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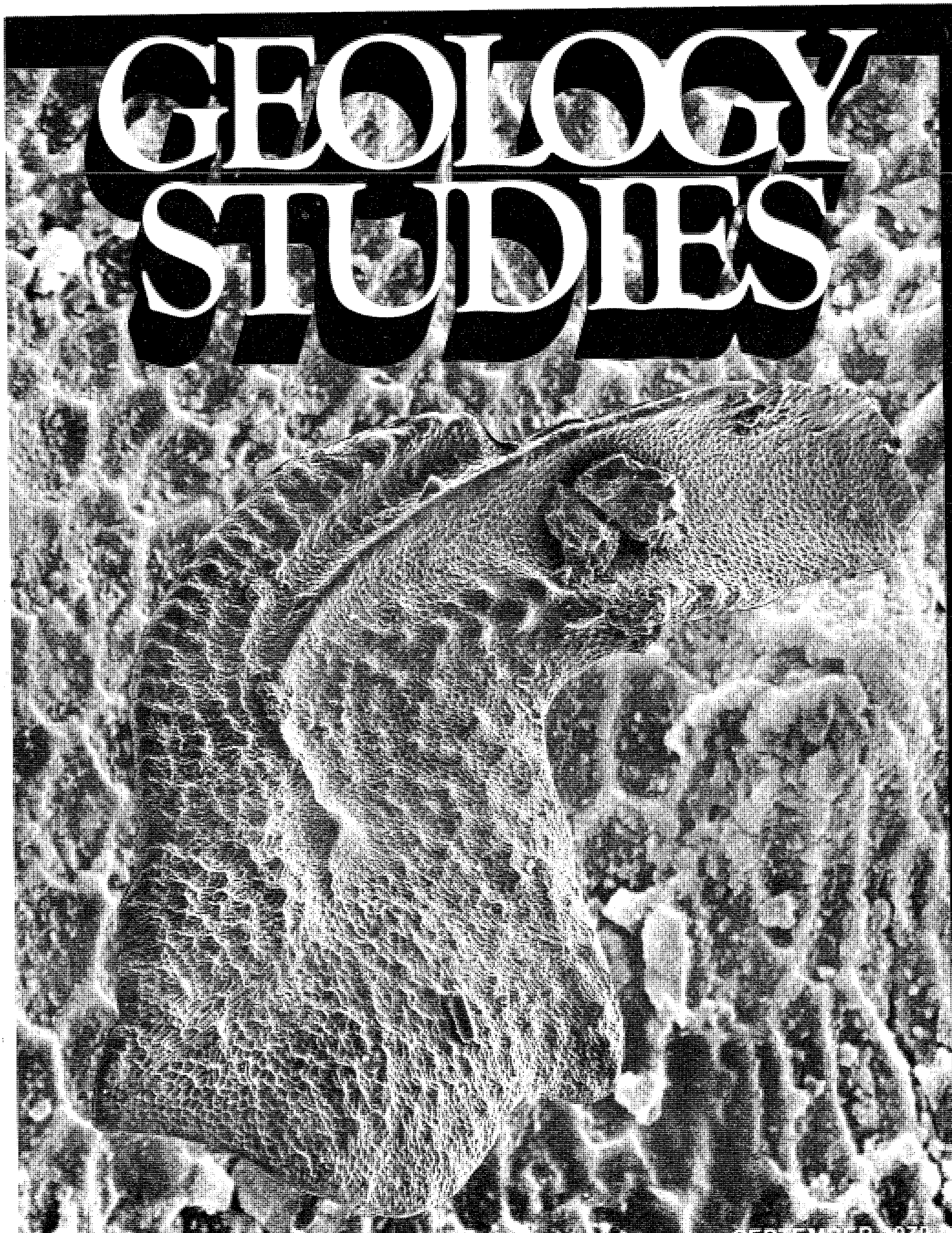

