent of the Plattsmouth Limestone and indicates an atypical environment.

Localities #15 and #16 are again very similar to each other relative to the second factor, and are situated on the bottom half of the axis. Thus, the ichthyoliths which are highly and positively correlated with this factor tend to be absent at these localities whereas those which are associated at high negative values are generally present at localities #15 and #16. The ichthyolith types highly correlated with this factor are not common.

No clear pattern of the localities is apparent relative to factors III, IV, V, VI and VII. However, locality #4 is distinct from the other localities relative to factor III. The ichthyoliths which correlated highly and positively with this factor (#148 and #172) were both absent in the Plattsmouth Limestone at locality #4. Those ichthyolith types which were associated at high negative values were all present at this locality.

Localities #6 and #7 are segregated from the other localities along the fourth principal coordinates axis, but are situated at opposite ends of the axis. Those ichthyolith types which correlate at high positive values with factor IV (Table 5) were generally present at locality #7 and absent at locality #6, whereas those ichthyolith with high negative correlations were absent at locality #7 and present at locality #6.

Localities #15 and #16 are separated from each other along the fifth and seventh axes. The ichthyoliths highly correlated with these factors are rare and many of them were distributed oppositely at these localities (that is, present at one and absent at the other). Factor VI resulted in an identical placement of localities #15 and #16 along the bottom of the axis. Most of the ichthyolith types which correlate highly and positively with this factor were absent at localities #15 and #16, while those which are associated at high negative values were generally present. Text-figures 17 and 18 further illustrate the close relationship of localities #15 and #16 relative to the first and sixth axes and the second and sixth axes, respectively.

DISCUSSION

General Observations

The variously-colored ichthyolith assemblage in the Stoner Limestone in Cass County, Iowa, is difficult to explain. Reworking or stratigraphic leakage may have occurred, but presumably the conodonts would be variously colored as well. However, other factors might result in such an anomaly. For example, the ichthyoliths may have been more susceptible to reworking, but there is no apparent reason why this should be true. Another explanation is that both the ichthyoliths and conodonts were reworked but that the ichthyoliths were more susceptible to organic metamorphism and are therefore variously colored. However, there is no evidence of reworking of the conodonts (von Bitter, pers. comm.). It is also possible that the ichthyoliths were altered and eroded from deposits barren of conodonts, then redeposited in the present locality. The accumulation of radioactive isotopes could also account for the darker-colored ichthyoliths (Zidek, pers. comm.), but the same problem exists in trying to explain the variation of colors.

Geothermometry

Ichthyoliths alter both in color and structure with increasing temperatures. This demonstrates that ichthyoliths could be used to determine the amount of thermal alteration that the surrounding rock matrix has undergone. The grade of any hydrocarbons which might be present could be determined based on the altered ichthyoliths. In addition, since zonations have not yet been worked out for ichthyoliths, the presence of variously-colored ichthyoliths in a sample could be used to determine reworking or stratigraphic leakage.

The greater sensitivity of ichthyoliths relative to conodonts may be due to two main factors. First of all, ichthyoliths may have a higher ratio of organic to inorganic matrix than conodonts and it is this organic material which causes the carbonization to take place. Second, ichthyoliths are generally more porous than conodonts because of the numerous vascular canals. This porosity would result in greater exposure of the organic material and therefore a lower alteration temperature. The greater porosity of ichthyoliths also makes them more susceptible to other, unrelated phenomena such as leaching, chemical alterations and staining. For example, I have attempted to induce thermal changes in dermal denticles from a Recent shark. In order to disaggregate the scales from the hide, I dissolved the hide in 5% sodium hypochlorite (standard household bleach). Unfortunately, the scales would not alter after this treatment since it resulted in a destruction not only of the hide but also of the organic matrix of the scales. Since sodium hypochlorite is sometimes used to disaggregate rock samples, one must be certain what chemicals have been used to recover specimens when looking at ichthyoliths for carbonization studies. Conodonts are apparently not susceptible to sodium hypochlorite in this way (Bruce Wardlaw, pers. comm.) as are palynomorphs (L. R. Wilson, pers. comm.). In fact, conodonts are resistant to most chemicals used. In addition, I have observed, as have others (for example, Mike Hansen, pers. comm.), discolored ichthyoliths in rocks which have apparently not undergone thermal alteration. For example, in deposits rich in hematite, the ichthyoliths are often stained reddish-brown (very close to one of their alteration colors). Although the susceptibility of ichthyoliths to chemical changes is in some ways a disadvantage, I believe that it may be an advantage as well. It simply indicates that ichthyoliths, as a group, should prove to be more sensitive to any changes than conodonts. But as much caution must be exercised in processing the ichthyoliths as is needed with palynomorphs.

The different reactions of various types of ichthyoliths (for example, chondrichthyans versus osteichthyans) is apparently due to the varying relative amounts of organic and inorganic material in the different types of ichthyoliths (for example, chondrichthyans versus osteichthyans). This is similar to Wilson's (1971) findings that different palynomorph genera undergo thermal alterations differently. It will be necessary, therefore, to set up a separate thermal alteration scale for each of the major groups of ichthyoliths.

Field observations (Bobb Schaeffer, pers. comm.; Paul Olsen, pers. comm.) have been made of fish remains which have been thermally altered in rocks near the Palisades Sill. Fish remains in rocks approaching the sill become progressively darker until very near the sill where they become chalk white. In rocks adjacent to the sill, the fish remains are crystal clear and very brittle. These observations are strikingly similar to those of Epstein et al. (1977)

of the conodont thermal alterations. Olsen (pers. comm.) has observed that fish bone appears to alter before teeth and scales, probably due to the greater relative amount of organic material in bone versus teeth and scales.

The more substantial structural change of the osteodentin relative to the orthodentin is a result of the greater amount of organic material in the osteodentin which, when it volatilizes, effects the structure of the inorganic matrix of the tooth. Although initial studies have been done on large elasmobranch teeth, it will be necessary to study these changes in the smaller teeth and scales as well. Differences in surface/volume ratios could have an effect on the structural alterations. The larger teeth began to fracture at much lower temperatures (500°C for 24 h) than the small ichthyoliths. Observations of structural changes might be useful in distinguishing ichthyoliths which are reddish-brown due to thermal change from those due to hematite staining.

Geographic Variation/Biostratigraphy

Text-figures 4 and 5 illustrated a generalized trend of increasing diversity in a northward direction for the Heebner/Eudora and Plattsmouth/Stoner members. They also show an abrupt increase in ichthyolith abundance and diversity in the Leavenworth/Captain Creek members at localities #1 and #16. These patterns indicate a response of the ichthyoliths to a more nearshore environment. However, these graphs provided only generalized information regarding abundance and diversity. For example, in Text-figure 4, localities #11 and #13 have approximately the same diversity but there might be a totally different ichthyolith fauna at each of these localities. This difference would not be indicated in this graph. Multivariate techniques provided more refined information regarding the relationship of the localities based on their ichthyolith fauna.

The results of the geographic variation analyses for the Leavenworth Limestone/Captain Creek Limestone indicated a substantial difference in the ichthyolith fauna at localities #1, #15 and #16. This is in close agreement with Toomey's (1966, 1969a) placement of localities #1 and #16 into an aggregate-grain facies, and locality #15 into a mudstone facies. The relationship of the localities in the dendrogram of the geographic variation analysis appears to support the trend seen in Text-fig. 5 in which the southern localities (with the exception of locality #1) have a lower diversity which gradually increases toward the north. The same relationship was produced by principal components analysis.

The results of the biostratigraphic analysis also indicated a distinction of localities #16, #15 and #1. The segregation of these localities from the others relative to principal coordinates axis II is a result of the high correlation of the abundant ichthyoliths with factor II. Thus, the distinction of localities #16, #15 and #1 is a result of the much higher diversity and different ichthyolith fauna at these localities. Although in Text-figure 5 locality #15 did not have a significantly greater diversity than the other localities, the ichthyolith fauna at locality #15 is sufficiently different to result in its clear separation from the other localities in both the geographic variation and biostratigraphic analyses.

The higher similarity of localities #1 and #16 (versus #15 and #16) is also in agreement with Toomey's (1966, 1969a) results. An initial interpretation of this geographic variation is that the increase in ichthyolith abundance and diversity at the two edges of the transect was a result of increasing nearness to shore. However, the different stratigraphic position of localities #15 and #16 is now a more satisfactory explanation for their relationship. The difference in the ichthyolith fauna at locality #1 is still best interpreted as a reflection of environmental change (nearness to shore) since the unit at locality #1 is still considered to be the Leavenworth Limestone.

The geographic variation analysis of the Heebner Shale/Eudora Shale resulted in no distinction of the Iowa samples. However, in the biostratigraphic analysis, there was a segregation of localities #15 and #16 relative to the seventh principal coordinates axes. This is in agreement with von Bitter's (1976) results regarding the conodont distribution.

In both the geographic variation and biostratigraphic analyses, locality #14 also tended to segregate out from the other localities. The apparent similarity of He-14 with He-15 and He-16 in the biostratigraphic analysis is puzzling. Von Bitter (pers. comm.) and von Bitter and Merrill (1980, see their Table 2) have observed that the presence of Gondolella postdenuda and other gondolellids is unusual in the Heebner Shale at Johannsen Quarry in Cass County, Nebraska. Although He-14 has clustered closely to He-15 and He-16 in my analyses (which are the Captain Creek Limestone), von Bitter and Merrill (1980) noted a greater faunal similarity of He-14 to the Queen Hill Shale (Lecompton Formation, Shawnee Group). If the Heebner Shale at locality #14 has been misidentified, its close similarity with He-15 and He-16 may be due to the different assemblages present at all three localities even though they represent different stratigraphic horizons. This would be due to their lower similarity with the other Heebner Shale localities.

The geographic variation analysis of the Plattsmouth Limestone/Stoner Limestone did not result in a clustering of localities #15 and #16 relative to the other localities, indicating a similar environment during the deposition of the Stoner and Plattsmouth limestones. However, localities #15 and #16 showed a higher similarity to each other than to all the other localities in the cluster analysis of the biostratigraphic data. In principal coordinates analysis, the Iowa localities were most similar relative to the sixth principal coordinates axis. Thus, the ichthyolith assemblage which correlated highly with this factor would be characteristic of these localities relative to the others. Based on these results, the Stoner Limestone could be distinguished from the Plattsmouth Limestone by the absence of ichthyolith types #032, #165 and #210 since these ichthyoliths were highly and negatively correlated with factor VI. Four of the six ichthyolith types which occurred in the Stoner Limestone but not in the Plattsmouth (#236, #237, #239 and #240) were negatively correlated with factor VII but were not effective in separating localities #15 and #16 from the other localities. This is probably due to the lower correlations of these rare ichthyoliths than the more common ichthyoliths.

The principal coordinates analyses of the Heebner and Plattsmouth members indicated a distinction of locality #3 in Osage County, Oklahoma. The ichthyolith fauna was particularly sparse here, and even the common ichthyolith types were absent. This may be due to the fact that this locality was the southernmost extent of the Plattsmouth and nearly the southernmost extent of the Heebner. This extreme nearness to shore was apparently detrimental to the ichthyolith fauna in these members.

The analyses of geographic variation showed increasing trends in the abundances and diversities of the ichthyoliths from south to north and segregated those localities which had very low similarities based on the ichthyoliths. Except for the Leavenworth Limestone, however, no clustering or separation of the Iowa localities resulted. The biostratigraphic analyses showed a greater distinction of the Iowa localities both in cluster analysis and in principal coordinates analysis since localities #15 and #16 were seen to be more similar to each other than they were to the other localities. Although the cluster analysis illustrated the higher similarity of the Iowa localities to each other than to the other localities, it still clustered these localities in with the others and did not segregate them. The results of the principal coordinates analyses were quite complex due to the large number of ichthyoliths used in the analyses. However principal coordinates analysis provided useful information regarding the ichthyolith fauna characteristic of the Iowa localities through an examination of the ichthyolith correlations with each factor. It was also necessary to re-examine the raw data to understand the complex relationships resulting from the principal coordinates analysis.

Six ichthyolith types (#236, #237, #239, #240, #242 and #245) occurred in the Iowa samples but nowhere else. In addition, 18 ichthyolith types (#022, #032, #064, #067, #070, #096, #107, #124, #132, #134, #165, #177, #201, #203, #210, #229, #231 and #232) were present at other localities but were absent at localities #15 and #16. Although there were many differences in the ichthyolith fauna in Iowa, they did not have a great effect in separating these localities, probably because there were so many ichthyolith types used in the analyses which occurred in both the Lansing and Shawnee group samples. Thus, the overall similarity of the ichthyolith assemblages at all localities was relatively high.

CONCLUSIONS

The use of ichthyoliths to solve geological problems has been extremely limited, largely due to the taxonomic problems encountered with the disarticulated elements. However, the use of a utilitarian taxonomic system provided a means of identifying the ichthyoliths and utilizing them in various analyses.

Although the Mesozoic and Cenozoic ichthyoliths have been shown to be biostratigraphicly useful, the Late Paleozoic ichthyoliths have been virtually ignored. Throughout this study, it has been essential to compare the ichthyolith distributions with those of the conodonts since they provided an important control. The results of this study indicate that the distributions of ichthyoliths and conodonts are remarkably similar and that Late Paleozoic ichthyoliths have the potential to provide the same information as conodonts in shallow-water marine deposits. Therefore, ichthyoliths could contribute to solving biostratigraphic and geographic variation problems in other Upper Pennsylvanian strata of the midcontinent region. In addition, initial results of carbonization studies show that ichthyoliths can also provide valuable information regarding the thermal history of rocks. Their color and internal structural changes are both time and temperature dependent, indicating that ichthyoliths may become a valuable tool for hydrocarbon exploration.

Ichthyoliths have the potential of exceeding the usefulness of conodonts for various applications in geology because of their longer stratigraphic range and wider ecological distributions. The similar reactions of ichthyoliths and conodonts to thermal alterations provide an even greater incentive to better understand ichthyoliths. The results of this research indicate that Late Paleozoic ichthyoliths are a potentially important group of microfossils for studies of biostratigraphy and geographic variation and merit intensive study.

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Table 1. Average abundances and diversities of ichthyoliths in each member.

Member	Average no. ichthyoliths/kg	Total no. ichthyolith types
Leavenworth Limestone	38.79	56
Captain Creek Limestone	71.41	42
Heebner Shale	106.54	92
Eudora Shale	28.99	46
Plattsmouth Limestone	127.59	130
Stoner Limestone	311.34	116

Table 2. Percentage of variation explained by seven factors resulting from principal coordinates analysis based on presence-absence data of combined members.

Factor	Leavenworth/ Captain Creek	Heebner/ Eudora	Plattsmouth/ Stoner
I	19.98	22.49	26.26
II	16.49	13.90	16.04
III	13.50	12.06	9.29
IV	10.23	8.11	8.86
V	8.65	7.59	7.10
VI	7.76	6.03	6.81
VII	7.36	5.97	5.98
Cumulative Percentage	83.97	76.15	80.34

Table 3. Correlations of ichthyolith types with the first seven factors of principal coordinates analysis using biostratigraphic data from the Leavenworth Limestone. Product-moment correlation coefficient = r. Correlations > |0.500| are shown.

Factor	Type	r	Type	r	Type	r	Type	r
I	035	-.735	038	-.735	056	.597		
II	005	.525	006	.746	009	.525	011	.571
	012	.502	013	.571	031	.737	033	.518
	035	.614	038	.614	040	.737	054	.505
	056	.542	058	.519	066	.525	068	.509
	072	.690	089	.525	091	.737	118	.525
	127	.737	128	.525	135	.525	137	.690
	139	.525	142	.525	148	.525	164	.737
	172	.525	175	.525	190	.737	191	.525
	205	.737	206	.525	207	.525	208	.525
III	007	.517	017	.625	047	.604	068	.552
	119	.711						
IV	012	-.604	057	-.741				
V	033	.671	047	-.604	086	-.594	152	-.591
VI	169	-.515						

Table 3. Continued.

Factor	Type	r	Type	r	Type	r	Type	r
VII	005	-.584	009	-.584	011	-.584	013	-.518
	015	-.503	066	-.584	089	-.584	118	-.584
	128	-.584	139	-.584	142	-.584	148	-.584
	172	-.584	175	-.584	191	-.584	193	-.610
	206	-.584	207	-.584	208	-.584		

Table 4. Correlations of ichthyolith types with the first seven factors of principal coordinates analysis using biostratigraphic data from the Heebner Shale. Product-moment correlation coefficient = r. Correlations > |0.500| are shown.

Factor	Type	r	Type	r	Type	r	Type	r
I	006	.907	007	.695	009	.892	013	.713
	015	.602	017	.808	018	.670	021	.652
	031	.557	035	.532	040	.557	054	.562
	056	.789	057	.542	058	.725	068	.658
	074	.587	091	.541	095	.698	118	.572
	119	.602	128	.525	136	.695	138	.557
	139	.519	140	.523	142	.530	152	.536
	154	.582	156	.907	193	.840	208	.596
II	038	.603	193	-.505				
III	007	.570	145	.580				
IV	035	.593	214	-.584	217	-.605		
V	047	-.597	142	-.586				

Table 4. Continued.

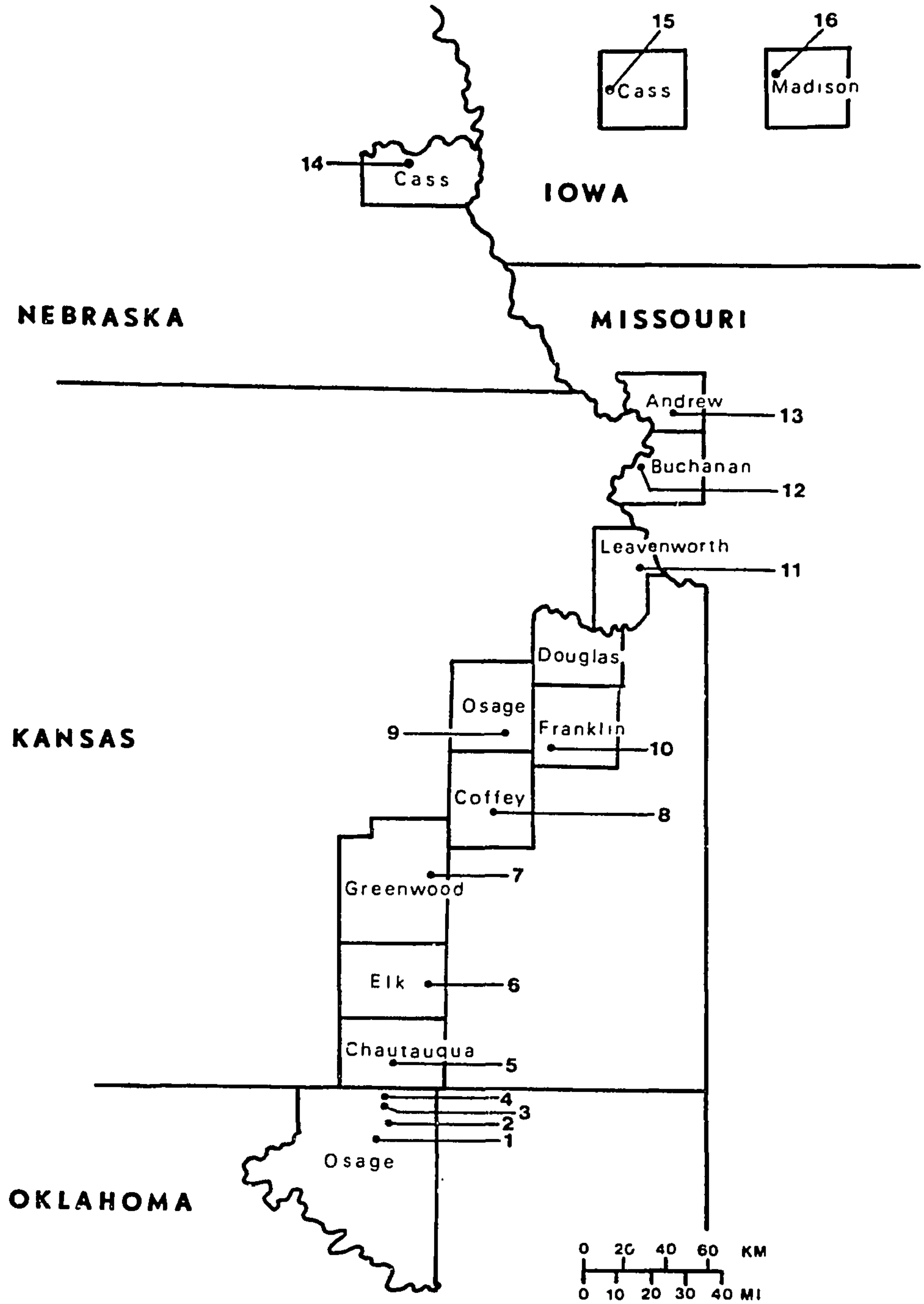
Factor	Type	r	Type	r	Type	r	Type	r
VI	141	-.519	157	-.670	208	.530		
VII	002	-.596	011	.569	087	.556	092	-.523
	135	.653	172	-.650	211	-.592	215	-.705
	216	-.523						

Table 5. Correlations of ichthyolith types with the first seven factors of principal coordinates analysis using biostratigraphic data from the Plattsmouth Limestone. Product-moment correlation coefficient = r. Correlations > |0.500| are shown.

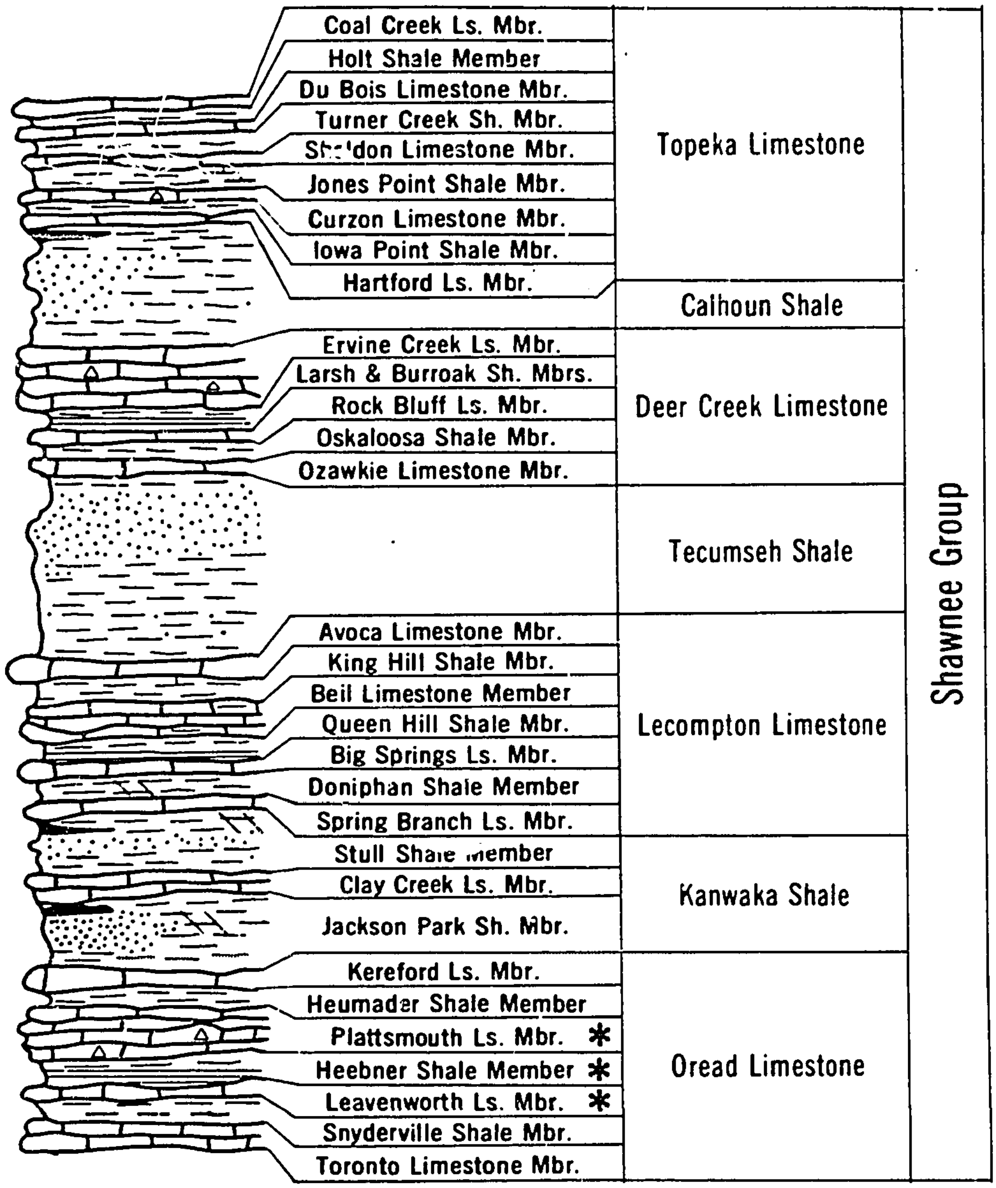
Factor	Type	r	Type	r	Type	r	Type	r
I	005	.790	007	.917	009	.712	011	.917
	013	.917	015	.917	018	.596	021	.719
	026	.555	031	.917	035	.917	040	.606
	047	.780	049	.590	054	.790	056	.719
	057	.745	058	.917	062	.790	066	.917
	068	.780	072	.917	074	.568	089	.547
	091	.593	095	.652	118	.651	119	.593
	128	.764	136	.583	137	.587	140	.745
	142	.538	148	.540	156	.790	187	.558
	190	.737	193	.728	208	.640	211	.745
	213	.540						
II	012	.550	057	-.602	074	-.616	095	-.648
	118	-.532	139	-.531	140	-.602	211	-.602
	213	-.502	214	-.776	218	-.531	232	.517

Table 5. Continued.

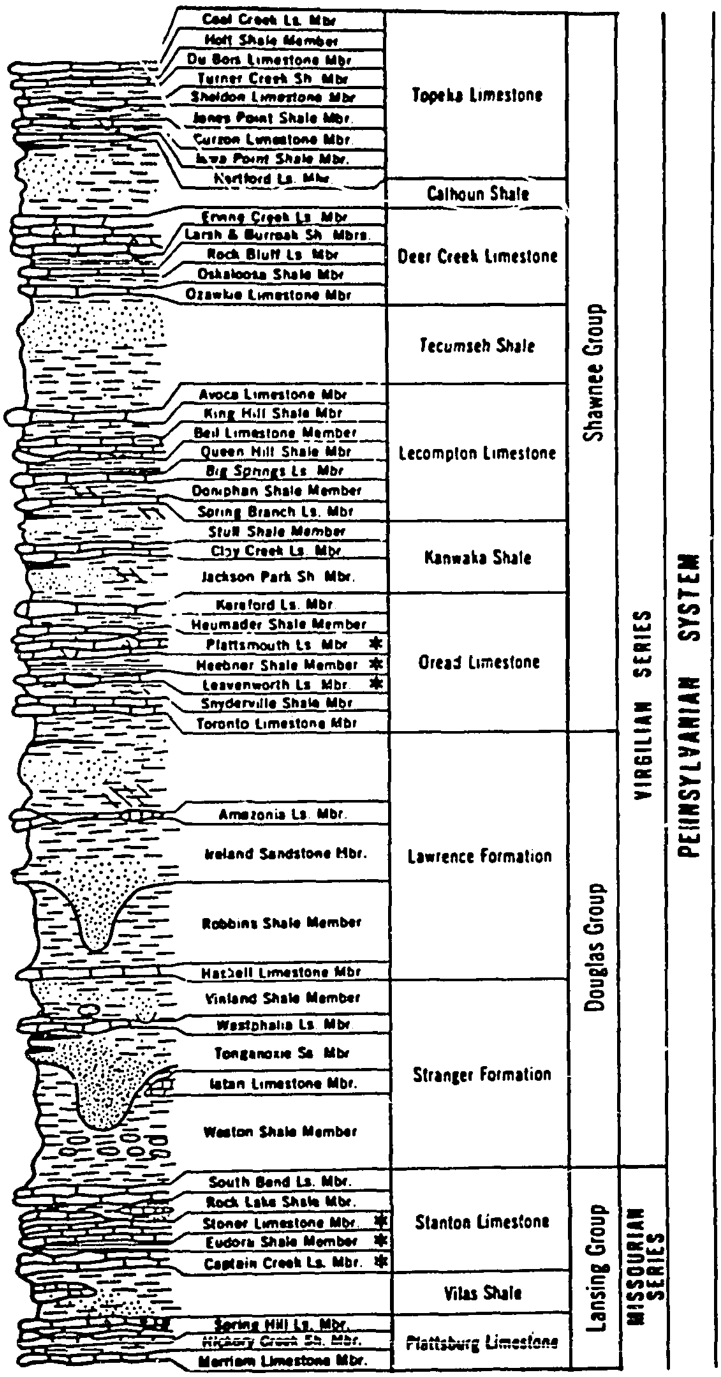
Factor	Type	r	Type	r	Type	r	Type	r
III	028	-.573	029	-.715	086	-.713	092	-.585
	105	-.508	141	-.507	148	.611	172	.767
	173	-.566	203	-.659	216	-.594	219	-.594
IV	001	.524	009	-.506	021	-.506	033	.620
	056	-.506	091	-.502	119	-.502	145	.645
	206	.563	232	-.633				
V	008	.518	019	-.522	033	-.579	082	.572
	098	.540	127	-.608	220	-.505	233	-.733
	234	-.583						
VI	001	-.524	032	.627	070	.592	083	-.548
	165	.727	173	.543	176	-.514	187	-.503
	202	-.597	210	.627				
VII	032	-.531	089	.622	090	.565	140	-.700
	144	-.779	152	.670	157	.627	191	-.584
	199	-.624	210	-.531	212	-.701	227	-.720
	231	.630	236	-.524	237	-.524	239	-.524



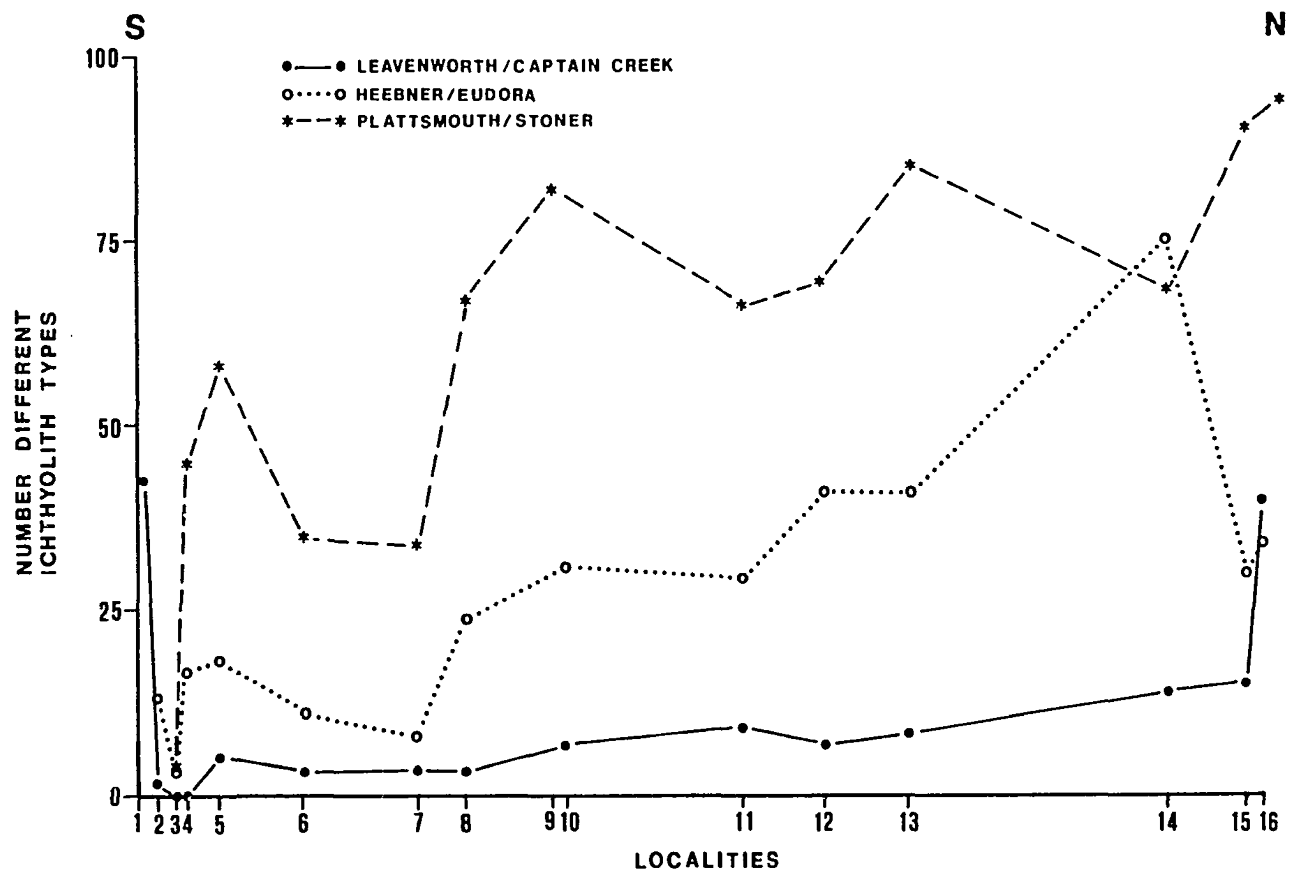
Text-fig. 1. Map of study area and sampled localities (modified from Toomey, 1969a).



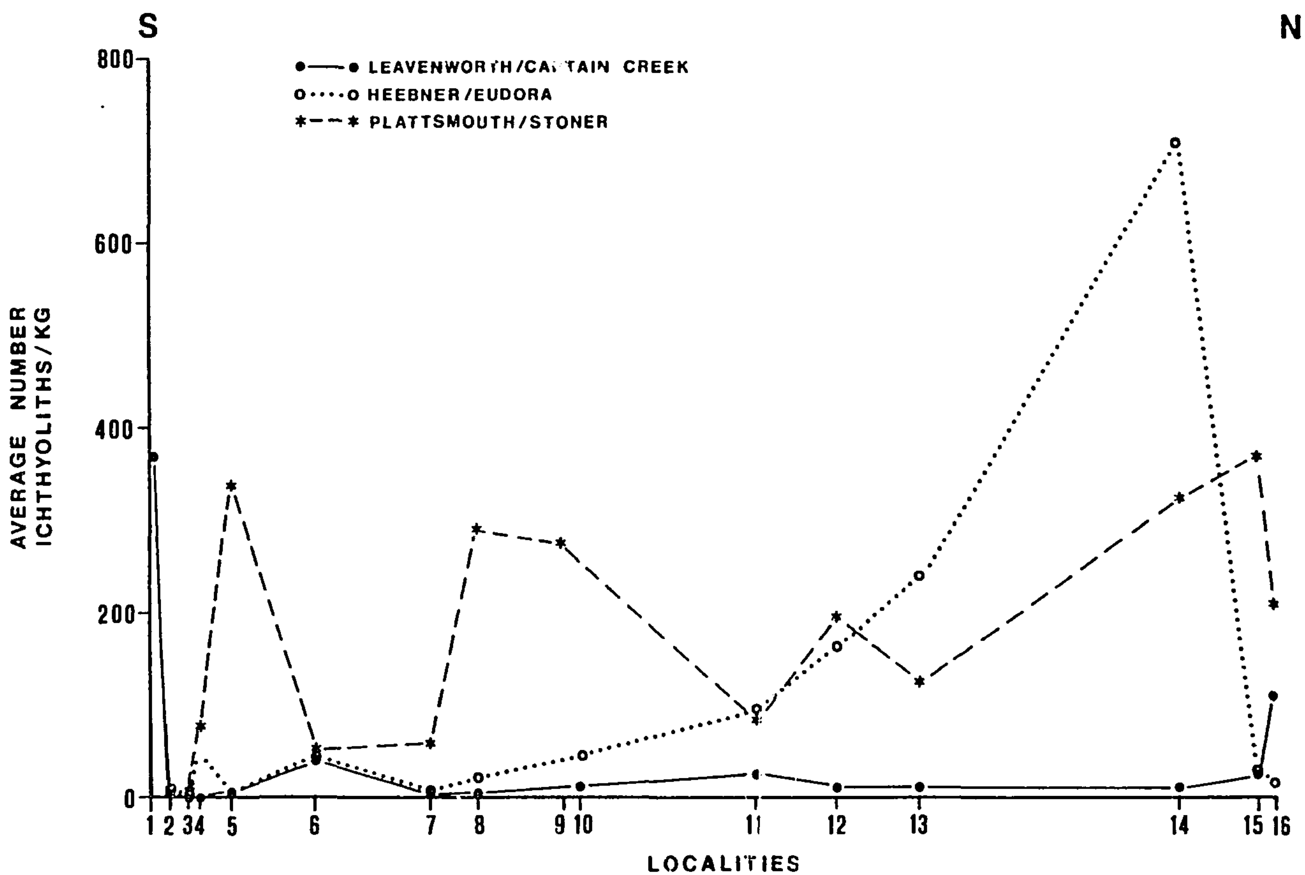
Text-fig. 2. Stratigraphic sequence of the Shawnee Group (modified from Plate 1 of Jewett et al., 1968). The studied members are noted with asterisks.



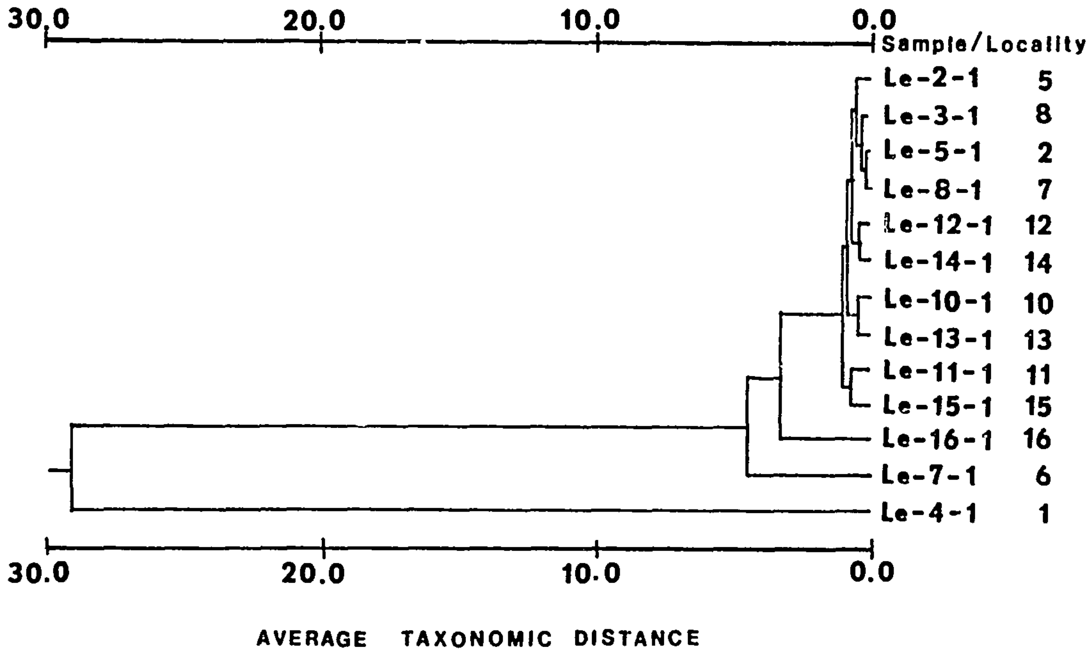
Text-fig. 3. Stratigraphic relationship of the Shawnee and Lansing groups (modified from Plate 1 of Jewett et al., 1968). The studied members are noted with asterisks.



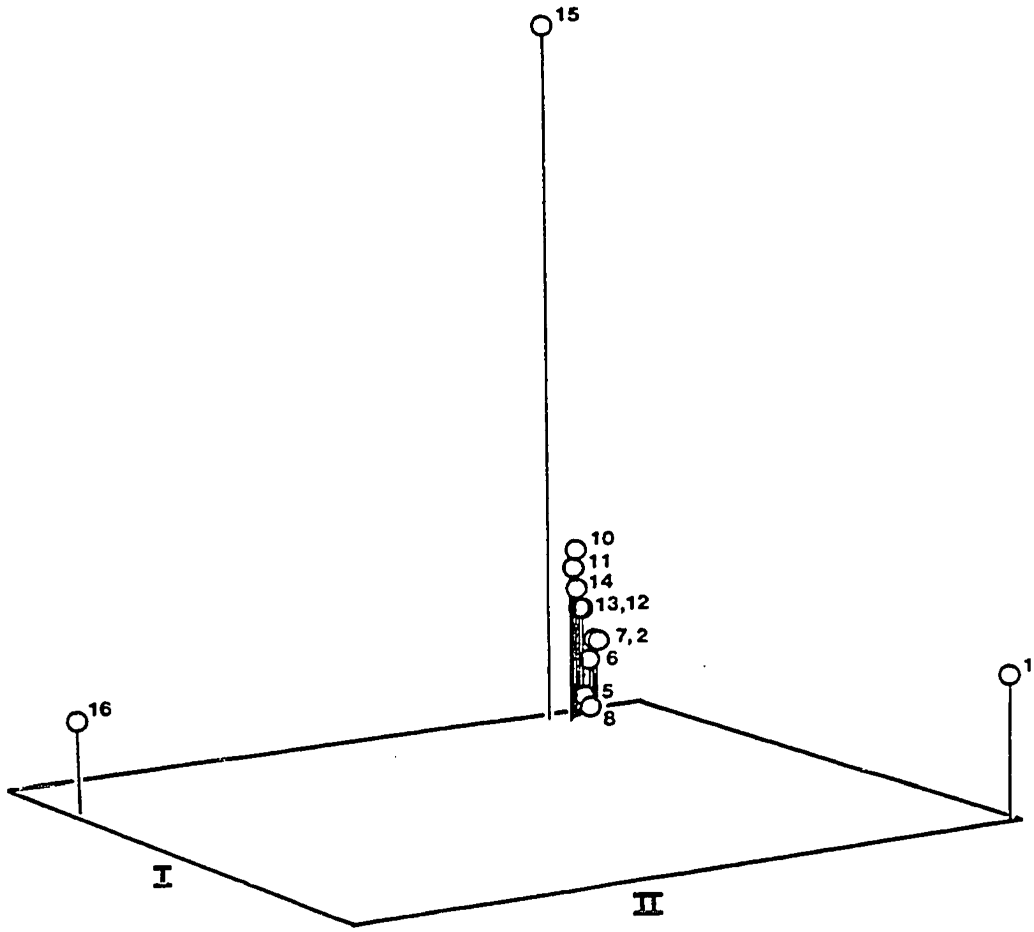
Text-figure 4. Ichthyolith diversity in each member along transect. Horizontal axis shows the relationship of the localities from south to north.



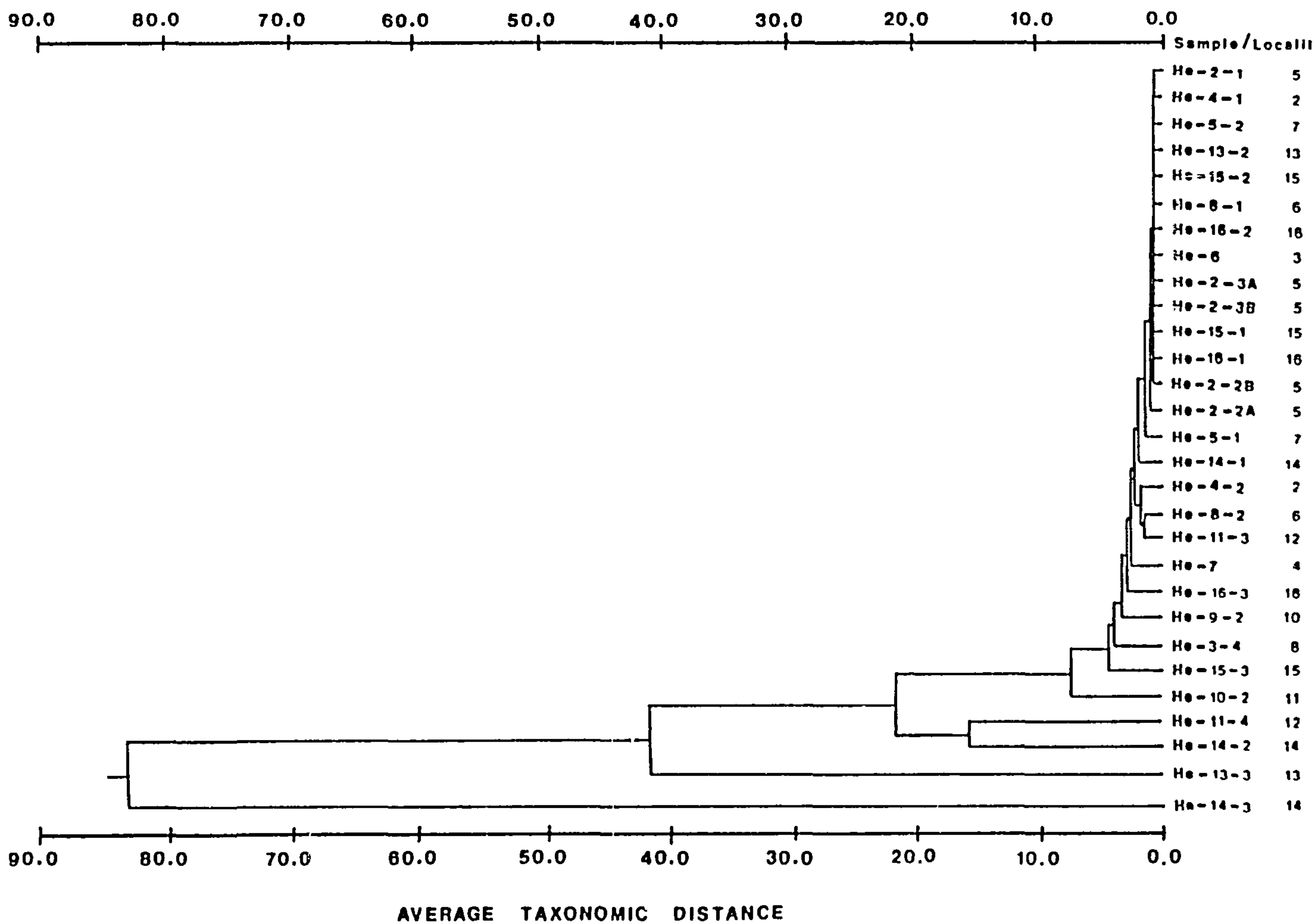
Text-figure 5. Ichthyolith abundance in each member along transect. Horizontal axis shows the relationship of the localities from south to north.



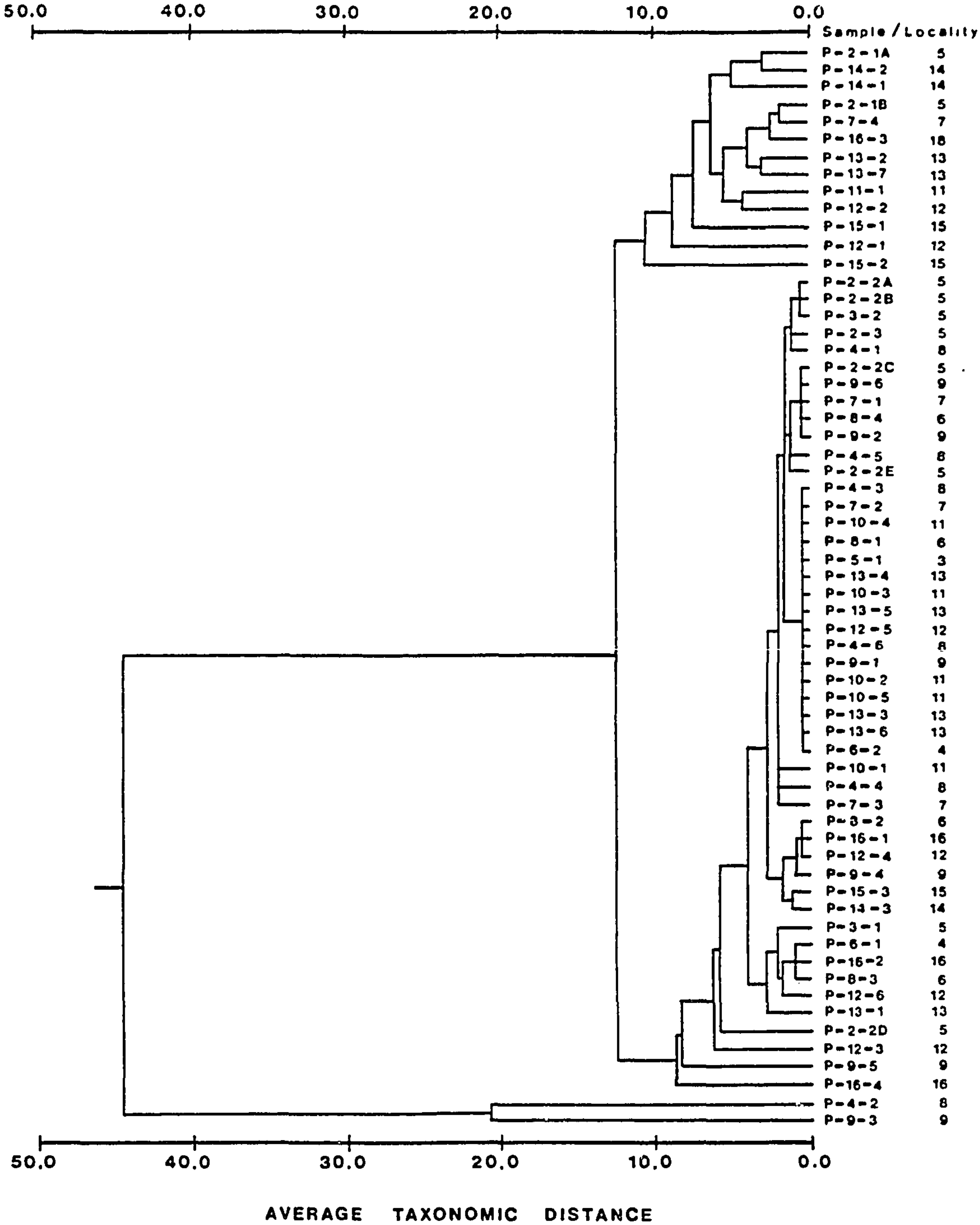
Text-fig. 6. Dendrogram based on an analysis of the abundance data of the Leavenworth and Captain Creek limestones (r_c=1.00).



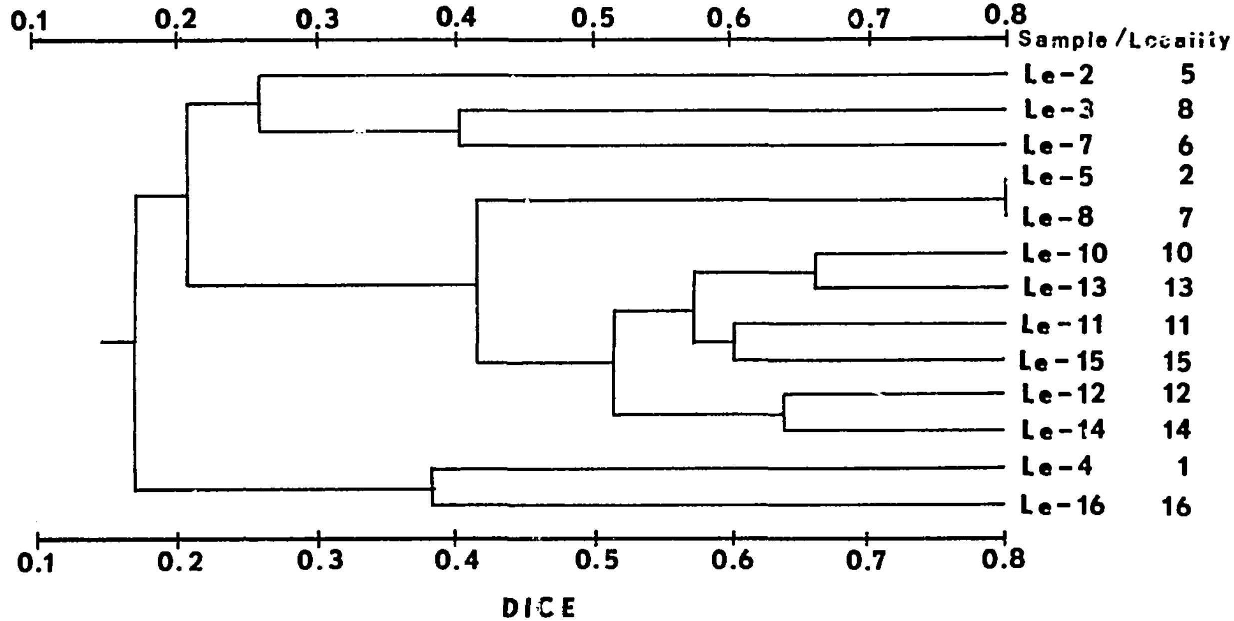
Text-fig. 7. Three-dimensional plot of the first three principal components axes based on an analysis of the abundance data of the Leavenworth and Captain Creek limestones.