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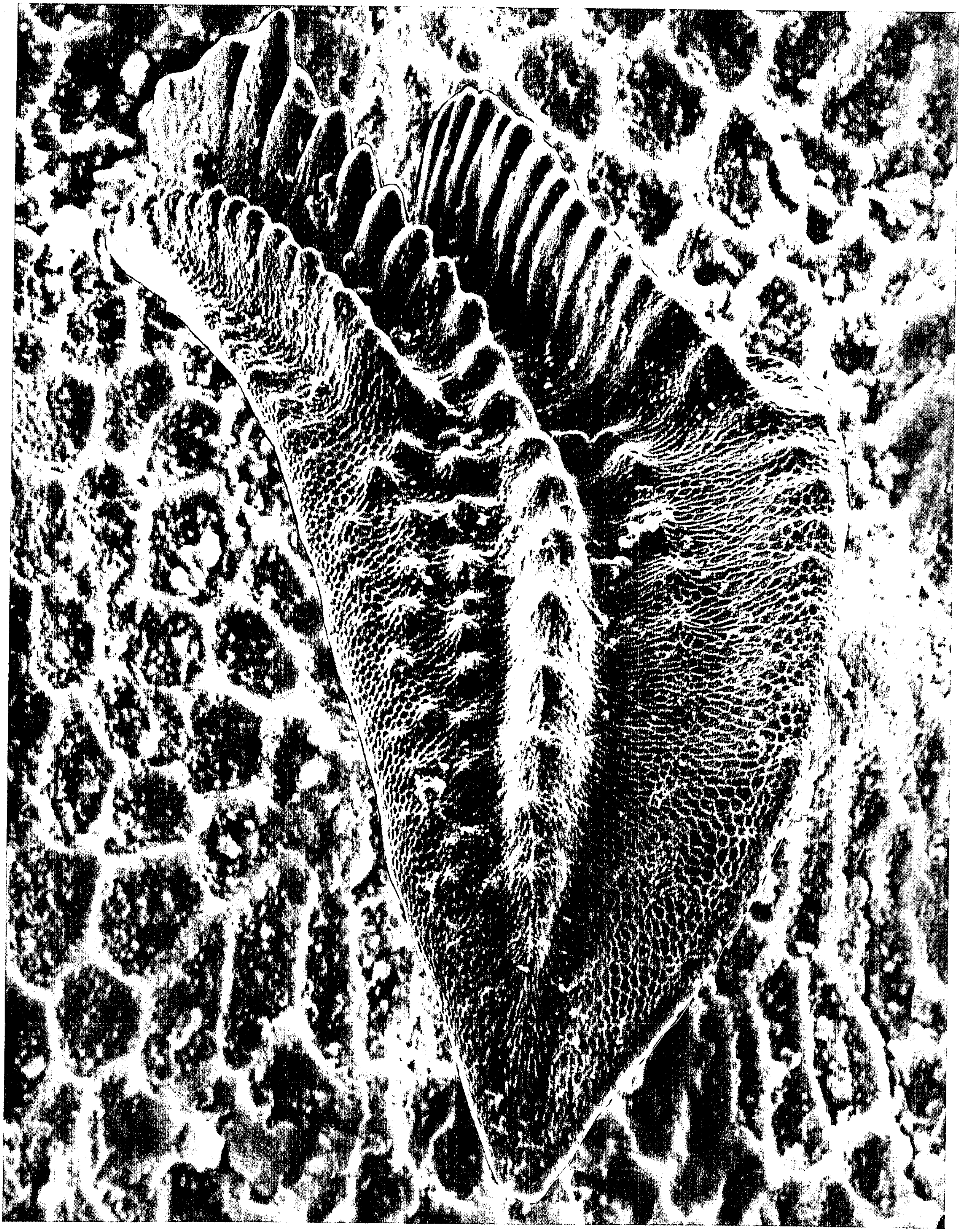