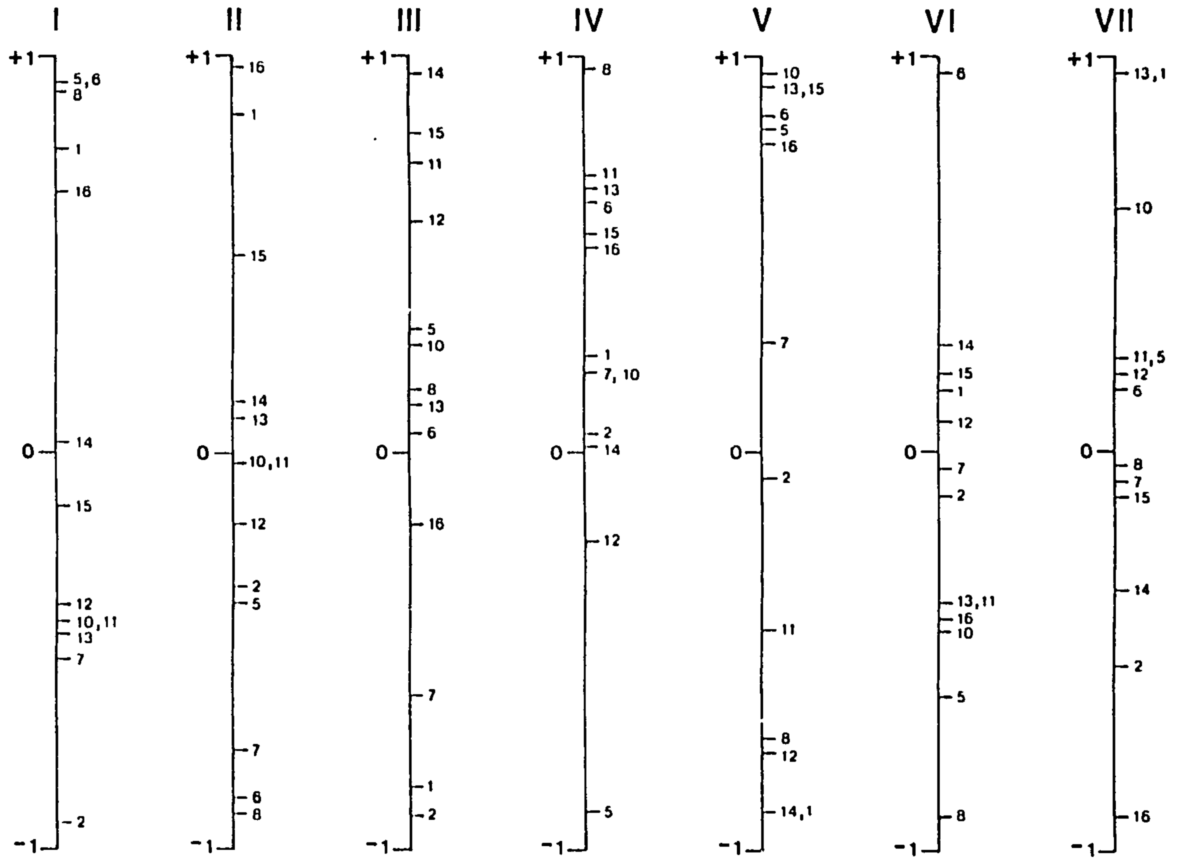
Text-fig. 8. Dendrogram based on an analysis of the abundance data of the Heebner and Eudora shales (r_c=0.99).



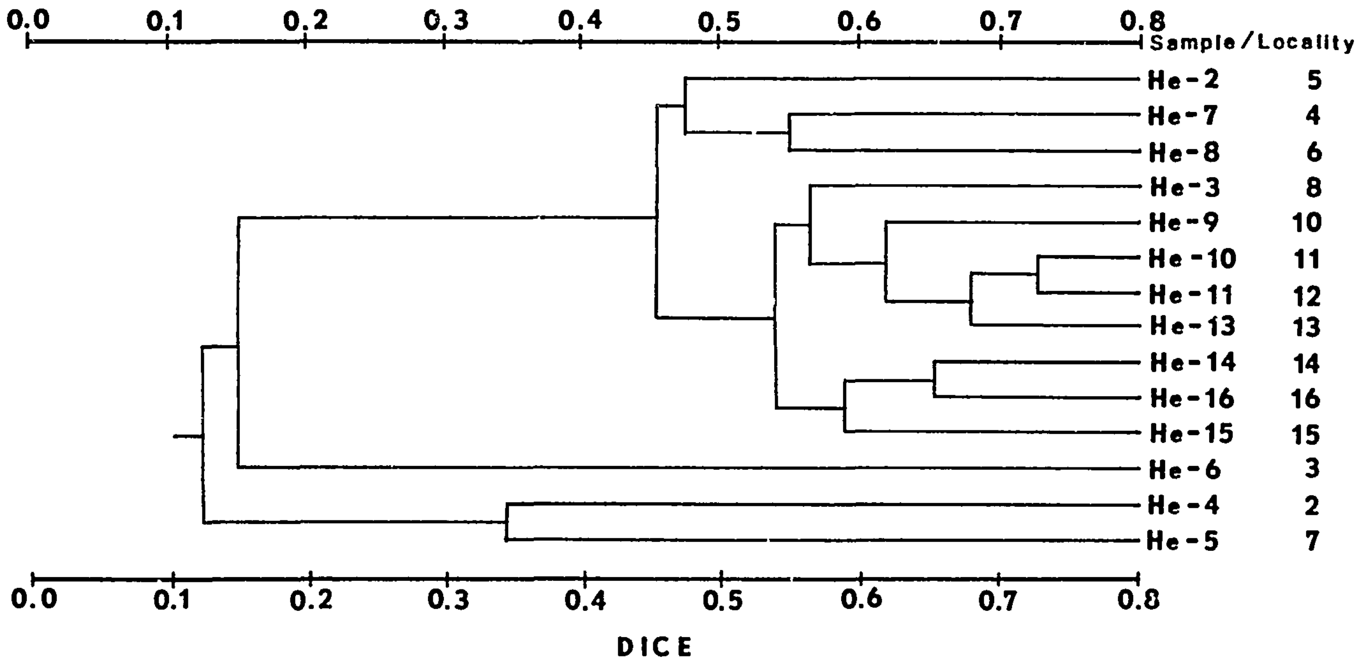
Text-fig. 9. Dendrogram based on an analysis of abundance data of the Plattsmouth and Stoner limestones (r_c=0.96).



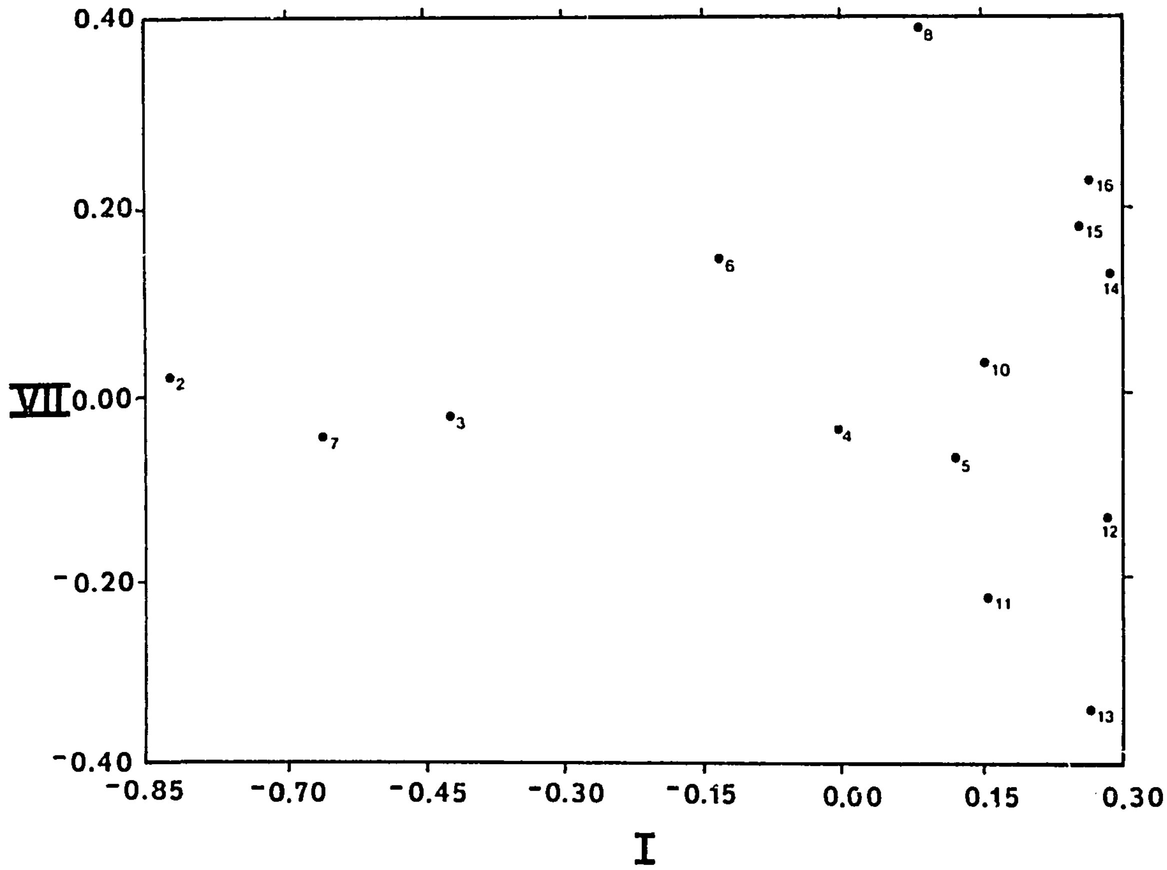
Text-fig. 10. Dendrogram based on an analysis of the presence-absence data of the Leavenworth and Captain Creek limestones (r_c=0.87).



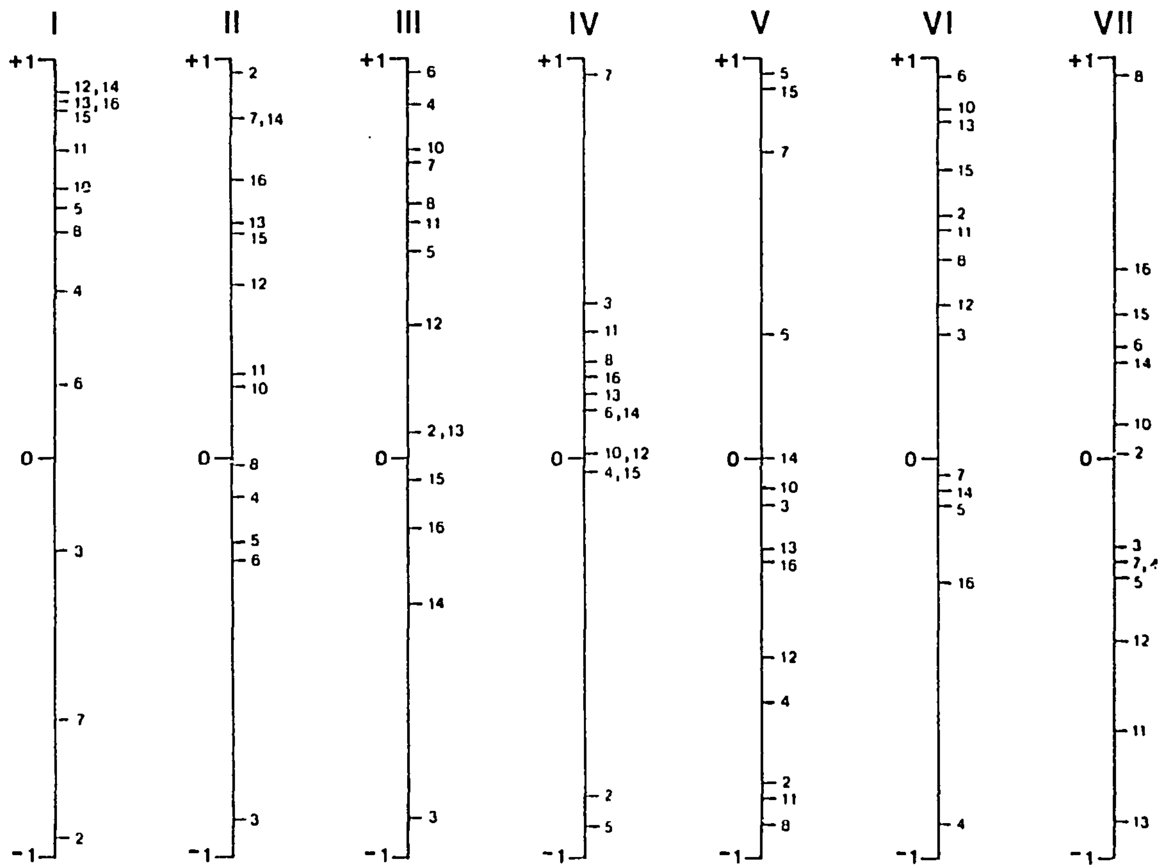
Text-fig. 11. Relationship of localities to first seven factors extracted from principal coordinates analysis based on presence-absence and range-through data of the Leavenworth/Captain Creek limestones.



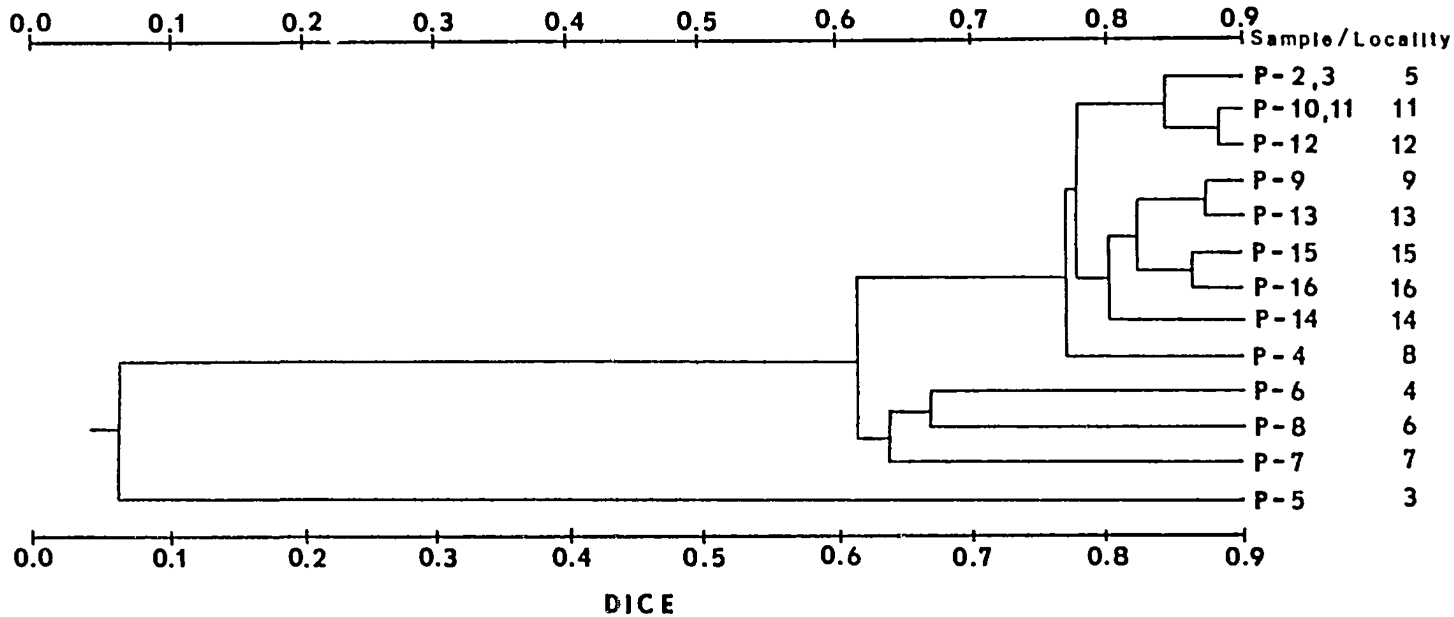
Text-fig. 12. Dendrogram based on an analysis of the presence-absence data of the Heebner and Eudora shales (r_c=0.94).



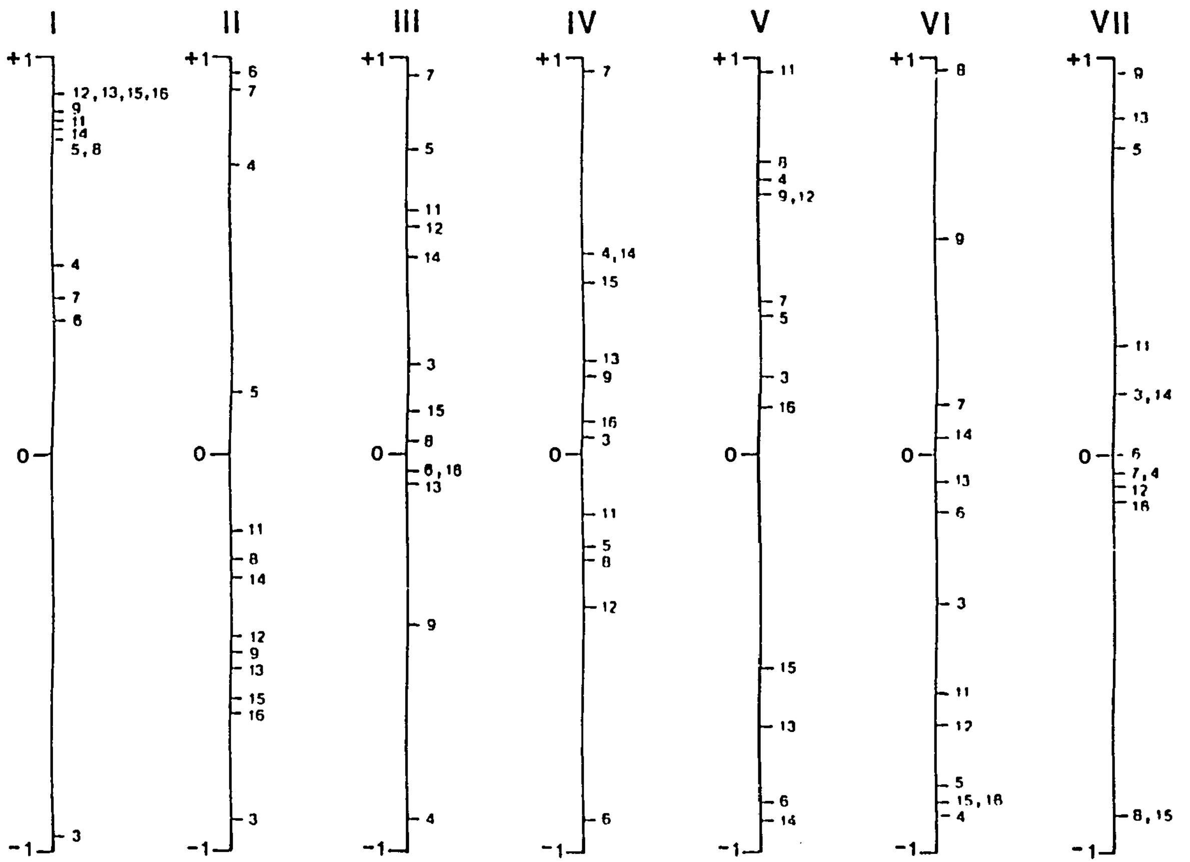
Text-fig. 13. Scatter diagram of principal coordinates axes I and VII based on an analysis of the presence-absence data of the Heebner and Eudora shales.



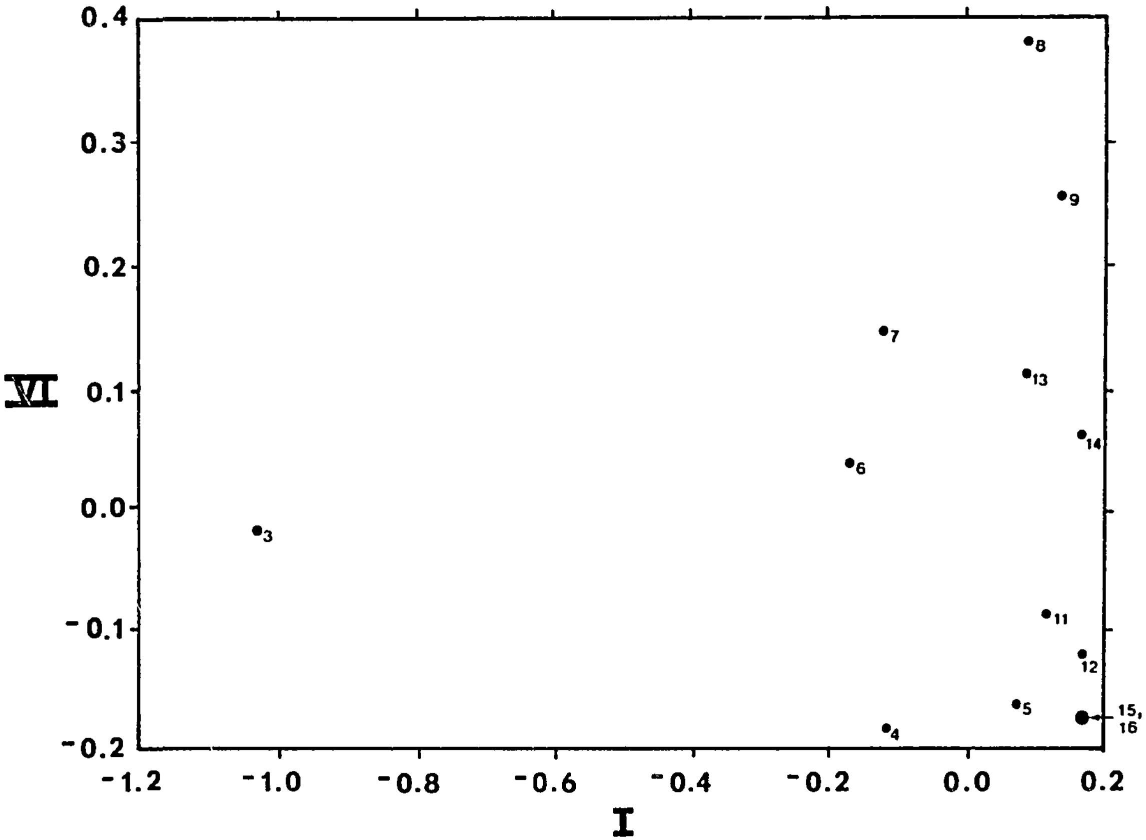
Text-fig. 14. Relationship of localities to first seven factors extracted from principal coordinates analysis based on presence-absence and range-through data of the Heebner/Eudora shales.



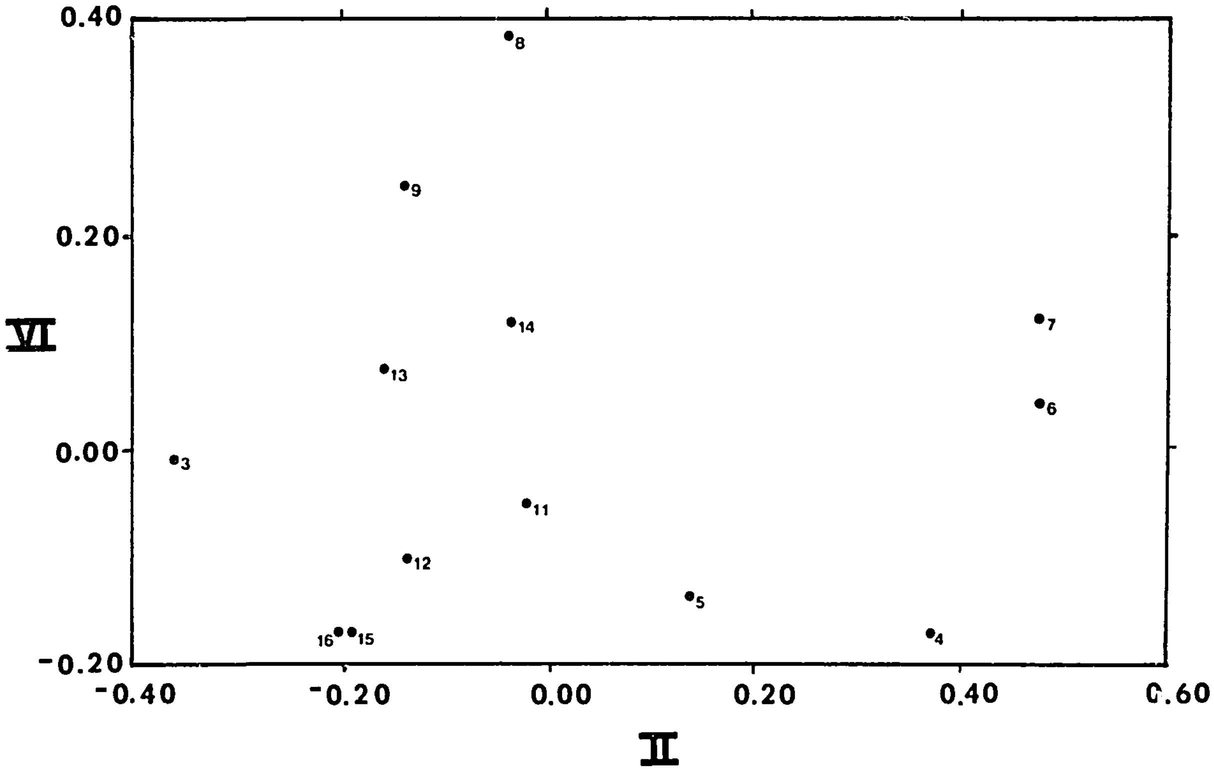
Text-fig. 15. Dendrogram based on an analysis of the presence-absence data of the Plattsmouth and Stoner limestones (r_c=0.99).



Text-fig. 16. Relationship of localities to first seven factors extracted from principal coordinates analysis based on presence-absence and range-through data of the Plattsmouth/Stoner limestones.

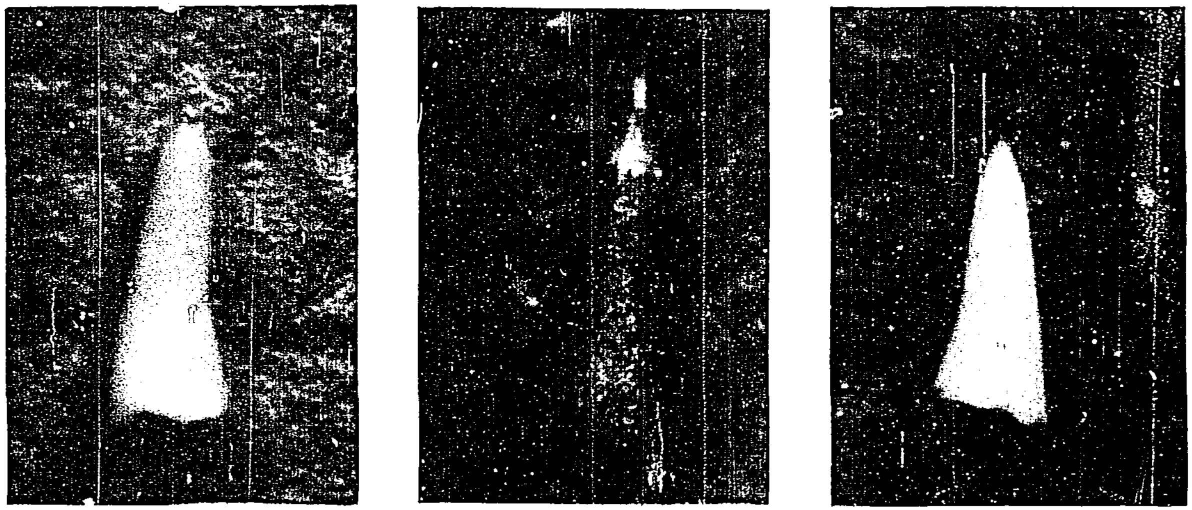


Text-fig. 17. Scatter diagram of principal coordinates axes I and VI based on an analysis of the presence-absence data of the Plattsmouth and Stoner limestones.



Text-fig. 18. Scatter diagram of principal coordinates axes II and VI based on an analysis of the presence-absence data of the Plattsmouth and Stoner limestones.

Plate 1. Variously-colored ichthyolith assemblage from the Stoner Limestone in Cass County, Iowa (30X).



a b c

Plate 2. (a) Unaltered palaeoniscoid tooth. (b) Thermally altered palaeoniscoid tooth (550°C for 8 hr.). (c) Thermally altered palaeoniscoid tooth (950°C for 4 hr.). All magnifications 50X.

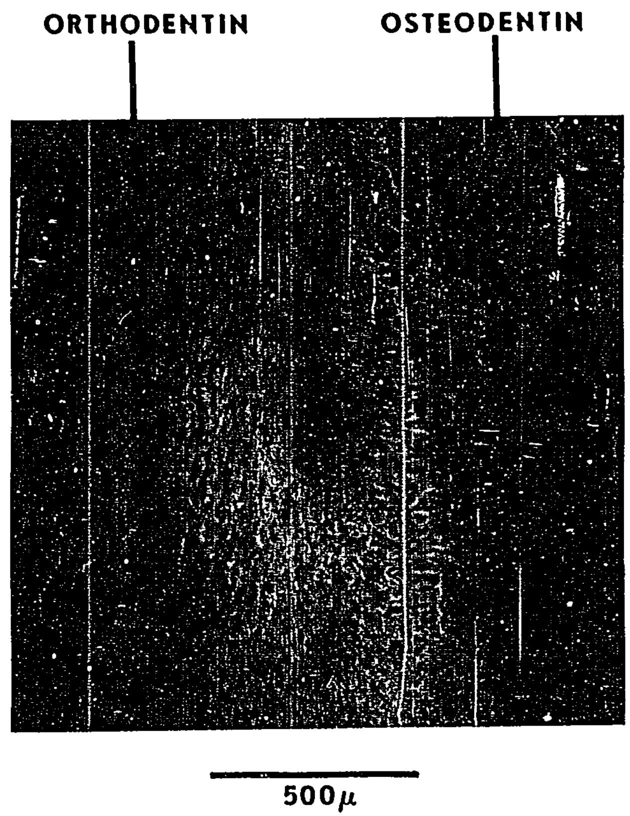


Plate 3. Longitudinal section of an elasmobranch tooth showing the orthodentin and osteodentin.

ORTHODENTIN

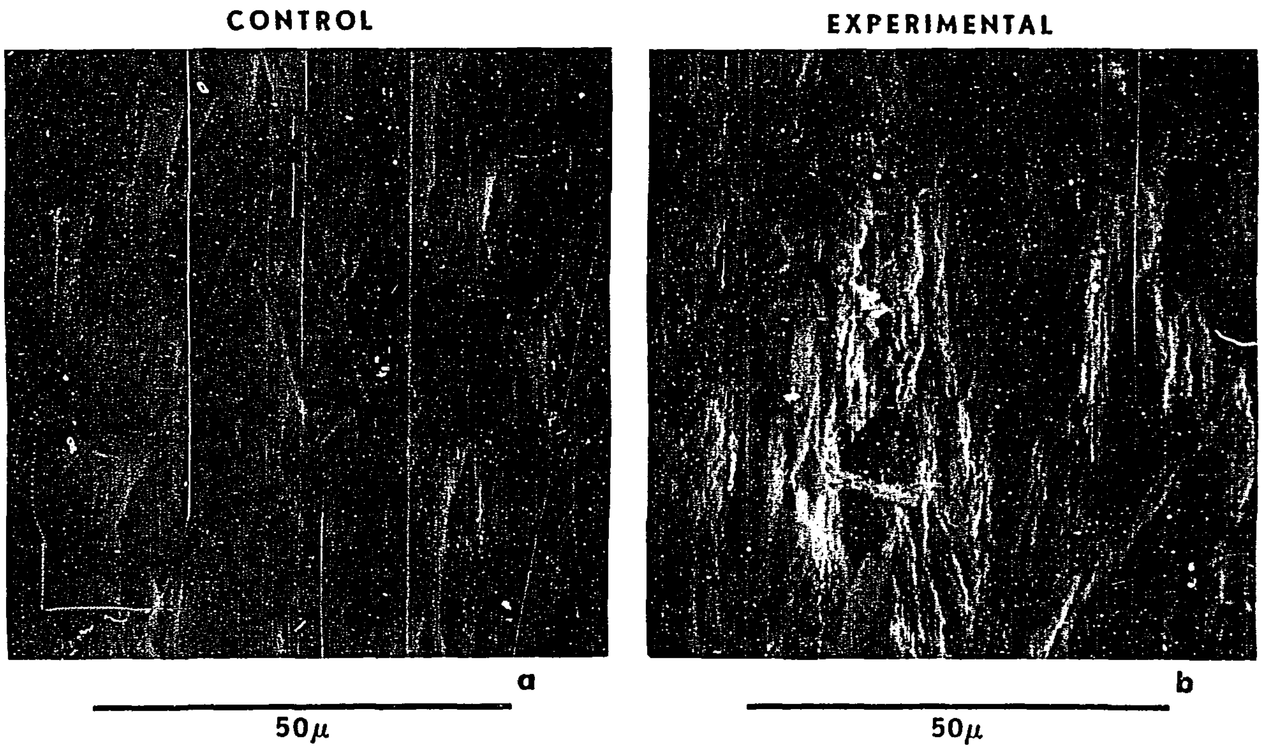


Plate 4. Orthodentin of a control (a) and an experimental (b) elasmobranch tooth. The experimental tooth was heated in open-air at 600°C for 24 hours.

OSTEODENTIN

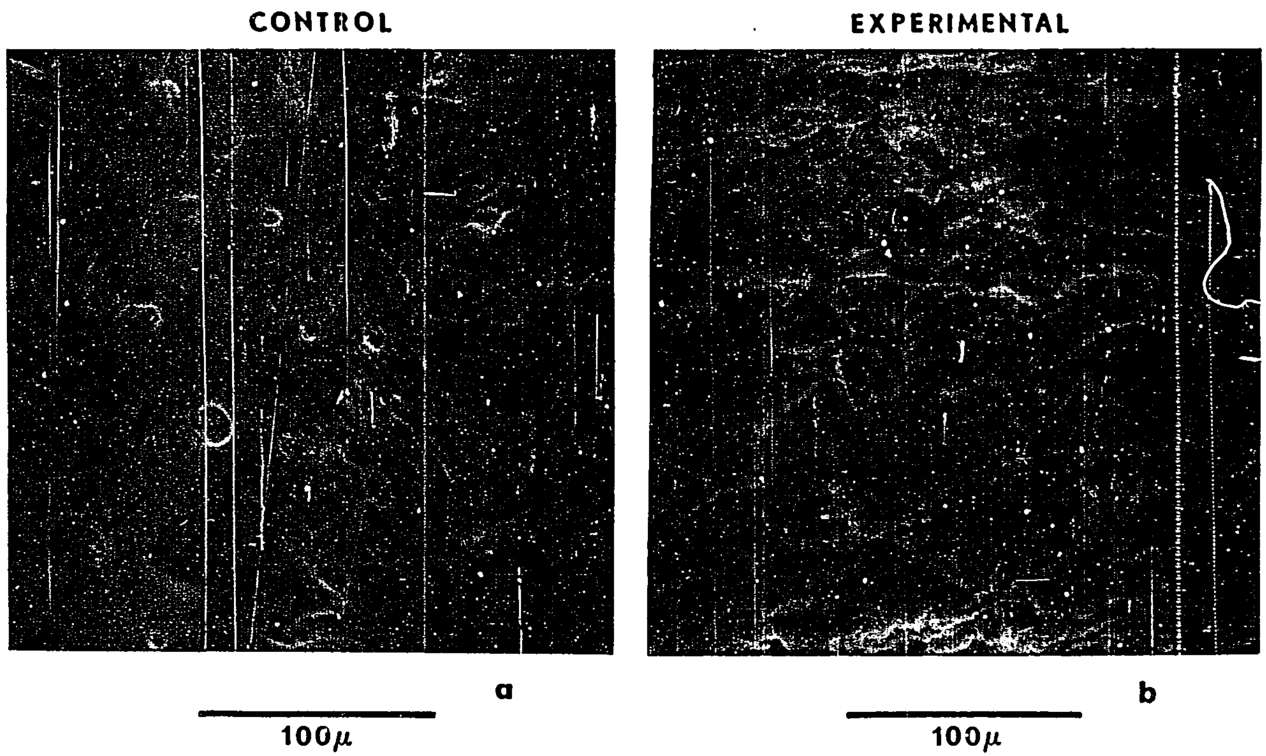


Plate 5. Osteodentin of a control (a) and an experimental (b) elasmobranch tooth. The experimental tooth was heated in open-air at 600°C for 24 hours.

APPENDIX A

MODIFICATIONS OF DESCRIPTOR SYSTEM FOR PALEOZOIC ICHTHYOLITHS

APPENDIX A

MODIFICATIONS OF DESCRIPTOR SYSTEM FOR PALEOZOIC ICHTHYOLITHS

Several new categories were added to the original key for Paleozoic ichthyoliths (Tway, 1979a) and are here indicated by an asterisk. In addition, some of the categories listed in the previous key have been further defined or altered (here indicated by italics). A "±" indicates that a particular feature may or may not be present. The reader is referred to Doyle et al. (1974) and Tway (1979a) for an explanation of the way in which the descriptor code is formulated.

Modifications of Descriptor System

a. 3. *polygonal with no platform*

4. lanceolate *or somewhat polygonal with a platform*

*16. circular to subcircular with no platform (Fig. 1)

b. *10. stippled surface (Fig. 2)

Type a2/b1,2

i. *9. keel(s) toothed (Fig. 3)

j. Number of lines or keels *on front (anterior) side of blade*

k. *7. very irregular (Fig. 4)

*8. crescentic (Fig. 5)

*m. Number of lines or keels present on reverse (posterior) side of blade

0. indeterminate or absent
1. one
2. two
3. three

etc.

Type a3,4/b1,2,9/c2

d. *8. more than one keel on reverse (posterior) side of blade

*9. curved keel on reverse (posterior) side of blade which is approximately parallel to edge of blade (Fig. 6)

*10. curved depression surrounding junction of platform with blade (Fig. 7)

f. *7. ovoid

g. 2. platform approximately same width as blade

*i. Length/width ratio

0. indeterminate
1. length greater than width
2. length approximately equal to width
3. length less than width

Type a3,4/b1,2,9/c4

d. 3. three or more parallel to subparallel lines on crown not converging centrally

4. three or more parallel to subparallel lines on crown converging at or near one corner

6. concentric chevrons <u>on crown</u> with center at one corner of element

7. concentric rhombs <u>on base</u> with center at middle of element

*8. many parallel to subparallel lines originating predominantly from one or two edges of corwn (Fig. 8)

*9. concentric rhombs on crown with center at one corner of element (Fig. 9)

Type a5/b1,2

d. *6. single median keel on reverse (posterior) side of blade

*7. more than one keel on reverse (posterior) side of blade

*8. single median depression on front (anterior) side of blade

*9. curved keel on reverse (posterior) side which is approximately parallel to edge of blade.

Type a6/b1,2

c. *6. single broad median depression

*7. one or more keels on reverse (posterior) side of blade

*8. curved keel on reverse (posterior) side of blade which is approximately parallel to edge of blade

d. *6. diamond-shaped

Type "a8/b1,5" should read "a8/<u>b5</u>"

*Type a8/b1,2

c. Number of margins with prominent flexure

0. indeterminate
1. one
2. two

d. Number of lines or keels
   0. indeterminate
   1. absent
   2. one median keel on front (anterior) side of blade
   3. two parallel to subparallel keels on front (anterior) side of blade
   4. three or more parallel to subparallel keels on front (anterior) side of blade
   5. one median keel on reverse (posterior) side of blade
   6. more than one keel on reverse (posterior) side of blade

e. Nature of tip or peak of blade
   0. indeterminate
   1. sharp
   2. blunt
   3. tip curved posteriorly (Fig. 10)

f. Shape of margin opposite peak
   0. indeterminate
   1. rounded
   2. roughly V-shaped, angular
   3. irregular, uneven or undulating
   4. flared into an irregular structure

g. Outline of platform
   1. circular to subcircular

2. triangular

3. square

h. Size of platform

1. wider than blade

2. approximately same width as blade

3. narrower than blade

Type a9/b1,2

e. 5. two lines <u>or</u> <u>keels</u> each present on edge of blade

f. 5. "platform present" should read "<u>base</u> present"

i. "platform shape" should read "<u>base</u> shape"

*8. flared (Fig. 11)

*9. thick and curved (Fig. 12)

j. "platform size" should read "<u>base</u> size"

h. *6. more than one keel on reverse (posterior) side of element

*7. flange on reverse side of element (Fig. 13)

*8. toothed keels

Type a9/b5

e. *7. tip translucent

*8. small, translucent, circular disc on top of cone (Fig. 14)

Type a10/b1,2

d. 2. "elongate and rectangular" should read "elongate and <u>bar-shaped</u>"

5. "thick and triangular" should read "thick and <u>polygonal</u>"

e. 2. "triangular, curved labially" should read "triangular, curved lingually"

Type "a11/b1,2" should read "all/b1,2,3"

d. 2. "elongate and rectangular" should read "elongate and bar-shaped"

5. "thick and triangular" should read "thick and polygonal"

*7. circular to subcircular and flat with a buttonlike process (Fig. 15)

*8. circular to subcircular and thick with a buttonlike process (Fig. 16)

*9. flat and star-shaped (Fig. 17)

e. 2. "triangular, curved labially" should read "triangular, curved lingually"

*5. none of the above

h. *0. not linear

4. *i. Blade flattening

0. none

1. flattened laterally

2. flattened antero-posteriorly

*Type a12/b3

c. Nature of top of element

1. pointed (Fig. 18)

2. flat (Fig. 19)

d. Nature of keels

1. smooth (Fig. 20)

2. toothed (Fig. 21)

Type a12/b8

c. 1. concave and circular

2. flat and circular

Type "a13/b1,2" should read "a13/b1,2,3"

c. *5. very irregular (Fig. 22)

d. *6. distinct ridges on more than one edge but not all edges (Fig. 23)

*f. Width of base

0. indeterminate

1. wider than top of element (Fig. 24)

2. approximately same width as top of element (Fig. 25)

3. narrower than top of element (Fig. 26)

*Type a14/b3

c. Number of radiating lines or keels:

Recorded as numbers

d. Nature of edges

1. all edges curved inward (Fig. 27)

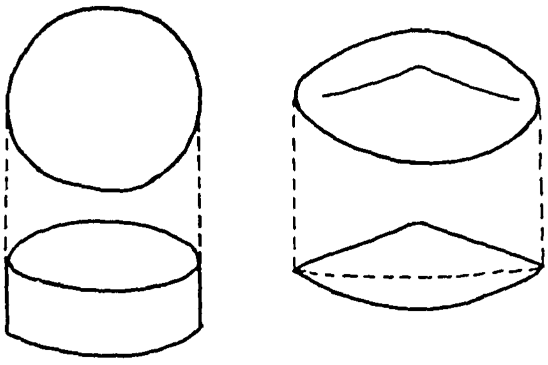
2. two edges straight and one edge curved inward (Fig. 28)

*Type a15/b2

c. Nature of lines

1. parallel

2. radiate from margin



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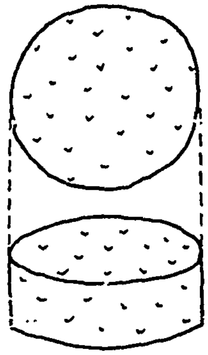

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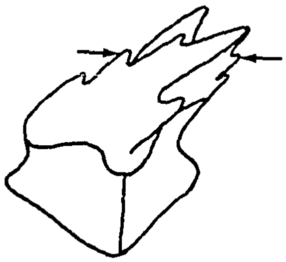

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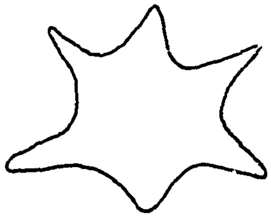
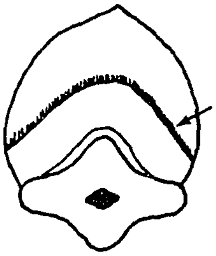


Figure 4

Figure 5



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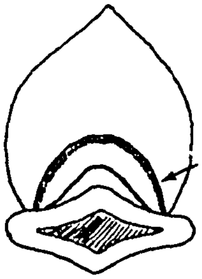

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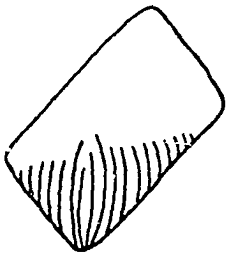

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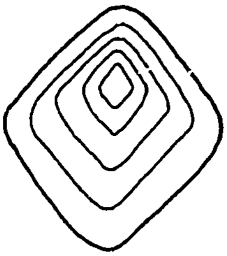

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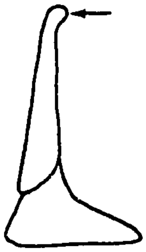

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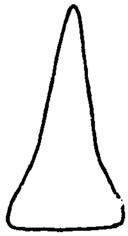

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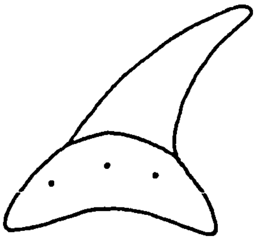
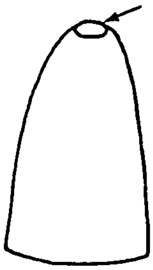


Figure 12

Figure 13



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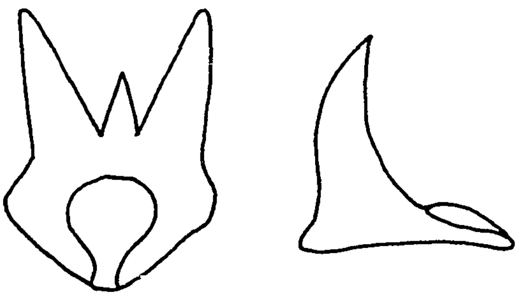
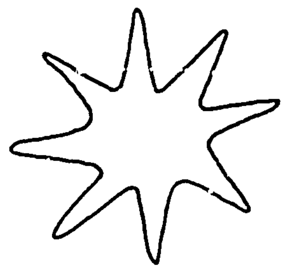


Figure 15

Figure 16



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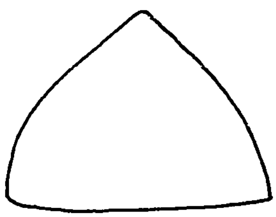

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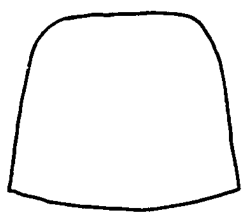

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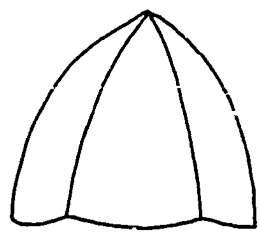

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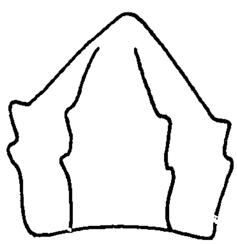

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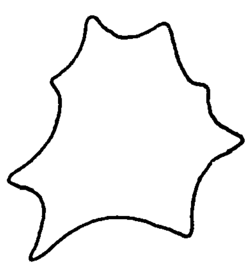

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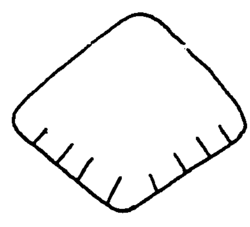

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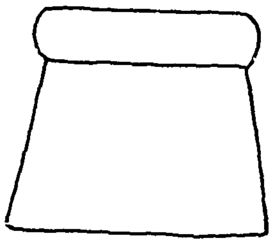

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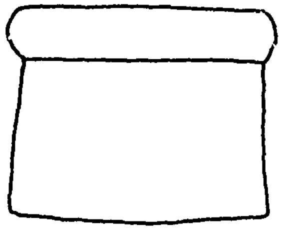

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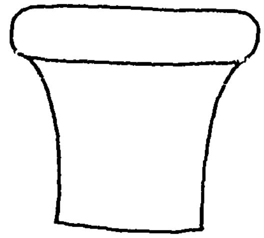


Figure 26

Figure 27

Figure 28

APPENDIX B

DIAGNOSES OF ICHTHYOLITH TYPES

The 156 ichthyolith types are on deposit at the Department of Vertebrate Paleontology (DVP) of the Royal Ontario Museum (ROM) in Toronto, Canada, under the catalog numbers listed in this appendix.

APPENDIX B

DIAGNOSES OF ICHTHYOLITH TYPES

PART I

SECTION I: ELLIPTICAL TO LANCEOLATE ELEMENTS, EACH WITH AN ACUTELY DENTATE EDGE

Type Number: 001 (Fig. 1a-e)

Code: a2/b1/c3-7/d1/e1,2/f3/g3/h4/i1/j0/k1/l1,2/m0,1

ROM DVP Catalog Number: 28045

Diagnosis: Symmetrical to asymmetrical blade with from three to seven peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks slitlike. Margin opposite peaks flared into an irregular structure. Tridentate feature present at base of blade. Outline of platform circular to subcircular; platform wider than or approximately same width as blade. Single median keel may or may not be present on posterior side of blade.

Type Number: 005 (Fig. 2a-e)

Code: a2/b2/c3/d1/e1/f2,3/g2/h4/i2/j1/k5/l2/m1

ROM DVP Catalog Number: 23034

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak two or more times length of lateral peaks; depressions between peaks roughly V-shaped; single median keel. Margin opposite peaks flared into an irregular structure. Outline of platform square to cruciform; platform approximately same width as blade. Single median keel present on posterior side of blade.

Type Number: 058 (Fig. 3a-e)

Code: a2/b1/c3/d3/e1/f1-3/g1/h1/i0/j0/k8/l2,3/m0

ROM DVP Catalog Number: 23046

Diagnosis: Symmetrical blade with three peaks; blade length less than width; median peak ranges from less than twice to more than three times length of lateral peaks; depressions between peaks U-shaped. Margin opposite peaks rounded. No lines or keels present on anterior or posterior sides of blade. Outline of platform crescentic; platform narrower than or approximately equal to width of blade.

Type Number: 062 (Fig. 4a-e)

Code: a2/b2/c3/d1/e1/f3/g1/h4/i2/j3/k1,5/l1/m0

ROM DVP Catalog Number: 23047

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks U-shaped; three subparallel keels do not converge. Margin opposite peaks flared into an irregular structure. Outline of platform circular or square; platform wider than blade. No lines or keels present on posterior side of blade.

Type Number: 066 (Fig. 5a-c)

Code: a2/b2/c5-9/d1/e1/f3/g2,3/h4/i9/j1/k5/l2,3/m1

ROM DVP Catalog Number: 23048

Diagnosis: Symmetrical blade with from five to nine peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks V-shaped to slitlike; single median, toothed keel. Margin opposite peaks flared into an irregular structure. Outline of platform square to cruciform; platform narrower than or approximately same width as blade. Single median, toothed keel present on posterior side of blade.

Type Number: 070 (Fig. 6a-c)

Code: a2/b2/c5-7/d1/e2/f2/g2/h4/i9/j2-4/k4,7/l2/m2-4

ROM DVP Catalog Number: 23049

Diagnosis: Asymmetrical blade with five to seven peaks; blade length greater than width; median peak two to three times length of lateral peaks; depressions between peaks V-shaped; two to four toothed keels do not converge. Margin opposite peaks flared into an irregular structure. Outline of platform circular to very irregular; platform approximately same width as blade. Two to four toothed keels present on posterior side of blade.

Type Number: 078 (Fig. 7a-b)

Code: a2/b2/c3/d1/e1/f3/g2/h0/i2/j4-6/k0/l0/m0

ROM DVP Catalog Number: 23050

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak more than three times length of lateral peaks;

depressions between peaks V-shaped; four to six parallel to subparallel keels present on anterior side of blade which do not converge. Margin opposite peaks indeterminate. Outline and size of platform indeterminate. No lines or keels present on posterior side of blade.

Type Number: 089 (Fig. 8a-f)

Code: a2/b2/c3/d1/e1/f3/g1/h1/i2/j1/k5/l1/m0

ROM DVP Catalog Number: 23051

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks U-shaped; single median keel. Margin opposite peaks rounded. Outline of platform square to cruciform; platform wider than blade. No lines or keels present on posterior side of blade.