Brigham Young University Geology Studies

Volume 26, Part 3

Conodont Biostratigraphy of the Great Basin and Rocky Mountains

The proceedings of the Pander Society symposium, workshop, and post-meeting field trip held in conjunction with the Rocky Mountain section, Geological Society of America, at Brigham Young University, Provo, Utah, on April 28–May 2, 1978

Charles A. Sandberg and David L. Clark
Editors

Front cover: Late Devonian conodont Palmatolepis rugosa ampla.
Inside front cover: Early Mississippian conodont Siphonodella isosticha. *Both are SEM photomicrographs. See preface for details.*

THE GLORY OF GOD IS INTELLIGENCE

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PREFACE

The distribution of papers of this symposium volume among the various geologic systems is a good representation of the focus of regional conodont biostratigraphic work in the Great Basin and Rocky Mountains, with one notable exception. Work on the Cambrian System by J. F. Miller is not included because it either had been already published or was scheduled for publication elsewhere. Moreover, the guidebook for the Pander Society field trip on Cambrian and Ordovician rocks, held on April 26–27, 1978, immediately preceding the symposium at Provo, Utah, has already been published (Miller 1978). Judging by the numbers of papers published here and elsewhere, conodont work in the Great Basin and Rocky Mountain regions appears to be focused primarily on the Ordovician, Permian, and Triassic Systems, and secondarily on the Cambrian, Devonian, and Mississippian Systems. It is noteworthy that no papers in this volume are devoted to the Silurian and Pennsylvanian Systems. Although some work on these systems in the Great Basin has appeared in the past, the editors were unable to find workers actively enough engaged in studies of these systems on a regional basis to contribute to the present symposium. Hence the Silurian and Pennsylvanian Systems appear to offer fertile, uncrowded fields for future investigators.

In editing the papers of this symposium volume, an increasing awareness of conodont biofacies was noted among authors of all systems. Although there is still some indication that provinciality of conodont faunas existed in the western United States during limited intervals of geologic time, it is becoming evident that more and more seemingly provincial conodont faunas are being encountered as conodont studies extend westward off the former shelf into more offshore, deeper-water realms in central Nevada. Continued work on several systems in the Great Basin region may eventually discern as many lateral biofacies as the eight that have been recognized in the *Polygnathus styriacus* Zone of the Upper Devonian in the same region by Sandberg (1976) and Sandberg and Ziegler (1979). As demonstrated by Sandberg (1976), the combined Rocky Mountain and Great Basin regions offer an unparalleled opportunity for conodont workers to study faunas of the same age in a transect of environments, ranging from peritidal to far offshore pelagic—even including rises surrounding island arcs.

The front cover and inside front cover of this volume, which show the Late Devonian conodont *Palmatolepis rugosa ampla* and the Early Mississippian conodont *Siphonodella isosticha,* respectively, against a background of platform-conodont micro-ornamentation, were composited from SEM photomicrographs made at the Fachbereich Geowissenschaften, Philipps-Universität, Marburg, Federal Republic of Germany, under the direction of Prof. Dr. Willi Ziegler, to whom we are grateful for permission to use them.

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Triassic Conodont Biostratigraphy in the Great Basin

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Abstract.—The first Triassic conodont fauna described and illustrated was from the Great Basin in 1956. The definite occurrence of conodonts in post-Paleozoic rocks had been confirmed by Idaho specimens only 4 years earlier. Thus, the Great Basin was pivotal for worldwide Triassic studies. Research in succeeding years and on a worldwide basis established the presence of at least 22 Triassic faunal assemblages, many of which were described first from Nevada.

Since 1971, when Triassic conodont biostratigraphy was organized formally, most Great Basin work has been with the Lower Triassic. Multiple Griesbachian and Dienerian faunas are known now. Smithian sequences in Utah have yielded specimens that support the refinement and expansion of *Parachirognathus*/*Furnishius* assemblage (interval 7) including elimination of *Neospathodus conservativus* as a zonal species and the restriction of the *Neogondolella milleri* assemblage. Also, Smithian and Spathian conodont assemblages, not found in sequence prior to 1971, are now known to be continuous and support earlier but more tenuous biostratigraphic interpretations. At least 11 Great Basin Lower Triassic conodont faunas are recognized. Considerable work is in progress on Middle and Upper Triassic strata in the Great Basin, but a redefinition of the 4 Middle and 5 Upper Triassic faunas would be premature.