Type Number: 191 (Fig. 9a-e)

Code: a2/b1/c3-6/d1/e2/f1-4/g1,2/h4/i0/j0/k7/l1/m0

ROM DVP Catalog Number: 23052

Diagnosis: Asymmetrical blade with three to six peaks; blade length greater than width; length of median peak relative to lateral peaks highly variable; peaks arise independently of each other; depressions between peaks U-shaped or V-shaped. Margin opposite peaks flared into an irregular structure. Outline of platform irregular; platform wider than blade. No lines or keels present on anterior or posterior side of blade.

Type Number: 199 (Fig. 10a-e)

Code: a2/b2/c3/d1/e1/f2,3/g2/h4/i2/j3-6/k1,5/l1-3/m3-6

ROM DVP Catalog Number: 23053

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak two or more times length of lateral peaks; depressions between peaks V-shaped; three to six parallel keels do not converge. Margin opposite peaks flared into an irregular structure. Outline of platform roughly circular to square; platform ranges from narrower to wider than blade. Three to six keels present on posterior side of blade.

Type Number: 213 (Fig. 11a-e)

Code: a2/b2/c3-5/d1/e1,2/f3/g2/h4/i9/j2/k5/l2,3/m1

ROM DVP Catalog Number: 23054

Diagnosis: Symmetrical to asymmetrical blade with three to five peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks V-shaped; two toothed keels present on anterior side of blade which do not converge. Margin opposite peaks flared into an irregular structure. Outline of platform square to cruciform; platform narrower than or approximately same width as blade. Single median, toothed keel present on posterior side of blade.

Type Number: 220 (Fig. 12a-e)

Code: a2/b2/c5-11/d2/e1/f3/g2/h4/i9/j2/k0/l0/m1

ROM DVP Catalog Number: 23055

Diagnosis: Symmetrical blade with five to eleven peaks; blade length approximately equal to width; median peak more than three times length of lateral peaks; depressions between peaks V-shaped; two toothed keels present on anterior side of blade which do not converge. Margin opposite peaks flared into an irregular structure. Outline and size of platform indeterminate. Single median, toothed keel present on posterior side of blade.

Type Number: 224 (Fig. 13a-e)

Code: a2/b2/c3/d1/e1/f3/g2/h4/i2/j3/k3/l2,3/m3

ROM DVP Catalog Number: 23056

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks V-shaped; three parallel to subparallel keels present on anterior of blade which do not converge. Margin opposite peaks flared into an irregular structure. Outline of platform triangular with apex pointing posteriorly; platform narrower than or approximately same width as blade. Three keels present on posterior side of blade.

Type Number: 227 (Fig. 14a-e)

Code: a2/b2/c5-7/d1,2/e1/f3/g2/h4/i2/j1/k5/l2/m1

ROM DVP Catalog Number: 23057

Diagnosis: Symmetrical blade with five to seven peaks; blade length greater than or approximately equal to width; median peak more than three times length of lateral peaks; depressions between peaks V-shaped; single median keel present on anterior side of blade. Margin opposite peaks flared into an irregular structure. Outline of platform square to cruciform; platform approximately same width as blade. Single, median keel present on posterior side of blade.

Type Number: 229 (Fig. 15a-c)

Code: a2/b2/c3/d1/e1/f3/g3/h4/i2/j3/k9/l2/m1

ROM DVP Catalog Number: 23058

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks slitlike; three parallel to subparallel keels present on anterior of blade. Margin opposite peaks flared into an irregular structure. Outline of platform lobed; platform approximately same width as blade. Single median keel present on posterior side of blade.

Type Number: 234 (Fig. 16a-b)

Code: a2/b2/c5-7/d1/e1/f3/g2/h4/i2/j1/k0/l1/m1

ROM DVP Catalog Number: 23059

Diagnosis: Symmetrical blade with five to seven peaks; blade length greater than width; median peak more than three times length of lateral peaks; depressions between peaks V-shaped; single median keel present on anterior side of blade. Margin opposite peaks flared into an irregular structure. Outline of platform indeterminate; platform wider than blade. Single median keel present on posterior side of blade. Element very flattened.

Type Number: 237 (Fig. 17a-d)

Code: a2/b2/c3/d1/e1/f2/g2/h4/i2/j4-6/k3/l2/m0

ROM DVP Catalog Number: 23060

Diagnosis: Symmetrical blade with three peaks; blade length greater than width; median peak two to three times length of lateral peaks; depression between peaks V-shaped; four to six keels present on anterior side of blade. Margin opposite peaks flared into an irregular structure. Outline of platform triangular with apex pointing posteriorly cruciform; platform approximately same width as blade. No lines or keels present on posterior side of blade.

SECTION II: LANCEOLATE (TO POLYGONAL) ELEMENTS LESS THAN 1mm, EACH WITH PLATFORM

Type Number: 002 (Fig. 18a-e)

Code: a4/b2/c2/d3,4/e4/f5/g1/h1/i1

Diagnosis: Lanceolate blade with two or more keels; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform wider than blade. No development of lateral peaks on blade.

Type Number: 003 (Fig. 19a-e)

Code: a4/b2/c2/d2/e2,3/f4,6/g1/h1/i1

ROM DVP Catalog Number: 23062

Diagnosis: Lanceolate blade with single median keel; blade length greater than width. Margin opposite peak angular to undulating. Outline of platform square to cruciform; platform wider than blade. No development of lateral peaks on blade.

Type Number: 022 (Fig. 20a-c)

Code: a4/b2/c2/d2/e1/f2/g1/h2/i1

ROM DVP Catalog Number: 23063

Diagnosis: Lanceolate blade with single median keel; blade length greater than width. Margin opposite peak rounded. Outline of platform triangular (isosceles); platform wider than blade. Development of lateral peaks on blade beginning.

Type Number: 026 (Fig. 21a-e)

Code: a4/b2/c2/d4+10/e1/f4,6/g1-3/h1,2/i1,2

ROM DVP Catalog Number: 23064

Diagnosis: Lanceolate blade with three or more keels; a curved depression surrounding junction of platform with blade present; blade length greater or approximately equal to width. Margin opposite peak rounded. Outline of platform square to cruciform; platform size highly variable. No development of lateral peaks on blade except in rare forms.

Type Number: 028 (Fig. 22a-e)

Code: a4/b2/c2/d1/e4/f5/g1/h1/i3

ROM DVP Catalog Number: 23065

Diagnosis: Lanceolate blade with no lines or keels; blade length less than width. Margin opposite peak flared into irregular structure. Outline of platform is irregular with crenulated margins; platform wider than blade. No development of lateral peaks on blade.

Type Number: 029 (Fig. 23a-d)

Code: a4/b2/c2/d4±9/e2/f4,6/g2,3/h1/i2

ROM DVP Catalog Number: 23066

Diagnosis: Lanceolate (to square) blade with three or more parallel keels; a curved keel is present on the posterior side of blade which is approximately parallel to edge of blade; blade length approximately equal to width. Margin opposite peak angular. Outline of platform square to cruciform; platform narrower than or approximately same width as blade. No development of lateral peaks on blade.

Type Number: 031 (Fig. 24a-d)

Code: a4/b2/c2/d4±7/e3/f4,6/g1-3/h2/i1,2

ROM DVP Catalog Number: 23067

Diagnosis: Lanceolate blade with three keels and additional median keel may be present on posterior side of blade; blade length greater than or approximately equal to width. Margin opposite peak undulating. Outline of platform square or cruciform; platform size highly variable. No development of lateral peaks on blade.

Type Number: 033 (Fig. 25a-c)

Code: a4/b1/c2/d1/e1/f0/g0/h1/i1

ROM DVP Catalog Number: 23068

Diagnosis: Lanceolate blade with no lines or keels; blade length greater than width. Margin opposite peak rounded. Size and shape of platform indeterminate. No development of lateral peaks on blade.

Type Number: 054 (Fig. 26a-e)

Code: a4/b2/c2/d2/e4/f5/g1,2/h1/i1,2

ROM DVP Catalog Number: 23069

Diagnosis: Lanceolate blade with single median keel on anterior side of blade; blade length greater than or approximately equal to width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform same width as, or wider than, blade. No development of lateral peaks on blade.

Type Number: 060 (Fig. 27a-e)

Code: a4/b2/c2/d2±10/e2,3/f4,6/g1,2/h1/i1

ROM DVP Catalog Number: 23070

Diagnosis: Lanceolate blade with single median keel; may have a curved depression surrounding junction of platform with blade; blade length greater than width. Margin opposite peak angular to undulating. Outline of platform square to cruciform; platform wider than or approximately same width as blade. No development of lateral peaks on blade.

Type Number: 064 (Fig. 28a-e)

Code: a4/b2/c2/d4/e4/f5/g1/h1/i2

ROM DVP Catalog Number: 23071

Diagnosis: Lanceolate blade with three keels; blade length approximately equal to width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform wider than blade. No development of lateral peaks on blade.

Type Number: 065 (Fig. 29a-e)

Code: a4/b2/c2/d2±7+9/e2/f6/g2,3/h1/i1,2

ROM DVP Catalog Number: 23072

Diagnosis: Lanceloate blade with single median keel on anterior side of blade; an additional median keel may be present on posterior side of blade; curved keel present on posterior side of blade which is approximately parallel to edge; blade length greater than or approximately equal to width. Margin opposite peak angular. Outline of platform cruciform; platform narrower than or approximately same width as blade. No development of lateral peaks on blade.

Type Number: 072 (Fig. 30a-e)

Code: a4/b2/c2/d3/e4/f5/g1-3/h1/i2

ROM DVP Catalog Number: 23073

Diagnosis: Lanceolate blade with two keels; blade length approximately equal to width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform size highly variable. No development of lateral peaks on blade.

Type Number: 076 (Fig. 31a-e)

Code: a4/b2/c2/d4±7/e4/f3/g1/h1/i1

ROM DVP Catalog Number: 23074

Diagnosis: Lanceolate blade with more than three keels; an additional median keel may be present on posterior side of blade; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform subcircular with smooth margins; platform wider than blade. No development of lateral peaks on blade.

Type Number: 090 (Fig. 32a-e)

Code: a4/b1/c2/d1+9/e2/f4,6/g2,3/h1/i1

ROM DVP Catalog Number: 23075

Diagnosis: Lanceolate blade with no lines or keels; curved keel present on posterior side of blade which is approximately parallel to edge; blade length greater than width. Margin opposite peak V-shaped. Outline of platform square to cruciform; platform narrower than or approximately same width as blade. No development of lateral peaks on blade.

Type Number: 104 (Fig. 33a-b)

Code: a4/b2/c2/d4+8/e4/f0/g0/h1/i2

ROM DVP Catalog Number: 23076

Diagnosis: Lanceolate blade with three or more keels on anterior side of blade and additional keels on posterior side of blade; blade length approximately equal to width. Margin opposite peak flared into an irregular structure. Platform shape and size indeterminate. No development of lateral peaks on blade.

Type Number: 112 (Fig. 34a-b)

Code: a4/b2/c2/d4+7/e5/f0/g0/h1/i2,3

ROM DVP Catalog Number: 23077

Diagnosis: Lanceolate blade with three keels and additional median keel on posterior side of blade; blade narrower than or approximately equal to width. Margin opposite peak undulating. Platform shape and size indeterminate. Development of lateral peaks on blade beginning.

Type Number: 116 (Fig. 35a-b)

Code: a4/b2/c2/d4/e2,3/f0/g0/h1/i1

ROM DVP Catalog Number: 23078

Diagnosis: Lanceolate blade with three or more parallel keels; blade length greater than width. Margin opposite peak angular to undulating. Shape and size of platform indeterminate. No development of lateral peaks on blade.

Type Number: 147 (Fig. 36a-d)

Code: a4/b2/c2/d2+7/e2/f4,6/g2/h1/i2

ROM DVP Catalog Number: 23079

Diagnosis: Lanceolate blade with single median keel on anterior side of blade and additional median keel on posterior side of blade; blade length approximately equal to width. Margin opposite peak angular. Outline of platform square to cruciform; platform approximately same width as blade. No development of lateral peaks on blade.

Type Number: 154 (Fig. 37a-e)

Code: a4/b2/c2/d4+8/e4/f5/g2/h1/i1

ROM DVP Catalog Number: 23080

Diagnosis: Lanceolate blade with more than three keels on anterior side of blade and additional keels on posterior side of blade; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform approximately same width as blade. No development of lateral peaks on blade.

Type Number: 157 (Fig. 38a-e)

Code: a4/b2/c2/d2-4,±7,+9/e4/f4,7/g2/h2/i1

ROM DVP Catalog Number: 23081

Diagnosis: Lanceolate blade with one or more median keels; an additional median keel may be present on posterior side of blade; a curved keel is present on posterior side of blade which is approximately parallel to edge; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform diamaond-shaped to ovoid; platform approximately same width as blade. Development of lateral peaks on blade beginning.

Type Number: 158 (Fig. 39a-e)

Code: a4/b1/c2/d1±8/e4/f5/g1/h1,2/i1

ROM DVP Catalog Number: 23082

Diagnosis: Lanceolate blade with no keels on the anterior side of blade but a single median keel may be present on the posterior side of blade; blade length greater than width. Margin opposite flared into an irregular structure. Outline of platform irregular with crenulated margins; platform wider than blade. No development of lateral peaks in most forms, but in some forms development of lateral peaks is beginning.

Type Number: 164 (Fig. 40a-e)

Code: a4/b2/c2/d3+7/e4/f5/g1/h1/i1

ROM DVP Catalog Number: 23083

Diagnosis: Lanceolate blade with two keels on the anterior side of blade and a single median keel on the posterior side of blade; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform wider than blade. No development of lateral peaks on blade.

Type Number: 190 (Fig. 41a-e)

Code: a4/b2/c2/d2+7/e4/f5/g1/h1/i1

ROM DVP Catalog Number: 23084

Diagnosis: Lanceolate blade with a single median keel on the anterior side of blade and a single median keel on the posterior side of blade; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform wider than blade. No development of lateral peaks on blade.

Type Number: 195 (Fig. 42a-d)

Code: a4/b1/c2/d1/e2/f4/g2/h1/i2

ROM DVP Catalog Number: 23085

Diagnosis: Lanceolate blade with no lines or keels; blade length approximately equal to width. Margin opposite peak rounded. Outline of platform square to diamond-shaped; platform approximately same width as blade. No development of lateral peaks on blade.

Type Number: 219 (Fig. 43a-e)

Code: a4/b2/c2/d4+7,8+10/e3/f3,4/g1,2/h1/i2

ROM DVP Catalog Number: 23086

Diagnosis: Lanceolate blade with three or more keels on the anterior side of blade and one or more keels on posterior side of blade; curved keel is present on posterior side of blade which is approximately parallel to edge of blade; blade length approximately equal to width. Margin opposite peak undulating. Outline of platform circular to square; platform wider than or approximately same width as blade. No development of lateral peaks on blade.

Type Number: 225 (Fig. 44a-d)

Code: a4/b2/c2/d4/e1,4/f6/g2/h1/i2,3

ROM DVP Catalog Number: 23087

Diagnosis: Lanceolate blade with three or more keels on the anterior side of blade; blade length less than or approximately equal to width. Margin opposite peak rounded to undulating. Outline of platform cruciform; platform approximately same width as blade. No development of lateral peaks.

Type Number: 230 (Fig. 45a-d)

Code: a4/b2/c2/d5+7/e4/f3,5/g1/h1/i1

ROM DVP Catalog Number: 23088

Diagnosis: Lanceolate blade with three or more lines or keels on the anterior side of blade and a single median keel on the posterior side of blade; blade length greater than width. Margin opposite peak flared into an irregular structure. Outline of platform subcircular to irregular; platform wider than blade. No development of lateral peaks on blade.

Type Number: 245 (Fig. 46a-b)

Code: a4/b2/c2/d4/e4/f5/g3/h1/i2

ROM DVP Catalog Number: 23089

Diagnosis: Lanceolate blade with three keels on anterior side of blade; blade length approximately equal to width. Margin opposite peak flared into an irregular structure. Outline of platform irregular with crenulated margins; platform narrower than blade. No development of lateral peaks on blade.

SECTION III: POLYGONAL ELEMENTS WITH NO PLATFORM

Type Number: 011 (Fig. 47a-c)

Code: a3/b2/c4/d3/e1/f2/g1,2

ROM DVP Catalog Number: 23090

Diagnosis: Rhombic element with three or more subparallel lines on crown which do not converge. Length greater than width. Element moderately to very flattened.

Type Number: 012 (Fig. 48a-c)

Code: a3/b1/c4/d1/e1/f1/g1

ROM DVP Catalog Number: 23091

Diagnosis: Rhombic element with no lines or keels. Length greater than width. Element very flattened.

Type Number: 013 (Fig. 49a-c)

Code: a3/b2/c4/d3/e1/f2/g1,2

ROM DVP Catalog Number: 23092

Diagnosis: Rhombic element with three or more subparallel lines on crown which do not converge. Length greater than width. Keel present on basal side. Element moderately to very flattened.

Type Number: 015 (Fig. 50a-c)

Code: a3/b1/c4/d1/e1/f2/g1,2

ROM DVP Catalog Number: 23093

Diagnosis: Rhombic element with keel on basal side. No lines present on crown. Length greater than width. Element moderately to very flattened.

Type Number: 067 (Fig. 51a-c)

Code: a3/b2/c4/d4/e1/f1/g1

ROM DVP Catalog Number: 23094

Diagnosis: Rhombic element with three or more subparallel lines on crown which converge near one corner. Length greater than width. Element very flattened.

Type Number: 087 (Fig. 52a-c)

Code: a3/b9/c4/d±6,+9/e1,2/f1/g3,4

ROM DVP Catalog Number: 23095

Diagnosis: Rhombic element with concentric rhombs with center at one corner of element; may or may not have concentric chevrons on basal side of element. Length greater than or equal to width. Element moderately to very thick.

Type Number: 091 (Fig. 53a-d)

Code: a3/b1,9/c4/d1,7/e1,2/f1,5/g3

ROM DVP Catalog Number: 23038

Diagnosis: Rhombic element which may or may not have concentric rhombs with center at middle of element. Length greater than or equal to width. Crown extends into a peglike structure in most forms. Element moderately thick.

Type Number: 092 (Fig. 54a-c)

Code: a3/b1,9/c4/d1,7/e1,2/f1/g2,3

ROM DVP Catalog Number: 23096

Diagnosis: Rhombic element with three or more subparallel lines which converge at one corner. Length greater than or equal to width. Element moderately flattened to moderately thick.

Type Number: 214 (Fig. 55a-c)

Code: a3/b2/c4/d4/e1,2/f5/g3

ROM DVP Catalog Number: 23097

Diagnosis: Rhombic element with three or more subparallel lines which converge at one corner. Length greater than or equal to width. Crown extends into a peglike structure in most forms. Element moderately thick.

Type Number: 218 (Fig. 56a-c)

Code: a3/b2/c4/d8/e1/f1/g2

ROM DVP Catalog Number: 23098 ROM DVP Catalog Number: 23098

Diagnosis: Rhombic element with many parallel to subparallel lines originating predominantly from one or two edges of crown. Length greater than width. Element moderately flattened.

SECTION IV: CIRCULAR TO ELLIPTICAL ELEMENTS, EACH WITH PLATFORM; IF ELLIPTICAL, BLADE LENGTH LESS THAN WIDTH

Type Number: 008 (Fig. 57a-d)

Code: a5/b1/c2/d1/e4/f2,3

ROM DVP Catalog Number: 23099

Diagnosis: Elliptical blade with no keels; blade length less than width. Outline of platform elliptical with crenulated margins; platform narrower than or approximately equal to blade width.

Type Number: 049 (Fig. 58a-c)

Code: a5/b2/c1,2/d5/e3/f3

ROM DVP Catalog Number: 23100

Diagnosis: Circular to elliptical element with more than three keels; blade length less than or equal to width. Outline of platform elliptical with smooth margins; platform narrower than blade.

Type Number: 138 (Fig. 59a-e)

Code: a5/b2/c2/d5±6,±7,+9/e3,4/f2,3

ROM DVP Catalog Number: 23040

Diagnosis: Elliptical element with three or more keels on anterior side of blade and one or more keels may be present on posterior side of blade; a curved keel is present on posterior side of keel which is approximately parallel to edge of blade; blade length less than width. Outline of platform elliptical with smooth or crenulated margins; platform narrower than or approximately same width as blade.

Type Number: 141 (Fig. 60a-e)

Code: a5/b2/c1/d4,5±6+9/e3,4/f2,3

ROM DVP Catalog Number: 23101

Diagnosis: Approximately circular blade with two or more keels on anterior side of blade and a single median keel may be present on posterior side of blade; a curved keel is present on posterior side of blade which is approximately parallel to edge of blade; blade length same as width. Outline of platform elliptical with smooth or crenulated margins; platform narrower than or same width as blade.

Type Number: 145 (Fig. 61a-d)

Code: a5/b2/c2/d5+9/e5/f2

ROM DVP Catalog Number: 23102

Diagnosis: Elliptical element with three or more keels on anterior side of blade; curved keel is present on posterior side which is approximately parallel to edge of blade; blade length less than width. Margin of blade near platform angular. Outline of platform square to cruciform; platform approximately same width as blade.

Type Number: 222 (Fig. 62a-b)

Code: a5/b2/c2/d6+8/e0/f0

ROM DVP Catalog Number: 23103

Diagnosis: Elliptical blade with a single median depression on anterior side and a single keel on posterior side; blade length less than width. Shape and size of platform indeterminate.

SECTION V: ELLIPTICAL ELEMENTS WITH BLADE LENGTH GREATER THAN WIDTH

<u>Type Number</u>: 082 (Fig. 63a-c)

<u>Code</u>: a6/b2/c5±7/d1,3/e2,3

<u>ROM DVP Catalog Number</u>: 23104

<u>Diagnosis</u>: Elliptical blade with more than three keels on anterior side of blade and more than one keel may be present on posterior side of blade; blade length greater than width. Outline of platform circular to elliptical with smooth margins; platform narrower than or approximately same width as blade.

<u>Type Number</u>: 098 (Fig. 64a-e)

<u>Code</u>: a6/b2/c5+7/d1,3/e1,2

<u>ROM DVP Catalog Number</u>: 23105

<u>Diagnosis</u>: Elliptical blade with more than three keels on anterior side of blade and more than one keel on posterior side of blade; blade length greater than width. Outline of platform circular to elliptical with smooth margins; platform wider than or approximately same width as blade.

<u>Type Number</u>: 111 (Fig. 65a-d)

<u>Code</u>: a6/b1/c8/d3/e3

<u>ROM DVP Catalog Number</u>: 23041

<u>Diagnosis</u>: Elliptical blade with no keels on anterior side of blade; a curved keel is present on posterior side which is approximately parallel to edge of blade; blade length greater than width. Outline of platform elliptical with smooth margins; platform narrower than or approximately same width as blade.

Type Number: 165 (Fig. 66a-e)

Code: a6/b2/c5/d2,3/e1-3

ROM DVP Catalog Number: 23106

Diagnosis: Elliptical blade with more than three keels on anterior side of blade; blade length greater than width. Outline of platform triangular to elliptical with smooth margins; platform size highly variable.

Type Number: 210 (Fig. 67a-b)

Code: a6/b2/c5+7/d1/e2

ROM DVP Catalog Number: 23107

Diagnosis: Elliptical blade with three or more keels on anterior side of blade and more than one keel on posterior side of blade; blade length greater than width. Outline of platform approximately same width as blade.

Type Number: 215 (Fig. 68a-d)

Code: a6/b2/c3±5,+8/d6/e2,3

ROM DVP Catalog Number: 23108

Diagnosis: Elliptical blade with a broad median keel and occasionally additional lateral keels on the anterior side; a curved keel is present on the posterior side which is approximately parallel to edge of blade; blade length greater than width. Outline of platform diamond-shaped; platform narrower than or approximately same width as blade.

SECTION VI: TRIANGULAR ELEMENTS, EACH WITH BOTH MARGINS HAVING A

PROMINENT ANGULAR FLEXURE

Type Number: 175 (Fig. 69a-b)

Code: a8/b2/c2/d2-4,±5/e2/f4/g1/h1

ROM DVP Catalog Number: 23036

Diagnosis: Triangular element with both margins having a prominent angular flexure; one or more keels on anterior side of blade; additional keels may be present on posterior side of blade. Tip blunt; margin opposite peak flared into an irregular structure. Outline of platform circular with smooth margins; platform wider than blade.

Type Number: 221 (Fig. 70a-d)

Code: a8/b1/c2/d1/e2+3/f1/g2/h1

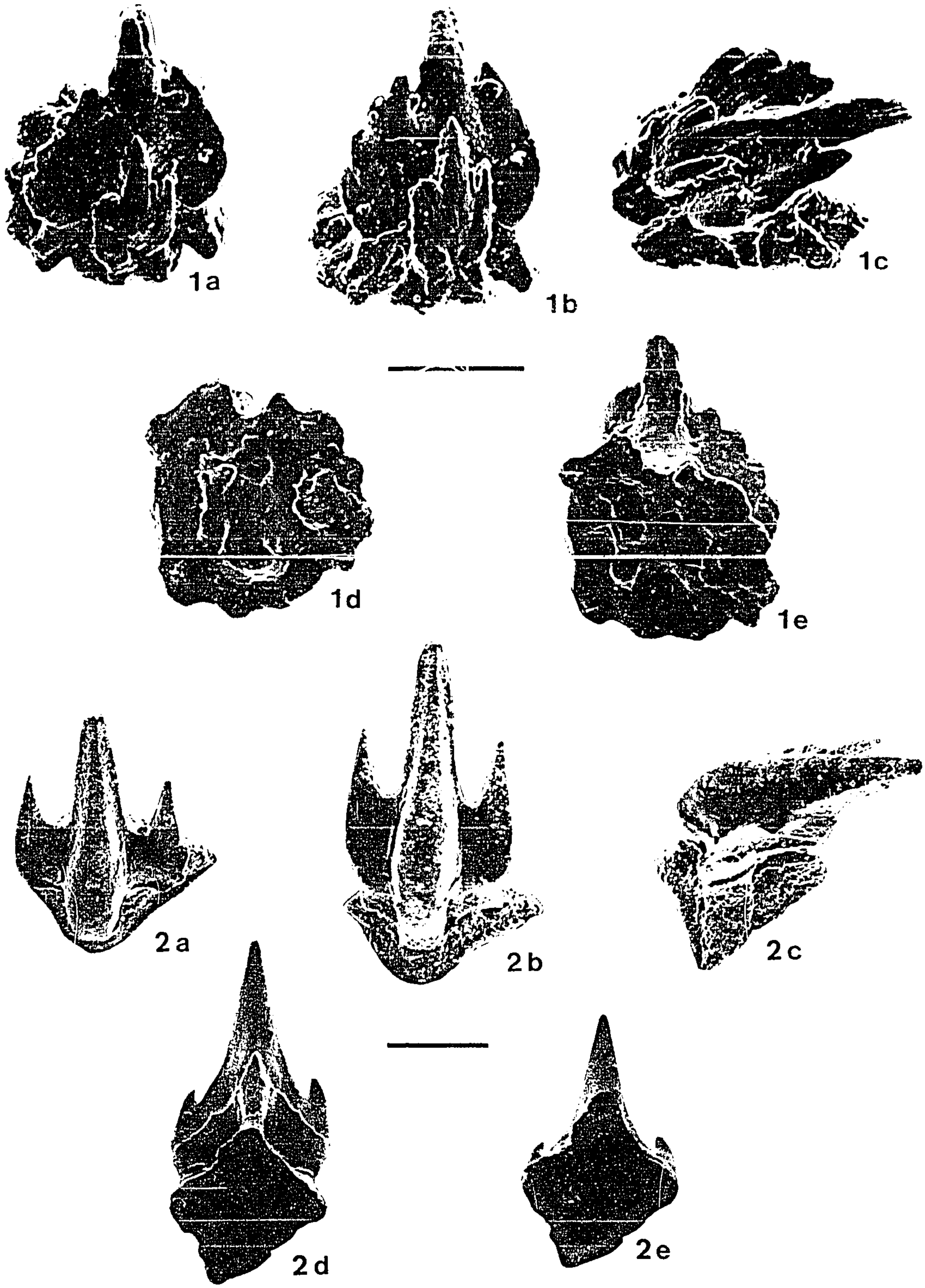
ROM DVP Catalog Number: 23109

Diagnosis: Triangular element with both margins having a prominent angular flexure. No keels present. Tip blunt and posteriorly curved. Shape of margin opposite peak rounded. Outline of platform triangular. Size of platform wider than blade.

FIGURES 1-2

1a-e Type Number 001 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: a, top; b, anterior; c, lateral; d, basal; e, posterior views. Scale equals 0.2mm.

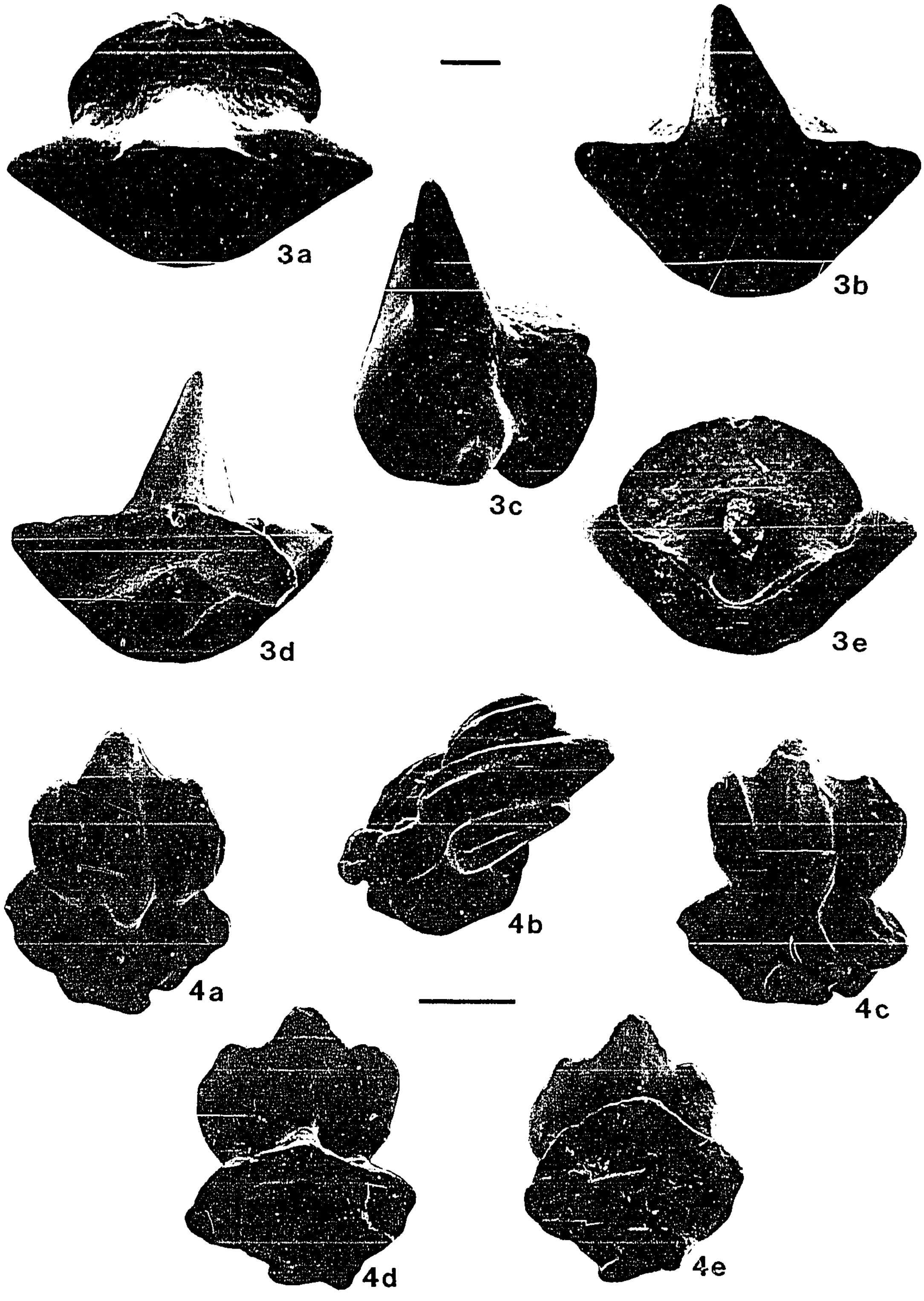
2a-e Type Number 005 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas (a-c), and Buchanan County, Missouri (d&e): a, top; b, anterior; c, lateral; d, posterior; e, basal views. Scale equals 0.2mm.


1a
1b
1c
1d
1e
2a
2b
2c
2d
2e

FIGURES 3-4

3a-e Type Number 058 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, top; b, anterior; c, lateral; d, posterior; e, basal. Scale equals 0.2mm.

4a-e Type Number 062 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Oklahoma: a, top; b, lateral; c, anterior; d, posterior; e, basal. Scale equals 0.2mm.


3a
3b
3c
3d
3e
4a
4b
4c
4d
4e

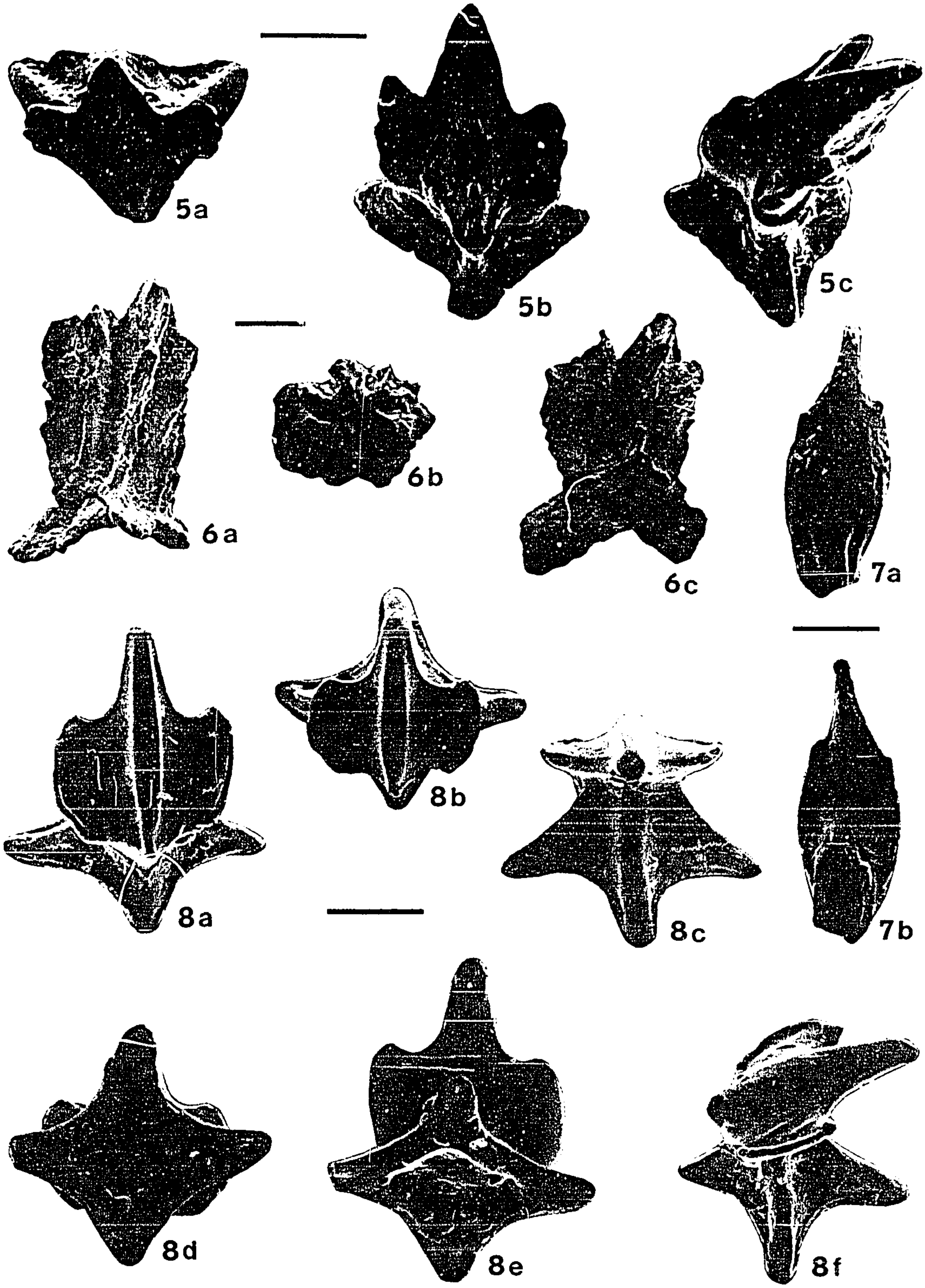
FIGURES 5-8

5a-c Type Number 066 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, top; b, anterior; c, lateral views. Scale equals 0.2mm.

6a-c Type Number 070 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, lateral; b, top; c, oblique basal views. Scale equals 0.2mm.

7a-b Type Number 078 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: a, anterior; b, posterior views. Scale equals 0.2mm.

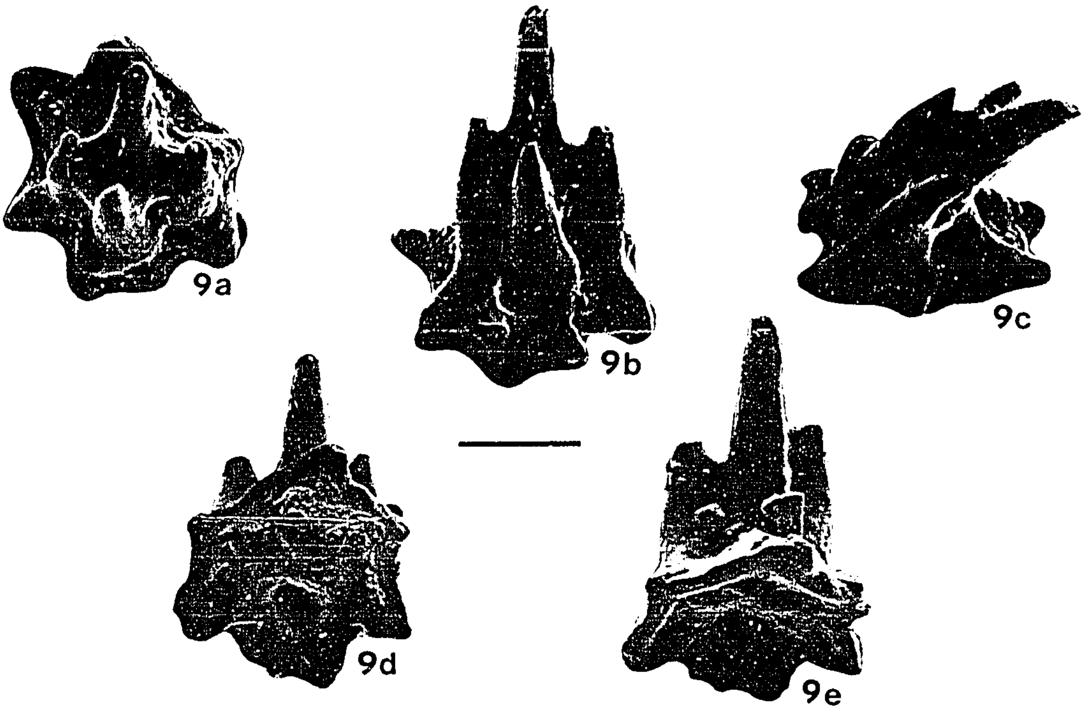
8a-f Type Number 089 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas: a, anterior; b, top; c, posterior edge; d, basal; e, posterior; f, lateral views. Scale equals 0.2mm.

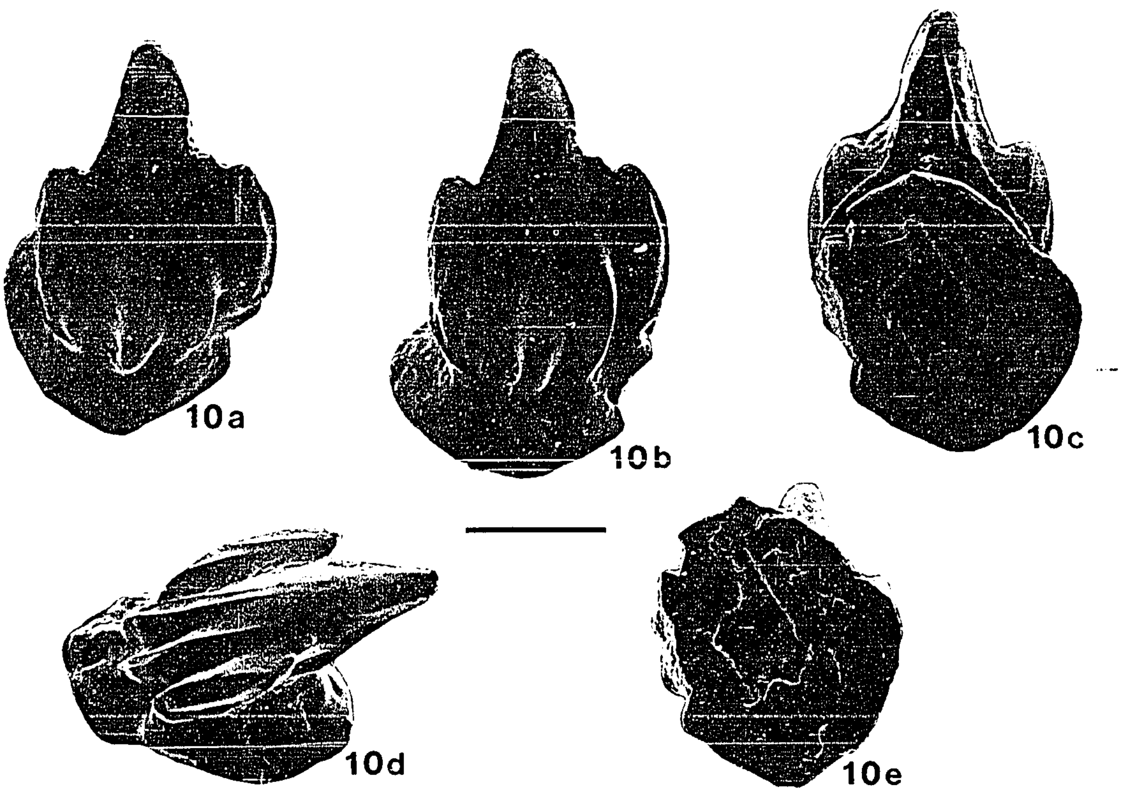

5a
5b
5c
6a
6b
6c
7a
7b
8a
8b
8c
8d
8e
8f

FIGURES 9-10

9a-e Type Number 191 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, anterior; c, lateral; d, basal; e, posterior views. Scale equals 0.1mm.

10a-e Type Number 199 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, anterior; c, posterior; d, lateral; e, basal views. Scale equals 0.2mm.


9a
9b
9c
9d
9e


10a
10b
10c
10d
10e

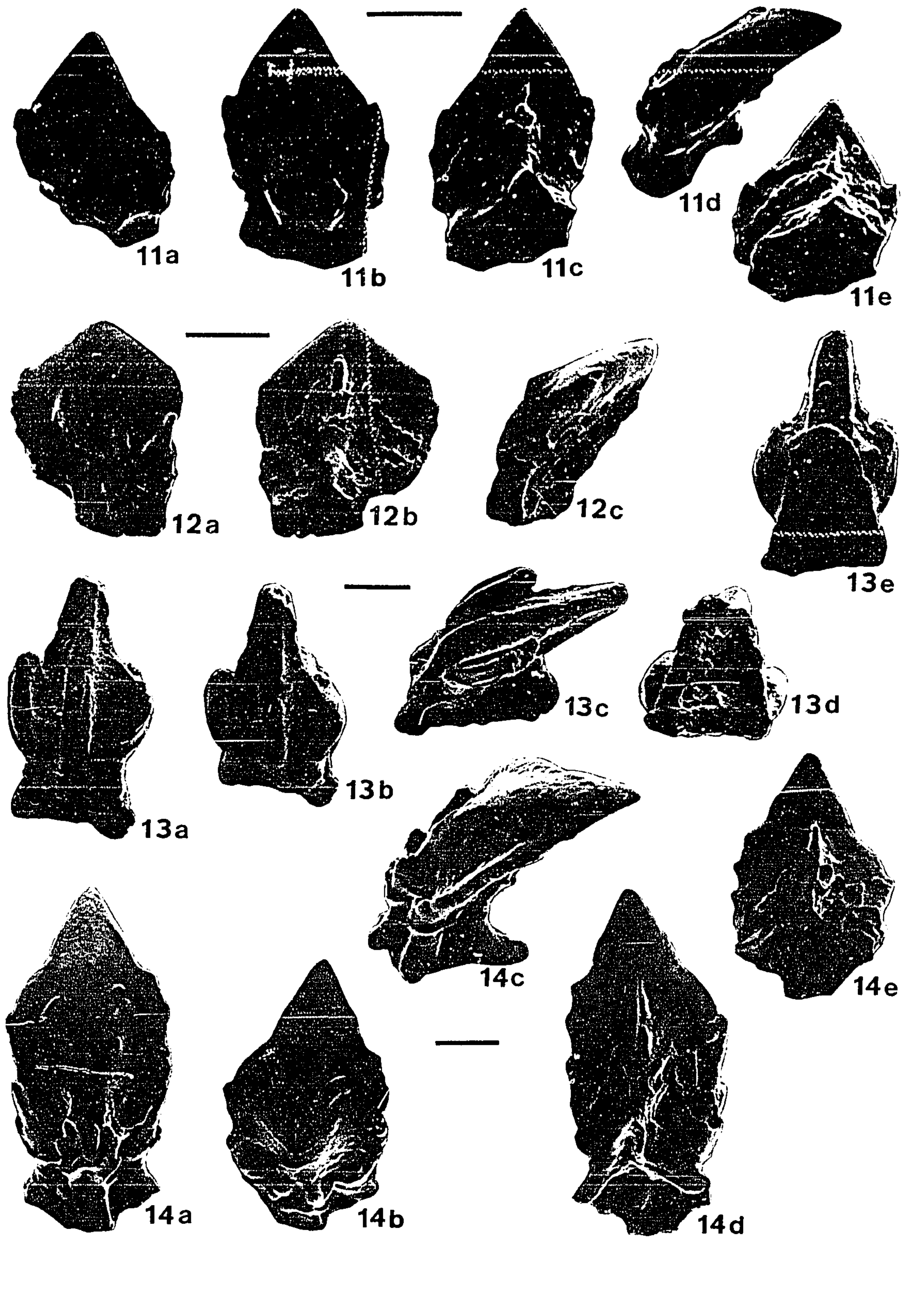
FIGURES 11-14

11a-e Type Number 213 from the Plattsmouth Limestone (Shawnee Group) in Coffey County, Kansas: a, top; b, anterior; c, posterior; d, lateral; e, basal views. Scale equals 0.2mm.

12a-e Type Number 220 from the Plattsmouth Limestone (Shawnee Group) in Coffey County, Kansas: a, anterior; b, posterior; c, lateral views. Scale equals 0.2mm.

13a-e Type Number 224 from the Heebner Shale (Shawnee Group) in Leavenworth County, Kansas: a, anterior; b, top; c, lateral; d, basal; e, posterior views. Scale equals 0.1mm.

14a-e Type Number 227 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, anterior; b, top; c, lateral; d, posterior; e, basal views. Scale equals 0.1mm.


11a
11b
11c
11d
11e
12a
12b
12c
13e
13a
13b
13c
13d
14c
14e
14a
14b
14d

FIGURES 15-19

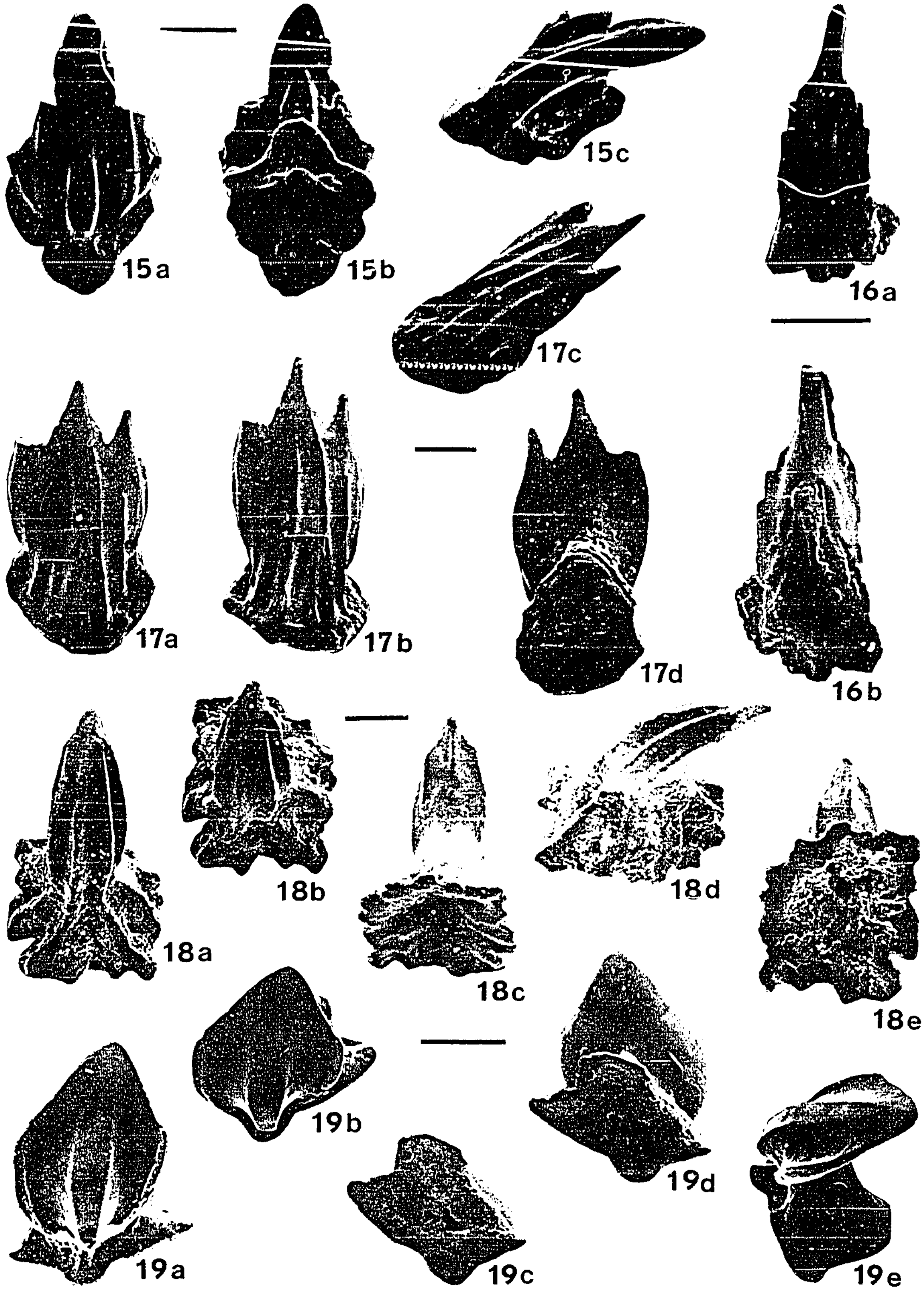
15a-c Type Number 229 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Oklahoma: a, anterior; b, posterior; c, lateral views. Scale equals 0.1mm.

16a-b Type Number 234 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, anterior; b, posterior views. Scale equals 0.2mm.

17a-d Type Number 237 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, anterior; c, lateral; d, posterior views. Scale equals 0.1mm.

18a-e Type Number 002 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, anterior; b, top; c, posterior; d, lateral; e, basal views. Scale equals 0.2mm.

19a-e Type Number 003 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, top; c, basal; d, posterior; e, lateral views. Scale equals 0.2mm.

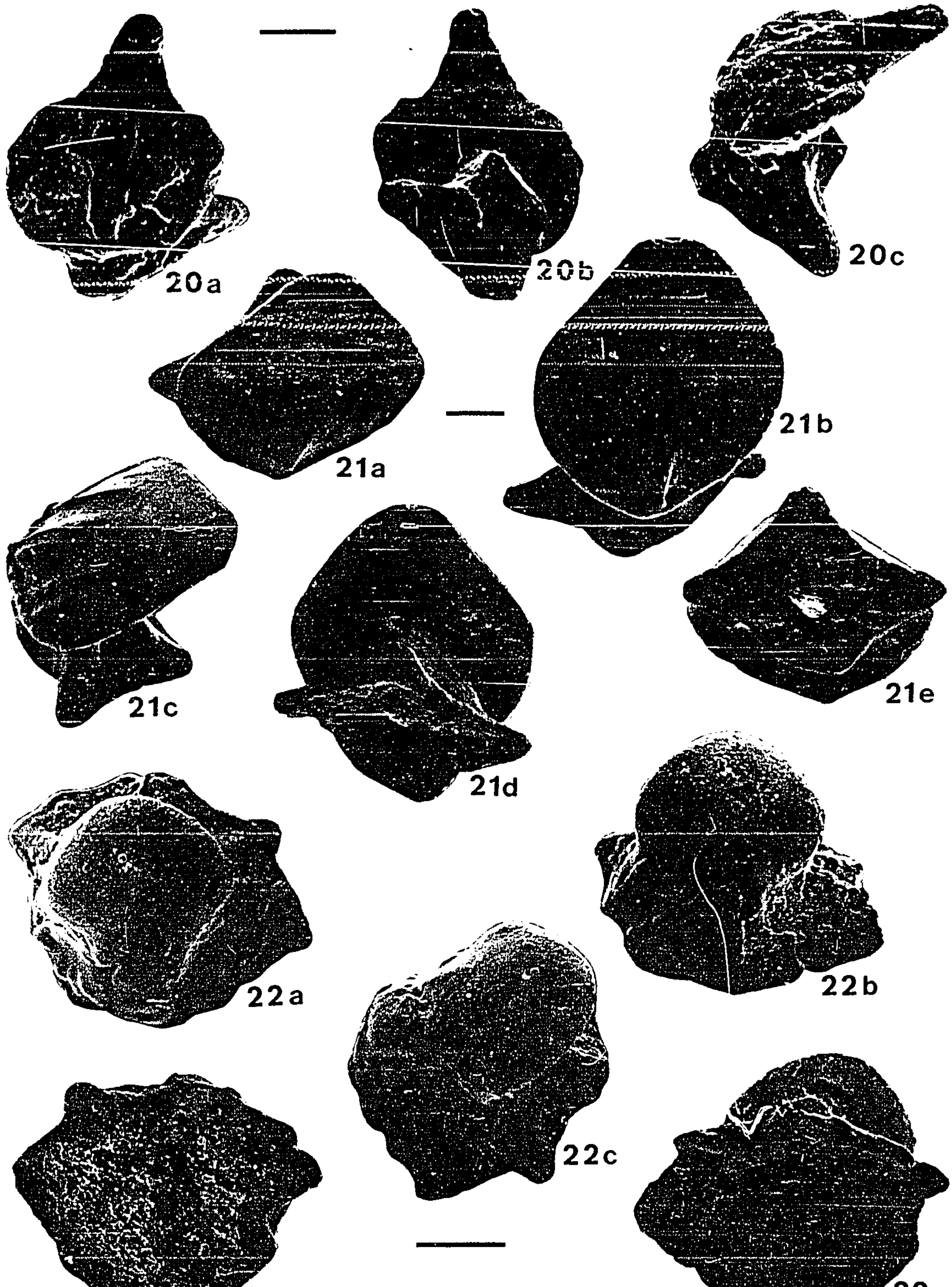

15a
15b
15c
16a
17c
17a
17b
17d
16b
18a
18b
18c
18d
18e
19a
19b
19c
19d
19e

FIGURES 20-22

20a-c Type Number 022 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: a, anterior; b, posterior; c, lateral views. Scale equals 0.1mm.

21a-e Type Number 026 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas: a, top; b, anterior; c, lateral; d, posterior; e, basal views. Scale equals 0.1mm.

22a-e Type Number 028 from the Avoca Limestone (Shawnee Group) in Jefferson County, Kansas: a, top; b, anterior; c, lateral; d, basal; e, posterior views. Scale equals 0.2mm.


20a
20b
20c
21a
21b
21c
21d
21e
22a
22b
22c
22d
22e

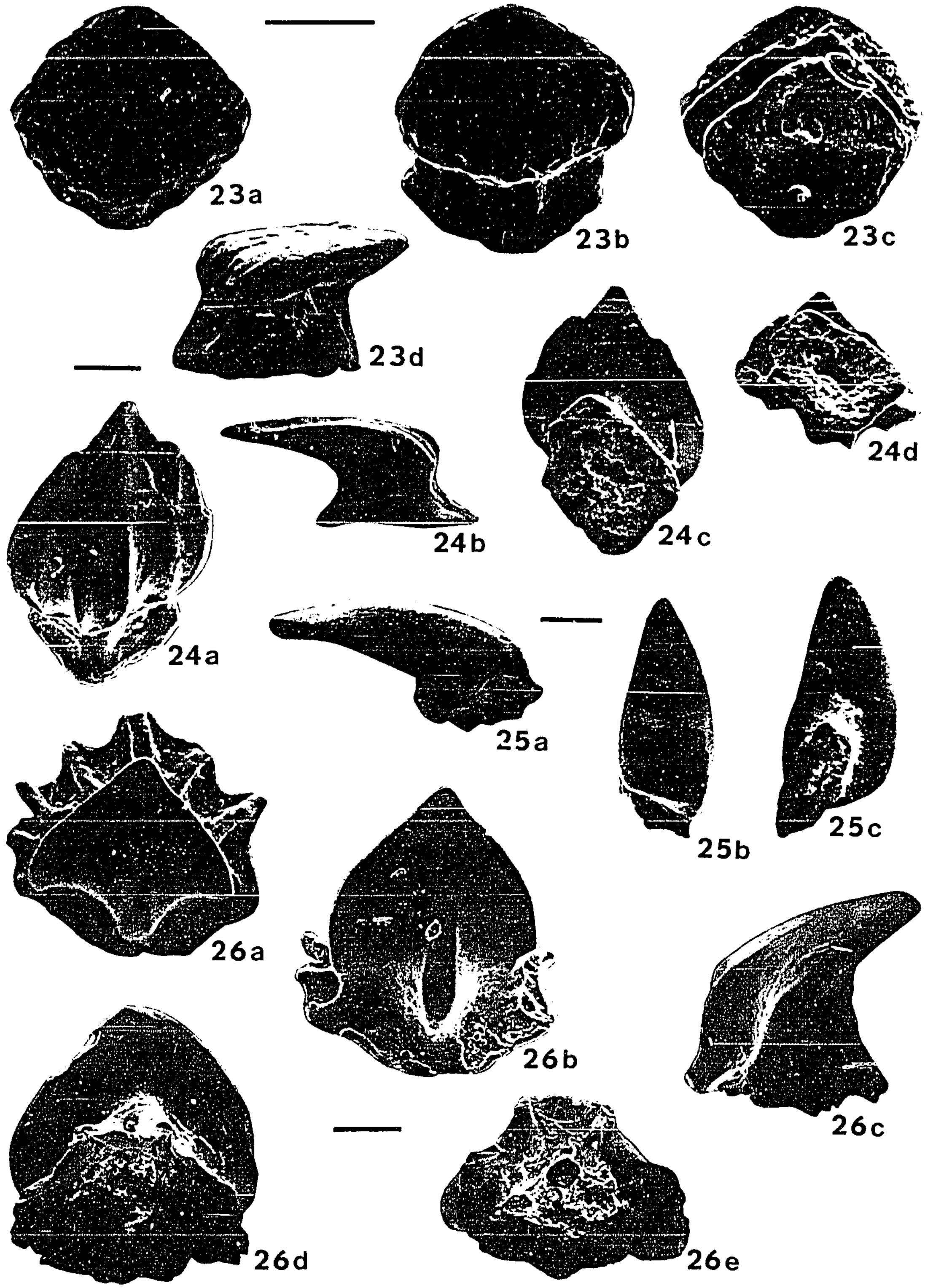
FIGURES 23-26

23a-d Type Number 029 from the Eudora Shale (Lansing Group) in Cass County, Iowa: a, top; b, anterior; c, basal; d, lateral views. Scale equals 0.2mm.

24a-d Type Number 031 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, lateral; c, posterior; d, basal views. Scale equals 0.1mm.

25a-c Type Number 033 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, lateral; b, anterior; c, posterior views. Scale equals 0.2mm.

26a-e Type Number 054 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, top; b, anterior; c, lateral; d, posterior; e, basal views. Scale equals 0.1mm.



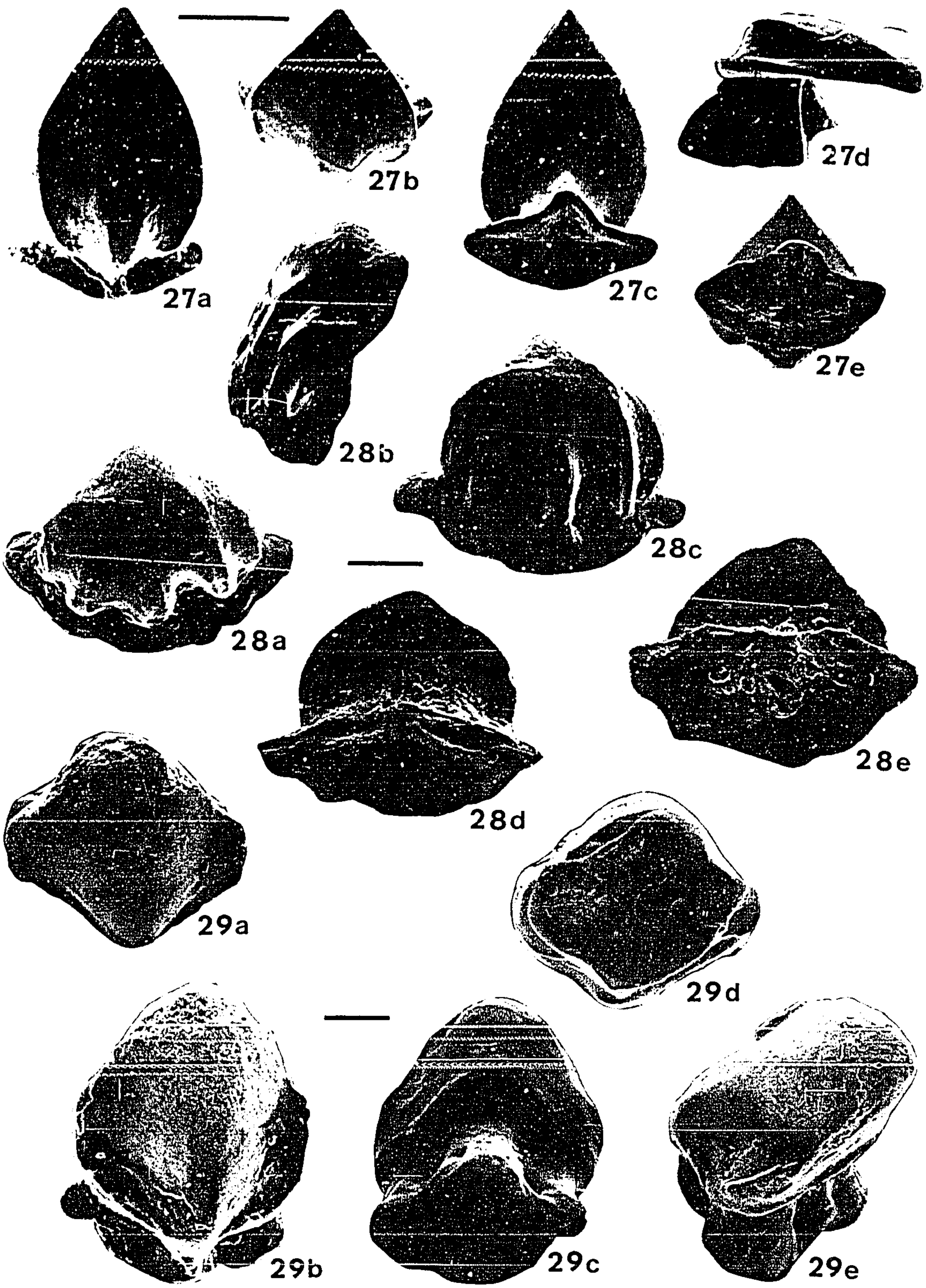
23a
23b
23c
23d
24a
24b
24c
24d
25a
25b
25c
26a
26b
26c
26d
26e

FIGURES 27-29

27a-e Type Number 060 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, top; c, posterior; d, lateral; e, basal views. Scale equals 0.2mm.

28a-e Type Number 064 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, lateral; c, anterior; d, posterior; e, basal views. Scale equals 0.1mm.

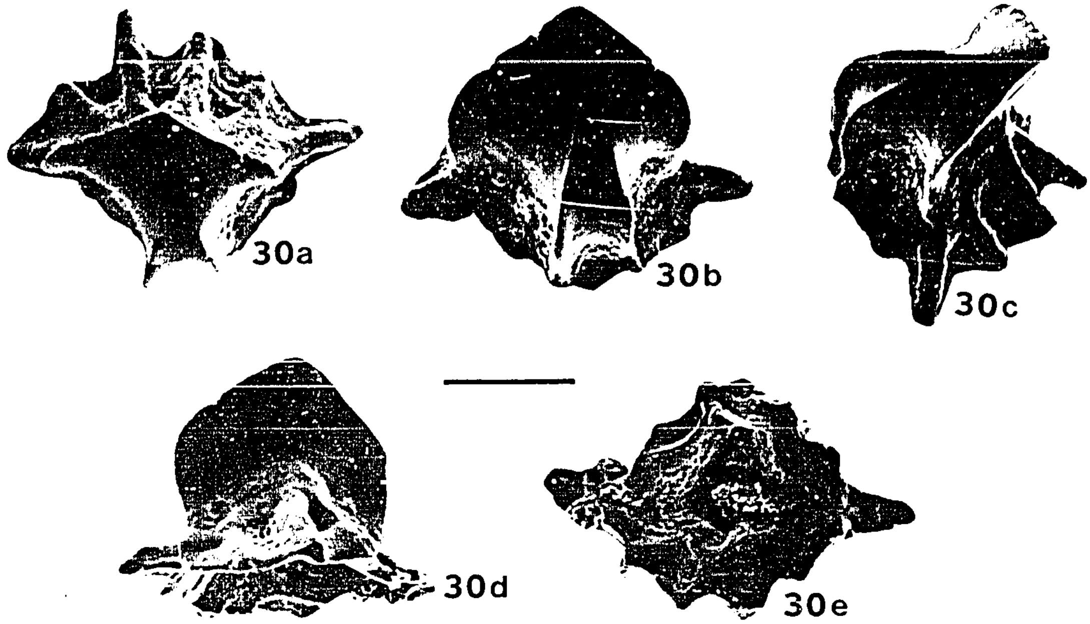
29a-e Type Number 065 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Oklahoma: a, top; b, anterior; c, posterior; d, basal; e, lateral views. Scale equals 0.1mm.

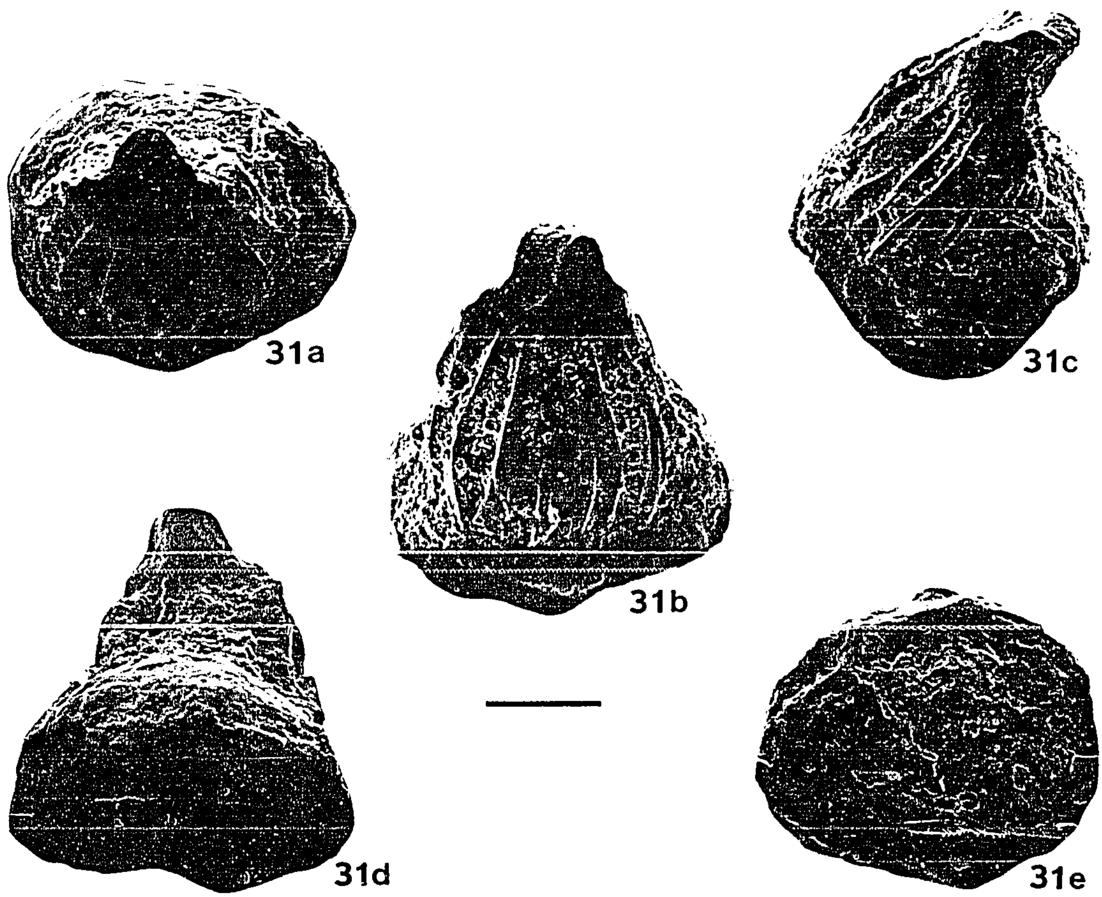

27a
27b
27c
27d
27e
28a
28b
28c
28d
28e
29a
29b
29c
29d
29e

FIGURES 30-31

30a-e Type Number 072 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, anterior; c, lateral; d, posterior; e, basal views. Scale equals 0.2mm.

31a-e Type Number 076 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: a, top; b, anterior; c, lateral; d, posterior; e, basal views. Scale equals 0.2mm.


30a
30b
30c
30d
30e


31a
31b
31c
31d
31e

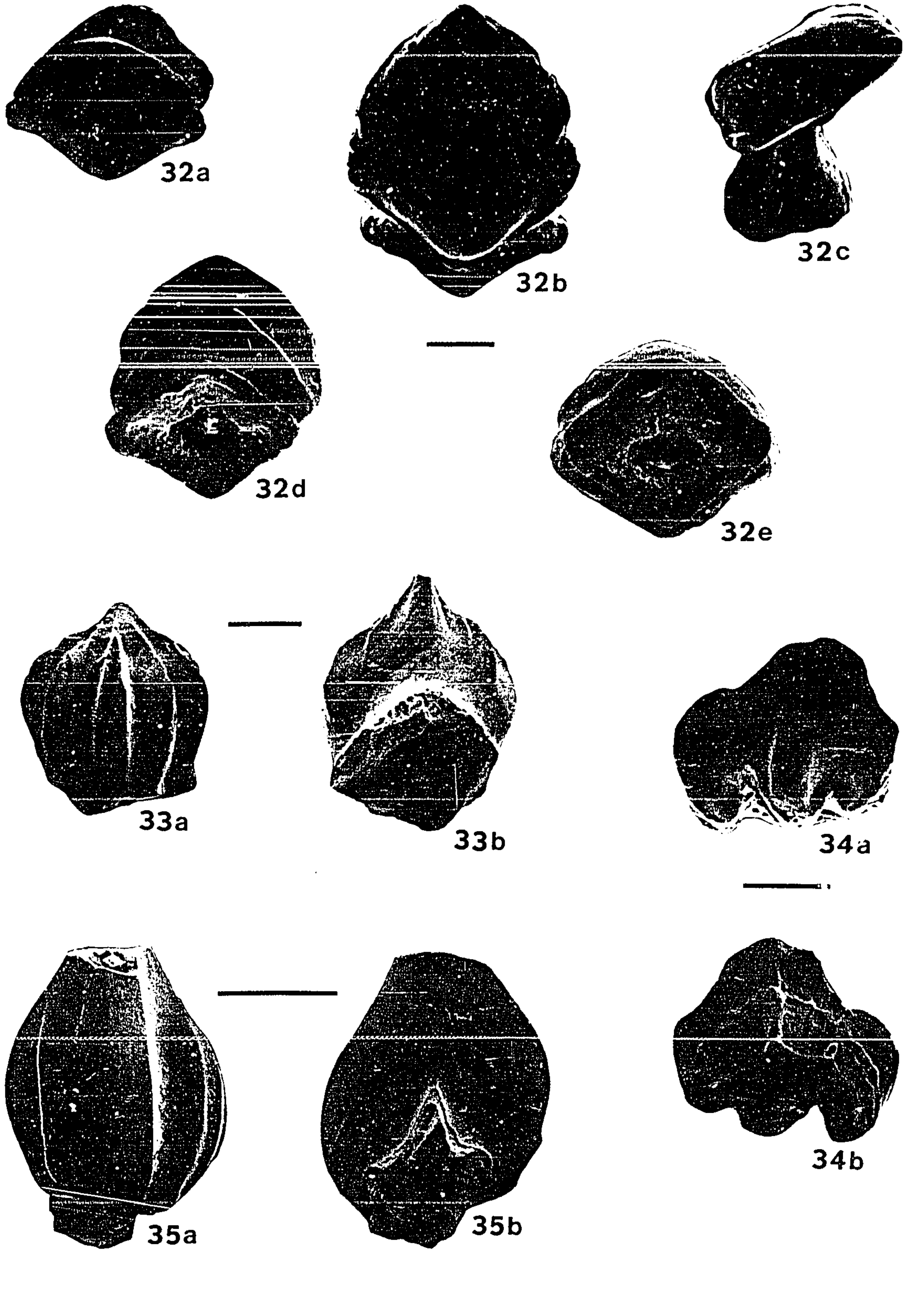
FIGURES 32-35

32a-e Type Number 090 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, anterior; c, lateral; d, posterior; e, basal views. Scale equals 0.1mm.

33a-b Type Number 104 from the Heebner Shale (Shawnee Group) in Cass County, Nebraska: a, anterior; b, posterior views. Scale equals 0.2mm.

34a-b Type Number 112 from the Curzon Limestone (Shawnee Group) in Shawnee County, Kansas: a, anterior; b, posterior views. Scale equals 0.2mm.

35a-b Type Number 116 from the Doniphan Shale (Shawnee Group) in Douglas County, Kansas: a, anterior; b, posterior views. Scale equals 0.2mm.

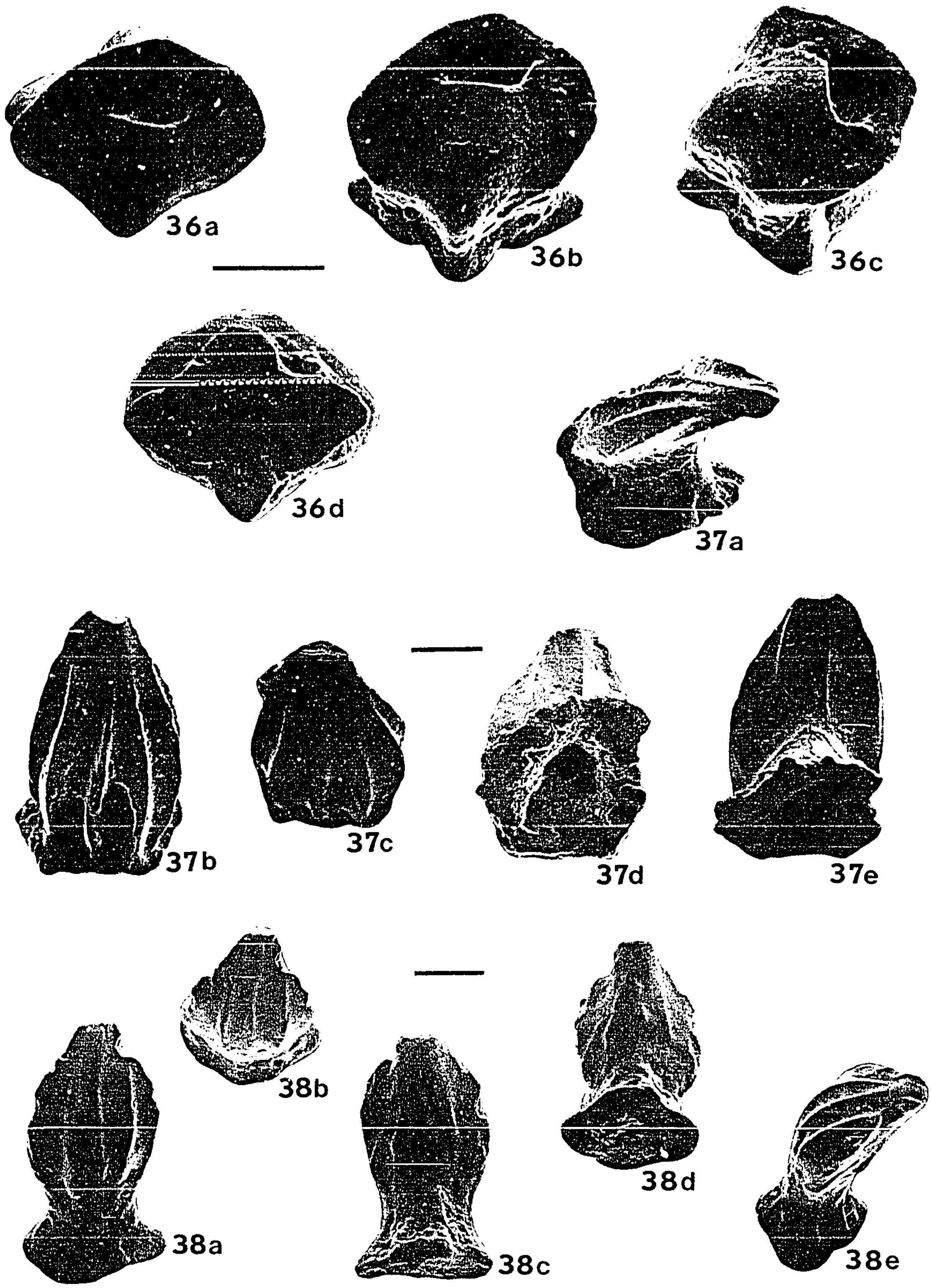

32a
32b
32c
32d
32e
33a
33b
34a
34b
35a
35b

FIGURES 36-38

36a-d Type Number 147 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, top; b, anterior; c, lateral; d, basal views. Scale equals 0.1mm.

37a-e Type Number 154 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, lateral; b, anterior; c, top; d, basal; e, posterior views. Scale equals 0.2mm.

38a-e Type Number 157 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, top; c, posterior; d, basal; e, lateral views. Scale equals 0.1mm.

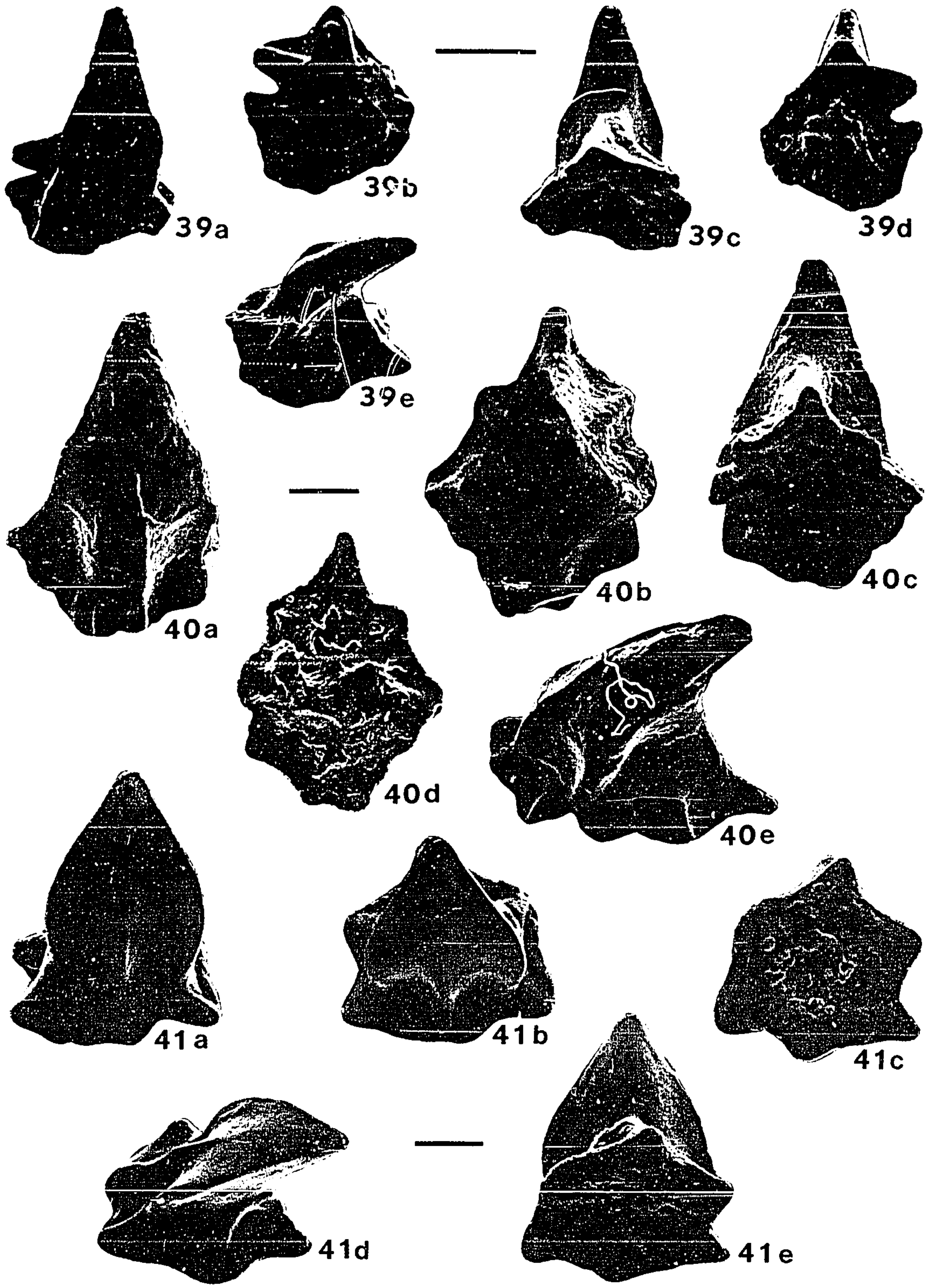

36a
36b
36c
36d
37a
37b
37c
37d
37e
38a
38b
38c
38d
38e

FIGURES 39-41

39a-e Type Number 158 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, anterior; b, top; c, posterior; d, basal; e, lateral views. Scale equals 0.2mm.

40a-e Type Number 164 from the Coal Creek Limestone (Shawnee Group) in Shawnee County, Kansas: a, anterior; b, top; c, posterior; d, basal; e, lateral views. Scale equals 0.1mm.

41a-e Type Number 190 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, anterior; b, top; c, basal; d, lateral; e, posterior views. Scale equals 0.1mm.

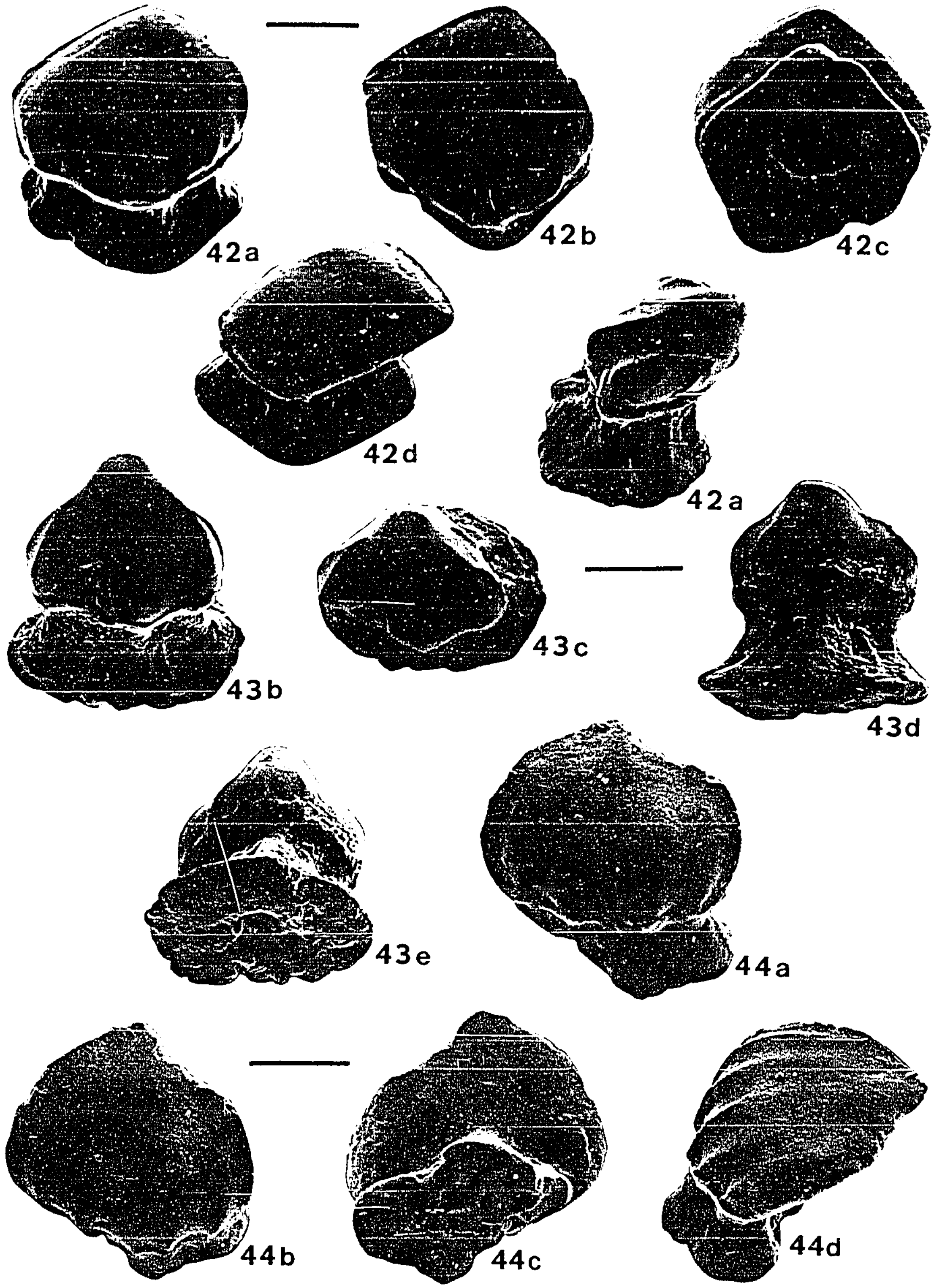

39a
39b
39c
39d
39e
40a
40b
40c
40d
40e
41a
41b
41c
41d
41e

FIGURES 42-44

42a-d Type Number 195 from the Captain Creek Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, top; c, basal; d, lateral views. Scale equals 0.1mm.

43a-e Type Number 219 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, lateral; b, anterior; c, top; d, posterior; e, basal views. Scale equals 0.2mm.

44a-d Type Number 225 from the Heebner Shale (Shawnee Group) in Buchanan County, Missouri: a, anterior; b, top; c, posterior; d, lateral views. Scale equals 0.1mm.


42a
42b
42c
42d
42a
43b
43c
43d
43e
44a
44b
44c
44d

FIGURES 45-49

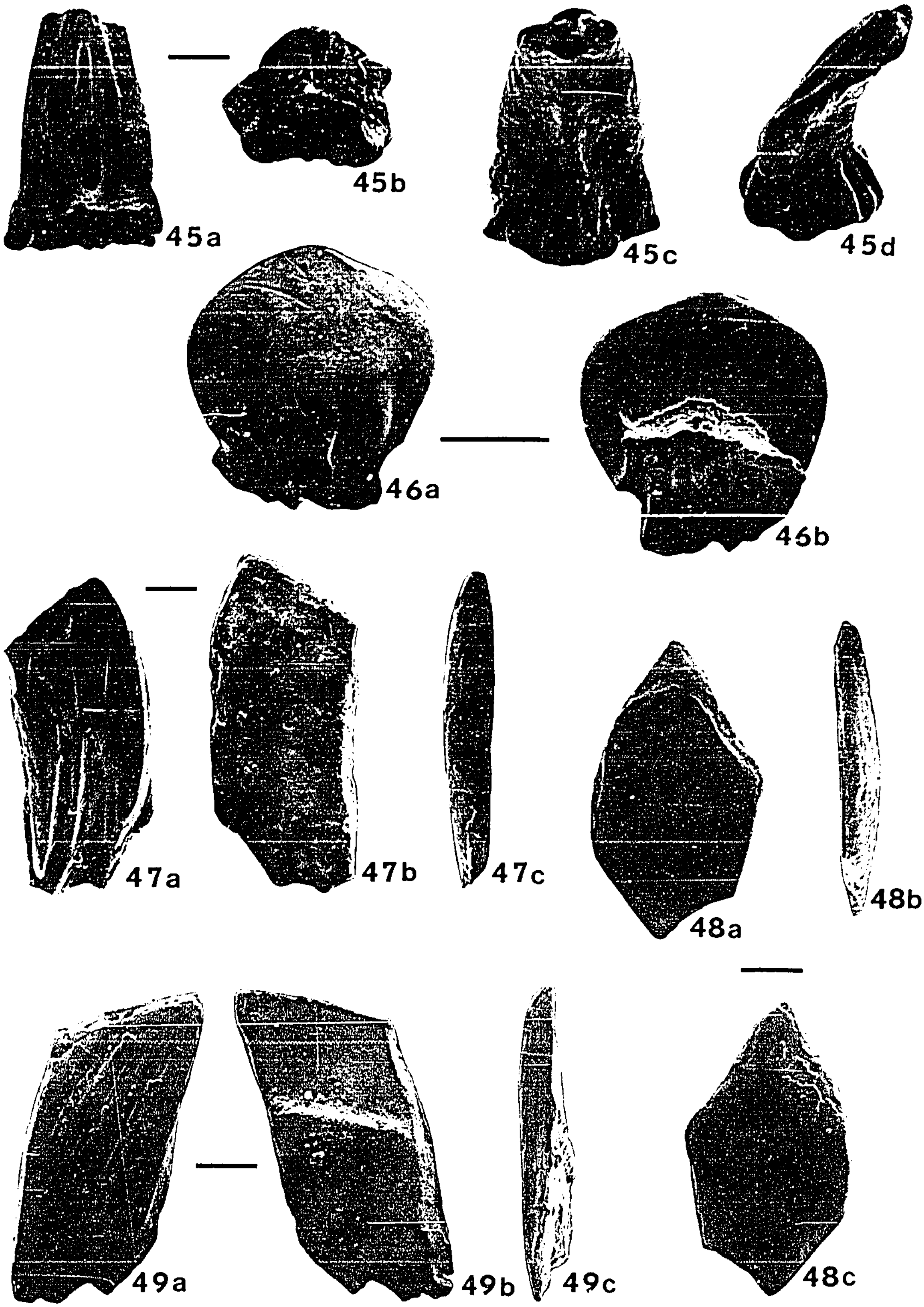
45a-d Type Number 230 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, top; c, posterior; d, lateral views. Scale equals 0.2mm.

46a-b Type Number 245 from the Eudora Shale (Lansing Group) in Cass County, Iowa: a, anterior; b, posterior views. Scale equals 0.2mm.

47a-c Type Number 011 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas: a, coronal; b, basal; c, lateral views. Scale equals 0.2mm.

48a-c Type Number 012 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: a, coronal; b, lateral; c, basal views. Scale equals 0.2mm.

49a-c Type Number 013 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas: a, coronal; b, basal; c, lateral views. Scale equals 0.2mm.


45a
45b
45c
45d
46a
46b
47a
47b
47c
48a
48b
49a
49b
49c
48c

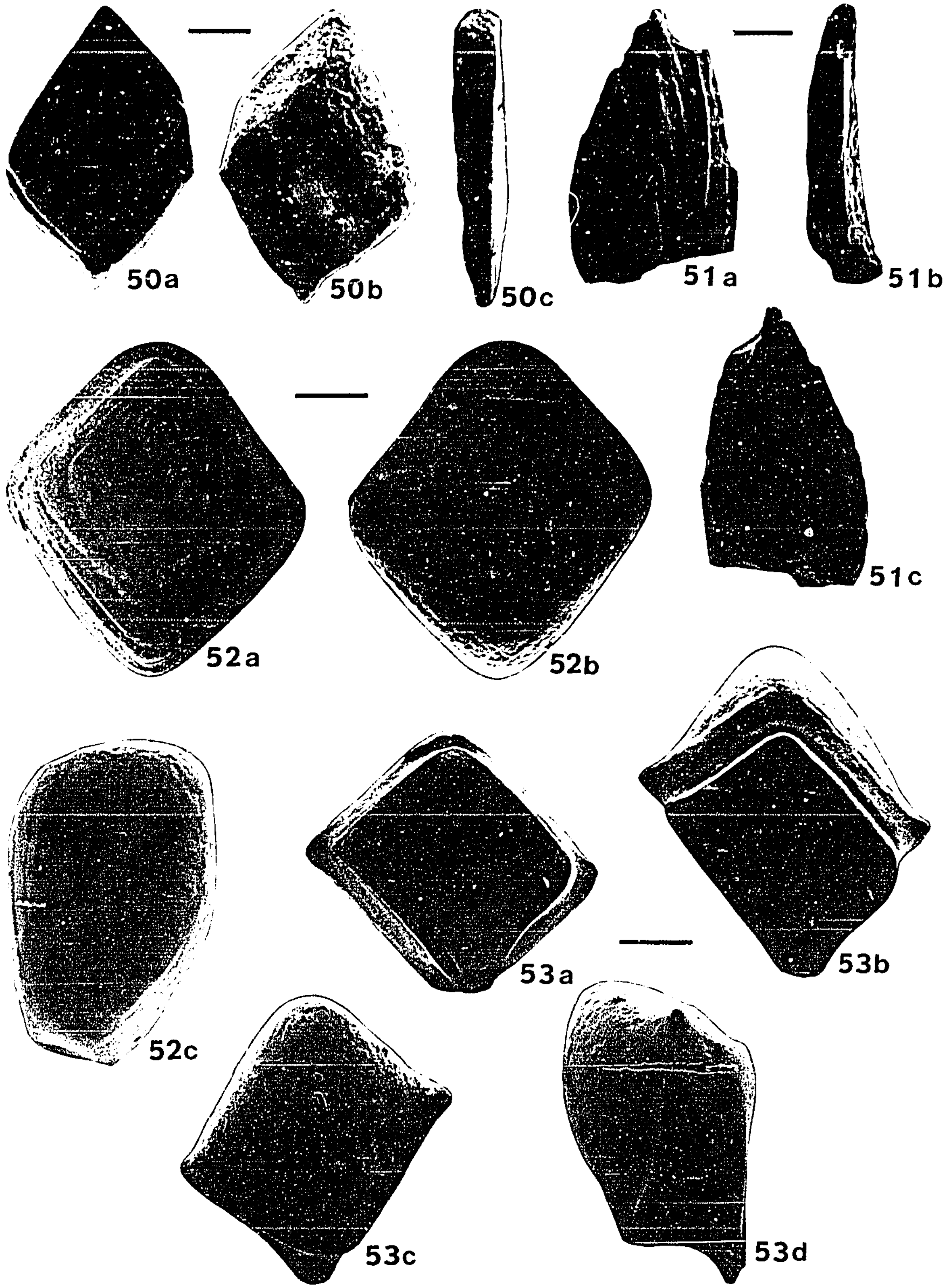
FIGURES 50-53

50a-c Type Number 015 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, coronal; b, basal; c, lateral views. Scale equals 0.2mm.

51a-c Type Number 067 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: a, coronal; b, lateral; c, basal views. Scale equals 0.2mm.

52a-c Type Number 087 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: a, coronal; b, basal; c, lateral views. Scale equals 0.2mm.

53a-d Type Number 091 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, coronal; b, oblique coronal; c, basal; d, lateral views. Scale equals 0.2mm.


50a
50b
50c
51a
51b
51c
52a
52b
52c
53a
53b
53c
53d

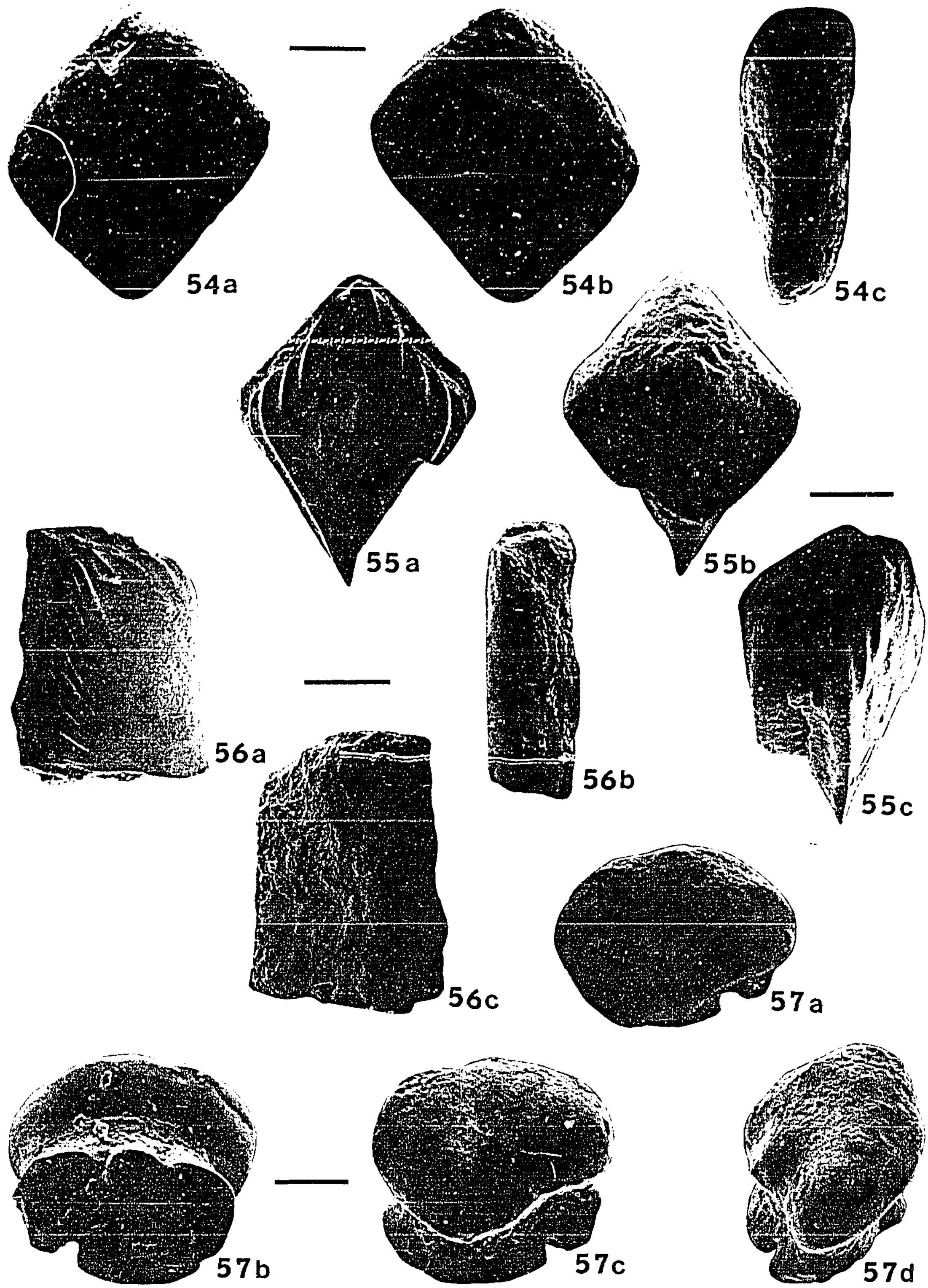
FIGURES 54-57

54a-c Type Number 092 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: a, coronal; b, basal; c, lateral views. Scale equals 0.2mm.

55a-c Type Number 214 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, coronal; b, basal; c, lateral views. Scale equals 0.1mm.

56a-c Type Number 218 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: a, coronal; b, lateral; c, basal views. Scale equals 0.2mm.

57a-d Type Number 008 from the Heebner Shale (Shawnee Group) in Cass County, Nebraska: a, top; b, posterior; c, anterior; d, lateral views. Scale equals 0.1mm.

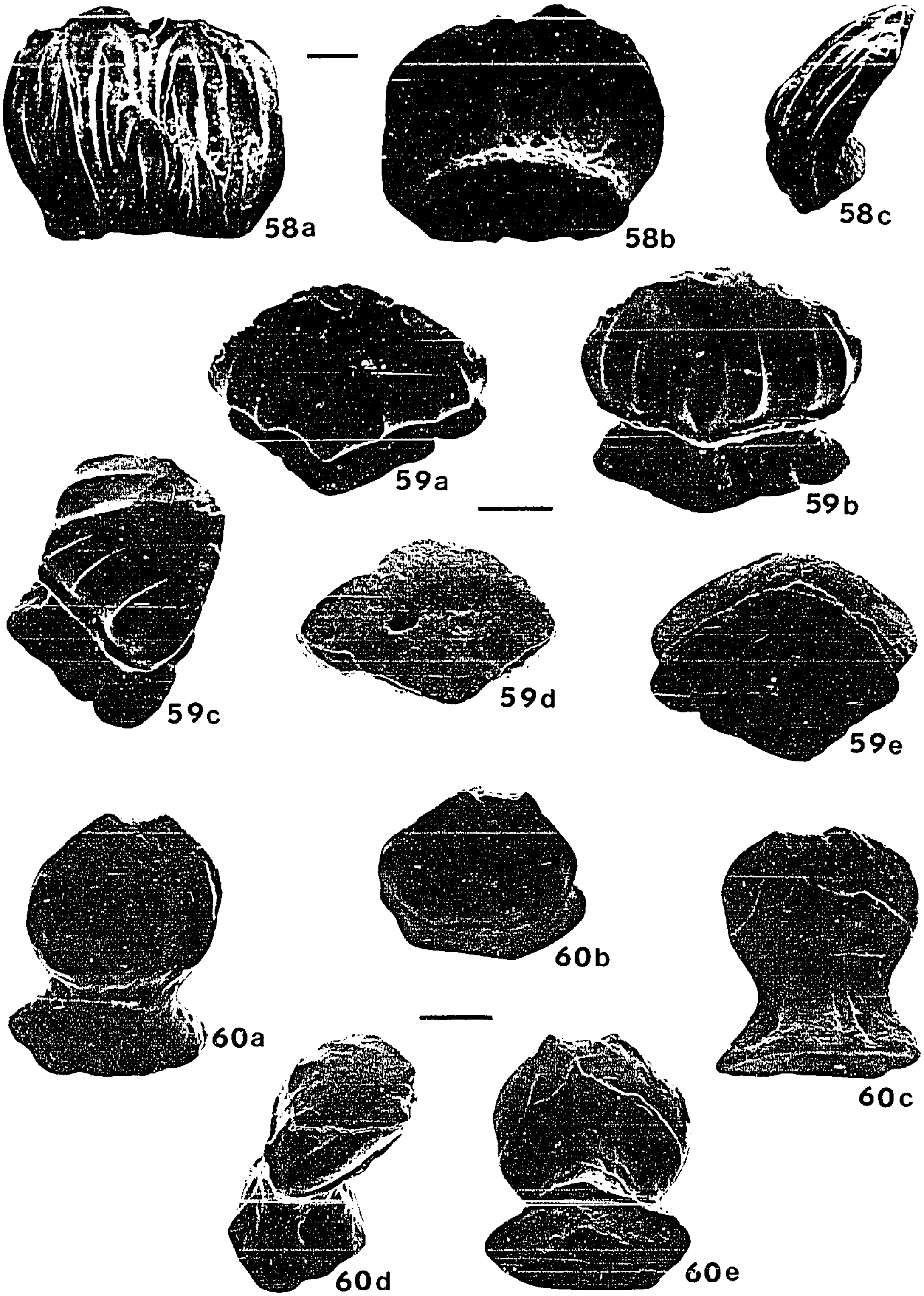

54a
54b
54c
55a
55b
55c
56a
56b
56c
57a
57b
57c
57d

FIGURES 58-60

58a-c Type Number 049 from the Plattsmouth Limestone (Shawnee Group) in Chautauqua County, Kansas: a, anterior; b, posterior; c, lateral views. Scale equals 0.2mm.

59a-e Type Number 138 from the Plattsmouth Limestone (Shawnee Group) in Lea venworth County, Kansas: a, top; b, anterior; c, lateral; d, basal; e, posterior views. Scale equals 0.1mm.

60a-e Type Number 141 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, anterior; b, top; c, posterior; d, lateral; e, basal views. Scale equals 0.1mm.


58a
58b
58c
59a
59b
59c
59d
59e
60a
60b
60c
60d
60e

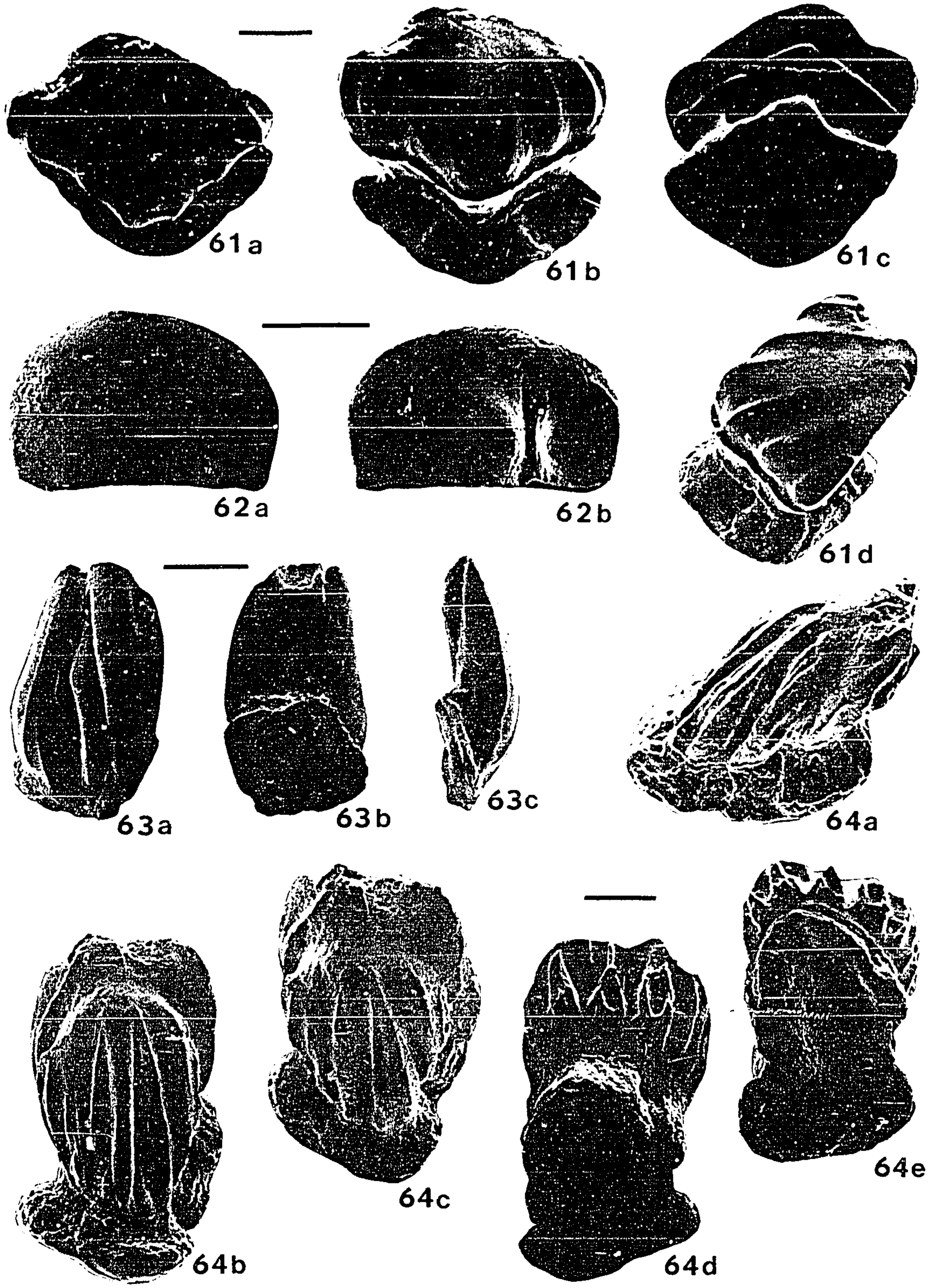
FIGURES 61-64

61a-d Type Number 145 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, anterior; c, posterior; d, lateral views. Scale equals 0.1mm.

62a-b Type Number 222 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, anterior; b, posterior views. Scale equals 0.2mm.

63a-c Type Number 082 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, anterior; b, posterior; c, lateral views. Scale equals 0.2mm.

64a-e Type Number 098 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: a, lateral; b, anterior; c, top; d, posterior; e, basal views. Scale equals 0.2mm.

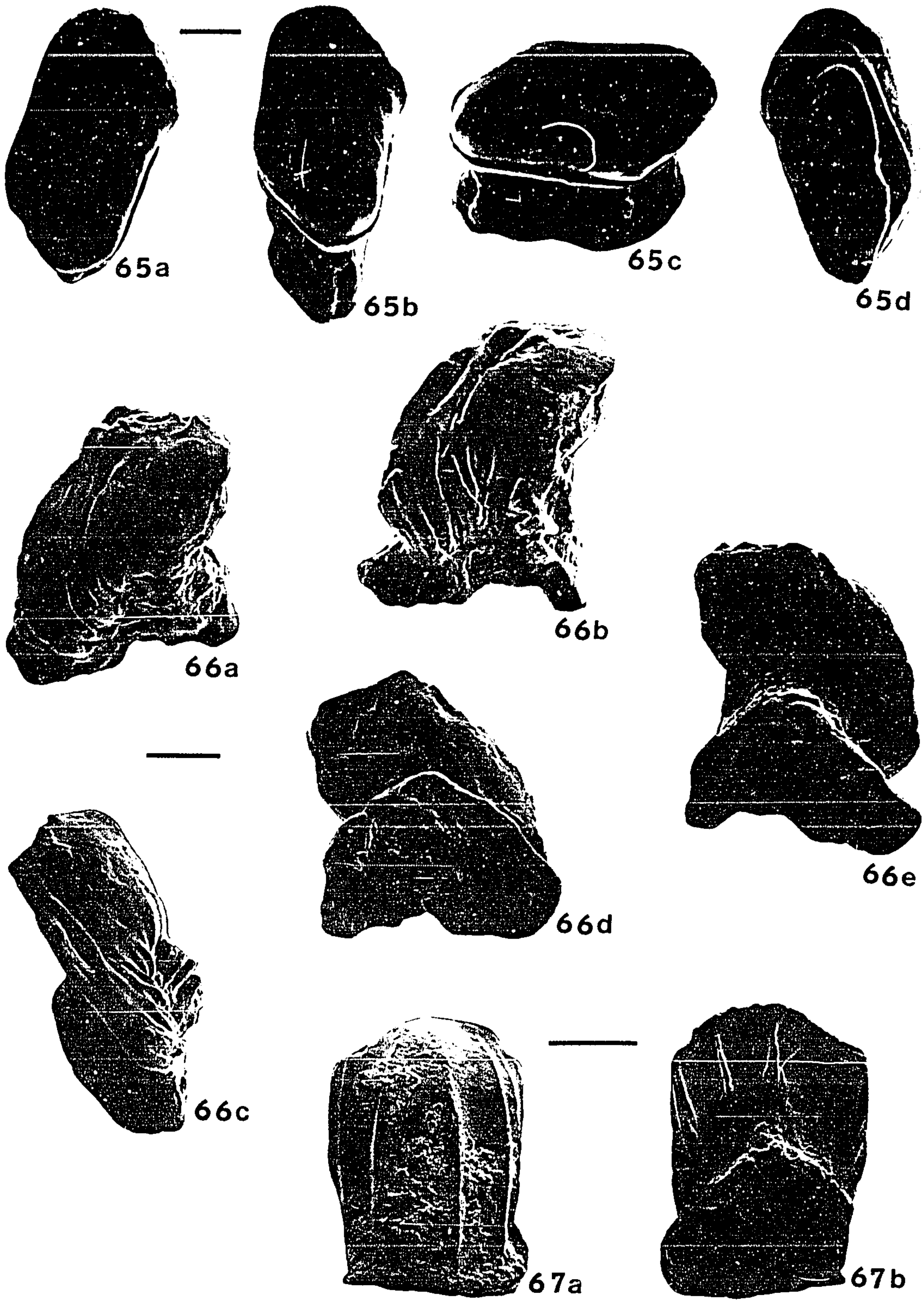

61a
61b
61c
62a
62b
61d
63a
63b
63c
64a
64b
64c
64d
64e

FIGURES 65-67

65a-d Type Number 111 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, anterior; c, lateral; d, basal views. Scale equals 0.1mm.

66a-e Type Number 165 from the Coal Creek Limestone (Shawnee Group) in Shawnee County, Kansas: a, top; b, anterior; c, lateral; d, basal; e, posterior views. Scale equals 0.2mm.

67a-b Type Number 210 from the Plattsmouth Limestone (Shawnee Group) in Coffey County, Kansas: a, anterior; b, posterior views. Scale equals 0.2mm.

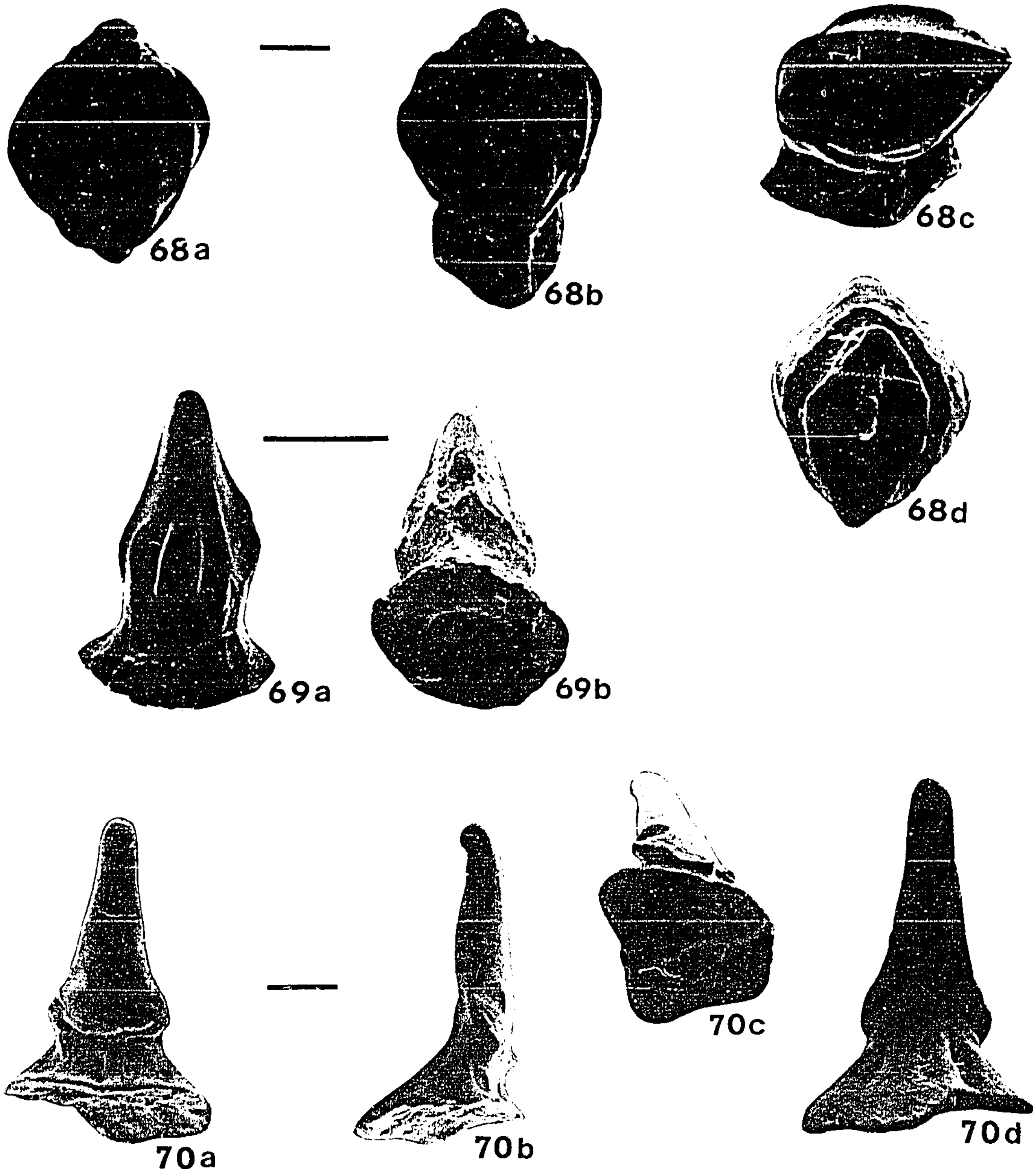

65a
65b
65c
65d
66a
66b
66c
66d
66e
67a
67b

FIGURES 68-70

68a-d Type Number 215 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Oklahoma: a, top; b, anterior; c, lateral; d, basal views. Scale equals 0.1mm.

69a-b Type Number 175 from the Jones Point Shale (Shawnee Group) in Shawnee County, Kansas: a, anterior; b, posterior views. Scale equals 0.2mm.

70a-d Type Number 221 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, anterior; b, lateral; c, basal; d, posterior views. Scale equals 0.2mm.


68a
68b
68c
68d
69a
69b
70a
70b
70c
70d

PART II

SECTION VII: TRIANGULAR ELEMENTS WITH NO ANGULAR FLEXURE OF MARGINS

Type Number: 006 (Fig. 1a-b)

Code: a9/b5/c1/d2/e7/f2/g1

ROM DVP Catalog Number: 23037

Diagnosis: Triangular element with transverse line and translucent tip. Length more than three times width; axis not curved. Apex sharp and tip margins even with margins of cone. No lines or keels present.

Type Number: 007 (Fig. 2a-b)

Code: a9/b5/c1/d3/e7/f2/g1/

ROM DVP Catalog Number: 23110

Diagnosis: Triangular element with transverse line and translucent tip. Length more than three times width; axis curved. Apex sharp and tip margins even with margins of cone. No lines or keels present.

Type Number: 017 (Fig. 3a-e)

Code: a9/b2/c2/d2/e3/f3/g1/h2+5+6/i1/j1

ROM DVP Catalog Number: 23111

Diagnosis: Triangular element with sharp tip and with several parallel keels on anterior and posterior side which extend only part way up from base. Blade flattened antero-posteriorly and not curved.

Two winglike projections extend from margins of blade. Base present which is circular with smooth margins; base wider than blade.

Type Number: 032 (Fig. 4a-b)

Code: a9/b2/c1/d1/e3/f2/g1/h5/i9/j1

ROM DVP Catalog Number: 23112

Diagnosis: Triangular element with sharp tip and several parallel keels which extend from base to tip. Blade slightly flattened laterally and curved. Base thick and curved and wider than blade.

Type Number: 035 (Fig. 5a-b)

Code: a9/b5/c2/d1,2/e7/f2,3/g1

ROM DVP Catalog Number: 23113

Diagnosis: Triangular element with transverse line and translucent tip. Length two to three times width; axis may or may not be curved. Apex either sharp or blunt and tip margins even with margins of cone. No lines or keels present.

Type Number: 038 (Fig. 6a-b)

Code: a9/b5/c3/d1,2/e7/f3/g1

ROM DVP Catalog Number: 23114

Diagnosis: Triangular element with transverse line and translucent tip. Length less than twice the width; axis may or may not be curved. Apex blunt and tip margins even with margins of cone. No lines or keels present.

Type Number: 047 (Fig. 7a-b)

Code: a9/b5/c1/d3/e7/f2/g1

ROM DVP Catalog Number: 23115

Diagnosis: Triangular element with transverse line and translucent tip. Length more than three times width. Main part of axis not curved with only tip strongly curved. Apex sharp and tip margins even with margins of cone. No lines or keels present.

Type Number: 056 (Fig. 8a-c)

Code: a9/b2/c1/d1/e3/f3/g1/h5/i2,3/j1

ROM DVP Catalog Number: 23042

Diagnosis: Triangular element with sharp tip and several parallel keels which extend from base to tip. Blade flattened laterally and curved. Base ovoid to triangular with smooth margins; platform wider than blade.

Type Number: 068 (Fig. 9a-b)

Code: a9/b5/c1,2/d1,2/e3+7/f2,3/g1

ROM DVP Catalog Number: 23116

Diagnosis: Triangular element with transverse line and translucent tip. Length two or more times width; axis may or may not be curved. Parallel lines extend from base of cone to transverse line. Apex either sharp or blunt and tip margins even with margins of cone.

Type Number: 073

Code: a9/b5/c3/d1/e7/f2/g3

ROM DVP Catalog Number: 23117

Diagnosis: Triangular element with translucent tip. Length less than twice width; axis curved. Apex sharp and single hook-like translucent projection extends from margin of cone. No lines or keels present.

Type Number: 075 (Fig. 10a-b)

Code: a9/b1/c3/d2/e1/f1/g2/h5/i1/j1

ROM DVP Catalog Number: 23118

Diagnosis: Triangular element with blunt tip and no ornamentation. Blade not flattened but rounded in cross-section and not curved. Circular base with smooth margins present which is wider than blade.

Type Number: 095 (Fig. 11)

Code: a9/b2/c3/d1/e3/f2/g1/h0

ROM DVP Catalog Number: 23119

Diagnosis: Triangular element with sharp tip and several parallel lines which extend from base to tip. Blade round in cross-section and curved.

Type Number: 096 (Fig. 12)

Code: a9/b2/c3/d1/e3/f5/g1/h0

ROM DVP Catalog Number: 23120

Diagnosis: Triangular element with sharp tip and several parallel lines which occur on only one side of element. Blade round in cross-section and curved.

Type Number: 105 (Fig. 13)

Code: a9/b2/c3,4/d1/e3/f5/g2/h5/i6/j1

ROM DVP Catalog Number: 23121

Diagnosis: Triangular element with blunt tip and several parallel keels which extend from base to tip. Blade round or square in cross-section and curved. Base ball-shaped and wider than blade.

Type Number: 108 (Fig. 14)

Code: a9/b2/c1/d1/e3/f4/g1/h5/i0/j2

ROM DVP Catalog Number: 23122

Diagnosis: Triangular element with sharp tip and several parallel lines which extend only part way down from tip. Blade laterally flattened and curved. Base ovoid and same width as blade.

Type Number: 114 (Fig. 15)

Code: a9/b1/c3/d1,2/e1/f1/g1/h5/i8/j1

ROM DVP Catalog Number: 23123

Diagnosis: Triangular element with sharp tip and no apparent ornamentation. Blade not flattened and may or may not be curved. Flared base present which is wider than blade.

Type Number: 118 (Fig. 16a-e)

Code: a9/b1/c2/d1/e1/f1/g1/h5/i7/j1

ROM DVP Catalog Number: 23124

Diagnosis: Triangular element with sharp tip and no ornamentation. Blade flattened antero-posteriorly and curved. Cruciform base present which is wider than blade.

Type Number: 119 (Fig. 17a-d)

Code: a9/b1/c1/d1/e1/f1/g1/h5/i7/j1

ROM DVP Catalog Number: 23125

Diagnosis: Triangular element with sharp tip and no ornamentation. Blade flattened laterally and curved. Cruciform base present which is wider than blade.

Type Number: 128 (Fig. 18a-b)

Code: a9/b2/c1/d1/e3/f3/g2/h5/i3/j1

ROM DVP Catalog Number: 23126

Diagnosis: Triangular element with blunt tip and several coarse keels which extend only part way up from base. Blade laterally flattened and curved. Base present which is triangular with smooth margins; base wider than blade.

Type Number: 135 (Fig. 19)

Code: a9/b5/c2/d2/e6/f4/g1

ROM DVP Catalog Number: 23127

Diagnosis: Triangular element with transverse line and translucent tip. Length two to three times width; axis not curved. Posesses a line which is adjacent and subparallel to tip of cone with tip highly translucent. Apex blunt with cone nearly straight-sided rather than tapered. Tip margins even with margins of cone. No lines or keels present.

Type Number: 136 (Fig. 20)

Code: a9/b1/c3/d1/e1/f1/g1/h0

ROM DVP Catalog Number: 23128

Diagnosis: Triangular element with sharp tip and no apparent ornamentation. Blade round in cross-section and curved.

Type Number: 137 (Fig. 21a-b)

Code: a9/b1/c1+2/d1,2/e1/f1/g1,2/h0

ROM DVP Catalog Number: 23129

Diagnosis: Triangular element with sharp or blunt tip and no apparent ornamentaion. In rare forms, tip may be translucent. Blade tip flattened antero-posteriorly and base flattened laterally; may or may not be slightly curved posteriorly.

Type Number: 142 (Fig. 22a-b)

Code: a9/b1/c1/d1,2/e1/f1/g1/h1

ROM DVP Catalog Number: 23130

Diagnosis: Triangular element with sharp tip and no apparent ornamentation. Blade flattened laterally and curved; rare forms may not be curved. Single wing like projection extends from one margin of blade.

Type Number: 143 (Fig. 23)

Code: a9/b5/c2/d1,2/e1/f3/g4

ROM DVP Catalog Number: 23131

Diagnosis: Triangular element with transverse line and translucent tip. Length two to three times width; axis may or may not be curved. Apex blunt and tip margins wider than margins of cone. No lines or keels present.

Type Number: 152 (Fig. 24a-b)

Code: a9/b1/c5/d2/e1/f1/g2/h0

ROM DVP Catalog Number: 23132

Diagnosis: Triangular element with blunt tip and no apparent ornamentation. Blade flattened but not curved.

Type Number: 155 (Fig. 25)

Code: a9/b1/c3/d2/e1/f1/g1,2/h0

ROM DVP Catalog Number: 23133

Diagnosis: Triangular element with sharp or blunt tip and no apparent ornamentation. Blade round in cross-section and not curved.

Type Number: 156 (Fig. 26a-c)

Code: a9/b2/c2/d1/e3/f2,3/g1/h2+5/i2/j2

ROM DVP Catalog Number: 23134

Diagnosis: Triangular element with sharp tip and several coarse keels which extend either from base to tip or only part way up from base; additional keels present on posterior side of blade. Blade antero-posteriorly flattened and curved posteriorly. Platform ovoid and same width as blade. Two winglike projections from margins of blade.

Type Number: 166 (Fig. 27a-c)

Code: a9/b1/c2/d2/e1/f1/g2/h5/i3/j1,2

ROM DVP Catalog Number: 23135

Diagnosis: Triangular element with blunt tip and no ornamentation. Blade flattened antero-posteriorly and not curved. Triangular base with smooth margins present which is same width as or wider than blade.

Type Number: 174 (Fig. 28a-b)

Code: a9/b1/c5/d2/e1/f1/g1/h4

ROM DVP Catalog Number: 23136

Diagnosis: Triangular element with sharp tip and no apparent ornamentation. Blade flattened but not curved. Margins of blade serrated.

Type Number: 187 (Fig. 29a-b)

Code: a9/b5/c3/d1,2/e8/f4/g1

ROM DVP Catalog Number: 23137

Diagnosis: Triangular element with transverse line and small, translucent circular disc on top of cone. Length less than twice width; axis may or may not be curved. Apex blunt with cone almost straight-sided rather than tapered; tip margins even with margins of cone.

Type Number: 193 (Fig. 30a-b)

Code: a9/b2/c1/d1,2/e3/f2/g1/h0

ROM DVP Catalog Number: 23138

Diagnosis: Triangular element with sharp tip and several parallel lines which extend from base to tip. Blade flattened laterally and may or may not be curved.

Type Number: 203 (Fig. 31a-c)

Code: a9/b1/c2/d1/e1/f1/g2/h5/i2/j2

ROM DVP Catalog Number: 23139

Diagnosis: Triangular element with blunt tip and no ornamentation. Blade flattened antero-posteriorly and curved. Ovoid base present which is same width as blade.

Type Number: 211 (Fig. 32a-b)

Code: a9/b1/c2/d1/e1/f1/g1/h7

ROM DVP Catalog Number: 23140

Diagnosis: Triangular element with sharp tip and no apparent ornamentation. Blade flattened antero-posteriorly and curved. Flange present on posterior side of blade.

Type Number: 232 (Fig. 33)

Code: a9/b2/c0/d1/e3/f2/g1/h8

ROM DVP Catalog Number: 23141

Diagnosis: Triangular element with sharp tip and toothed keels which extend from base to tip. Blade curved; blade flattening indeterminate.

Type Number 233 (Fig. 34a-d)

Code: a9/b1/c2/d2/e1/f1/g2/h5/i2/j1

ROM DVP Catalog Number: 23142

Diagnosis: Triangular element with blunt tip and no ornamentation. Blade flattened antero-posteriorly and not curved. Ovoid base present which is wider than blade.

SECTION VIII: MULTICUSPID ELEMENTS

Type Number: 009 (Fig. 35a-e)

Code: a10,11/b2/c1/d2/e1/f3-15/g1/h2

ROM DVP Catalog Number: 23143

Diagnosis: Multicuspid element with three to fifteen widely spaced, striated cusps which are linearly arranged; cusps triangular and not curved. Body from which cusps arise elongate and bar-shaped. Element symmetrical with larger median cusp and lateral cusps decreasing in size from middle to edge of element, or cusps all equal in size.

Type Number: 018 (Fig. 36a-b)

Code: a11/b2/c2/d6/e3/f3-9/g1/h4/i2

ROM DVP Catalog Number: 28407

Diagnosis: Multicuspid element with three to nine antero-posteriorly flattened cusps which are unequal in size and arranged closely and linearly; cusps triangular and curved posteriorly with several parallel lines. Body from which cusps arise curved. Posterior cusp largest with succeeding anterior cusps decreasing in size.

Type Number: 019 (Fig. 37a-b)

Code: a11/b1/c2/d3/e3/f2-4/g1/h4/i2

ROM DVP Catalog Number: 23144

Diagnosis: Multicuspid element with two to four antero-posteriorly flattened cusps which are unequal in size and arranged closely and linearly; cusps triangular and curved posteriorly. Body from which cusps arise flat and platelike. Posterior cusp largest with succeesing anterior cusps decreasing in size.

Type Number: 021 (Fig. 38a-e)

Code: a11/b2/c1/d3/e2/f5-11/g1/h3

ROM DVP Catalog Number: 23145

Diagnosis: Multicuspid element with five to eleven widely spaced cusps which are unequal in size and linearly arranged; cusps triangular and curved labially with several parallel lines. Body from which cusps arise flat and platelike. Element symmetrical with median cusp largest and smaller lateral cusps but one of lateral cusps larger than lateral cusp nearest median cusp.

Type Number: 040 (Fig. 39a-b)

Code: a10/b1/c1/d3/e1/f2-50/g2

ROM DVP Catalog Number: 23146

Diagnosis: Multicuspid element with two to fifty widely spaced cusps not linearly arranged; cusps triangular and not curved. Body from which cusps arise flat and platelike. Cusps approximately equal in size.

Type Number: 057 (Fig. 40a-b)

Code: a11/b2/c2/d6/e3/f5-16/g2

ROM DVP Catalog Number: 23147

Diagnosis: Multicuspid element with five to sixteen cusps which are unequal in size and arranged closely but not linearly; cusps triangular and curved posteriorly with several parallel lines. Body from which cusps arise curved.

Type Number: 069 (Fig. 41a-e)

Code: a11/b2/c1/d6/e1/f3-5/g1/h2

ROM DVP Catalog Number: 23148

Diagnosis: Multicuspid element with three to five widely spaced cusps which are unequal in size and linearly arranged; cusps triangular and not curved with several parallel keels. Body from which cusps arise curved. Element symmetrical with larger median cusp and lateral cusps decreasing in size from middle to edge of element.

Type Number: 074 (Fig. 42a-b)

Code: a11/b2/c2/d4/e3/f2/g1/h4/i0,1,2

ROM DVP Catalog Number: 23149

Diagnosis: Multicuspid element with two cusps which are unequal in size and arranged closely and linearly; cusps triangular and curved posteriorly with several parallel lines; cusps may or may not be slightly flattened. Body from which cusps arise circular to subcircular in outline but not flattened. Posterior cusp larger than anterior cusp.

Type Number: 083 (Fig. 43a-d)

Code: a10,11/b1/c1/d5/e4/f3-5/g1/h2

ROM DVP Catalog Number: 23150

Diagnosis: Multicuspid element with three to five widely spaced cusps linearly arranged; cusps broad and blunt. Body from which cusps arise thick and polygonal. Element symmetrical with larger median cusp and lateral cusps decreasing in size from middle to edge of element, or cusps all equal in size.

Type Number: 100 (Fig. 44a-d)

Code: a11/b2/c1/d2/e2/f5-7/g1/h2,3

ROM DVP Catalog Number: 23151

Diagnosis: Multicuspid element with five to seven widely spaced cusps which are unequal in size and linearly arranged; cusps triangular and curved labially with several parallel lines. Body from which cusps arise elongate and bar-shaped. Element symmetrical with median cusp largest and lateral cusps decreasing in size from middle to edge of element, or one of lateral cusps larger than lateral cusp nearest medial cusp.

Type Number: 123 (Fig. 45)

Code: a11/b1/c1/d7/e0/f3/g1/h5

ROM DVP Catalog Number: 23152

Diagnosis: Multicuspid element with three widely spaced cusps which are unequal in size and linearly arranged; shape of cusps indeterminate. Body from which cusps arise circular to subcircular and flat with a buttonlike process. Median cusp smaller than lateral cusps.

Type Number: 124 (Fig. 46a-b)

Code: a11/b1/c2/d6/e3/f5-11/g2

ROM DVP Catalog Number: 23153

Diagnosis: Multicuspid element with five to eleven cusps which are unequal in size and arranged closely but not linearly; cusps triangular and curved posteriorly. Body from which cusps arise curved.

Type Number: 127 (Fig. 47a-b)

Code: a10/b1/c1/d1/e1/f8-24/g2

ROM DVP Catalog Number: 23154

Diagnosis: Multicuspid element with eight to twenty-four widely spaced cusps not linearly arranged; cusps triangular and not curved. Body from which cusps arise very thick with no particular shape. Cusps approximately equal in size.

Type Number: 139 (Fig. 48a-b)

Code: a10,11/b1,2/c1/d5/e1,4/f3-13/g2/h1

ROM DVP Catalog Number: 23043

Diagnosis: Multicuspid element with three to thirteen widely spaced cusps not linearly arranged; cusps either triangular and not curved or broad and blunt; cusps may or may not be striated. Body from which cusps arise thick and polygonal. Cusps equal in size or unequal with no order to their distribution.

Type Number: 148 (Fig. 49a-b)

Code: a11/b1/c2/d3/e3/f2-4/g1/h4/i1

ROM DVP Catalog Number: 23155

Diagnosis: Multicuspid element with two to four laterally flattened cusps which are unequal in size and arranged closely and linearly; cusps triangular and curved posteriorly. Body from which cusps arise flat and platelike. Posterior cusp largest with succeeding anterior cusps decreasing in size.

Type Number: 169 (Fig. 50a-e)

Code: a10/b2/c1/d6/e2/f3/g1

ROM DVP Catalog Number: 23156

Diagnosis: Multicuspid element with three widely spaced cusps linearly arranged; cusps broad and blunt; cusps striated. Body from which cusps arise thick and curved. Cusps approximately equal in size.

Type Number: 172 (Fig. 51a-b)

Code: a11/b3/c1,2/d5/e4/f2-7/g2

ROM DVP Catalog Number: 23157

Diagnosis: Multicuspid element with two to seven cusps which are unequal in size and not linearly arranged; cusps may be widely spaced or close together; cusps broad and blunt with radiating striations. Body from which cusps arise thick and polygonal.

Type Number: 173 (Fig. 52a-e)

Code: a11/b2/c1/d8/e2/f3/g1/h5

ROM DVP Catalog Number: 23158

Diagnosis: Multicuspid element with three widely spaced cusps which are unequal in size and linearly arranged; cusps triangular and curved lingually with several parallel lines. Body form which cusps arise circular and thick with a buttonlike process. Element symmetrical with smaller median cusp and large lateral cusps.

Type Number: 176 (Fig. 53a-c)

Code: a11/b1/c1/d3/e2/f3-7/g2

ROM DVP Catalog Number: 23159

Diagnosis: Multicuspid element with three to seven widely spaced cusps which are unequal in size and not linearly arranged; cusps triangular and curved lingually. Body from which cusps arise flat and platelike.

Type Number: 198 (Fig. 54a-c)

Code: a11/b2/c2/d3/e3/f4-10/g2

ROM DVP Catalog Number: 23160

Diagnosis: Multicuspid element with four to ten cusps which are unequal in size and arranged closely but not linearly; cusps triangular and curved posteriorly with or without several parallel lines. Body from which cusps arise flat and platelike.

Type Number: 202 (Fig. 55a-b)

Code: a11/b1/c2/d6/e3/f2-6/g1/h4/i0

ROM DVP Catalog Number: 23161

Diagnosis: Multicuspid element with two to six cusps which are unequal in size and arranged closely and linearly; cusps not flattened; cusps triangular and curved posteriorly. Body from which cusps arise thick and curved. Posterior cusp largest with succeeding anterior cusps decreasing in size.

Type Number: 205 (Fig. 56a-c)

Code: a11/b1/c2/d5/e3/f2-4/g2/h4/i2

ROM DVP Catalog Number: 23162

Diagnosis: Multicuspid element with two to four antero-posteriorly flattened cusps which are unequal in size and arranged closely and linearly; cusps triangular and curved posteriorly. Body from which cusps arise thick and polygonal. Cusps of different sizes with no order to their distribution.

Type Number: 207 (Fig. 57a-d)

Code: a11/b1/c1/d9/e3/f3/g2

ROM DVP Catalog Number: 23163

Diagnosis: Multicuspid element with three widely spaced cusps which are unequal in size and linearly arranged; cusps triangular and curved posteriorly. Body from which cusps arise flat and star-shaped. Median cusp larger than lateral cusps.

Type Number: 212 (Fig. 58a-c)

Code: a11/b2/c1/d0/e2+3/f2/g1/h1

ROM DVP Catalog Number: 23164

Diagnosis: Multicuspid element with two widely spaced unequal-size cusps with several parallel lines; cusps triangular and curved lingually. Body from which cusps arise indeterminate. One cusp larger than the other.

Type Number: 223 (Fig. 59a-c)

Code: a10/b1/c1/d0/e2/f2/g1

ROM DVP Catalog Number: 23165

Diagnosis: Multicuspid element with two widely spaced cusps which are equal in size; cusps triangular and curved lingually. Shape of platform indeterminate.

Type Number: 238 (Fig. 60a-c)

Code: a11/b2/c2/d5/e3/f5-9/g2

ROM DVP Catalog Number: 23166

Diagnosis: Multicuspid element with five to nine unequal-sized cusps with striations which are close together and not linearly arranged;

cusps triangular and curved posteriorly. Body from which cusps arise thick and polygonal.

Type Number: 239 (Fig. 61a-d)

Code: a11/b2/c1/d3/e2/f2/g1/h1

ROM DVP Catalog Number: 23167

Diagnosis: Multicuspid element with two widely spaced cusps with striations which are unequal in size and linearly arranged; cusps triangular and curved lingually. Body from which cusps arise flat and platelike. One cusp larger than the other.

SECTION IX: DOME-SHAPED ELEMENTS

Type Number: 086 (Fig. 62a-c)

Code: a12/b8/c1

ROM DVP Catalog Number: 23033

Diagnosis: Dome-shaped element which is entirely translucent. Base concave and circular.

Type Number: 102 (Fig. 63a-d)

Code: a12/b8/c2

ROM DVP Catalog Number: 23169

Diagnosis: Dome-shaped element which is entirely translucent. Base flat and circular.

Type Number: 126

Code: a12/b8/c3

ROM DVP Catalog Number: 23170

Diagnosis: Dome-shaped element which is entirely translucent. Base concave and flared into square to cruciform shape.

Type Number: 200 (Fig. 64a-b)

Code: a12/b3/c1/d1

ROM DVP Catalog Number: 23171

Diagnosis: Dome-shaped element with radiating lines. Top of element pointed; keels smooth.

Type Number: 231 (Fig. 65a-c)

Code: a12/b3/c2/d1

ROM DVP Catalog Number: 23172

Diagnosis: Dome-shaped element with radiating lines. Top of element flat; keels smooth.

Type Number: 236 (Fig. 66a-b)

Code: a12/b3/c1/d2

ROM DVP Catalog Number: 23173

Diagnosis: Dome shaped element with radiating lines. Top of element pointed; keels toothed.

SECTION X: MUSHROOM-SHAPED ELEMENTS, EACH WITH ROUNDED OR FLATTENED UPPER SURFACE.

Type Number: 103 (Fig. 67a-b)

Code: a13/b2/c1/d6/e2/f2

ROM DVP Catalog Number: 23174

Diagnosis: Mushroom-shaped element with flattened upper surface.

Outline triangular with ridges on more than one edge but not all edges. Base long and same width as top of element.

Type Number: 109 (Fig. 68a-c)

Code: a13/b1/c2/d3/c0/f0

ROM DVP Catalog Number: 23175

Diagnosis: Mushroom-shaped element with rounded upper surface. Outline five-sided with margins concave between projections but smooth throughout. Nature of base indeterminate.

Type Number: 134 (Fig. 69a-c)

Code: a13/b1/c1,2/d1/e2/f2,3

ROM DVP Catalog Number: 23035

Diagnosis: Mushroom-shaped element with flattened upper surface. Outline triangular to five-sided with ridges on more than one edge but not all edges. Base long and narrower than or approximately same width as top of element.

Type Number: 140 (Fig. 70a-d)

Code: a13/b3/c1,3/d5/e1/f1,2

ROM DVP Catalog Number: 23176

Diagnosis: Mushroom-shaped element with flattened upper surface and several radiating lines. Outline triangular to subcircular with distinct ridges on all edges. Base short and wider than or approximately same width as top of element.

Type Number: 144 (Fig. 71a-c)

Code: a13/b1/c2/d1/e2/f2,3

ROM DVP Catalog Number: 23177

Diagnosis: Mushroom-shaped element with flattened upper surface. Outline five-sided with smooth margins. Base long and narrower than or approximately same width as top of element.

Type Number: 192 (Fig. 72a-b)

Code: a13/b1/c5/d3/e1,2/f2,3

ROM DVP Catalog Number: 23178

Diagnosis: Mushroom-shaped element with rounded upper surface. Outline very irregular; with margins concave between projections but smooth throughout. Base short to long and narrower than or same width as top of element.

Type Number: 201 (Fig. 73a-b)

Code: a13/b1/c3/d1/e2/f1

ROM DVP Catalog Number: 23179

Diagnosis: Mushroom-shaped element with somewhat flattened upper surface. Outline circular with smooth margins. Base long and wider than top of element.

Type Number: 206 (Fig. 74a-b)

Code: a13/b1/c1/d4/e2/f1,2,3

ROM DVP Catalog Number: 23180

Diagnosis: Mushroom-shaped element with rounded upper surface. Outline triangular with distinct ridges on one edge. Base long with highly variable width.

Type Number: 240 (Fig. 75a-b)

Code: a13/b3/c5/d2/e1/f2

ROM DVP Catalog Number: 23181

Diagnosis: Mushroom-shaped element with flattened surface and radiating lines. Outline irregular with crenulated margins. Base short and approximately same width as blade.

Type Number: 242 (Fig. 76a-c)

Code: a13/b2/c4/d3/e2/f2,3

ROM DVP Catalog Number: 23168

Diagnosis: Mushroom-shaped element with flattened surface. Outline square; margins concave between projections but smooth throughout. Base long and narrower than or approximately same width as blade.

SECTION XI: PYRAMID-SHAPED ELEMENTS

Type Number: 107 (Fig. 77a-e)

Code: a14/b3/c2/d1

ROM DVP Catalog Number: 23044

Diagnosis: Pyramid-shaped element with two keels which radiate from center of top of element. Two edges curved inward and one edge straight.

Type Number: 216 (Fig. 78a-d)

Code: a14/b3/c3,4/d2

ROM DVP Catalog Number: 28401

Diagnosis: Pyramid-shaped element with three or four keels which radiate from center of element. Two edges straight and one edge curved inward.

SECTION XII: BAR-SHAPED ELEMENTS

Type Number: 177 (Fig. 79a-b)

Code: a15/b2/c1

ROM DVP Catalog Number: 23039

Diagnosis: Bar-shaped element with several parallel grooves on top of element and a ridge which runs perpendicular to grooves. Base flat with several foramen along side.

Type Number: 217 (Fig. 80a-b)

Code: a15/b3

ROM DVP Catalog Number: 28402

Diagnosis: Bar-shaped element with radiating lines.

SECTION XIII: CIRCULAR TO SUBCIRCULAR ELEMENTS; NO PLATFORM PRESENT

Type Number: 132 (Fig. 81a-b)

Code: a16/b9

ROM DVP Catalog Number: 28403

Diagnosis: Elliptical element with concentric lines. Upper surface of element more highly convex than base.

Type Number: 208 (Fig. 82a-b)

Code: a16/b10

ROM DVP Catalog Number: 28404

Diagnosis: Circular to subcircular element with flattened, stippled surfaces. Often pearlescent.

FIGURES 1-7

1a-b Type Number 006 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, lateral view in SEM; b, lateral view in reflected light to show translucent tip. Scale equals 0.2mm.

2a-b Type Number 007 from the Plattsmouth Limestone (Shawnee Group) in Greenwood County, Kansas: a, lateral view in SEM; b, lateral view in reflected light to show translucent tip. Scale equals 0.2mm.

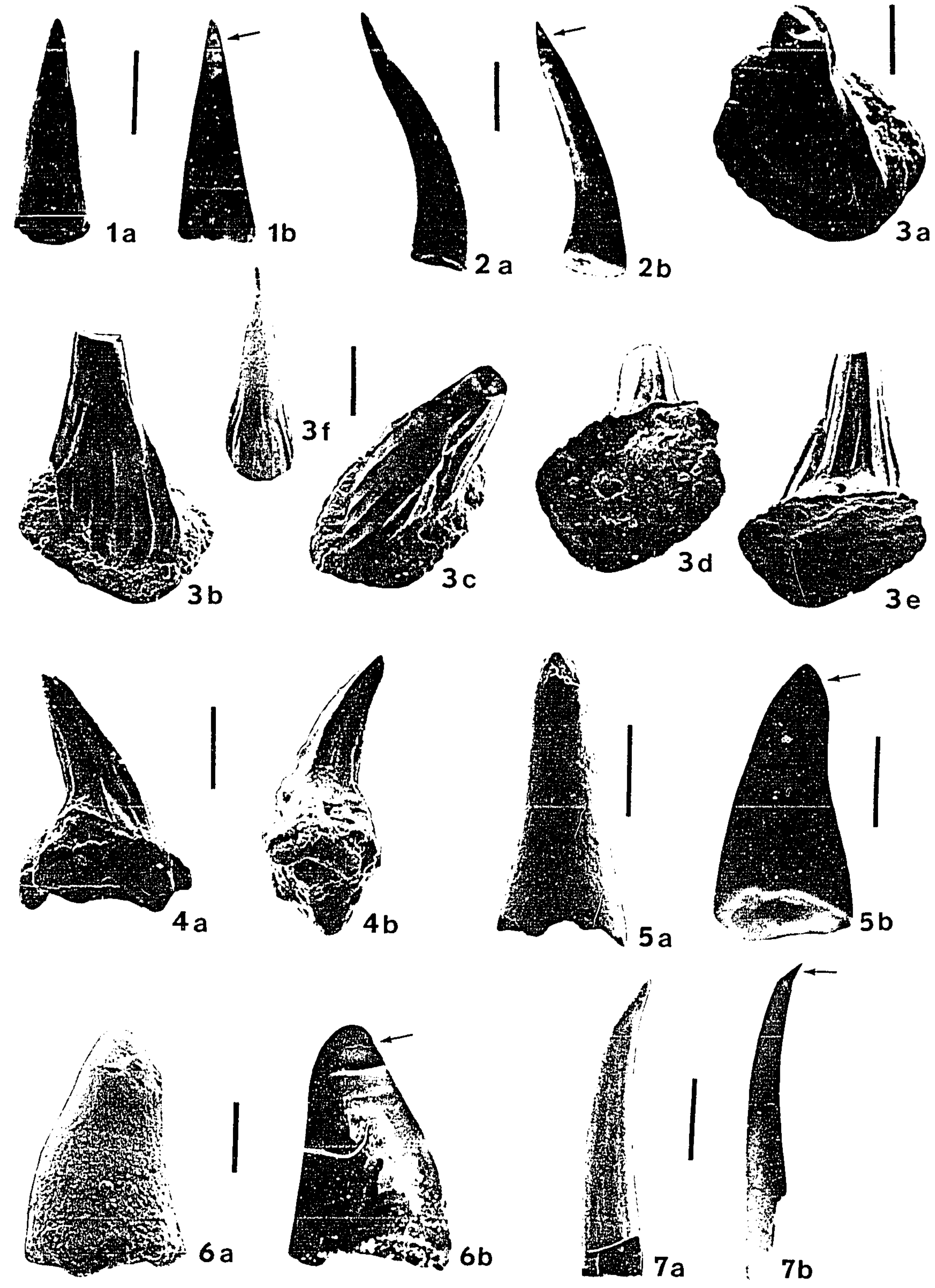
3a-e Type Number 017 from the Stoner Limestone (Lansing Group) in Cass County, Iowa (a-e), and the Leavenworth Limestone (Shawnee Group) in Cass County, Nebraska (f): a, top; b, anterior; c, lateral; d, basal; e, posterior views. Most commonly seen without base as in f (anterior view). Scale equals 0.2mm.

4a-b Type Number 032 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: a, lingual; b, posterior views. Scale equals 0.2mm.

5a-b Type Number 035 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas (a), and the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri (b): a, lateral view in SEM; b, lateral view in reflected light to show translucent tip. Scale equals 0.2mm.

6a-b Type Number 038 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Oklahoma (a), and Andrew County, Missouri (b): a, lateral view in SEM; b, lateral view in reflected light to show translucent tip. Scale equals 0.2mm.

7a-b Type Number 047 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas (a), and Andrew County, Missouri(b): a, lateral view in SEM; b, lateral view in reflected light to show translucent tip. Scale equals 0.2mm.


1a
1b
2 a
2b
3a
3b
3f
3c
3d
3e
4a
4b
5a
5b
6a
6b
7a
7b

FIGURES 8-15

8a-c Type Number 056 from the Plattsmouth Limestone (Shawnee Group) in Madison County, Iowa: a, lateral; b, oblique basal; c, basal. Scale equals 0.2mm.

9a-b Type Number 068 from the Plattsmouth Limestone (Shawnee Group) in Elk County, Kansas (a), and the Doniphan Shale (Shawnee Group) in Douglas County, Kansas (b): a, lateral view in SEM; b, lateral view in reflected light to show translucent tip. Scale equals 0.2mm.

10a-b Type Number 075 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, lateral views. Scale equals 0.2mm.

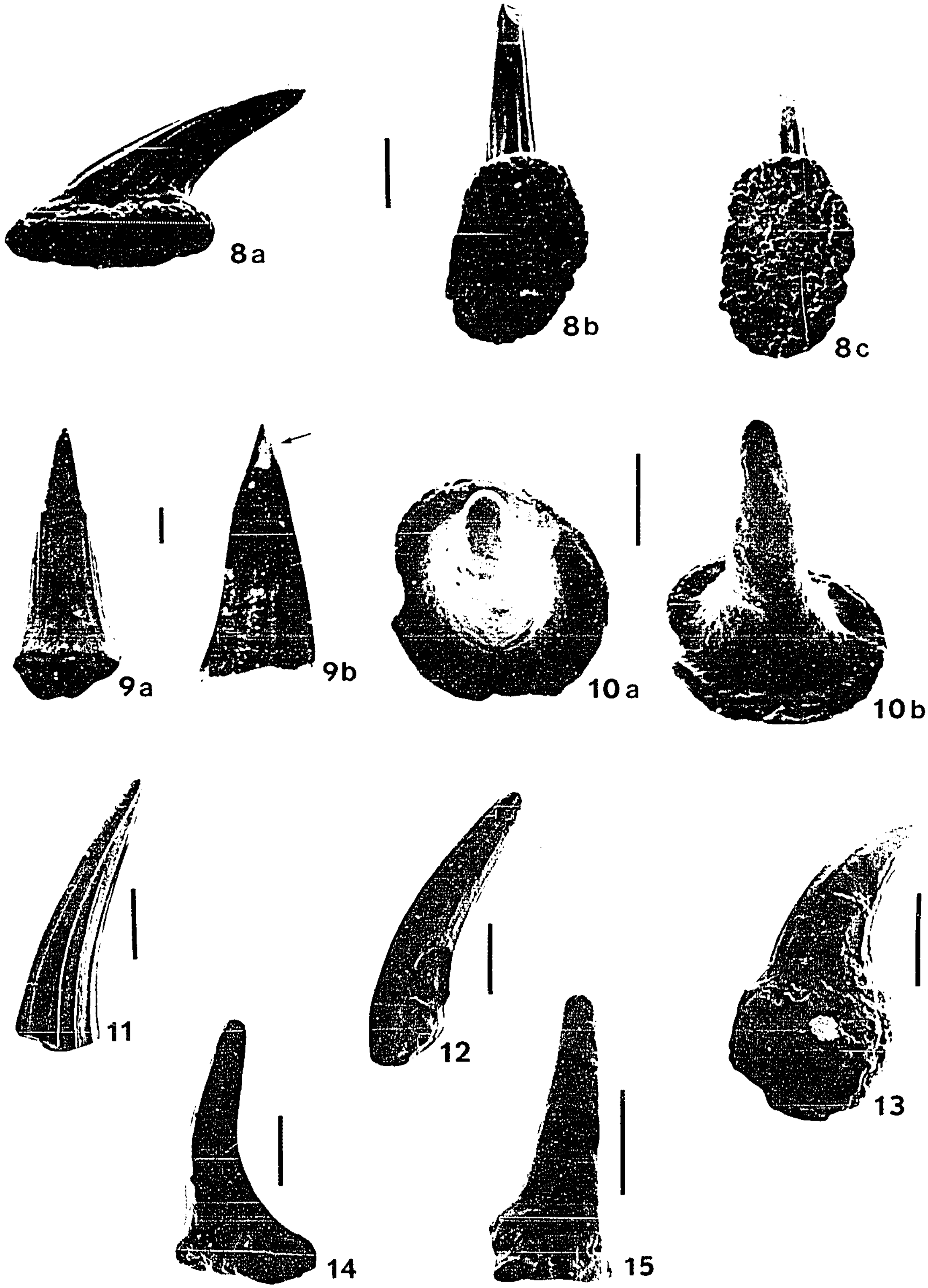
11 Type Number 095 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas: lateral view. Scale equals 0.2mm.

12 Type Number 096 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: lateral view. Scale equals 0.2mm.

13 Type Number 105 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: lateral view. Scale equals 0.2mm.

14 Type Number 108 from the Iowa Point Shale (Shawnee Group) in Shawnee County, Kansas: lateral view. Scale equals 0.2mm.

15 Type Number 114 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: lateral view. Scale equals 0.2mm.


8a
8b
8c
9a
9b
10a
10b
11
12
13
14
15

FIGURES 16-21

16a-e Type Number 118 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, anterior; b, top; c, posterior; d, basal; e, lateral views. Scale equals 0.2mm.

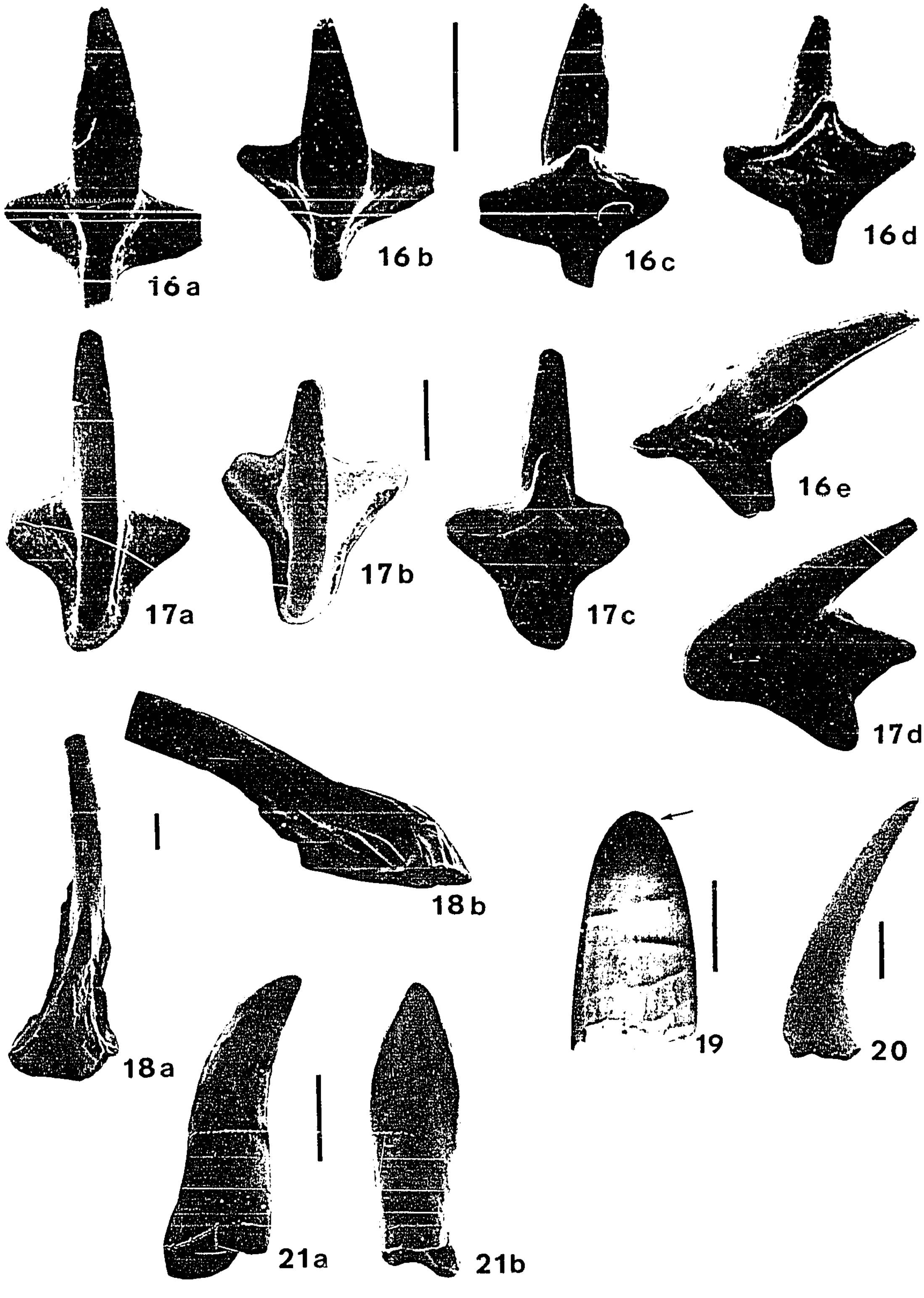
17a-d Type Number 119 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, anterior; b, top; c, posterior; d, lateral views. Scale equals 0.2mm.

18a-b Type Number 128 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, anterior; b, lateral views. Scale equals 0.2mm.

19 Type Number 135 from the Turner Creek Shale (Shawnee Group) in Shawnee County, Kansas: lateral view in reflected light to show translucent tip. Scale equals 0.2mm.

20 Type Number 136 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: lateral view. Scale equals 0.2mm.

21a-b Type Number 137 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, lateral; b, posterior views. Scale equals 0.1mm.


16a
16b
16c
16d
16e
17a
17b
17c
17d
18a
18b
19
20
21a
21b

FIGURES 22-30

22a-b Type Number 142 from the Captain Creek Limestone (Lansing Group) in Madison County, Iowa: a, lateral; b, edge views. Scale equals 0.2mm.

23 Type Number 143 from the Heebner Shale (Shawnee Group) in Cass County, Nebraska: lateral view. Scale equals 0.1mm.

24a-b Type Number 152 from the Heebner Shale (Shawnee Group) in Cass County, Nebraska: a, lateral; b, edge views. Scale equals 0.2mm.

25 Type Number 155 from the Heebner Shale (Shawnee Group) in Douglas County, Kansas: lateral view. Scale equals 0.2mm.

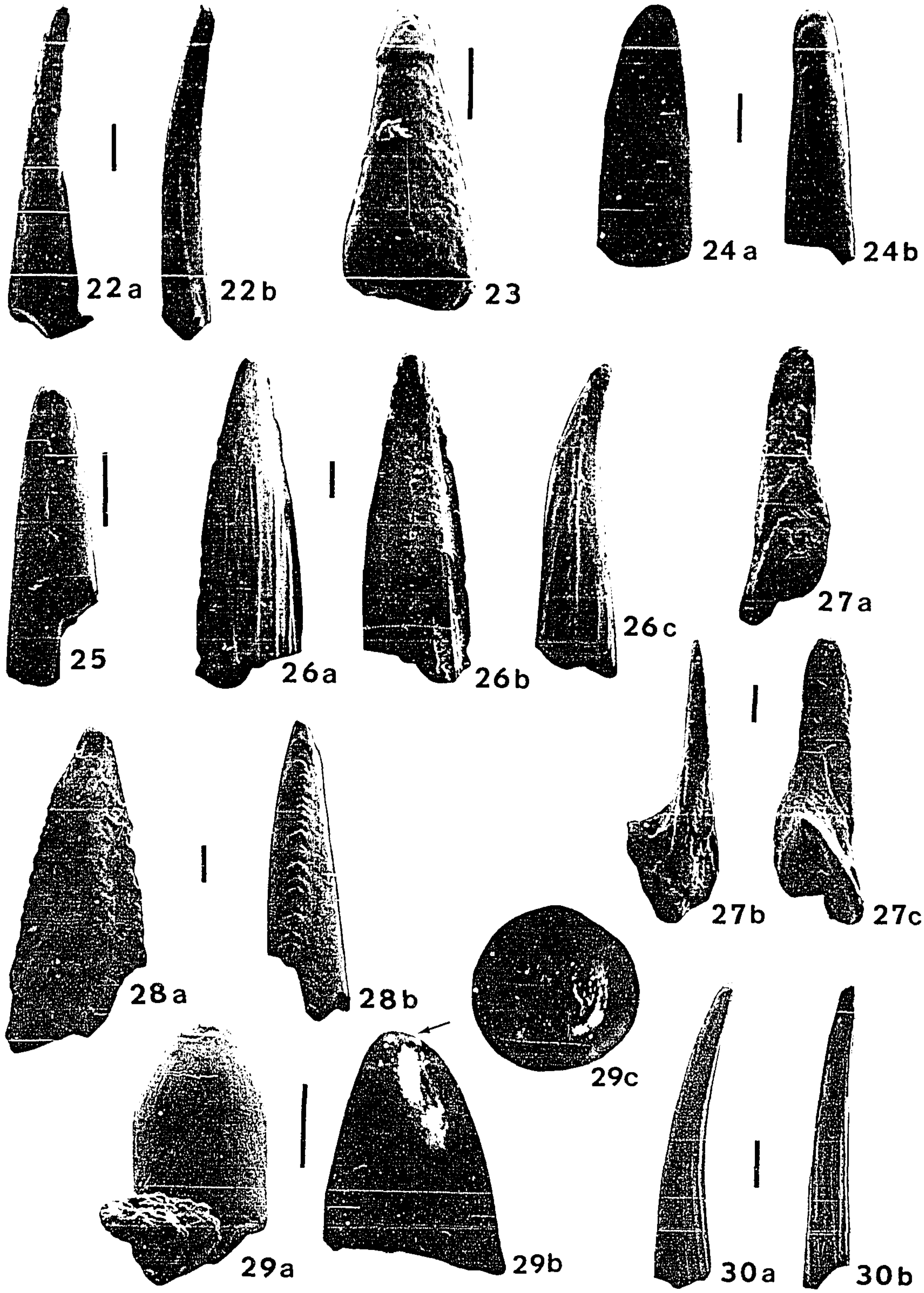
26a-c Type Number 156 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, anterior; b, posterior; c, edge views. Scale equals 0.2mm.

27a-c Type Number 166 from the Coal Creek Limestone (Shawnee Group) in Shawnee County, Kansas: a, anterior; b, edge; c, posterior views. Scale equals 0.2mm.

28a-b Type Number 174 from the Spring Branch Limestone (Shawnee Group) in Douglas County, Kansas: a, lateral; b, edge views. Scale equals 0.2mm.

29a-c Type Number 187 from the Plattsmouth Limestone (Shawnee Group) in Leavneworth County, Kansas: a, lateral view in SEM; b, lateral view in reflected light to show translucent circular disc; c, top view in reflected light to show translucent circular disc. Scale equals 0.2mm.

30a-b Type Number 193 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, lateral; b, edge views. Scale equals 0.2mm.


22a
22b
23
24a
24b
25
26a
26b
26c
27a
27b
27c
28a
28b
29a
29b
29c
30a
30b

FIGURES 31-37

31a-c Type Number 203 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Oklahoma: a, anterior; b, posterior; c, lateral views. Scale equals 0.2mm.

32a-b Type Number 211 from the Plattsmouth Limestone (Shawnee Group) in Chautauqua County, Kansas: a, anterior; b, posterior views. Scale equals 0.2mm.

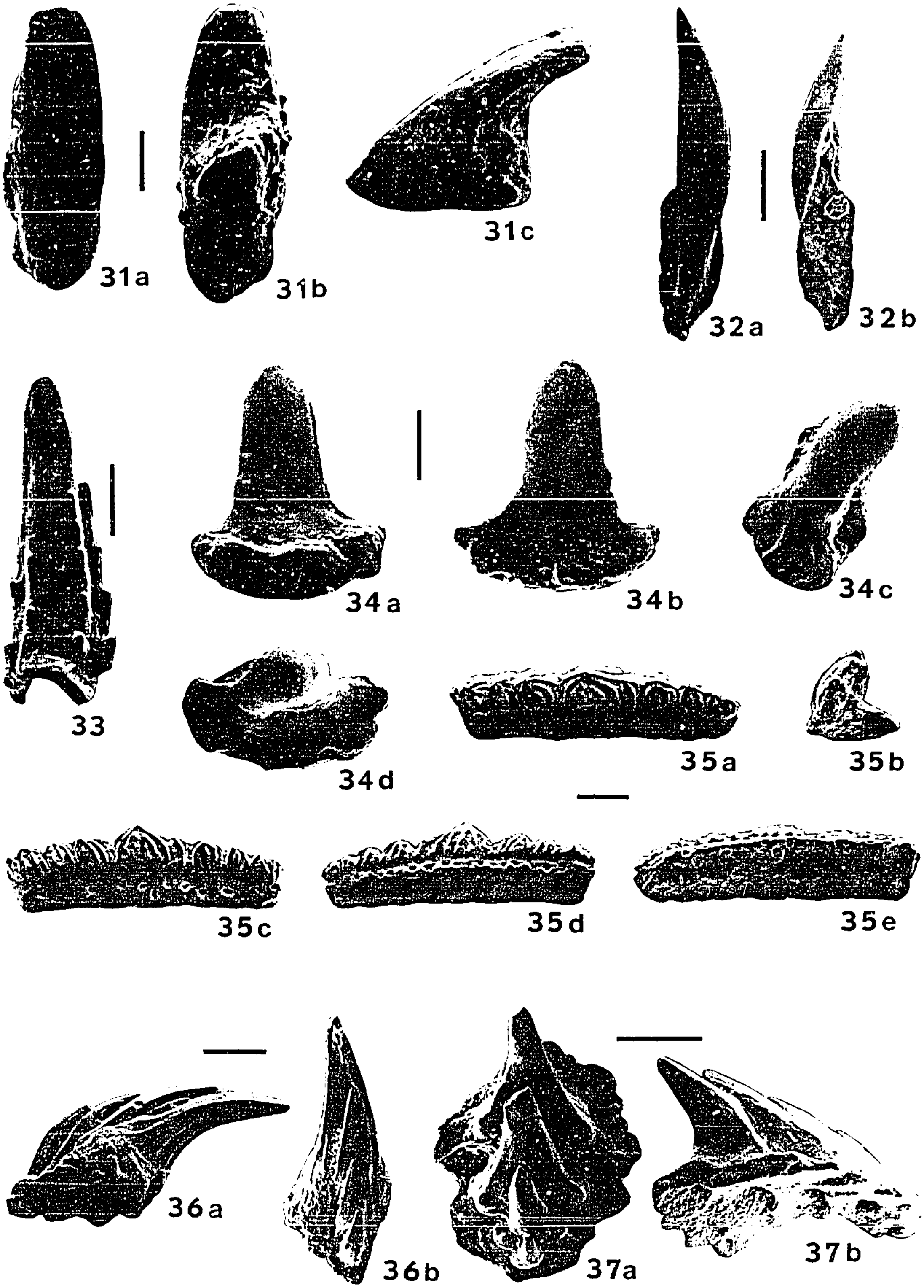
33 Type Number 232 from the Plattsmouth Limestone (Shawnee Group) in Elk County, Kansas: lateral view. Scale equals 0.2mm.

34a-d Type Number 233 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, lingual; b, labial; c, lateral; d, occlusal views. Scale equals 0.2mm.

35a-e Type Number 009 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, occlusal; b, lateral; c, lingual; d, labial; e, basal views. Scale equals 0.2mm.

36a-b Type Number 018 from the Heebner Shale (Shawnee Group) in Cass County, Nebraska: a, lateral; b, top views. Scale equals 0.2mm.

37a-b Type Number 019 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, top; b, lateral views. Scale equals 0.2mm.


31a
31b
31c
32a
32b
33
34a
34b
34c
34d
35a
35b
35c
35d
35e
36a
36b
37a
37b

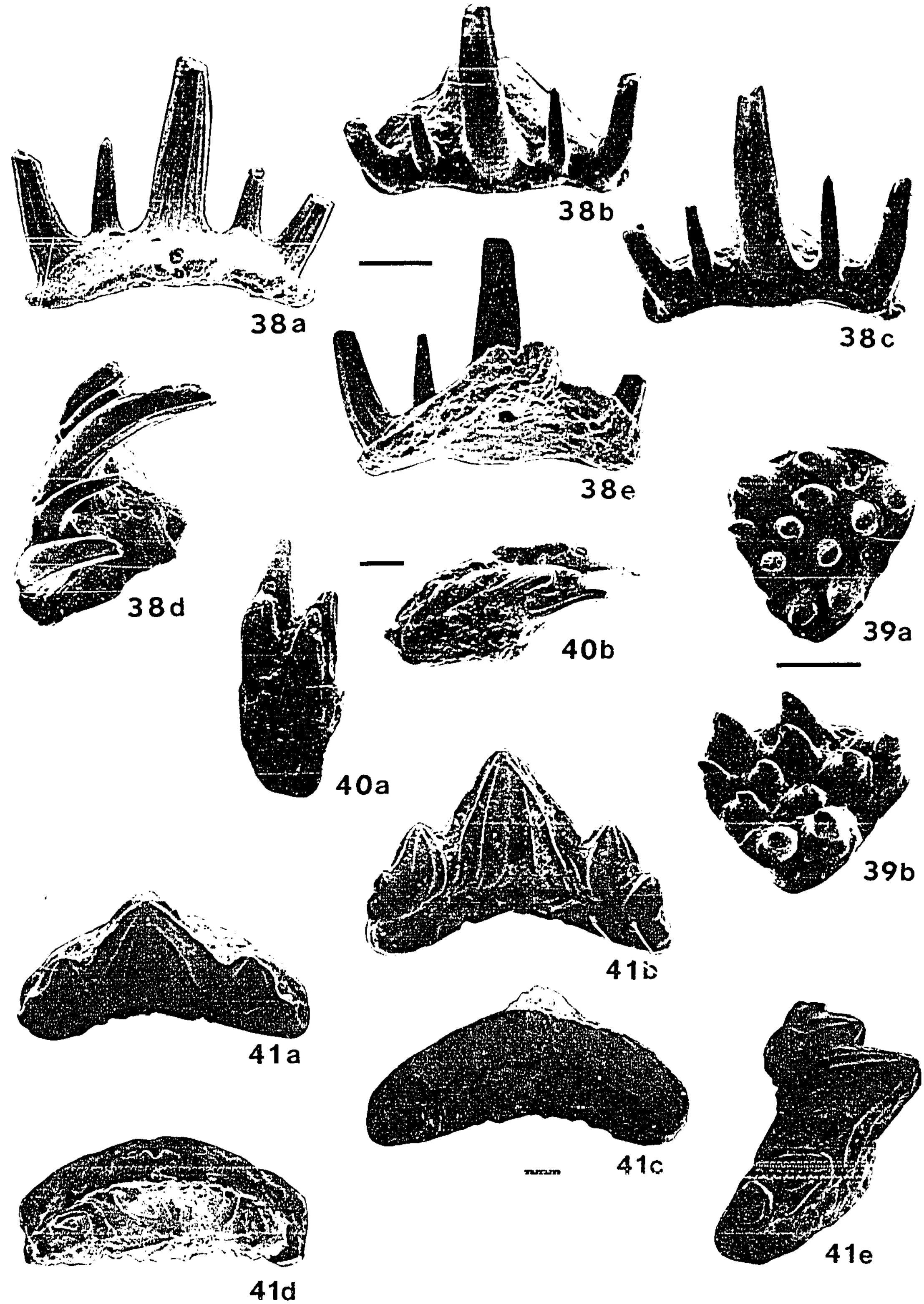
FIGURES 38-41

38a-e Type Number 021 from the Captain Creek Limestone (Lansing Group) in Madison County, Iowa: a, lingual; b, occlusal; c, labial; d, lateral; e, oblique basal views. Scale equals 0.2mm.

39a-b Type Number 040 from the Plattsmouth Limestone (Shawnee Group) in Leavenworth County, Kansas: a, top; b, oblique lateral views. Scale equals 0.2mm.

40a-b Type Number 057 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, lateral views. Scale equals 0.2mm.

41a-e Type Number 069 from the Ervine Creek Limestone (Shawnee Group) in Douglas County, Kansas: a, oblique labial; b, labial; c, basal; d, occlusal; e, oblique lateral views. Scale equals 0.2mm.


38a
38b
38c
38d
38e
39a
39b
40a
40b
41a
41b
41c
41d
41e

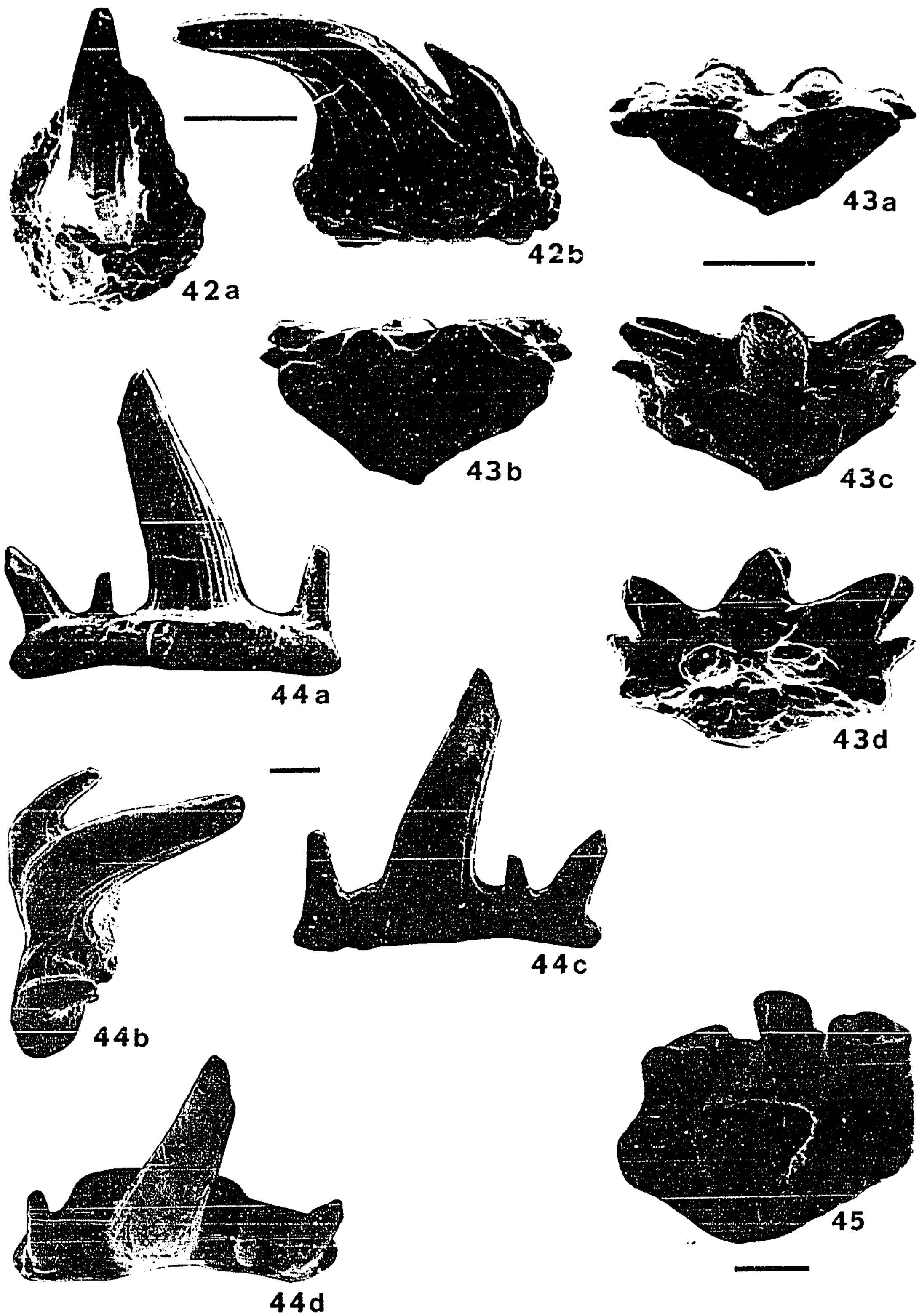
FIGURES 42-45

42a-b Type Number 074 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, top; b, lateral views. Scale equals 0.2mm.

43a-d Type Number 083 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, occlusal; b, basal; c, lingual; d, oblique labial views. Scale equals 0.2mm.

44a-d Type Number 100 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, lingual; b, oblique lateral; c, labial; d, occlusal views. Scale equals 0.2mm.

45 Type Number 123 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: oblique lingual view. Scale equals 0.2mm.



42a
42b
43a
43b
43c
43d
44a
44b
44c
44d
45

FIGURES 46-50

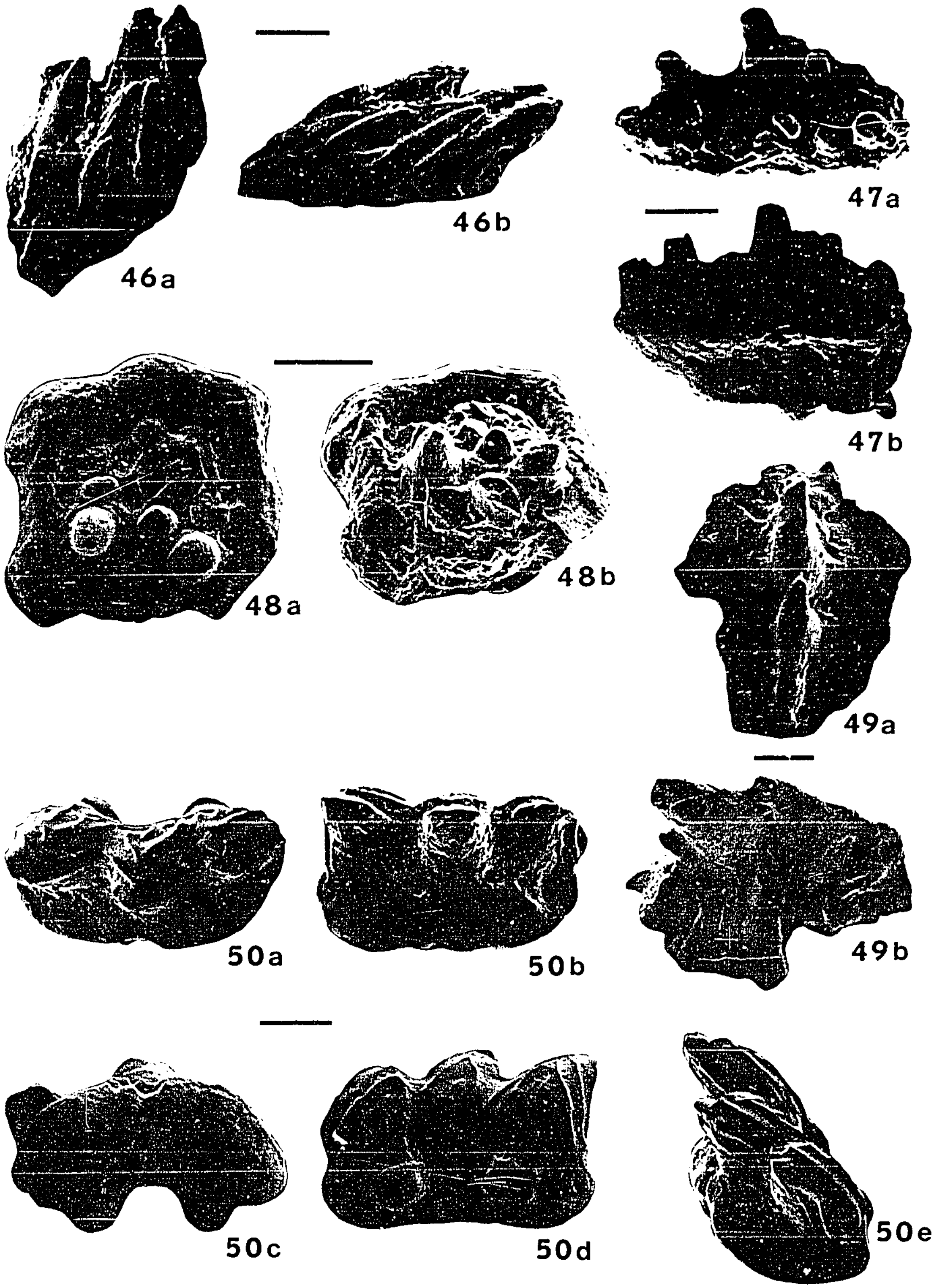
46a-b Type Number 124 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: a, top; b, lateral views. Scale equals 0.2mm.

47a-b Type Number 127 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: a, top; b, lateral views. Scale equals 0.2mm.

48a-b Type Number 139 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: a, top; b, oblique lateral views. Scale equals 0.2mm.

49a-b Type Number 148 from the Big Springs Limestone (Shawnee Group) in Douglas County, Kansas: a, top; b, lateral views. Scale equals 0.2mm.

50a-e Type Number 169 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, occlusal; b, lingual; c, basal; d, labial; e, oblique lateral views. Scale equals 0.2mm.


46a
46b
47a
47b
48a
48b
49a
49b
50a
50b
50c
50d
50e

FIGURES 51-55

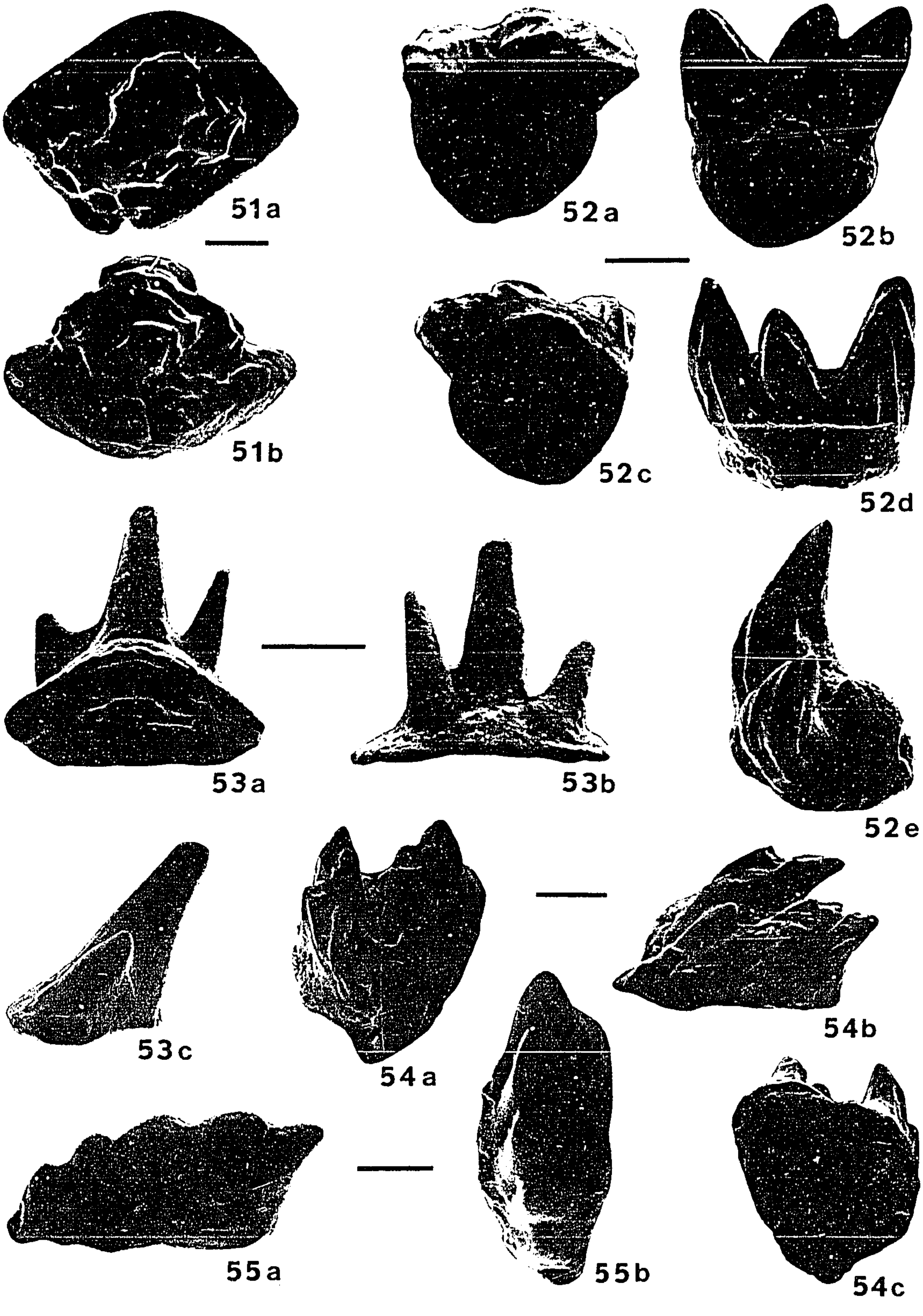
51a-b Type Number 172 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, top; b, lateral views. Scale equals 0.2mm.

52a-e Type Number 173 from the Bell Limestone (Shawnee Group) in Douglas County, Kansas: a, occlusal; b, lingual; c, basal; d, labial; e, oblique lateral views. Scale equals 0.2mm.

53a-c Type Number 176 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, oblique posterior; b, anterior; c, lateral views. Scale equals 0.1mm.

54a-c Type Number 198 from the Plattsmouth Limestone (Shawnee Group) in Buchanan County, Missouri: a, top; b, oblique lateral; c, basal views. Scale equals 0.2mm.

55a-b Type Number 202 from the Plattsmouth Limestone (Shawnee Group) in Coffey County, Kansas: a, lateral; b, top views. Scale equals 0.2mm.


51a
52a
52b
51b
52c
52d
53a
53b
52e
53c
54a
54b
55a
55b
54c

FIGURES 56-60

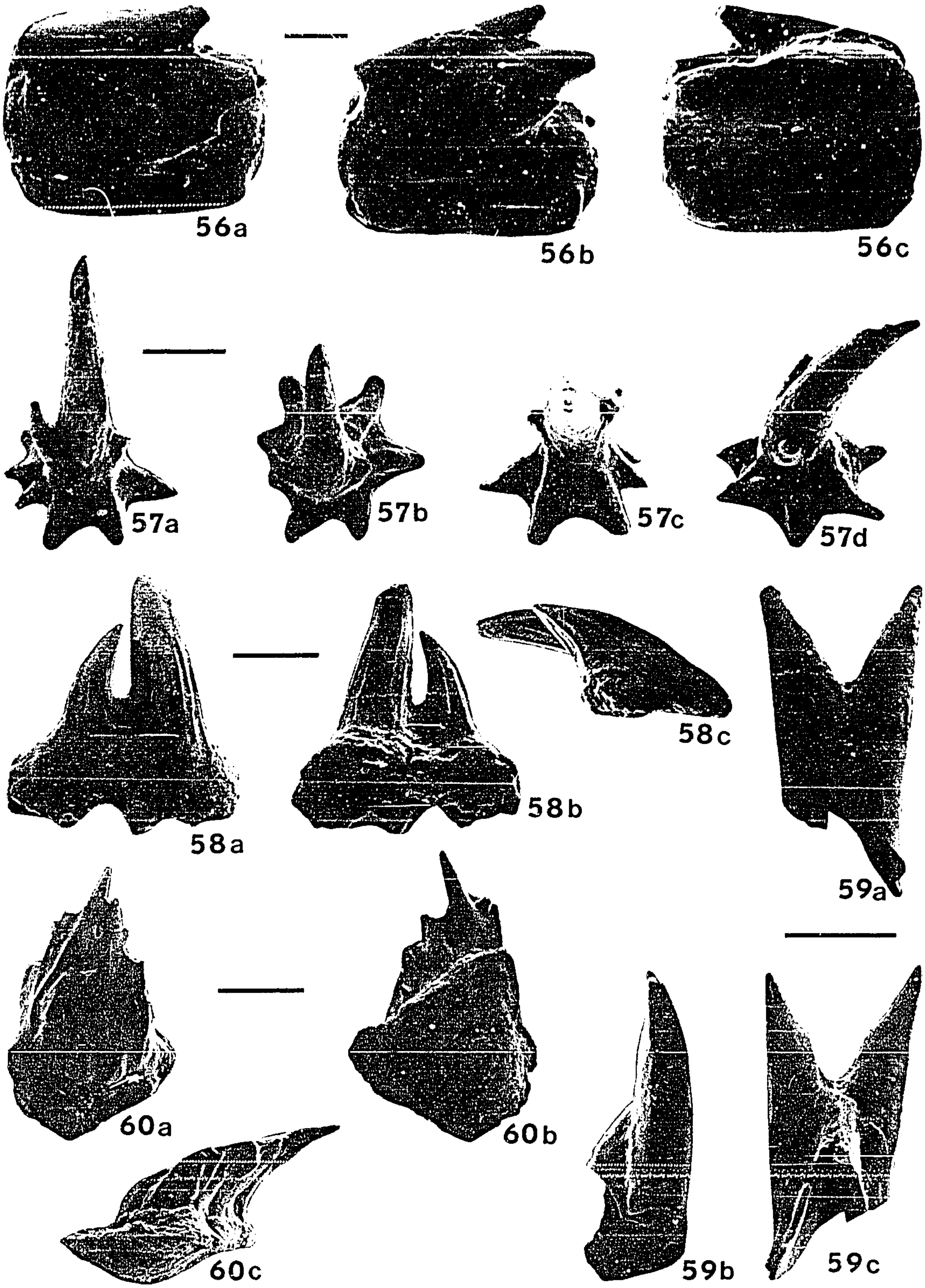
56a-c Type Number 205 from the Plattsmouth Limestone (Shawnee Group) in Greenwood County, Kansas: a, top; b, oblique lateral; c, basal views. Scale equals 0.1mm.

57a-d Type Number 207 from the Plattsmouth Limestone (Shawnee Group) in Cass County, Nebraska: a, anterior; b, top; c, posterior; d, lateral views. Scale equals 0.1mm.

58a-c Type Number 212 from the Plattsmouth Limestone (Shawnee Group) in Coffey County, Kansas: a, anterior; b, posterior; c, lateral views. Scale equals 0.2mm.

59a-c Type Number 223 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, anterior; b, lateral; c, posterior views. Scale equals 0.2mm.

60a-c Type Number 238 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, basal; c, lateral views. Scale equals 0.2mm.


56a
56b
56c
57a
57b
57c
57d
58a
58b
58c
59a
60a
60b
60c
59b
59c

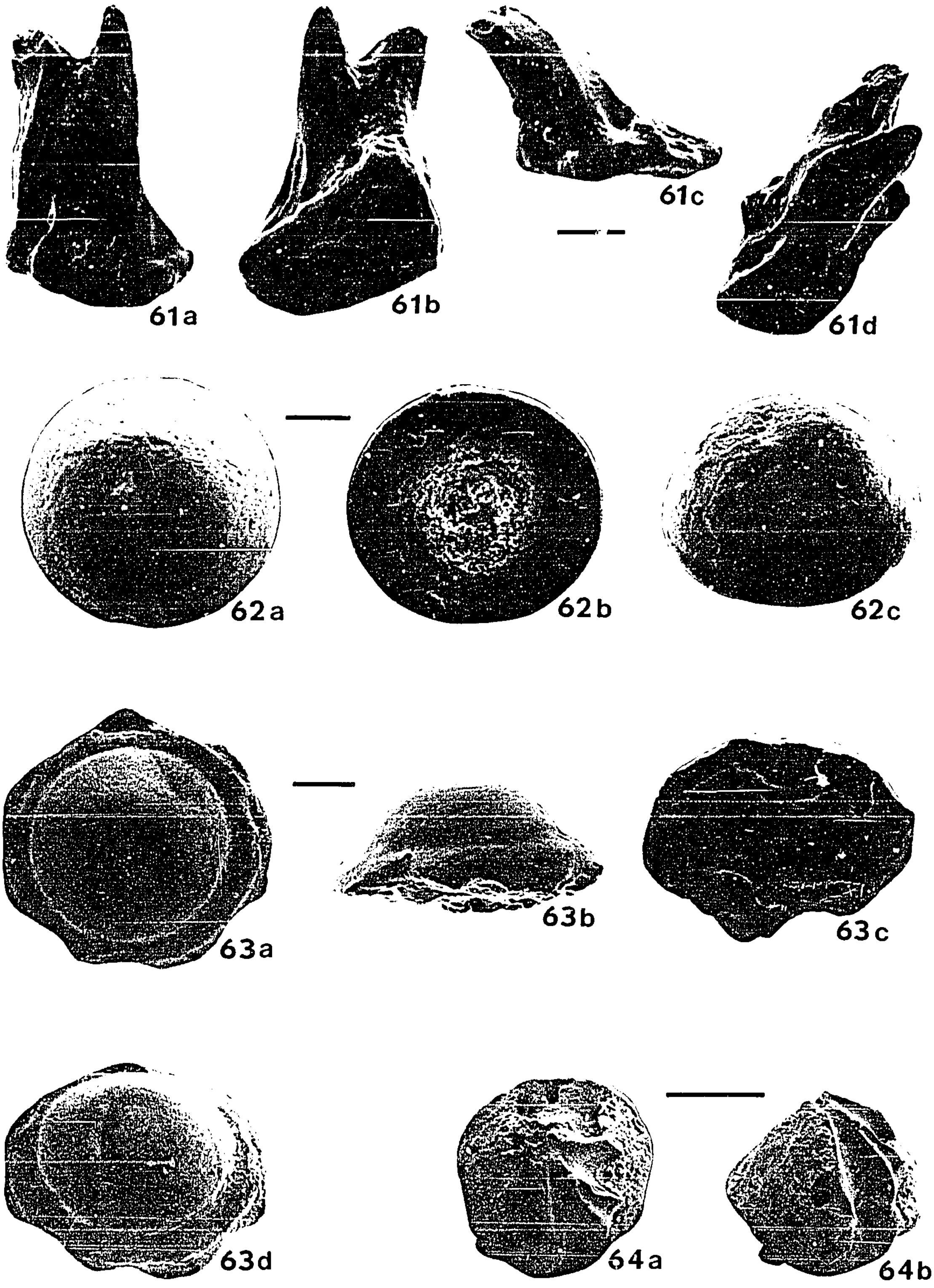
FIGURES 61-64

61a-d Type Number 239 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, anterior; b, posterior; c, lateral; d, oblique lateral views. Scale equals 0.1mm.

62a-c Type Number 086 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, top; b, basal; c, oblique lateral views. Scale equals 0.1mm.

63a-d Type Number 102 from the Doniphan Shale (Shawnee Group) in Douglas County, Kansas: a, top; b, lateral; c, oblique basal; d, oblique lateral views. Scale equals 0.2mm.

64a-b Type Number 200 from the Leavenworth Limestone (Shawnee Group) in Osage County, Oklahoma: a, top; b, lateral views. Scale equals 0.2mm.



61a
61b
61c
61d
62a
62b
62c
63a
63b
63c
63d
64a
64b

FIGURES 65-69

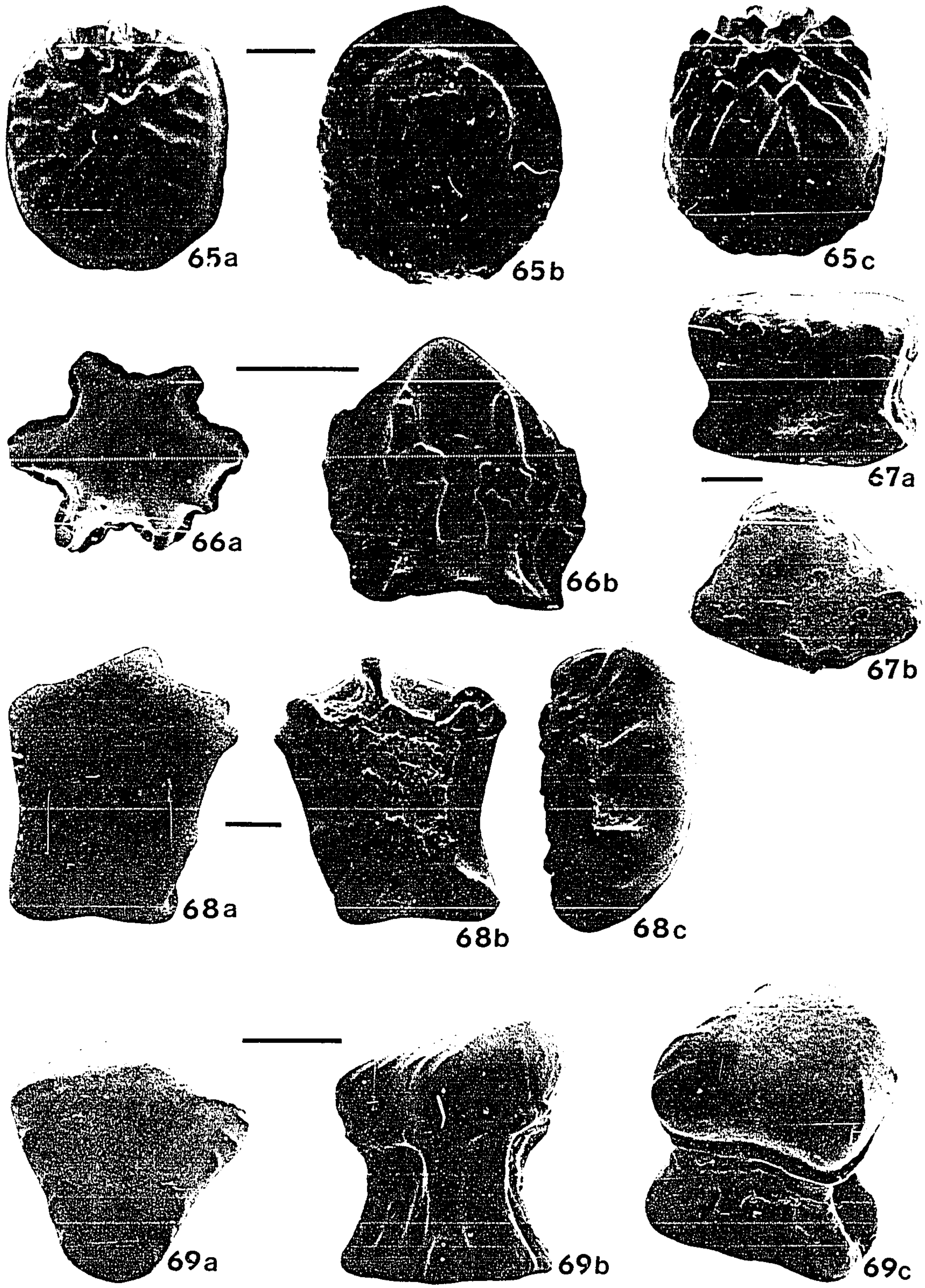
65a-c Type Number 231 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, top; b, basal; c, oblique lateral views. Scale equals 0.1mm.

66a-b Type Number 236 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, lateral views. Scale equals 0.2mm.

67a-b Type Number 103 from the Iowa Point Shale (Shawnee Group) in Shawnee County, Kansas: a, lateral; b, top views. Scale equals 0.1mm.

68a-c Type Number 109 from the Iowa Point Shale (Shawnee Group) in Shawnee County, Kansas: a, top; b, basal; c, lateral views. Scale equals 0.2mm.

69a-c Type Number 134 from the Hartford Limestone (Shawnee Group) in Shawnee County, Kansas: a, top; b, lateral; c, oblique lateral views. Scale equals 0.2mm.


65a
65b
65c
66a
66b
67a
67b
68a
68b
68c
69a
69b
69c

FIGURES 70-75

70a-d Type Number 140 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, basal; c, oblique lateral; d, oblique lateral views. Scale equals 0.1mm.

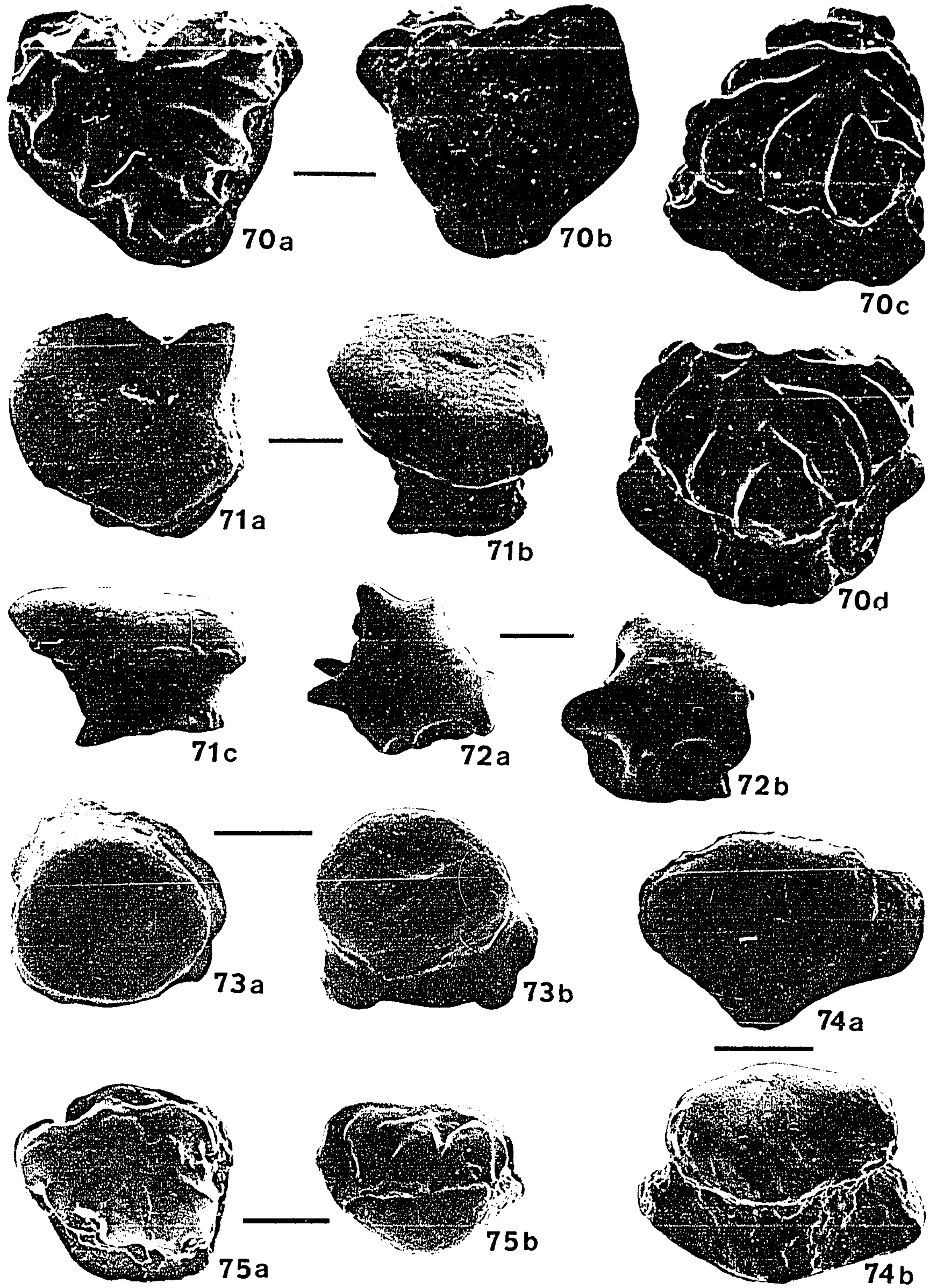
71a-c Type Number 144 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, oblique lateral; c, lateral views. Scale equals 0.2mm.

72a-b Type Number 192 from the Plattsmouth Limestone (Shawnee Group) in Greenwood County, Kansas: a, top; b, oblique lateral views. Scale equals 0.2mm.

73a-b Type Number 201 from the Leavenworth Limestone (Shawnee Group) in Osage County, Oklahoma: a, top; b, oblique lateral views. Scale equals 0.2mm.

74a-b Type Number 206 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: a, top; b, oblique lateral views. Scale equals 0.2mm.

75a-b Type Number 240 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, lateral views. Scale equals 0.2mm.


70a
70b
70c
71a
71b
70d
71c
72a
72b
73a
73b
74a
75a
75b
74b

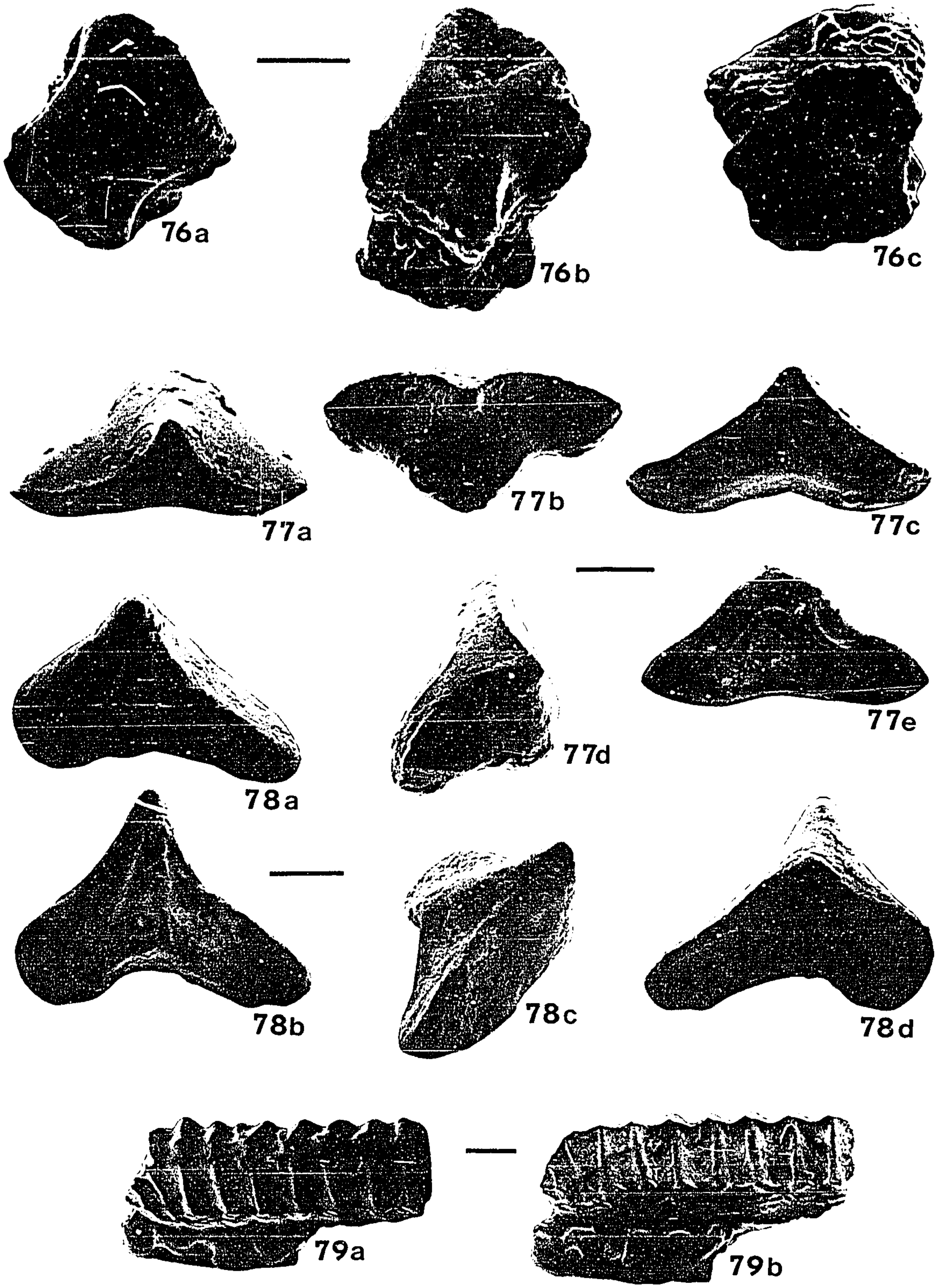
FIGURES 76-79

76a-c Type Number 242 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, oblique lateral; c, oblique basal views. Scale equals 0.2mm.

77a-e Type Number 107 from the Iowa Point Shale (Shawnee Group) in Shawnee County, Kansas: a, top; b, posterior; c, anterior; d, oblique lateral; e, basal views. Scale equals 0.2mm.

78a-d Type Number 216 from the Stoner Limestone (Lansing Group) in Madison County, Iowa: a, top; b, anterior; c, oblique lateral; d, oblique basal views. Scale equals 0.2mm.

79a-b Type Number 177 from the Heumader Shale (Shawnee Group) in Jefferson County, Kansas: a, top; b, lateral views. Scale equals 0.2mm.



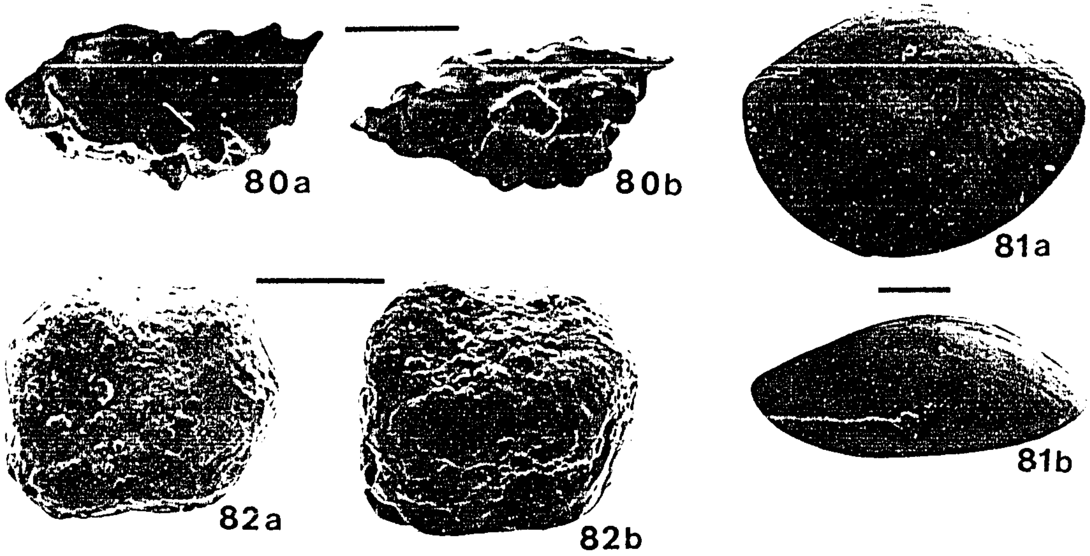
76a
76b
76c
77a
77b
77c
77d
77e
78a
78b
78c
78d
79a
79b

FIGURES 80-82

80a-b Type Number 217 from the Stoner Limestone (Lansing Group) in Cass County, Iowa: a, top; b, oblique lateral views. Scale equals 0.2mm.

81a-b Type Number 132 from the Plattsmouth Limestone (Shawnee Group) in Osage County, Kansas: a, top; b, lateral views. Scale equals 0.2mm.

82a-b Type Number 208 from the Plattsmouth Limestone (Shawnee Group) in Andrew County, Missouri: a, top; b, oblique lateral views. Scale equals 0.2mm.


80a
80b
81a
82a
82b
81b

APPENDIX C

LIST OF SAMPLES AND THEIR

ROYAL ONTARIO MUSEUM (ROM)

DEPARTMENT OF INVERTEBRATE PALEONTOLOGY (DIP)

ACCESSION NUMBERS

APPENDIX C

SAMPLE	ROM DIP ACCESSION NUMBER	LOCALITY NUMBER	COUNTY (STATE)
Le-2-1	69PB17	5	Chautauqua (KS)
Le-3-1	69PB99	8	Coffey (KS)
Le-4-1	72PB9	1	Osage (OK)
Le-5-1	72PB10	2	Osage (OK)
Le-6-1	72PB12	3	Osage (OK)
Le-7-1	72PB13	6	Elk (KS)
Le-8-1	72PB16	7	Greenwood (KS)
Le-9-1	72PB25	4	Osage (OK)
Le-10-1	72PB44	10	Franklin (KS)
Le-11-1	72PB50	11	Leavenworth (KS)
Le-12-1	72PB55	12	Buchanan (KS)
Le-13-1	72PB55	13	Andrew (MO)
Le-14-1	72PB83	14	Cass (NE)
Le-15-1	72PB90	15	Cass (IA)
Le-16-1	72PB91	16	Madison (IA)
He-2-1	69PB10	5	Chautauqua (KS)
He-2-2A	69PB11	5	Chautauqua (KS)
He-2-2B	69PB12	5	Chautauqua (KS)
He-2-3A	69PB14	5	Chautauqua (KS)
He-2-3B	69PB15	5	Chautauqua (KS)
He-3-1	69PB100	8	Coffey (KS)
He-3-4	69PB103	8	Coffey (KS)
He-4-1	72PB11	2	Osage (OK)
He-4-2 (Recoll'n)	73PB145	2	Osage (OK)
He-5-1	72PB14	7	Greenwood (KS)
He-5-2	72PB15	7	Greenwood (KS)
He-6 (Recoll'n)	73PB84	3	Osage (OK)
He-7 (Recoll'n)	72PB85	4	Osage (OK)
He-8-1	72PB35	6	Elk (KS)
He-8-2	72PB100	6	Elk (KS)
He-9-1	72PB43	10	Franklin (KS)
He-9-2	72PB42	10	Franklin (KS)
He-10-1	72PB51	11	Leavenworth (KS)
He-10-2	72PB52	11	Leavenworth (KS)
He-11-1	72PB56	12	Buchanan (KS)
He-11-2	72PB57	12	Buchanan (KS)
He-11-3	72PB58	12	Buchanan (KS)
He-11-4	72PB59	12	Buchanan (KS)

SAMPLE	ROM DIP ACCESSION NUMBER	LOCALITY NUMBER	COUNTY (STATE)
He-13-1	72PB74	13	Andrew (MO)
He-13-2	72PB75	13	Andrew (MO)
He-13-3	72PB76	13	Andrew (MO)
He-14-1	72PB77	14	Cass (NE)
He-14-2	72PB78	14	Cass (NE)
He-14-3	72PB79	14	Cass (NE)
He-15-1	72PB84	15	Cass (IA)
He-15-1R	72PB84	15	Cass (IA)
He-15-2	72PB85	15	Cass (IA)
He-15-3	72PB86	15	Cass (IA)
He-16-1	72PB92	16	Madison (IA)
He-16-2	72PB93	16	Madison (IA)
He-16-3	72PB94	16	Madison (IA)
P-2-1A	69PB18	5	Chautauqua (KS)
P-2-1B	69PB19	5	Chautauqua (KS)
P-2-2A	69PB20	5	Chautauqua (KS)
P-2-2B	69PB21	5	Chautauqua (KS)
P-2-2C	69PB22	5	Chautauqua (KS)
P-2-2D	69PB23	5	Chautauqua (KS)
P-2-2E	69PB24	5	Chautauqua (KS)
P-2-3	69PB25	5	Chautauqua (KS)
P-3-1	69PB26	5	Chautauqua (KS)
P-3-2	69PB27	5	Chautauqua (KS)
P-4-1	69PB28	8	Coffey (KS)
P-4-2	69PB29	8	Coffey (KS)
P-4-3	69PB30	8	Coffey (KS)
P-4-4	69PB31	8	Coffey (KS)
P-4-5	69PB32	8	Coffey (KS)
P-4-6	69PB113	8	Coffey (KS)
P-5-1	72PB22	3	Osage (OK)
P-6-1	72PB23	4	Osage (OK)
P-6-2	72PB24	4	Osage (OK)
P-7-1	72PB27	7	Greenwood (KS)
P-7-2	72PB28	7	Greenwood (KS)
P-7-3	72PB29	7	Greenwood (KS)
P-7-4	72PB30	7	Greenwood (KS)
P-8-1	72PB31	6	Elk (KS)
P-8-2	72PB32	6	Elk (KS)
P-8-3	72PB33	6	Elk (KS)
P-8-4	72PB34	6	Elk (KS)
P-9-1	72PB36	9	Osage (KS)

SAMPLE	ROM DIP ACCESSION NUMBER	LOCALITY NUMBER	COUNTY (STATE)
P-9-2	72PB37	9	Osage (KS)
P-9-3	72PB38	9	Osage (KS)
P-9-4	72PB39	9	Osage (KS)
P-9-5	72PB40	9	Osage (KS)
P-9-6	72PB41	9	Osage (KS)
P-10-1	72PB45	11	Leavenworth (KS)
P-10-2	72PB46	11	Leavenworth (KS)
P-10-3	72PB47	11	Leavenworth (KS)
P-10-4	72PB48	11	Leavenworth (KS)
P-10-5	72PB49	11	Leavenworth (KS)
P-11-1	72PB54	11	Leavenworth (KS)
P-12-1	72PB60	12	Buchanan (KS)
P-12-2	72PB61	12	Buchanan (KS)
P-12-3	72PB62	12	Buchanan (KS)
P-12-4	72PB63	12	Buchanan (KS)
P-12-5	72PB64	12	Buchanan (KS)
P-12-6	72PB65	12	Buchanan (KS)
P-13-1	72PB66	13	Andrew (MO)
P-13-2	72PB67	13	Andrew (MO)
P-13-3	72PB68	13	Andrew (MO)
P-13-4	72PB69	13	Andrew (MO)
P-13-5	72PB70	13	Andrew (MO)
P-13-6	72PB71	13	Andrew (MO)
P-13-7	72PB72	13	Andrew (MO)
P-14-1	72PB80	14	Cass (NE)
P-14-2	72PB81	14	Cass (NE)
P-14-3	72PB82	14	Cass (NE)
P-15-1	72PB87	15	Cass (IA)
P-15-1R	72PB87	15	Cass (IA)
P-15-2	72PB88	15	Cass (IA)
P-15-3	72PB89	15	Cass (IA)
P-16-1	72PB95	16	Madison (IA)
P-16-2	72PB96	16	Madison (IA)
P-16-3	72PB97	16	Madison (IA)
P-16-4	72PB98	16	Madison (IA)

APPENDIX D

LIST OF SAMPLE WEIGHTS

APPENDIX D

The following is a list of weights used in calculating the number of ichthyoliths/kilogram. W_i = the initial weight of rock processed in grams. W_c = the weight of undissolved coarse material in grams. W_d = the weight of rock actually dissolved in grams = $W_i - W_c$. The actual ichthyolith abundances were divided by W_d and multiplied by 1000 to yield the number of ichthyoliths/kg.

SAMPLE	W_i (g)	W_c (g)	W_d (g)
Le-2-1	1500	14	1486
Le-3-1	1500	11	1489
Le-4-1	2000	165	1835
Le-5-1	2000	107	1893
Le-6-1	2000	72	1928
Le-7-1	2000	158	1842
Le-8-1	2000	99	1901
Le-9-1	2000	92	1908
Le-10-1	2000	9	1991
Le-11-1	2000	50	1950
Le-12-1	2000	68	1932
Le-13-1	2000	46	1954
Le-14-1	2000	6	1994
Le-15-1	2000	261	1739
Le-16-1	2000	70	1930
He-2-1	1000	119	881
He-2-2A	1000	345	655
He-2-2B	1000	66	934
He-2-3A	1500	57	1443
He-2-3B	2000	141	1859
He-3-1	748	92	656
He-3-2	1000	110	890
He-3-3	1000	150	850
He-3-4	1500	44	1456
He-4-1	2000	7	1993
He-4-2 (Recoll'n)	2000	112	1888
He-5-1	2000	210	1790
He-5-2	2000	384	1616
He-6 (Recoll'n)	2000	90	1910

SAMPLE	W_i (g)	W_c (g)	W_d (g)
He-7 (Recoll'n)	2000	90	1910
He-8-1	2000	300	1700
He-8-2	2000	74	1926
He-9-1	2000	1248	752
He-9-2	2000	74	1926
He-10-1	2000	1180	820
He-10-2	2000	516	1484
He-11-1	2000	328	1672
He-11-2	2000	582	1418
He-11-3	1617	15	1602
He-11-4	1692	33	1659
He-13-1	2000	264	1736
He-13-2	2000	15	1985
He-13-3	1670	164	1506
He-14-1	2000	29	1971
He-14-2	2000	4	1996
He-14-3	2000	913	1087
He-15-1	2000	1037	963
He-15-1R	950	346	604
He-15-2	1880	551	1329
He-15-3	2000	43	1957
He-16-1	2000	78	1922
He-16-2	2000	1126	874
He-16-3	2000	26	1974
P-2-1A	500	20	480
P-2-1B	1000	9	991
P-2-2A	1000	60	940
P-2-2B	1000	47	953
P-2-2C	1000	11	989
P-2-2D	500	37	463
P-2-2E	500	71	429
P-2-3	2000	50	1950
P-3-1	2000	44	1956
P-3-2	1000	1	999
P-4-1	1000	12	988
P-4-2	1000	14	986
P-4-3	1000	2	998
P-4-4	1000	123	877
P-4-5	500	0	500
P-4-6	1000	22	978
P-5-1	2000	193	1807

SAMPLE	W_i (g)	W_c (g)	W_d (g)
P-6-1	2000	2	1998
P-6-2	2000	101	1899
P-7-1	795	2	793
P-7-2	2000	81	1919
P-7-3	2000	19	1981
P-7-4	2000	18	1982
P-8-1	2000	274	1726
P-8-2	2000	61	1939
P-8-3	1550	74	1478
P-8-4	2000	3	1997
P-9-1	2000	76	1924
P-9-2	2000	22	1978
P-9-3	1550	571	979
P-9-4	2000	99	1901
P-9-5	780	27	753
P-9-6	2000	23	1977
P-10-1	2000	6	1994
P-10-2	2363	257	2106
P-10-3	2000	449	1551
P-10-4	2000	485	1515
P-10-5	2000	157	1843
P-11-1	2000	31	1969
P-12-1	2000	333	1667
P-12-2	2000	137	1863
P-12-3	2000	6	1994
P-12-4	2000	19	1981
P-12-5	2000	485	1515
P-12-6	2000	500	1500
P-13-1	2000	76	1924
P-13-2	2000	335	1665
P-13-3	2000	15	1985
P-13-4	1950	1044	906
P-13-5	2000	451	1549
P-13-6	2000	274	1726
P-13-7	2000	150	1850
P-14-1	2000	12	1988
P-14-2	2000	26	1974
P-14-3	2000	10	1990
P-15-1	2000	190	1810
P-15-1R	2000	194	1806
P-15-2	2000	1	1999

SAMPLE	W_i (g)	W_c (g)	W_d (g)
P-15-3	2000	0	2000
P-16-1	2000	696	1304
P-16-2	2000	133	1867
P-16-3	2000	7	1993
P-16-4	2000	4	1996

APPENDIX E

ICHTHYOLITH DATA USED IN ANALYSES

PART I

ABUNDANCE DATA USED IN GEOGRAPHIC VARIATION ANALYSES

The data are arranged with the ichthyolith types across the top (columns) and the samples along the side (rows). The data represent the number of ichthyoliths per kilogram found in that sample.

	001	005	006	007	009	011	012	013	015	017
LL-2-1	0.0	0.0	0.0	1.350	0.0	0.0	0.670	0.0	2.020	0.0
LL-3-1	0.0	0.0	0.0	0.670	0.0	0.0	0.0	0.0	0.0	0.0
LL-4-1	0.0	0.0	2.7[illegible]0	2.180	0.0	1.090	0.0	0.0	0.0	0.0
LL-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-7-1	0.0	0.0	0.0	1.090	0.0	0.0	0.0	0.0	0.0	0.0
LL-[illegible]-1	0.0	0.0	0.0	1.050	0.0	0.0	0.0	0.0	0.0	0.0
LL-10-1	0.0	0.0	2.510	3.520	0.0	0.0	0.500	0.0	0.0	0.0
LL-11-1	0.0	0.0	3.5[illegible]0	6.150	0.0	0.0	0.0	0.0	0.0	0.0
LL-12-1	0.0	0.0	0.0	2.590	0.0	0.0	1.550	0.0	0.0	0.520
LL-13-1	0.0	0.0	1.020	6.140	0.0	0.0	0.0	0.0	0.0	0.0
LL-14-1	0.0	0.0	0.0	0.500	0.0	0.0	0.500	0.0	1.000	0.500
LL-15-1	0.5[illegible]0	0.0	1.730	5.750	0.0	2.300	0.0	1.730	0.580	0.580
LL-16-1	0.0	3.110	1.040	19.690	0.520	1.040	1.050	0.520	1.550	0.0

	[illegible]	[illegible]	031	032	033	035	038	040	047	054
LL-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-4-1	0.0	0.540	9.260	1.090	0.0	3.270	2.180	1.630	0.0	0.0
LL-5-1	0.0	0.0	0.0	0.0	0.0	0.520	0.530	0.0	0.0	0.0
LL-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-[illegible]-1	0.0	0.0	0.0	0.0	0.0	1.050	0.530	0.0	0.0	0.0
LL-10-1	0.0	0.0	0.0	0.0	0.500	1.510	2.510	0.0	0.0	0.0
LL-11-1	0.0	0.0	0.0	0.0	0.0	6.150	5.640	0.0	0.510	0.510
LL-12-1	0.0	0.0	0.0	0.0	0.0	2.070	1.040	0.0	0.520	0.0
LL-13-1	0.0	0.0	0.0	0.0	0.510	1.020	1.020	0.0	0.0	0.0
LL-14-1	0.500	0.0	0.0	0.0	0.0	3.010	1.000	0.0	0.500	0.0
LL-15-1	0.0	0.0	0.0	0.0	1.150	4.600	1.150	0.0	0.0	1.150
LL-16-1	0.0	0.0	5.330	0.0	0.520	12.420	5.180	0.520	0.0	7.770

	[illegible]	057	058	060	[illegible]	068	072	086	087	089
LL-2-1	0.670	1.350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-4-1	0.540	0.0	0.540	2.720	0.0	0.0	1.090	14.170	20.430	0.0
LL-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-7-1	0.0	0.0	0.540	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-[illegible]-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-10-1	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0	0.0	0.0
LL-11-1	0.0	0.0	0.0	0.0	0.0	0.510	0.0	0.0	0.0	0.0
LL-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0	0.0	0.0
LL-14-1	0.0	0.0	1.000	0.0	0.0	0.500	0.0	1.000	0.0	0.0
LL-15-1	0.0	0.0	0.5[illegible]0	0.0	0.0	[illegible]	0.0	0.0	0.0	0.0
LL-16-1	1.040	0.0	3.110	0.0	[illegible]	1.040	1.550	0.0	0.0	0.5[illegible]0

	090	091	092	095	098	107	111	118	119	127
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	1.[illegible]	255.040	10.900	1.090	1.090	0.540	0.540	0.0	0.0	0.540
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.060	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.520	0.0
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.020	0.0
LE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.500	0.0
LE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.730	0.0
LE-16-1	0.0	17.440	0.0	0.0	0.0	0.0	0.0	0.520	8.810	0.0

	124	125	136	137	1[illegible]	139	140	141	142	142
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	0.0	0.0	2.720	0.540	2.720	0.0	1.090	0.540	0.0	0.540
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	[illegible]	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-15-1	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	0.[illegible]	1.[illegible]	0.0	0.520	0.0	1.550	0.0	0.0	0.520	0.0

	143	147	149	15[illegible]	15[illegible]	157	164	169	172	175
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	1.340	0.0	0.0	0.0	1.340	0.0	0.0
LE-4-1	0.[illegible]	0.540	0.0	0.0	0.540	3.270	1.610	0.0	0.0	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	[illegible]	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	[illegible]	[illegible]	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	[illegible].500	0.0	0.0	0.0	0.0	0.0	0.0
LE-15-1	[illegible]	[illegible]	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	0.0	[illegible]	0.[illegible]	0.0	0.0	0.0	2.970	0.[illegible]	0.[illegible]	0.[illegible]

	190	191	193	198	199	200	201	202	203	205
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	0.510	0.0	0.0	1.070	2.180	2.180	0.540	0.540	0.540	0.540
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-15-1	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	0.520	1.040	0.520	0.0	0.0	0.0	0.0	0.0	0.0	0.520

	206	207	208	214
LE-2-1	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0
LE-4-1	0.0	0.0	0.0	0.540
LE-5-1	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	0.0
LE-15-1	0.0	0.0	0.0	0.0
LE-16-1	0.520	0.520	0.520	0.0

	002	005	006	007	008	009	011	013	015	017
HE-2-1	0.0	0.0	0.0	1.140	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	1.530	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	1.390	0.0	0.0	0.600	0.0	0.0	0.0	0.630
HE-2-3B	0.0	0.0	1.080	0.0	0.0	1.080	0.0	1.080	0.0	0.540
HE-3-4	0.0	0.0	22.610	8.930	0.0	0.0	2.000	0.0	0.650	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.0	7.420	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.620	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	2.620	8.380	0.0	1.140	0.0	0.520	0.0	0.0
HE-8-1	0.0	0.0	0.0	1.760	0.0	0.0	0.0	0.0	0.0	0.0
HE-9-2	0.0	0.0	6.750	6.750	0.0	0.0	0.0	0.0	0.0	0.0
HE-9-2	2.080	0.0	5.190	5.710	0.0	4.670	0.0	0.0	1.570	2.090
HE-10-2	2.070	0.0	16.170	38.410	0.0	0.670	0.0	0.670	0.0	1.350
HE-11-3	0.0	0.0	4.370	3.750	0.0	0.0	0.0	1.250	0.0	0.0
HE-11-4	3.620	0.0	42.800	220.010	0.0	6.030	0.0	0.600	0.0	0.0
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	1.950	0.0	27.220	401.060	0.0	5.310	0.0	3.980	1.550	4.650
HE-14-1	0.0	0.0	0.510	5.070	0.0	0.0	0.0	0.0	0.0	0.0
HE-14-2	0.0	0.0	7.010	111.220	0.0	1.500	0.0	0.0	0.0	2.000
HE-14-3	0.0	13.800	24.840	759.890	5.520	3.680	0.0	12.880	36.800	2.750
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.120	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.0	0.0	2.040	9.200	0.0	1.530	1.020	0.510	0.0	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	2.600	0.0	0.0	0.0	0.520
HE-16-2	0.0	0.0	0.0	1.140	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.510	3.550	0.510	3.550	0.0	1.520	0.510	0.510

	018	019	021	026	029	031	035	038	040	047
HE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3-4	0.0	0.0	0.0	0.0	0.0	0.0	7.550	0.0	0.0	0.690
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.0	0.0	0.0	0.0	1.060	0.0	0.530	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	6.700	3.350	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	2.090	4.190	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.0	0.0	0.0	0.0	6.230	0.0	0.0	0.0
HE-9-2	0.0	0.0	2.080	0.0	0.0	0.0	20.250	1.560	1.060	0.0
HE-10-2	0.670	0.0	0.0	0.0	0.0	0.910	51.210	1.350	0.0	2.020
HE-11-3	0.0	0.0	0.0	0.0	0.0	0.0	4.370	2.500	0.0	0.0
HE-11-4	0.600	0.0	4.220	0.0	0.0	3.010	101.870	6.030	0.0	4.010
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0	0.0
HE-13-3	3.980	0.0	2.660	0.0	0.660	3.980	81.010	4.650	0.660	0.0
HE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	1.520	0.510	0.0	0.0
HE-14-2	1.500	0.0	4.510	0.0	0.0	0.500	12.530	0.500	0.500	3.510
HE-14-3	4.600	0.920	4.600	17.480	3.680	2.760	162.830	19.320	8.280	5.520
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	1.040	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.510	0.0	1.530	0.0	0.510	0.0	9.200	4.090	0.0	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.520	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.510	0.0	1.010	0.0	0.0	1.010	2.530	1.010	0.0	0.510

	049	054	056	057	058	062	066	068	069	070
HE-2-1	1.140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	3.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.540	0.0	0.0	0.0	0.0	0.0	1.080	0.0
HE-3-4	0.0	0.0	0.0	0.0	2.750	0.0	0.0	2.060	0.0	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.530	0.0	0.0	0.0	0.0	0.530	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	0.520	0.0	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.520	0.0	0.0	0.0	0.0	2.600	0.0	0.0
HE-9-2	0.0	0.0	1.040	0.0	1.040	0.0	0.0	0.520	0.0	0.0
HE-10-2	0.0	0.0	4.040	0.0	1.350	0.0	0.0	0.670	0.0	0.0
HE-11-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-11-4	0.0	0.0	5.420	0.600	1.810	0.0	0.0	3.620	0.0	0.0
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	1.330	1.990	1.330	3.320	0.0	0.0	0.0	0.0	0.0
HE-14-1	0.0	0.0	0.0	0.510	0.0	0.510	1.520	0.0	4.570	0.0
HE-14-2	0.0	0.500	7.010	1.000	0.500	1.500	0.0	0.0	0.0	0.500
HE-14-3	1.840	10.040	20.240	1.840	37.720	7.360	10.120	2.760	0.920	0.0
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.0	1.020	1.020	1.530	2.550	0.0	0.0	0.0	0.0	0.0
HE-16-1	0.0	0.0	0.0	1.560	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.0	0.0	0.510	0.0	0.0	0.510	0.0	0.0

	072	074	082	087	089	091	092	095	098	102
HE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	1.070	0.0	0.0	0.0	0.0	0.0	1.070	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0	0.540	0.0	0.0	0.0	0.0
HE-3-4	0.0	0.0	0.0	0.690	0.0	0.0	0.0	10.300	0.0	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.180	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.570	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.670	0.0	0.0
HE-9-2	0.0	1.040	0.0	0.0	0.0	0.0	0.0	4.670	0.0	0.0
HE-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.870	0.0	0.670
HE-11-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.240	0.0	0.0
HE-11-4	0.0	1.210	0.0	0.0	0.0	0.600	0.0	22.910	0.600	0.0
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	1.330	1.330	0.0	0.0	0.0	1.330	24.570	0.0	0.0
HE-14-1	0.0	0.0	2.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-14-2	0.0	1.000	0.500	0.0	0.0	0.0	0.0	20.540	0.0	0.0
HE-14-3	10.560	0.920	0.920	2.760	12.880	0.0	0.0	11.960	0.0	0.0
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.750	0.0
HE-15-3	0.0	0.510	0.0	0.0	0.0	0.510	0.0	6.130	1.520	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	104	118	119	127	128	134	135	136	137	138
HE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3-4	0.0	0.690	0.0	0.0	0.0	0.0	0.690	0.690	0.0	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.0	0.0	0.0	0.0	0.530	0.0	0.0	0.520
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.190
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-9-2	0.0	0.520	0.0	0.520	2.080	0.0	0.0	0.0	0.0	0.0
HE-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.700	0.0	0.670
HE-11-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-11-4	0.0	1.210	1.210	0.0	0.0	0.0	0.0	3.010	0.0	0.600
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	1.330	0.0	0.0	0.660	0.0	0.0	0.660	0.660	1.990
HE-14-1	0.0	1.010	0.0	0.0	0.0	0.0	1.520	5.580	1.010	0.0
HE-14-2	1.500	0.0	0.500	1.000	0.0	0.0	0.0	0.500	0.500	0.0
HE-14-3	0.920	47.840	2.760	0.0	1.840	0.920	0.0	1.840	2.760	0.920
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	1.530	0.0	0.0	0.0	0.510	0.0	0.0	1.070	0.0	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.510	0.0	0.0	0.510	0.0	0.0	1.010	0.0	1.010

	13[illegible]	140	141	142	143	144	145	148	152	154
HE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.210
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0	0.0	1.080	0.0	0.0	0.0
HE-3-4	0.0	0.690	0.0	0.690	0.0	0.0	0.0	0.0	1.370	0.690
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.530	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.520	0.0	0.0	0.0	3.560	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.520	0.0	0.0	0.0
HE-9-2	0.0	0.0	0.0	3.120	0.0	0.0	0.520	0.0	0.520	4.670
HE-10-2	0.0	0.0	0.0	2.020	0.0	0.0	0.0	0.0	0.0	2.700
HE-11-3	0.0	1.250	0.0	0.620	0.0	0.0	1.250	0.0	0.0	0.620
HE-11-4	0.600	0.0	1.810	3.620	0.0	0.600	0.600	0.0	1.210	3.620
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	0.660	0.0	0.0	0.0	1.330	0.0	0.0	0.660	0.660
HE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-14-2	0.0	0.500	0.500	0.0	1.000	0.500	0.0	0.0	1.500	6.010
HE-14-3	0.0	1.840	0.920	0.920	0.0	0.0	0.0	3.680	1.840	4.600
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	1.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.720	0.0

	155	156	157	158	164	165	169	172	173	176
HE-2-1	1.140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	1.080	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3-4	1.370	1.370	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	1.060	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	1.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.520	0.0	1.570	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	2.600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-9-2	0.0	16.090	0.0	0.0	0.0	0.0	0.0	0.0	1.560	1.040
HE-10-2	6.060	2.020	0.0	0.0	0.0	0.0	0.0	0.670	0.0	0.0
HE-11-3	0.0	1.870	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-11-4	0.600	4.220	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.660	3.980	0.0	0.0	0.0	0.660	0.0	2.660	0.0	0.0
HE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-14-2	0.0	3.510	0.0	0.0	0.0	2.000	1.500	0.0	0.0	0.500
HE-14-3	0.920	0.920	0.0	6.440	0.920	0.920	3.680	0.0	0.920	0.920
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.0	0.510	0.0	0.510	0.0	0.0	0.510	0.0	0.0	0.0
HE-16-1	1.040	0.520	0.0	0.0	0.0	0.0	1.040	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.510	0.0	0.510	0.0	5.570	0.510	0.0	0.510

	187	190	191	192	193	198	199	200	208	210
HE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.530
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.650	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3-4	0.690	0.0	0.0	0.0	8.930	0.0	0.0	0.0	4.120	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.530	0.0	0.0	0.0	5.830	0.0	0.0	0.0	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.520	0.0	0.0	0.0	0.520	0.0
HE-7	0.520	0.0	0.0	0.0	6.280	0.0	0.0	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.0	0.0	5.190	0.0	0.0	0.0	1.040	0.0
HE-9-2	0.0	0.0	0.0	0.0	3.120	0.0	0.0	0.0	2.600	0.0
HE-10-2	0.0	0.0	0.0	0.0	24.260	0.0	0.0	0.0	3.370	0.0
HE-11-3	0.0	0.0	0.0	0.0	3.750	0.0	0.0	0.0	2.500	0.0
HE-11-4	1.210	0.0	0.0	0.0	50.030	0.0	0.0	0.600	101.270	0.600
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	0.0	0.0	0.0	29.230	0.0	0.0	0.0	83.670	0.0
HE-14-1	0.0	0.0	0.0	0.0	1.520	0.0	0.0	1.010	0.510	0.0
HE-14-2	0.500	0.0	0.0	0.0	19.540	0.0	0.500	0.0	110.240	0.0
HE-14-3	1.840	22.080	9.920	0.920	30.360	0.920	0.0	294.390	0.0	0.0
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.0	0.0	0.0	0.0	1.020	0.0	0.510	0.0	31.680	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.520	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0

	211	214	215	216	217	218	219	220	223	[illegible]
HE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	1.530	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3-4	1.370	2.060	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-1	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	1.590	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5-2	0.0	0.620	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	[illegible]	2.090	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	3.630	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-9-2	0.0	0.520	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-10-2	0.0	0.0	0.670	0.0	0.0	0.0	0.670	0.0	0.0	0.0
HE-11-3	0.0	0.0	1.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-11-4	0.0	4.220	1.210	0.0	0.0	0.0	0.0	0.0	0.0	0.600
HE-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	5.310	1.330	1.330	0.0	0.0	0.0	0.0	0.670	0.0
HE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-14-2	0.0	4.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-14-3	11.960	0.0	0.0	0.0	0.0	0.0	0.0	1.840	0.0	0.0
HE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.0	1.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-1	0.0	0.0	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	230	231	234	243	245
HE-2-1	0.0	0.0	0.0	0.0	0.0
HE-2-2A	0.0	0.0	0.0	0.0	0.0
HE-2-2B	0.0	0.0	0.0	0.0	0.0
HE-2-3A	0.0	0.0	0.0	0.0	0.0
HE-2-3B	0.0	0.0	0.0	0.0	0.0
HE-3-4	0.0	0.0	0.0	0.0	0.0
HE-4-1	0.0	0.0	0.0	0.0	0.0
HE-4-2	0.0	0.0	0.0	0.0	0.0
HE-5-1	0.0	0.0	0.0	0.560	0.0
HE-5-2	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0
HE-8-1	0.0	0.0	0.0	0.0	0.0
HE-8-2	0.0	0.0	0.0	0.0	0.0
HE-9-2	0.0	0.0	0.0	0.0	0.0
HE-10-2	0.0	0.0	0.0	0.0	0.0
HE-11-3	0.0	0.0	0.0	0.0	0.0
HE-11-4	0.0	0.0	0.0	0.0	0.0
HE-13-2	0.0	0.0	0.0	0.0	0.0
HE-13-3	0.0	0.0	0.0	0.0	0.0
HE-14-1	0.0	0.0	0.0	0.0	0.0
HE-14-2	0.0	0.500	0.500	0.500	0.0
HE-14-3	0.0	0.0	0.0	0.0	0.0
HE-15-1	0.0	0.0	0.0	0.0	0.0
HE-15-2	0.0	0.0	0.0	0.0	0.0
HE-15-3	0.0	0.0	0.0	0.0	0.510
HE-16-1	0.520	0.0	0.0	0.0	0.0
HE-16-2	0.0	0.0	0.0	0.0	0.0
HE-16-3	0.0	0.0	0.0	0.0	0.0

	001	002	003	005	006	007	008	009	011	012
P-2-1A	0.0	0.0	0.0	4.170	10.420	175.000	0.0	0.0	6.250	0.0
P-2-1B	0.0	2.020	0.0	2.020	9.060	93.840	0.0	0.0	6.050	2.020
P-2-2A	0.0	0.0	0.0	0.0	3.090	12.770	0.0	0.0	1.060	1.060
P-2-2B	0.0	0.0	0.0	0.0	2.100	11.540	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	10.180	0.0	0.0	0.0	2.020
P-2-2D	0.0	0.0	0.0	0.0	2.160	21.600	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	4.660	4.660	11.660	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	1.540	12.310	0.0	0.0	0.0	1.540
P-3-1	0.510	0.0	0.0	0.0	1.770	40.510	0.510	1.030	4.100	2.560
P-3-2	0.0	0.0	0.0	0.0	1.000	14.010	0.0	0.0	4.000	4.000
P-4-1	0.0	0.0	0.0	0.0	3.040	4.050	0.0	1.010	2.020	2.020
P-4-2	0.0	0.0	0.0	0.0	99.390	106.490	0.0	66.230	11.160	4.060
P-4-3	0.0	0.0	0.0	0.0	2.000	5.010	0.0	0.0	3.010	0.0
P-4-4	0.0	0.0	0.0	0.0	3.420	9.120	0.0	2.240	3.420	0.0
P-4-5	0.0	0.0	0.0	2.000	0.0	14.000	0.0	0.0	2.000	0.0
P-4-6	0.0	0.0	0.0	0.0	1.020	2.040	0.0	0.0	2.040	0.0
P-5-1	0.0	0.0	0.0	0.0	0.550	0.0	0.0	0.0	0.0	0.0
P-6-1	0.500	0.0	0.0	0.500	4.500	48.050	0.0	0.0	2.000	0.0
P-6-2	0.0	0.0	0.0	0.0	0.520	7.900	0.0	0.0	2.110	1.050
P-7-1	0.0	0.0	0.0	2.520	1.260	12.610	0.0	0.0	0.0	1.260
P-7-2	0.0	0.0	0.0	0.0	0.0	5.210	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	3.510	27.260	0.0	0.0	0.500	0.500
P-7-4	0.500	0.0	0.0	2.020	2.020	105.000	0.0	0.0	0.500	0.0
P-8-1	0.0	0.0	0.0	0.0	0.580	3.400	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	1.550	5.670	28.370	0.0	0.0	0.0	1.030
P-8-3	0.0	0.0	0.0	0.0	3.380	44.650	0.0	0.680	1.350	0.0
P-8-4	0.0	0.0	0.0	0.0	1.000	12.520	0.0	0.0	1.000	0.0
P-9-1	0.0	0.0	0.0	0.0	1.040	4.160	0.0	0.0	0.520	0.0
P-9-2	0.0	0.0	0.0	1.010	1.560	12.130	0.0	0.0	0.510	0.0
P-9-3	0.0	0.0	0.0	0.0	70.410	106.230	3.060	1.020	0.0	0.0
P-9-4	0.0	0.0	0.0	2.100	0.0	16.820	0.0	0.0	0.0	0.0
P-9-5	0.0	0.0	0.0	0.0	3.900	18.560	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	0.510	0.510	16.690	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.500	0.0	3.010	0.0	0.0	8.020	0.500
P-10-2	0.0	0.0	0.0	0.0	1.900	7.600	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	6.640	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	7.260	0.0	0.660	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	8.140	0.0	1.630	0.0	0.0
P-11-1	1.620	0.0	0.0	11.170	17.270	107.160	0.510	1.020	3.560	0.510
P-12-1	0.0	0.0	0.0	0.0	19.800	116.980	0.0	2.400	0.0	0.0
P-12-2	0.0	0.0	0.0	5.500	12.860	117.020	0.0	0.0	5.900	0.0
P-12-3	0.0	0.500	0.0	34.500	2.000	9.530	0.500	0.0	2.000	0.0
P-12-4	0.0	0.0	0.0	2.510	4.510	19.560	0.500	0.0	5.020	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	1.320	0.0	0.660	1.980	0.0
P-12-6	0.0	0.0	0.0	0.0	1.000	57.330	0.0	0.670	0.670	0.0
P-13-1	0.520	0.0	0.0	0.0	11.420	62.100	0.0	1.660	2.600	0.0
P-13-2	0.0	0.0	0.0	1.000	13.810	123.120	0.0	2.400	4.900	0.0
P-13-3	0.0	0.0	0.0	0.0	0.0	8.560	0.0	0.0	1.010	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	1.290	0.0	0.0	0.0	0.0

	001	002	003	005	006	007	008	009	011	012
P-13-6	0.0	0.0	0.0	2.700	1.160	9.270	0.0	0.0	1.160	0.580
P-13-7	0.0	0.0	2.700	4.000	9.720	120.110	0.0	0.540	2.160	2.700
P-14-1	0.500	2.010	0.0	9.050	8.550	180.080	0.0	0.0	3.520	0.0
P-14-2	0.510	0.0	0.0	3.550	1.010	164.640	0.0	0.0	4.650	0.0
P-14-3	0.0	0.0	0.0	2.010	15.580	2.410	0.0	0.0	7.040	2.510
P-15-1	1.100	1.100	1.660	8.290	4.420	151.930	0.0	2.760	4.970	0.0
P-15-2	0.500	0.0	0.0	10.500	5.500	233.630	0.0	1.000	4.500	0.0
P-15-3	0.0	0.0	0.0	4.000	0.500	16.000	0.0	1.000	0.500	0.0
P-16-1	0.0	0.0	0.0	0.770	0.0	28.370	0.0	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.0	3.210	39.100	0.0	0.540	2.140	0.0
P-16-3	1.000	0.0	0.0	7.010	3.510	110.390	0.0	0.0	0.0	0.0
P-16-4	0.500	0.0	13.030	13.030	4.510	68.140	6.510	0.500	3.010	2.510

	013	015	017	018	019	021	022	026	028	029
P-2-1A	4.170	4.170	8.330	4.170	2.000	0.0	8.330	0.0	0.0	0.0
P-2-1B	2.020	6.070	0.0	0.0	1.010	0.0	4.040	0.0	0.0	0.0
P-2-2A	3.130	0.0	0.0	0.0	0.0	0.0	0.0	1.060	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.160	0.0	0.0
P-2-2E	0.0	2.330	0.0	0.0	0.0	0.0	0.0	2.330	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.620	0.0	0.0
P-3-1	2.050	1.560	0.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	1.010	0.0	6.070	0.0	0.0
P-4-2	1.010	0.0	0.0	3.040	0.0	13.180	0.0	0.0	0.0	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	4.560	1.140	0.0	0.0	0.0	1.140	0.0	0.0	0.0	0.0
P-4-5	0.0	0.0	2.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	1.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	3.300	2.000	0.0	0.0	0.0	0.0	0.0	2.000	0.500	0.0
P-6-2	0.530	0.0	0.0	0.0	0.0	0.0	0.0	1.580	0.0	1.050
P-7-1	0.0	2.520	1.260	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	1.010	2.520	0.0	0.0	0.0	0.0	0.0	1.510	0.0	0.0
P-7-4	1.510	1.510	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	5.160	0.0	0.0	0.0	0.0	0.0	0.0	4.130	0.0	0.0
P-8-3	1.350	3.360	0.0	0.0	0.0	0.0	0.0	3.680	0.0	0.0
P-8-4	0.500	0.0	0.0	0.0	0.0	0.500	0.0	4.510	0.0	0.500
P-9-1	3.170	2.040	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.510	0.510	1.010	0.0	0.0	0.0	0.0	1.010	1.520	0.510
P-9-3	3.060	9.150	0.0	0.0	0.0	6.130	0.0	1.020	0.0	0.0
P-9-4	3.160	0.0	1.050	1.050	0.0	0.530	0.0	0.0	0.0	0.0
P-9-5	1.330	7.660	0.0	0.0	0.0	1.370	0.0	0.0	0.0	2.060
P-9-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	14.940	0.500	0.0	0.0	0.0	0.0	0.0	7.520	0.0	0.0
P-10-2	2.550	2.800	0.0	0.0	0.0	0.0	0.0	0.420	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.640	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	1.020	0.540	0.0	0.540	0.0	1.090	0.0	0.0	0.0	0.0
P-11-1	2.070	5.030	0.0	2.030	0.0	3.560	0.0	0.0	0.0	0.0
P-12-1	3.600	1.800	1.290	0.0	0.600	3.600	0.0	0.0	0.0	0.0
P-12-2	4.500	5.170	0.0	1.070	1.610	2.140	0.0	10.200	1.610	0.0
P-12-3	5.370	2.510	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
P-12-4	2.510	2.000	0.0	0.0	0.0	0.0	4.510	0.500	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	1.270	2.000	0.0	0.0	0.0	2.000	0.0	0.670	0.0	0.0
P-13-1	2.060	0.520	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.520
P-13-2	4.800	7.610	0.0	0.600	0.600	2.400	0.0	2.400	0.0	0.0
P-13-3	1.510	1.530	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	013	015	C17	018	019	021	022	026	028	029
P-13-6	0.540	0.0	0.0	0.580	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	[illegible]	2.700	0.540	0.0	0.540	0.540	0.0	0.0	0.540	0.0
P-14-1	8.040	13.000	0.0	0.0	0.0	1.510	0.0	10.560	0.0	0.0
P-14-2	14.650	2.530	0.0	0.0	0.0	1.010	0.0	1.520	0.0	0.0
P-14-3	1.510	5.530	1.010	0.0	0.0	0.0	0.0	13.070	0.0	0.0
P-15-1	3.310	6.630	0.550	2.760	2.760	4.420	0.0	0.0	1.100	0.0
P-15-2	9.000	2.000	0.0	0.0	6.500	0.500	0.0	0.0	0.500	1.000
P-15-3	1.000	0.0	0.0	0.0	1.000	2.000	0.0	0.0	0.0	0.500
P-16-1	0.770	3.070	0.0	0.0	0.0	2.300	0.0	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.540	0.0	0.0	0.0	1.610	0.0	0.0
P-16-3	3.510	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
P-16-4	0.0	0.0	0.0	0.0	3.010	0.500	0.0	0.0	0.500	0.0

	031	032	033	035	038	040	047	049	054	056
P-2-1A	0.0	0.0	0.0	30.580	12.500	4.170	2.080	0.0	4.170	2.080
P-2-1B	0.0	0.0	0.0	29.260	[illegible].020	0.0	2.020	0.0	7.060	0.0
P-2-2A	0.0	0.0	0.0	12.770	4.260	0.0	0.0	0.0	7.450	0.0
P-2-2B	0.0	0.0	0.0	13.640	3.150	0.0	0.0	0.0	0.0	0.0
P-2-2C	1.010	0.0	0.0	6.070	4.040	0.0	0.0	0.0	1.010	0.0
P-2-2D	0.0	0.0	0.0	15.120	64.480	0.0	0.0	0.0	0.0	0.0
P-2-2E	4.060	0.0	0.0	4.060	4.060	0.0	0.0	0.0	2.330	0.0
P-2-3	12.310	0.0	0.0	12.310	3.590	0.0	0.0	0.0	2.560	0.0
P-3-1	0.0	0.0	0.0	35.900	7.690	1.540	0.0	0.0	0.510	0.0
P-3-2	0.0	0.0	0.0	12.010	2.000	0.0	0.0	2.000	0.0	0.0
P-4-1	1.010	0.0	0.0	16.190	2.020	0.0	0.0	1.010	1.010	7.090
P-4-2	0.0	1.010	0.0	585.190	24.340	0.0	1.010	2.030	2.020	35.500
P-4-3	0.0	0.0	0.0	1.000	1.000	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	13.680	7.980	0.0	1.140	0.0	2.280	0.0
P-4-5	0.0	0.0	0.0	2.000	0.0	0.0	0.0	0.0	0.0	2.000
P-4-6	1.020	0.0	0.0	3.070	2.040	0.0	0.0	0.0	1.020	0.0
P-5-1	0.0	0.0	0.0	0.0	0.450	0.0	0.0	0.0	0.0	0.0
P-6-1	4.500	0.0	0.0	12.510	4.000	0.0	1.000	0.500	3.000	0.0
P-6-2	3.690	0.0	0.0	4.210	5.790	0.0	0.0	0.530	0.530	0.0
P-7-1	0.0	0.0	0.0	1.260	1.260	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.520	1.040	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.500	8.580	1.510	0.0	0.0	0.0	1.010	0.0
P-7-4	2.020	0.0	0.0	21.700	2.530	0.0	0.0	0.500	0.0	0.0
P-8-1	0.0	0.0	0.0	2.320	2.480	0.0	0.0	0.0	0.0	0.590
P-8-2	0.0	0.0	0.0	8.250	3.610	0.0	0.0	0.0	0.0	1.030
P-8-3	0.680	0.0	0.0	22.330	3.360	0.0	0.680	0.680	0.680	0.680
P-8-4	0.0	0.0	0.0	4.510	2.500	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	6.760	6.240	0.0	0.0	0.0	0.0	0.520
P-9-2	1.520	0.0	0.0	4.040	2.530	0.0	0.0	0.0	3.030	2.020
P-9-3	13.250	0.0	0.0	377.940	57.200	2.040	2.040	2.040	23.490	2.040
P-9-4	0.520	0.0	0.0	6.310	5.790	1.580	0.0	0.530	1.050	1.580
P-9-5	5.510	0.0	0.0	25.230	(5.010	0.0	0.0	0.0	0.0	10.620
P-9-6	0.0	0.0	0.0	4.550	6.580	0.510	0.0	0.510	2.020	0.0
P-10-1	0.0	0.0	0.0	0.500	1.010	0.500	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	3.800	0.470	0.0	0.950	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	1.930	1.290	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	1.980	0.660	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	1.760	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	3.560	0.0	0.0	71.100	5.080	2.540	0.0	0.0	9.140	3.050
P-12-1	0.0	0.0	0.0	112.180	5.400	0.600	0.600	0.0	1.800	2.300
P-12-2	5.370	0.0	0.0	45.630	3.760	2.150	0.0	0.0	25.760	6.440
P-12-3	0.0	0.0	0.0	3.530	0.500	0.500	0.0	0.0	0.0	0.0
P-12-4	0.0	0.0	0.0	15.550	1.010	0.500	1.000	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	5.280	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	1.320	0.0	0.0	23.330	2.000	0.0	0.670	0.670	0.670	0.0
P-13-1	1.040	0.0	0.0	29.110	2.080	0.0	0.0	0.0	0.0	2.090
P-13-2	0.0	0.0	0.600	30.440	4.090	1.200	3.600	0.0	6.610	9.610
P-13-3	0.500	0.0	0.0	9.070	0.0	0.0	0.0	0.0	2.520	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	1.290	0.0	0.0	0.0	0.0	0.0	0.0

	031	032	033	035	038	040	047	049	054	056
P-13-6	0.0	0.0	0.0	6.570	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	4.340	0.0	0.0	42.700	6.490	1.080	0.540	1.620	1.620	0.0
P-14-1	1.900	0.0	0.500	0.0	3.020	0.0	1.510	0.0	33.200	1.010
P-14-2	1.910	0.0	0.510	21.780	0.0	1.010	0.0	0.0	2.520	0.0
P-14-3	0.510	0.0	0.0	21.610	3.020	0.0	1.010	0.0	1.010	0.0
P-15-1	2.700	0.0	1.100	31.490	1.060	0.550	3.310	0.550	31.450	8.290
P-15-2	0.500	0.0	1.500	38.520	2.500	3.500	4.500	1.000	58.030	0.500
P-15-3	2.560	0.0	0.500	13.500	0.500	1.000	0.0	1.000	4.500	0.0
P-16-1	0.770	0.0	0.0	4.600	1.520	0.0	1.530	0.0	0.770	3.070
P-16-2	0.540	0.0	0.540	12.320	0.0	0.540	1.610	0.0	4.280	1.610
P-16-3	0.0	0.0	0.110	2.220	0.110	0.330	1.110	0.330	4.110	0.0
P-16-4	22.550	0.0	1.500	58.120	5.010	2.000	0.500	25.550	17.020	0.0

	057	059	060	062	064	065	066	067	068	069
P-2-1A	[illegible]	2.950	0.0	0.0	0.0	0.0	10.420	0.0	8.320	0.0
P-2-1B	1.910	0.0	0.0	1.010	0.0	0.0	1.010	0.0	2.020	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	1.010	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	4.320	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	4.060	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0
P-3-1	0.510	2.560	0.0	0.0	0.0	0.0	0.0	0.0	1.030	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	3.000	0.0
P-4-1	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0	2.020	1.010
P-4-2	4.360	0.0	0.0	0.0	0.0	0.0	1.010	0.0	43.610	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-4-4	0.0	2.230	0.0	0.0	0.0	0.0	1.140	0.0	3.420	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	8.000	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	1.020	0.0	0.0	0.0	0.0	1.020	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	1.090	0.0	5.510	0.0	0.500	2.000	0.0	1.000	0.0
P-6-2	0.0	0.530	0.0	2.630	0.0	0.0	0.530	0.0	0.0	0.0
P-7-1	0.0	2.520	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	2.020	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.500	0.0	1.010	0.0	0.0	2.520	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.520	0.0	2.060	0.0
P-8-3	0.0	0.600	0.0	0.0	0.0	1.350	0.0	0.0	1.350	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-9-1	0.0	2.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.0	0.0	0.0	1.010	0.0	0.0	1.010	0.0	0.0	0.0
P-9-3	27.570	0.0	11.240	0.0	0.0	0.0	0.0	1.020	5.110	8.170
P-9-4	1.560	1.580	0.0	1.050	0.0	0.0	5.260	0.0	1.050	0.0
P-9-5	5.300	6.640	0.0	0.0	0.0	0.0	0.0	0.0	11.050	2.660
P-9-6	1.010	1.010	0.0	1.010	0.0	0.0	1.010	0.0	0.0	0.0
P-10-1	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0
P-10-2	1.420	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.420	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.510	12.190	0.0	3.570	0.0	0.0	18.790	0.0	2.030	0.0
P-12-1	1.210	7.200	0.0	1.200	0.0	0.0	0.600	0.0	0.600	0.0
P-12-2	2.630	[illegible]	0.0	4.290	0.0	0.0	6.980	0.0	2.650	0.0
P-12-3	0.0	1.070	0.0	1.500	0.0	0.0	53.160	0.0	0.500	0.0
P-12-4	0.0	1.000	0.0	0.500	0.0	0.0	2.000	0.0	0.500	0.0
P-12-5	[illegible]	0.660	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	2.300	0.0	0.670	0.0	0.670	0.670	0.0	0.670	0.0
P-13-1	-0.5[illegible]	1.560	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	0.0	16.020	0.0	1.200	0.0	0.0	12.610	0.0	3.000	0.0
P-13-3	0.0	1.010	1.010	0.0	0.0	0.0	3.530	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	057	058	060	062	064	065	066	067	068	069
P-13-6	0.0	0.390	0.0	0.0	0.0	0.0	1.160	0.0	0.0	0.0
P-13-7	0.0	2.160	0.0	1.620	0.0	0.0	15.080	0.0	0.540	0.0
P-14-1	2.010	15.030	0.0	4.530	0.500	0.0	13.010	0.0	1.510	0.0
P-14-2	0.0	0.0	0.0	0.0	0.0	0.0	6.590	0.0	1.520	0.0
P-14-3	0.0	0.0	0.0	2.010	0.0	0.0	4.020	0.0	0.0	0.0
P-15-1	1.560	3.310	0.0	1.660	0.0	0.0	14.920	0.0	0.0	0.0
P-15-2	0.0	4.000	2.000	4.000	0.0	0.0	10.560	0.0	1.500	0.0
P-15-3	0.500	1.500	0.0	2.000	0.0	0.0	2.500	0.0	0.0	0.0
P-16-1	0.770	1.530	0.0	0.0	0.0	0.0	0.770	0.0	1.530	0.0
P-16-2	0.0	1.610	0.0	2.680	0.0	0.0	0.0	0.0	1.070	0.0
P-16-3	0.0	0.550	0.0	0.220	0.0	0.0	0.440	0.0	0.110	0.110
P-16-4	0.0	10.220	2.000	4.510	0.0	1.500	20.540	0.0	1.000	0.0

	073	07[illegible]	074	075	076	082	083	086	087	089
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.170
P-2-1B	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0	5.050
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.010
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.160
P-2-2F	0.0	2.330	0.0	2.330	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	0.0	1.010	0.0	0.0	1.010	0.0	0.0	12.170	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.140	0.0
P-4-5	0.0	0.0	0.0	2.000	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	1.020	1.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	1.500	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
P-6-2	0.0	0.530	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	3.200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.0	0.510	0.510	0.0	0.0	0.0	0.0	0.0	0.0	1.010
P-9-3	0.0	2.040	0.0	0.0	0.0	1.020	0.0	1.020	3.010	0.0
P-9-4	0.0	0.530	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.640	0.0
P-9-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	1.000
P-10-2	0.0	0.470	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.620	0.540
P-11-1	0.0	0.0	0.0	0.0	0.0	0.0	1.020	0.0	0.0	0.0
P-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.200	1.200	0.600
P-12-2	0.0	2.150	2.150	0.0	0.0	0.0	1.610	1.070	0.0	5.900
P-12-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0	2.510
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.330
P-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	0.0	1.200	1.200	0.0	0.0	0.0	0.0	0.0	0.0	0.630
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.940

	071	072	074	075	076	082	083	086	087	089
P-13-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.540
P-13-7	0.0	1.080	0.0	0.0	0.0	0.0	0.0	1.080	0.0	15.140
P-14-1	0.0	4.530	1.510	0.0	0.500	0.0	0.0	0.0	0.0	3.010
P-14-2	0.510	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	6.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-1	0.0	4.970	1.830	0.0	0.0	0.0	1.660	0.0	0.0	0.0
P-15-2	0.0	6.500	0.0	1.500	0.0	0.500	1.000	0.0	0.0	0.0
P-15-3	0.0	2.000	0.0	0.0	0.0	0.0	0.0	1.000	1.500	0.0
P-16-1	0.0	0.0	0.770	0.0	0.0	0.770	0.0	0.0	0.770	0.0
P-16-2	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-3	0.0	0.330	0.0	0.0	0.110	0.110	0.220	0.0	0.220	0.0
P-16-4	0.0	2.010	0.0	1.000	1.000	2.000	0.500	2.000	1.500	13.530

	090	091	092	095	096	098	100	102	104	105
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1B	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	1.030	3.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	1.010	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	101.410	4.060	78.090	0.0	0.0	0.0	0.0	0.0	0.0
P-4-3	0.0	2.090	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	19.260	0.0	9.120	0.0	0.0	0.0	0.0	0.0	0.0
P-4-5	0.0	4.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	3.690	0.530	0.0	0.0	0.0	0.0	0.0	0.0	0.570
P-6-2	0.0	3.630	0.530	0.0	0.0	0.0	0.0	0.0	0.0	0.530
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.520	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.511	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0
P-9-3	1.020	12.440	14.300	63.330	1.070	1.020	0.0	0.0	0.0	0.0
P-9-4	0.0	1.050	0.0	1.050	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	0.0	56.410	7.070	27.890	0.0	0.0	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	0.640	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.640	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	1.090	1.070	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-1	0.0	0.0	0.0	4.200	0.0	0.0	0.0	0.0	0.0	0.0
P-12-2	1.970	0.540	0.0	5.000	0.0	0.540	0.0	0.0	0.0	0.0
P-12-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	0.0	1.560	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	4.570	0.0	1.530	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.0	16.630	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	0.0	0.0	0.0	5.410	0.0	0.0	0.0	0.0	0.0	0.0
P-13-3	0.0	0.500	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	090	091	092	095	096	098	100	102	104	105
P-13-6	0.0	1.740	0.0	0.580	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	2.100	21.080	3.790	1.620	0.0	0.0	0.0	0.540	0.0	0.0
P-14-1	1.010	0.0	0.0	9.050	0.0	0.0	0.0	0.0	0.0	0.0
P-14-2	0.0	0.0	0.0	1.520	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	1.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510
P-15-1	0.0	5.940	0.0	7.180	0.0	0.0	0.0	0.0	0.0	0.0
P-15-2	0.0	0.500	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-15-3	0.0	2.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-1	0.0	2.300	0.770	0.770	0.0	0.0	0.770	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-3	0.0	0.290	0.0	2.220	0.0	0.0	0.0	0.0	0.0	0.0
P-16-4	1.500	4.010	1.500	0.500	0.0	0.0	0.500	0.500	0.0	0.0

	107	111	114	118	119	124	127	128	132	134
P-2-1A	0.0	0.0	0.0	4.170	2.080	0.0	0.0	2.080	0.0	0.0
P-2-1B	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	2.130	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	2.160	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.510	0.510	0.510	0.0	1.030	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.230	0.0	2.030
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-5	0.0	0.0	2.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.520	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.680	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.0	0.0	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0
P-9-3	0.0	3.060	0.0	7.040	0.0	1.020	0.0	5.110	2.040	0.0
P-9-4	0.0	0.0	0.0	1.050	0.0	0.0	0.0	1.050	0.0	0.0
P-9-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	2.530	1.010	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.470	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.540	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.0	2.030	0.0	1.020	0.0	0.630	0.0	0.510	0.510	0.0
P-12-1	0.0	0.0	0.0	7.900	0.600	0.0	0.0	0.0	0.0	0.0
P-12-2	0.0	0.0	0.0	15.320	0.0	0.0	0.0	1.070	0.0	0.0
P-12-3	0.0	0.0	0.0	3.530	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	0.0	0.0	0.0	1.500	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	0.0	0.0	4.330	0.170	0.0	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	0.0	0.0	0.0	14.410	0.0	1.200	0.0	0.600	0.0	0.0
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	107	111	114	116	119	124	127	128	132	134
P-13-6	0.540	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	0.0	0.540	0.0	6.490	0.540	0.540	0.540	0.0	0.0	0.540
P-14-1	0.0	0.0	0.0	14.080	0.0	0.0	1.010	1.010	0.0	0.0
P-14-2	0.0	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	0.0	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0
P-15-1	0.0	0.0	0.500	11.510	0.0	0.0	1.660	2.210	0.0	0.0
P-15-2	0.0	0.0	0.500	11.510	0.0	0.0	0.500	0.0	0.0	0.0
P-15-3	0.0	0.0	0.0	2.500	0.500	0.0	0.0	0.0	0.0	0.0
P-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.770	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-3	0.0	0.0	0.0	2.670	0.0	0.0	0.0	0.0	0.0	0.0
P-16-4	0.0	3.010	0.0	27.560	10.520	0.0	1.000	1.500	0.0	0.0

	135	136	137	138	139	140	141	142	144	145
P-2-1A	2.080	2.080	0.0	2.080	0.0	0.0	0.0	2.080	0.0	0.0
P-2-1B	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	1.050	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	1.010	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	13.180	1.010	0.0	1.010	1.010	1.010	13.180	1.010	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.280	0.0	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	0.0	0.0	0.530	0.0	0.0	0.530	0.0	0.0	0.0
P-6-2	0.0	0.0	0.0	0.530	0.0	0.530	0.0	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	1.550	1.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.0	0.0	0.510	0.0	0.0	0.510	0.0	0.0	0.0	0.510
P-9-3	0.0	8.170	3.060	1.020	3.060	3.060	0.0	10.210	0.0	3.060
P-9-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	0.0	6.140	0.0	0.0	0.0	0.0	0.0	2.660	0.0	0.0
P-9-6	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.950	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	2.170	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.0	0.0	0.0	0.0	0.0	16.760	1.520	0.0	1.520	1.020
P-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.630	0.0	0.0	0.0
P-12-2	0.0	[illegible]	0.540	0.0	0.0	0.540	0.0	0.540	0.0	0.0
P-12-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.0	0.0	0.520	0.0	0.0	[illegible]	0.0	2.600
P-13-2	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	[illegible]	0.0	0.600
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	[illegible]	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	135	136	137	138	139	140	141	142	144	145
P-12-6	0.0	1.160	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	0.0	0.530	3.240	0.0	0.540	0.540	0.0	1.620	0.0	2.160
P-14-1	0.0	0.500	0.0	0.0	1.510	1.010	0.0	0.0	0.0	0.0
P-14-2	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	0.0	0.510	0.0	0.0	0.510	0.0	0.0	0.0	0.510
P-15-1	0.0	0.0	2.210	0.0	1.100	1.100	0.550	0.0	0.0	0.0
P-15-2	0.0	2.000	6.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-3	0.0	0.0	3.500	0.500	0.0	0.500	0.500	0.0	1.500	0.500
P-16-1	0.0	0.770	0.770	0.0	0.770	0.0	0.770	0.770	0.0	0.0
P-16-2	0.0	0.540	1.070	0.0	0.0	0.0	0.0	0.540	0.0	0.0
P-16-3	0.0	0.220	0.670	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-4	0.500	2.000	2.000	7.520	0.500	11.020	6.010	0.0	0.0	5.510

	147	148	152	154	155	156	157	158	164	165
P-2-1A	0.0	0.0	0.0	0.0	0.0	8.330	0.0	0.0	0.0	0.0
P-2-1B	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	2.160	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	2.330	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.030	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	1.010	0.0	0.0	1.010	3.040	0.0	0.0	1.010	7.100
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	0.0	1.140	2.280	0.0	0.0	0.0	1.140
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	0.0	0.0	0.0	0.0	4.210	1.500	0.0	0.0	0.0
P-6-2	0.0	0.0	0.0	0.0	0.0	4.210	1.050	0.530	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.500	0.0	0.500	0.0	0.0	0.0	0.0
P-7-4	0.0	0.500	0.0	0.500	0.0	0.0	0.500	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.680	0.0	0.680	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.520	0.0	0.0	0.0	0.0
P-9-2	0.0	0.0	0.0	0.510	0.0	1.010	0.510	0.0	0.0	0.0
P-9-3	0.0	0.0	0.0	0.0	3.010	21.450	0.0	0.0	0.0	0.0
P-9-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.530	1.050	1.050
P-9-5	0.0	0.0	10.620	0.0	0.0	11.950	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	1.520	0.0	0.0	0.0	0.0	0.0	0.0	0.510
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	0.0	0.470	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.660	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	4.340	0.0	0.0	0.0	0.0
P-11-1	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.510	0.0	0.0
P-12-1	0.0	0.0	0.0	1.600	0.0	8.900	0.0	0.0	0.0	0.0
P-12-2	0.540	2.150	1.070	[illegible]	1.070	2.680	0.0	0.0	0.0	0.0
P-12-3	11.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	11.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.660	0.0	0.0	0.0	0.0
P-12-6	0.0	0.670	0.670	0.0	0.0	0.670	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.520	1.040	0.520	3.120	1.040	0.0	0.0	0.520
P-13-2	0.0	1.200	0.0	2.400	0.0	[illegible]	0.0	1.030	0.0	0.0
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	147	148	152	154	155	156	157	158	164	165
P-13-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	0.0	0.540	0.540	0.0	0.0	1.020	1.020	1.080	0.0	0.0
P-14-1	1.010	0.500	0.0	2.520	0.0	1.010	2.010	0.0	0.0	0.0
P-14-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0	0.0
P-15-1	0.0	1.100	0.0	1.100	0.0	0.0	0.0	3.310	0.0	0.0
P-15-2	0.500	3.500	0.0	0.0	0.0	0.500	0.0	5.500	0.0	0.0
P-15-3	0.0	1.000	0.0	0.0	0.0	0.500	0.0	0.0	0.0	0.0
P-16-1	0.0	0.0	0.0	0.0	1.530	0.0	0.0	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.0	0.0	0.540	0.540	0.0	0.0	0.0
P-16-3	0.0	0.890	0.0	0.0	0.0	0.220	0.440	0.0	0.0	0.0
P-16-4	1.500	4.010	0.0	0.0	0.0	1.500	11.020	2.510	0.500	0.0

	169	172	173	175	176	177	187	190	191	192
P-1-1A	0.0	0.0	0.0	0.0	2.080	0.0	2.080	0.0	0.0	2.080
P-1-1B	0.0	1.010	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.600	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.010	1.010
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	1.140	0.0	0.0	0.0	0.0	1.140	0.0	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.040	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
P-6-2	0.0	0.0	0.530	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.350	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.040	0.0	0.0
P-9-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-3	0.0	0.0	5.110	0.0	0.0	0.0	0.0	0.0	0.0	1.020
P-9-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.530	0.0	0.530
P-9-5	0.0	0.0	1.330	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.010
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0
P-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.540	0.0	0.0	0.0
P-11-1	0.0	0.0	0.0	0.510	0.510	2.070	0.0	2.070	0.0	0.510
P-12-1	0.0	0.600	0.0	0.0	0.0	0.0	0.600	0.0	0.0	0.0
P-12-2	0.0	0.540	1.070	0.0	0.0	0.0	0.540	1.610	1.070	0.0
P-12-3	0.0	0.0	0.0	0.0	0.500	0.0	0.0	0.0	0.0	1.000
P-12-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.010	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	1.200	0.0	3.030	0.0	0.0	0.0	0.600	1.200	0.0	4.800
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	167	172	173	175	176	177	187	190	191	192
P-13-6	0.0	0.0	0.0	0.0	0.0	0.0	0.580	0.0	0.0	0.0
P-13-7	0.0	0.0	0.0	0.0	0.0	0.540	0.0	0.540	0.0	0.0
P-14-1	0.0	2.520	0.500	0.0	0.500	0.0	0.500	4.530	0.0	0.500
P-14-2	0.0	0.0	0.0	0.0	2.030	0.0	0.0	0.510	1.520	0.0
P-14-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.510	1.010	0.0
P-15-1	1.100	16.570	0.0	0.0	0.550	0.0	0.0	4.970	6.010	0.0
P-15-2	1.500	2.000	0.0	0.0	0.0	0.0	0.500	13.000	0.0	0.0
P-15-3	1.000	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0	1.000
P-16-1	0.770	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-3	0.110	0.0	0.0	0.0	0.0	0.0	0.0	0.770	0.0	0.110
P-16-4	0.500	0.0	0.0	0.500	0.0	0.0	1.000	6.010	0.0	1.000

	193	[illegible]	[illegible]	200	201	202	203	205	206	207
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.010
P-2-1B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	1.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	[illegible]	4.000	2.030	0.0	0.0	7.100	0.0	0.0	0.0	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0
P-6-2	0.0	0.0	0.0	0.0	0.0	0.0	0.530	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0
P-7-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-3	[illegible]	[illegible]	0.0	2.045	[illegible]	0.0	0.0	0.0	0.0	0.0
P-9-4	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.330	0.0
P-9-6	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	[illegible]	0.0	0.470	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.0	0.0	0.510	1.020	[illegible]	0.0	0.0	0.0	0.0	0.0
P-12-1	[illegible]	[illegible]	1.200	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-2	[illegible]	[illegible]	[illegible]	0.540	0.0	0.0	0.0	0.0	0.0	0.0
P-12-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
P-12-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	[illegible]	0.0	0.0	0.0	0.0	[illegible]	0.0	0.0	0.0	0.0
P-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	197	198	199	200	201	202	203	205	206	207
P-13-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-1	1.519	0.0	0.0	0.0	0.0	0.500	0.0	0.0	0.0	0.0
P-14-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-1	3.870	2.210	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.210
P-15-2	0.600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-3	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-1	3.070	0.0	0.0	0.770	0.0	0.0	0.0	0.0	0.0	0.0
P-16-2	0.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-4	0.0	0.0	3.510	0.0	0.0	0.0	0.0	4.010	0.0	0.0

	209	210	211	212	213	214	215	216	217	218
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1B	0.0	0.0	2.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	2.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	139.960	2.030	0.0	0.0	3.040	5.070	0.0	0.0	0.0	0.0
P-4-3	2.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	3.440	1.140	0.0	1.140	0.0	0.0	0.0	0.0	0.0	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	4.050	1.020	1.020	0.0	1.020	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.0
P-6-2	0.0	0.0	0.0	0.0	0.0	0.0	1.050	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.0	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	1.010	0.0	0.510	0.0	0.510	0.0	0.0	0.0	0.0	0.0
P-9-3	172.100	0.0	0.0	0.0	0.0	4.000	2.040	3.060	1.010	1.020
P-9-4	13.150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	14.610	0.0	0.0	0.0	1.320	5.310	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.470	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.770	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	33.010	0.0	0.510	0.0	0.510	0.510	0.0	0.0	0.0	0.0
P-12-1	65.850	0.0	0.0	0.0	0.0	2.400	0.0	0.0	0.0	0.0
P-12-2	53.140	0.0	0.540	0.0	0.540	0.540	0.0	0.0	0.0	0.0
P-12-3	6.020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	5.720	0.0	0.0	0.0	0.0	1.040	0.0	0.0	0.0	1.010
P-13-2	4.800	0.0	0.0	0.0	0.0	1.200	0.0	0.0	0.0	0.600
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	209	210	211	212	213	214	215	216	217	218
P-13-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	5.940	0.0	0.540	0.0	0.540	0.540	0.0	0.540	0.0	0.0
P-14-1	18.610	0.0	0.0	0.0	1.510	1.010	0.0	0.500	0.0	0.0
P-14-2	0.0	0.0	2.030	0.0	0.510	0.0	0.0	0.0	0.510	0.0
P-14-3	3.020	0.0	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-1	77.350	0.0	0.550	0.550	1.660	3.870	0.0	1.100	0.550	0.0
P-15-2	45.520	0.0	1.500	0.0	2.000	1.500	0.0	0.0	0.0	1.000
P-15-3	13.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-1	3.830	0.0	0.0	0.0	0.0	1.530	0.0	0.0	0.0	0.0
P-16-2	1.070	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.540
P-16-3	2.890	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.110
P-16-4	3.510	0.0	1.000	0.0	0.0	2.000	2.510	0.500	0.0	0.0

	219	220	221	222	223	227	229	230	231	232
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	1.010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.680
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.0	0.0	0.0	0.0	0.0	0.0	0.510	0.0	0.510	0.0
P-9-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	1.330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.660	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.0	0.0	0.0	0.0	0.510	0.0	0.0	0.0	0.0	0.0
P-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-2	0.0	0.0	0.0	0.0	0.0	0.540	0.0	0.0	0.0	0.0
P-12-3	0.0	1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	[illegible]	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	0.0	1.230	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-3	0.0	0.0	0.0	1.510	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	1.510	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	219	220	221	222	223	227	229	230	231	232
P-13-6	0.0	0.540	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	0.540	2.160	0.0	0.0	1.080	0.0	0.0	0.540	0.540	0.0
P-14-1	0.500	0.500	0.0	0.0	1.010	0.0	0.0	0.0	0.0	0.0
P-14-2	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-1	0.0	0.0	0.0	0.0	0.550	1.100	0.0	0.0	0.0	0.0
P-15-2	0.0	0.0	0.0	0.500	0.500	2.500	0.0	1.000	0.0	0.0
P-15-3	0.540	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-1	0.770	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-2	0.0	0.0	0.0	0.0	0.540	0.0	0.0	0.0	0.0	0.0
P-16-3	0.0	0.220	0.110	0.0	0.0	0.110	0.0	0.0	0.0	0.0
P-16-4	2.510	3.010	0.0	0.0	0.0	0.500	0.0	2.500	0.0	0.0

	233	234	235	237	239	240	242	245
P-2-1A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-1B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-2E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	233	234	236	237	239	240	242	245
P-13-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-1	0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14-2	0.0	0.510	0.0	0.0	0.0	0.0	0.0	0.0
P-14-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15-1	0.550	0.0	3.310	2.760	0.550	0.550	0.0	0.0
P-15-2	1.500	0.500	0.0	0.0	0.0	0.0	0.0	0.0
P-15-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-16-1	0.0	0.0	0.0	0.0	0.0	0.0	0.770	0.0
P-16-2	0.0	0.0	0.540	0.0	0.0	0.0	0.0	0.0
P-16-3	0.0	0.0	0.0	0.0	0.0	0.0	0.110	0.0
P-16-4	0.0	0.0	0.0	0.0	0.0	0.500	0.0	0.500

PART II

PRESENCE-ABSENCE AND RANGE-THROUH DATA USED IN BIOSTRATIGRAPHIC ANALYSES

The data are arranged with the ichthyolith types across the top (columns) and the samples along the side (rows). A value of 1.000 indicates that the ichthyolith type was present in that sample or ranged through it. A value of 0.0 indicates that the ichthyolith type was absent in that sample and did not range through it.

	001	005	006	007	009	011	012	013	015	017
LE-2-1	0.0	0.0	0.0	1.000	0.0	0.0	1.000	0.0	1.000	0.0
LE-3-1	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	0.0	0.0	1.000	1.000	0.0	0.0	1.000	0.0	0.0	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	1.000	1.000	0.0	0.0	1.000	0.0	0.0	0.0
LE-11-1	0.0	0.0	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	1.000	0.0	0.0	1.000	0.0	0.0	1.000
LE-13-1	0.0	0.0	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	1.000	0.0	0.0	1.000	0.0	1.000	1.000
LE-15-1	1.000	0.0	1.000	1.000	0.0	1.000	0.0	1.000	1.000	1.000
LE-16-1	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0

	021	026	031	032	033	035	038	040	047	054
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	0.0	1.000	1.000	1.000	0.0	1.000	1.000	1.000	0.0	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	1.000	1.000
LE-12-1	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	1.000	0.0
LE-13-1	0.0	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0
LE-14-1	1.000	0.0	0.0	0.0	0.0	1.000	1.000	0.0	1.000	0.0
LE-15-1	0.0	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	1.000
LE-16-1	0.0	0.0	1.000	0.0	1.000	1.000	1.000	1.000	0.0	1.000

	056	057	058	060	066	068	072	086	087	089
LE-2-1	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	1.000	0.0	1.000	1.000	0.0	0.0	1.000	1.000	1.000	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0
LE-14-1	0.0	0.0	1.000	0.0	0.0	1.000	0.0	1.000	0.0	0.0
LE-15-1	0.0	0.0	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0
LE-16-1	1.000	0.0	1.000	0.0	1.000	1.000	1.000	0.0	0.0	1.000

	090	091	092	095	098	107	111	114	118	119
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	0.0	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
LE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
LE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
LE-16-1	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0

	127	128	135	136	137	138	139	140	141	142
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	1.000	0.0	0.0	1.000	1.000	1.000	0.0	1.000	1.000	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	1.000	1.000	1.000	0.0	1.000	0.0	1.000	0.0	0.0	1.000

	143	144	147	148	152	155	157	164	169	172
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000	0.0
LE-4-1	1.000	1.000	1.000	0.0	0.0	1.000	1.000	1.000	0.0	0.0
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
LE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000	1.000	1.000

	175	190	191	193	195	198	199	200	201	202
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	0.0	1.000	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
LE-15-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	1.000	1.000	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0

	20[illegible]	205	206	207	208	214
LE-2-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-3-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-4-1	1.000	1.000	0.0	0.0	0.0	1.000
LE-5-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-7-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-8-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-10-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-11-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-12-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-13-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-14-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-15-1	0.0	0.0	0.0	0.0	0.0	0.0
LE-16-1	0.0	1.000	1.000	1.000	1.000	0.0

	001	002	005	006	007	008	009	011	012	013
HE-2	0.0	0.0	0.0	1.000	1.000	0.0	1.000	0.0	1.000	1.000
HE-3	0.0	0.0	0.0	1.000	1.000	0.0	1.000	1.000	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	1.000	1.000	0.0	1.000	1.000	0.0	0.0
HE-8	0.0	0.0	0.0	1.000	1.000	0.0	0.0	0.0	0.0	0.0
HE-9	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0	0.0
HE-10	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0	1.000
HE-11	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0	1.000
HE-13	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0	1.000
HE-14	0.0	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000
HE-15	1.000	0.0	1.000	1.000	1.000	0.0	1.000	1.000	0.0	1.000
HE-16	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

	015	017	018	019	021	026	029	031	033	035
HE-2	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	1.000	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000
HE-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-9	1.000	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
HE-10	0.0	1.000	1.000	0.0	0.0	0.0	0.0	1.000	0.0	1.000
HE-11	0.0	1.000	1.000	0.0	1.000	0.0	0.0	1.000	0.0	1.000
HE-13	1.000	1.000	1.000	0.0	1.000	0.0	1.000	1.000	1.000	1.000
HE-14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000
HE-15	1.000	1.000	1.000	0.0	1.000	0.0	1.000	0.0	1.000	1.000
HE-16	1.000	1.000	1.000	0.0	1.000	0.0	0.0	1.000	1.000	1.000

	038	040	047	049	054	056	057	058	062	066
HE-2	0.0	0.0	0.0	1.000	0.0	1.000	1.000	0.0	0.0	0.0
HE-3	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0
HE-8	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0
HE-9	1.000	1.000	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0
HE-10	1.000	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0
HE-11	1.000	1.000	1.000	0.0	0.0	1.000	1.000	1.000	0.0	0.0
HE-13	1.000	1.000	0.0	0.0	1.000	1.000	1.000	1.000	0.0	0.0
HE-14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
HE-15	1.000	0.0	0.0	0.0	1.000	1.000	1.000	1.000	0.0	0.0
HE-16	1.000	1.000	1.000	0.0	1.000	1.000	0.0	1.000	0.0	1.000

	068	069	070	072	074	082	083	087	089	091
HE-2	1.000	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
HE-3	1.000	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-9	1.000	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
HE-10	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-11	1.000	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
HE-13	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0	0.0
HE-14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000
HE-15	1.000	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
HE-16	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000	1.000

	092	095	098	102	104	118	119	127	128	134
HE-2	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3	0.0	1.000	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
HE-8	0.0	1.000	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0
HE-9	0.0	1.000	0.0	0.0	0.0	1.000	0.0	1.000	1.000	0.0
HE-10	0.0	1.000	0.0	1.000	0.0	0.0	1.000	0.0	0.0	0.0
HE-11	0.0	1.000	1.000	0.0	0.0	1.000	1.000	0.0	0.0	0.0
HE-13	1.000	1.000	0.0	0.0	0.0	1.000	1.000	0.0	1.000	0.0
HE-14	0.0	1.000	1.000	0.0	1.000	1.000	1.000	1.000	1.000	1.000
HE-15	0.0	1.000	1.000	0.0	1.000	0.0	1.000	0.0	1.000	0.0
HE-16	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	1.000	0.0

	135	136	137	138	139	140	141	142	143	144
HE-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3	1.000	1.000	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	1.000	0.0	0.0	1.000	1.000	0.0	0.0
HE-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0
HE-10	0.0	1.000	0.0	1.000	0.0	0.0	0.0	1.000	0.0	0.0
HE-11	0.0	1.000	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000
HE-13	0.0	1.000	1.000	1.000	0.0	1.000	0.0	0.0	0.0	1.000
HE-14	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
HE-15	0.0	1.000	0.0	0.0	1.000	1.000	0.0	0.0	0.0	0.0
HE-16	1.000	1.000	1.000	1.000	1.000	0.0	0.0	1.000	0.0	0.0

	145	148	152	154	155	156	157	158	164	165
HE-2	1.000	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0	0.0
HE-3	0.0	0.0	1.000	1.000	1.000	1.000	0.0	0.0	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
HE-7	1.000	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0
HE-8	1.000	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
HE-9	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0	0.0	0.0
HE-10	0.0	0.0	1.000	1.000	1.000	1.000	0.0	0.0	0.0	0.0
HE-11	1.000	0.0	1.000	1.000	1.000	1.000	0.0	0.0	0.0	0.0
HE-13	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0	1.000
HE-14	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000
HE-15	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0
HE-16	0.0	1.000	1.000	0.0	1.000	1.000	0.0	0.0	1.000	0.0

	169	172	173	175	176	187	190	191	192	193
HE-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-3	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-9	0.0	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0	1.000
HE-10	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-11	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000
HE-13	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
HE-14	1.000	0.0	1.000	0.0	1.000	1.000	1.000	1.000	1.000	1.000
HE-15	1.000	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	1.000
HE-16	1.000	0.0	0.0	1.000	0.0	0.0	1.000	0.0	0.0	1.000

	198	199	200	205	208	210	211	213	214	215
HE-2	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
HE-3	0.0	0.0	0.0	0.0	1.000	0.0	1.000	0.0	1.000	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
HE-6	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
HE-8	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000	0.0
HE-9	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000	0.0
HE-10	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000	1.000
HE-11	0.0	0.0	1.000	0.0	1.000	1.000	0.0	0.0	1.000	1.000
HE-13	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	1.000	1.000
HE-14	1.000	1.000	1.000	0.0	1.000	0.0	0.0	0.0	1.000	0.0
HE-15	0.0	1.000	0.0	0.0	1.000	0.0	0.0	1.000	0.0	0.0
HE-16	0.0	1.000	1.000	1.000	1.000	1.000	0.0	0.0	1.000	0.0

	216	217	218	219	220	223	225	230	231	234
HE-2	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-10	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
HE-11	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0
HE-13	1.000	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0
HE-14	0.0	0.0	0.0	0.0	1.000	1.000	0.0	0.0	1.000	1.000
HE-15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE-16	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000	0.0	0.0

	245
HE-2	0.0
HE-3	0.0
HE-4	0.0
HE-5	0.0
HE-6	0.0
HE-7	0.0
HE-8	0.0
HE-9	0.0
HE-10	0.0
HE-11	0.0
HE-13	0.0
HE-14	0.0
HE-15	1.000
HE-16	0.0

	001	002	003	005	006	007	008	009	011	012
P-2+3	1.000	1.000	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-4	0.0	0.0	0.0	1.000	1.000	1.000	0.0	1.000	1.000	1.000
P-5	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
P-6	1.000	0.0	0.0	1.000	1.000	1.000	0.0	0.0	1.000	1.000
P-7	1.000	0.0	0.0	1.000	1.000	1.000	0.0	0.0	1.000	1.000
P-8	0.0	0.0	0.0	0.0	1.000	1.000	0.0	1.000	1.000	1.000
P-9	0.0	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	0.0
P-10+11	1.000	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-12	0.0	1.000	0.0	1.000	1.000	1.000	1.000	1.000	1.000	0.0
P-13	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000
P-14	1.000	1.000	0.0	1.000	1.000	1.000	0.0	1.000	1.000	1.000
P-15	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000	0.0
P-16	1.000	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

	013	015	017	018	019	021	026	028	029	031
P-2+3	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	0.0	1.000
P-4	1.000	1.000	1.000	1.000	0.0	1.000	1.000	0.0	0.0	1.000
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	1.000	1.000	0.0	0.0	0.0	0.0	1.000	1.000	1.000	1.000
P-7	1.000	1.000	1.000	1.000	0.0	0.0	1.000	0.0	0.0	1.000
P-8	1.000	1.000	0.0	0.0	0.0	1.000	1.000	0.0	1.000	1.000
P-9	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000	1.000	1.000
P-10+11	1.000	1.000	0.0	1.000	0.0	1.000	1.000	0.0	0.0	1.000
P-12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000
P-13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-14	1.000	1.000	1.000	0.0	0.0	1.000	1.000	0.0	0.0	1.000
P-15	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000
P-16	1.000	1.000	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000

	032	033	035	038	040	047	049	054	056	057
P-2+3	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-4	1.000	0.0	1.000	1.000	0.0	1.000	1.000	1.000	1.000	1.000
P-5	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	0.0	1.000	1.000	0.0	1.000	1.000	1.000	0.0	0.0
P-7	0.0	1.000	1.000	1.000	1.000	0.0	1.000	1.000	0.0	0.0
P-8	0.0	0.0	1.000	1.000	0.0	1.000	1.000	0.0	1.000	0.0
P-9	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-10+11	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-12	0.0	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-13	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-14	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000
P-15	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-16	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

	058	060	062	064	065	066	067	068	069	070
P-2+3	1.000	1.000	1.000	0.0	0.0	1.000	0.0	1.000	0.0	0.0
P-4	1.000	0.0	1.000	0.0	0.0	1.000	0.0	1.000	1.000	1.000
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	1.000	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0
P-7	1.000	0.0	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0
P-8	1.000	0.0	0.0	0.0	1.000	1.000	0.0	1.000	0.0	0.0
P-9	1.000	0.0	1.000	0.0	0.0	1.000	1.000	1.000	1.000	0.0
P-10+11	1.000	0.0	1.000	0.0	0.0	1.000	0.0	1.000	0.0	0.0
P-12	1.000	0.0	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0
P-13	1.000	1.000	1.000	0.0	0.0	1.000	0.0	1.000	0.0	0.0
P-14	1.000	0.0	1.000	1.000	0.0	1.000	0.0	1.000	0.0	1.000
P-15	1.000	1.000	1.000	0.0	0.0	1.000	0.0	1.000	0.0	0.0
P-16	1.000	1.000	1.000	0.0	1.000	1.000	0.0	1.000	1.000	0.0

	072	074	075	076	082	083	086	087	089	090
P-2+3	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0	1.000	1.000
P-4	1.000	1.000	1.000	0.0	1.000	0.0	0.0	1.000	0.0	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	1.000	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0	0.0
P-7	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9	1.000	1.000	0.0	0.0	1.000	0.0	1.000	1.000	1.000	1.000
P-10+11	1.000	0.0	0.0	0.0	1.000	1.000	0.0	1.000	1.000	0.0
P-12	1.000	1.000	1.000	0.0	1.000	1.000	0.0	1.000	1.000	1.000
P-13	1.000	1.000	0.0	0.0	0.0	0.0	1.000	0.0	1.000	1.000
P-14	1.000	1.000	0.0	1.000	0.0	0.0	0.0	0.0	1.000	1.000
P-15	1.000	1.000	1.000	0.0	1.000	1.000	1.000	1.000	0.0	0.0
P-16	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

	091	092	095	096	098	100	102	104	105	107
P-2+3	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4	1.000	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9	1.000	1.000	1.000	1.000	1.000	0.0	0.0	1.000	0.0	0.0
P-10+11	1.000	1.000	1.000	0.0	1.000	1.000	0.0	0.0	0.0	0.0
P-12	1.000	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0
P-13	1.000	1.000	1.000	0.0	0.0	0.0	1.000	0.0	0.0	1.000
P-14	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-15	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-16	1.000	1.000	1.000	0.0	0.0	1.000	1.000	0.0	0.0	0.0

	111	114	118	119	124	127	128	132	134	135
P-2+3	0.0	1.000	1.000	1.000	0.0	1.000	1.000	0.0	1.000	1.000
P-4	0.0	0.0	0.0	1.000	0.0	0.0	1.000	0.0	1.000	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	1.000	0.0	1.000	0.0	0.0	1.000	0.0	0.0	0.0
P-7	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0
P-9	1.000	0.0	1.000	1.000	1.000	0.0	1.000	1.000	0.0	0.0
P-10+11	0.0	0.0	1.000	1.000	0.0	1.000	1.000	0.0	1.000	0.0
P-12	0.0	0.0	1.000	1.000	0.0	0.0	1.000	0.0	0.0	0.0
P-13	1.000	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000	0.0
P-14	0.0	0.0	1.000	0.0	0.0	1.000	1.000	0.0	0.0	0.0
P-15	0.0	1.000	1.000	1.000	1.000	1.000	1.000	0.0	0.0	0.0
P-16	1.000	0.0	1.000	1.000	0.0	1.000	1.000	0.0	0.0	1.000

	136	137	138	139	140	141	142	144	145	147
P-2+3	1.000	1.000	1.000	0.0	1.000	0.0	1.000	0.0	0.0	0.0
P-4	1.000	1.000	0.0	1.000	1.000	1.000	1.000	1.000	0.0	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	1.000	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0
P-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-8	1.000	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9	1.000	1.000	1.000	1.000	1.000	0.0	1.000	0.0	1.000	0.0
P-10+11	0.0	0.0	1.000	0.0	1.000	0.0	1.000	0.0	0.0	0.0
P-12	1.000	1.000	0.0	0.0	1.000	0.0	1.000	0.0	0.0	1.000
P-13	1.000	1.000	0.0	1.000	1.000	0.0	1.000	0.0	1.000	0.0
P-14	1.000	1.000	0.0	1.000	1.000	0.0	0.0	0.0	1.000	1.000
P-15	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000
P-16	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000

	149	152	154	155	156	157	158	164	165	169
P-2+3	1.000	1.000	0.0	0.0	1.000	1.000	0.0	1.000	0.0	0.0
P-4	1.000	0.0	0.0	1.000	1.000	0.0	0.0	1.000	1.000	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0
P-7	1.000	0.0	1.000	0.0	1.000	1.000	0.0	0.0	0.0	0.0
P-8	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0
P-10+11	1.000	1.000	1.000	0.0	1.000	1.000	1.000	0.0	0.0	1.000
P-12	1.000	1.000	1.000	1.000	1.000	0.0	0.0	0.0	0.0	1.000
P-13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.0	1.000	1.000
P-14	1.000	0.0	1.000	0.0	1.000	1.000	1.000	0.0	0.0	0.0
P-15	1.000	0.0	1.000	0.0	1.000	0.0	1.000	0.0	0.0	1.000
P-16	1.000	0.0	0.0	1.000	1.000	1.000	1.000	1.000	0.0	1.000

	172	173	175	176	177	187	190	191	192	193
P-2+3	1.000	0.0	0.0	1.000	0.0	1.000	1.000	0.0	0.0	1.000
P-4	0.0	1.000	0.0	0.0	0.0	0.0	1.000	1.000	1.000	1.000
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
P-7	1.000	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000	1.000
P-8	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0
P-9	0.0	1.000	0.0	0.0	0.0	0.0	1.000	0.0	1.000	1.000
P-10+11	1.000	0.0	0.0	0.0	0.0	1.000	1.000	1.000	1.000	1.000
P-12	1.000	0.0	0.0	1.000	0.0	1.000	1.000	1.000	0.0	1.000
P-13	0.0	1.000	0.0	0.0	1.000	1.000	1.000	0.0	0.0	1.000
P-14	1.000	1.000	0.0	1.000	0.0	1.000	1.000	1.000	1.000	1.000
P-15	1.000	0.0	0.0	1.000	0.0	1.000	1.000	1.000	1.000	1.000
P-16	0.0	0.0	1.000	0.0	0.0	1.000	1.000	1.000	1.000	1.000

	198	199	200	201	202	203	205	206	207	208
P-2+3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-4	1.000	1.000	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000	0.0	1.000
P-7	0.0	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	0.0
P-8	0.0	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0	0.0
P-9	1.000	0.0	1.000	1.000	0.0	0.0	0.0	1.000	0.0	1.000
P-10+11	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
P-12	1.000	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	1.000
P-13	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
P-14	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	1.000
P-15	1.000	1.000	0.0	0.0	0.0	0.0	0.0	0.0	1.000	1.000
P-16	0.0	1.000	1.000	0.0	0.0	0.0	1.000	0.0	0.0	1.000

	210	211	212	213	214	215	216	217	218	219
P-2+3	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4	1.000	1.000	1.000	1.000	1.000	0.0	0.0	0.0	1.000	0.0
P-5	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
P-6	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0	0.0	1.000
P-7	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9	0.0	1.000	0.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
P-10+11	0.0	1.000	0.0	1.000	1.000	0.0	0.0	1.000	0.0	0.0
P-12	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
P-13	0.0	1.000	0.0	1.000	1.000	1.000	1.000	0.0	1.000	1.000
P-14	0.0	1.000	0.0	1.000	1.000	0.0	1.000	1.000	1.000	1.000
P-15	0.0	1.000	1.000	1.000	1.000	0.0	1.000	1.000	1.000	1.000
P-16	0.0	1.000	0.0	0.0	1.000	1.000	1.000	0.0	1.000	1.000

	220	221	222	223	227	229	230	231	232	233
P-2+3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4	0.0	0.0	0.0	0.0	1.000	0.0	0.0	0.0	0.0	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000	0.0
P-9	0.0	0.0	0.0	0.0	0.0	1.000	0.0	1.000	0.0	0.0
P-10+11	0.0	1.000	0.0	1.000	0.0	0.0	0.0	0.0	0.0	0.0
P-12	1.000	1.000	0.0	1.000	1.000	0.0	0.0	0.0	0.0	0.0
P-13	1.000	0.0	1.000	1.000	0.0	0.0	1.000	1.000	0.0	1.000
P-14	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.000
P-15	1.000	0.0	1.000	1.000	1.000	0.0	1.000	0.0	0.0	1.000
P-16	1.000	1.000	0.0	1.000	1.000	0.0	1.000	0.0	0.0	0.0

	234	236	237	239	240	242	245
P-2+3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-10+11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-14	1.000	0.0	0.0	0.0	0.0	0.0	0.0
P-15	1.000	1.000	1.000	1.000	1.000	0.0	0.0
P-16	0.0	0.0	0.0	0.0	1.000	1.000	1.000

APPENDIX F

LOCALITY DESCRIPTIONS

APPENDIX F

LOCALITY DESCRIPTIONS

The 16 localities shown in Text-figure 1 represent only generalized collecting sites where a complete section of the Leavenworth, Heebner and Plattsmouth members were collected. Several of the localities consisted of other sublocalities nearby where one or two of these members were actually collected because of their better exposure elsewhere. These sublocalities are indicated in this appendix by small letters (for example, localities 5a and 5b). All information within these descriptions are from von Bitter's field notes. The abbreviation "a.b." refers to "above base" of that particular member. The measurements are given in inches.

Locality Number: 1

Geographic Coordinates: C NW1/4, Sec 18, T27N, R10E, Osage County, Oklahoma

Locality Description: Country road cutoff on Highway 99, 6.4 mi. north of intersection of Highways 60 and 99; 1.1 mi. from Highway 99.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-4-1	0-7"a.b.

Locality Number: 2

Geographic Coordinates: NW1/4, Sec 28, T28N, R10E, Osage County, Oklahoma

Locality Description: On SW side of hill, 200 ft. from side of main road.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-5-1	0-13"a.b.
Heebner Sh.	He-4-1	36-48"a.b.

Locality Number: 3a

Geographic Coordinates: NE1/4, NE1/4, Sec 7, T28N, R10E, Osage County, Oklahoma

Locality Description: 5.6 mi. from junction of Culver Ranch Road and Highway 99.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-6-1	0-16"a.b.

Locality Number: 3b

Geographic Coordinates: SW SW Sec 19, T29N, R10E, Osage County, Oklahoma

Locality Description: Roadcut

Member:	Sample(s):	Stratigraphic Position:
Heebner Sh.	He-6 (Recoll'n)	72-84"a.b.
Plattsmouth Ls	P-5-1	0-21"a.b.

Locality Number: 4

Geographic Coordinates: SE1/4 NE1/4 Sec 14, T29N, R9E, Osage County, Oklahoma

Locality Description: South of Caney Road.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-9-1	0-15"a.b.
Heebner Sh.	He-7 (Recoll'n)	0-72"a.b.
Plattsmouth Ls.	P-6-1	0-60"a.b.
	P-6-2	10-91"a.b.

Locality Number: 5a

Geographic Coordinates: W1/2 S1/4 Sec 33, T33N, R11E, Chautauqua County, Kansas

Locality Description: 1 mi. NW of Sedan, Chautauqua County, Kansas, on Highway 99 just below quarry.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-2-1	0-21"a.b.
Heebner Sh.	He-2-1	0-5"a.b.
	He-2-2A	5-18"a.b.
	He-2-2B	18-41"a.b.
	He-2-2C	41-56"a.b.

	He-2-3A	56-64"a.b.
	He-2-3B	64-79"a.b.
Plattsmouth Ls.	P-3-1	0-27"a.b.
	P-3-2	27-37.5"a.b.

Locality Number: 5b

Geographic Coordinates: W1/2 S1/4 Sec 33, T33N, R11E, Chautauqua County, Kansas

Locality Description: Roadcut on US 99, 1 mi. NW of Sedan, Chautauqua County, Kansas.

Member:	Sample(s):	Stratigraphic Position:
Plattsmouth Ls.	P-2-1A	0-31"a.b.
	P-2-1B	31-57"a.b.
	P-2-2A	57-80"a.b.
	P-2-2B	80-104"a.b.
	P-2-2C	104-129.5"a.b.
	P-2-2D	129.5-162"a.b.
	P-2-2E	162-189"a.b.
	P-2-3	189-250"a.b.

Locality Number: 6a

Geographic Coordinates: NE NE Sec 13, T29S, R12E, Elk County, Kansas

Locality Description: Exposure in roadcut on north-south trending country road.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-7-1	0-21.5"a.b.

Locality Number: 6b

Geographic Coordinates: SE SE SW Sec 24, T29S, R12E, Elk County, Kansas

Locality Description: Approximately 2 mi. north of Busby.

Member:	Sample(s):	Stratigraphic Position:
Heebner Sh.	He-8-1	0-26"a.b.
	He-8-2	26-60"a.b.

Locality Number: 6c

Geographic Coordinates: NW NE Sec 21, T31S, R12E, Elk County, Kansas

Locality Description: In quarry on west side of road, 2 mi. due south of Longton.

Member:	Sample(s):	Stratigraphic Position:
Plattsmouth Ls.	P-8-1	0-4"a.b.
	P-8-2	4-57"a.b.
	P-8-3	57-81"a.b.
	P-8-4	81-123"a.b.

Locality Number: 7a

Geographic Coordinates: Sec 32, T26S, R13E, Greenwood County, Kansas

Locality Description: North side of east-west road on section 32.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-8-1	0-15.5"a.b.
Heebner Sh.	He-5-1	0-15"a.b.
	He-5-2	15-30"a.b.

Locality Number: 7b

Geographic Coordinates: SW NE Sec 26, T27S, R12E, Greenwood County, Kansas

Locality Description: Exposed section in quarry.

Member:	Sample(s):	Stratigraphic Position:
Plattsmouth Ls.	P-7-1	0-4"a.b.
	P-7-2	4-43"a.b.
	P-7-3	43-97"a.b.
	P-7-4	97-140"a.b.

Locality Number: 8a

Geographic Coordinates: SE1/4 Sec 2, T22S, R15E, Coffey County, Kansas

Locality Description: Quarry 1/4 mi. west of the Neosho River, 2 mi. south of Burlington, Kansas.

Member:	Sample(s):	Stratigraphic Positon:
Leavenworth Ls.	Le-3-1	0-11"a.b.
Heebner Sh.	He-3-1	0-1.5"a.b.

He-3-2	1.5-27.5"a.b.
He-3-3	27.5-43.5"a.b.
He-3-4	43.5-56.5"a.b.

Locality Number: 8b

Geographic Coordinates: C Sec 14, T21S, R15E, Coffey County, Kansas

Locality Description: Quarry near Neosho River at Burlington, Pecka Property

Member:	Sample(s):	Stratigraphic Position:
Plattsmouth Ls.	P-4-1	0-29"a.b.
	P-4-2	29-40"a.b.
	P-4-3	40-72"a.b.
	P-4-4	72-113"a.b.
	P-4-5	113-120"a.b.

Locality Number: 9

Geographic Coordinates: EWL SE1/4 Sec 3, T18S, R16E, Osage County, Kansas

Locality Description: Roadcut 1 mi. due east of Melvern, Osage County, Kansas.

Member:	Sample(s):	Stratigraphic Position:
Plattsmouth Ls.	P-9-1	0-33"a.b.
	P-9-2	33-105.5"a.b.
	P-9-3	105.5-113.5"a.b.

	P-9-4	113.5-188.5"a.b.
	P-9-5	188.5-190.5"a.b.
	P-9-6	190.5-276.5"a.b.

Locality Number: 10

Geographic Coordinates: SW NW Sec8, T18S, R18E, Franklin County, Kansas

Locality Description: Approximately 2 mi. east of Williamsburg, north of excavations for Interstate-35.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-10-1	0-15"a.b.
Heebner Sh.	He-9-1	0-28"a.b.
	He-9-2	28-56"a.b.

Locality Number: 11a

Geographic Coordinates: SW SE Sec 33, T8S, R22E, Leavenworth County, Kansas

Locality Description: Outcrop located on west side near top of hill.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-11-1	0-21"a.b.

Locality Number: 11b

Geographic Coordinates: C Sec 33, T8S, R22E, Leavenworth County, Kansas

Locality Description: Located at sharp bend of Highway 92.

Member:	Sample(s):	Stratigraphic Position:
Heebner Sh.	He-10-1	0-26"a.b.
	He-10-2	26-42"a.b.
	He-10-3	42-65"a.b.
Plattsmouth Ls.	P-11-1	0-12"a.b.

Locality Number: 11c

Geographic Coordinates: NW SE Sec 2, T9S, R21E, Leavenworth County, Kansas

Locality Description: Hamm Quarry, west of Leavenworth, Kansas.

Member:	Sample(s):	Stratigraphic Position:
Plattsmouth Ls.	P-10-1	0-55"a.b.
	P-10-2	55-77"a.b.
	P-10-3	77-97"a.b.
	P-10-4	97-165"a.b.
	P-10-5	165-199"a.b.

Locality Number: 12

Geographic Coordinates: NW SW NE Sec 22, T55N, R37W, Buchanan County, Missouri

Locality Description: Quarry in high bank or bluffs above Missouri River floodplain; 4 mi. east of Atchison, Kansas, and 0.9 mi. north of corner of intersection of 59 and 45.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-12-1	0-22"a.b.
Heebner Sh.	He-11-1	0-28"a.b.
	He-11-2	28-52"a.b.
	He-11-3	52-70"a.b.
	He-11-4	70-74"a.b.
Plattsmouth Ls.	P-12-1	0-6"a.b.
	P-12-2	6-14"a.b.
	P-12-3	14-39"a.b.
	P-12-4	39-112"a.b.
	P-12-5	112-187"a.b.
	P-12-6	187-248"a.b.

Locality Number: 13a

Geographic Coordinates: N1/2 Sec 34, T59N, R35W, Andrew County, Missouri

Locality Description: Gordon Brothers Quarry, 400-500 ft. west of Cumberland Ridge Creek, south of Savannah. Leavenworth sampled in northwest part of quarry in drainage ditch. Plattsmouth sampled from southwest portion of quarry.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-13-1	0-21"a.b.
Plattsmouth Ls.	P-13-1	0-9"a.b.
	P-13-2	9-26"a.b.
	P-13-3	26-106"a.b.

P-13-4	106-113"a.b.
P-13-5	113-162"a.b.
P-13-6	162-182"a.b.
P-13-7	182-242"a.b.

Locality Number: 13b

Geographic Coordinates: Sec 19, T58N, R35W, Andrew County, Missouri

Locality Description: A few hundred feet north of Buchanan, Andrew County, Missouri, on the north slope of brook, 200-300 ft. west of local dump.

Member:	Sample(s):	Stratigraphic Position:
Heebner Sh.	He-13-1	0-23"a.b.
	He-13-2	23-50"a.b.
	He-13-3	50-56"a.b.

Locality Number: 14

Geographic Coordinates: NW1/2 Sec 15, T12N, R10E, Cass County, Nebraska

Locality Description: Johannsen Quarry, west of south bend, Cass County, Nebraska. Samples taken from high on bluff.

Member:	Sample(s):	Stratigraphic Position:
Leavenworth Ls.	Le-14-1	0-21"a.b.
Heebner Sh.	He-14-1	0-24.5"a.b.
	He-14-2	24.5-40"a.b.

	He-14-3	40-61"a.b.
Plattsmouth Ls.	P-14-1	0-10"a.b.
	P-14-2	10-42.5"a.b.
	P-14-3	42.5-88"a.b.

Locality Number: 15

Geographic Coordinates: SE1/4 Ne1/4 Sec 16, T75N, R37W, Cass County, Iowa

Locality Description: Rock cut in Nishnabotna River.

Member:	Sample(s):	Stratigraphic Position:
Captain Creek Ls.	Le-15-1	0-31"a.b.
Eudora Sh.	He-15-1	0-9"a.b.
	He-15-2	9-16"a.b.
	He-15-3	16-37"a.b.
Stoner Ls.	P-15-1	0-32"a.b.
	P-15-2	32-78"a.b.
	P-15-3	78-128"a.b.

Locality Number: 16

Geographic Coordinates: SW1/4 SW1/4 NW1/4 Sec 7, T75N, R29W, Madison County, Iowa

Locality Description: Streambank near Madison-Adair County line.

Member:	Sample(s):	Stratigraphic Position:
Captain Creek Ls.	Le-16-1	0-12"a.b.
Eudora Sh.	He-16-1	0-6.5"a.b.

	He-16-2	6.5-18.5"a.b.
	He-16-3	18.5-37"a.b.
Stoner Ls.	P-16-1	0-18"a.b.
	P-16-2	18-67"a.b.
	P-16-3	67-148.5"a.b.
	P-16-4	148.5-171.5"a.b.