The Great Basin may have the most complete Triassic conodont sequences worldwide. More important, correlation of diversity and abundance of Great Basin taxa with multiple cycles of marine transgressional and terrigenous progradational lithofacies suggests that the ecologic control for conodont distribution may be interpreted.

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INTRODUCTION

The development of Triassic conodont biostratigraphy has relied heavily on Great Basin sections. Müller (1956) published the first description and illustration of Lower Triassic conodonts, and Mosher (1968a) developed the first biostratigraphy for the Middle and Upper Triassic, all on the basis of Great Basin collections. In addition, the confirmation that conodonts occurred in post-Paleozoic strata was based on northern Great Basin conodonts (Youngquist 1952). The historic importance of the Great Basin Triassic sequence is well documented.

Advances in Triassic conodont biostratigraphy outside the Great Basin have been primarily in the Lower Triassic and from the Tethyan region (Sweet 1970a, 1970b; Teichert and others 1973). The first worldwide synthesis of Triassic conodont distribution shows both the Lower Triassic Tethyan bias and the importance of Great Basin Middle and Upper Triassic (Sweet and others 1971). It is appropriate that the first conodont symposium held in the Great Basin should include both a review and an updating of Great Basin Triassic research.

HISTORIC DEVELOPMENT

Following Müller's (1956) initiatory publication on Great Basin Lower Triassic conodonts, research flourished. Clark (1957, 1959, 1960) and Clark, Sincavage, and Stone (1964) published additional details concerning Lower Triassic conodonts, and Mosher and Clark (1965) published descriptions of Middle Triassic taxa. The great thicknesses of Cordilleran geosyncline Triassic carbonate rocks discouraged the detailed sampling needed for precise biostratigraphy, and in these early days of Triassic research presence or absence was considered profound. Because of this, early attempts at biostratigraphy were crude (e.g., Clark 1960), and some errors introduced in the 1960s have only been recently corrected. For example, the type species for *Platyvillosus* was based on material submitted by oil company geologists, who reported that the sample had been obtained from strata below the Smithian ammonoid *Meekoceras* (Clark and others 1964, Mosher and Clark 1965). Detailed sampling later established that the ammonoids associated with *Platyvillosus* were *Tirolites*, not *Meekoceras*, and consequently were early Spathian, not Smithian, in age. This error was corrected by Sweet and others (1971).

Detailed sampling of the Triassic section was initiated in the 1960s.

Mosher and Clark (1965) compared the relatively slow evolution of Middle Triassic conodonts to evolution of Middle Triassic ammonoids. Detailed Middle and Upper Triassic Great Basin conodont biostratigraphy was developed in connection with European studies by Mosher (1967, 1968a, 1968b). Additional Lower Triassic work was reported by Collinson (1968). All this Great Basin work was incorporated with work in Europe and Asia for the first synthesis of worldwide Triassic conodont biostratigraphy by Sweet and others (1971). Since then most Triassic conodont research in the Great Basin has concentrated on the Lower Triassic (Clark and Rosser 1976, Collinson and others 1976, Clark and others 1977, Solien 1979).

CURRENT RESEARCH

Recently published and unpublished Lower Triassic Great Basin research by the University of Wisconsin group includes a report on a single section of the Thaynes Formation in Salt Lake City by Solien (1979); detailed study of Griesbachian and Dienerian faunas in Utah and Nevada by Paull; and Smithian and Spathian studies in Utah and Nevada by T. R. Carr. Middle and Upper Triassic studies by Clark are currently in progress. Although the principal objective of some of these investigations is paleoecologic, the detailed sampling involved will provide some refinements of previous biostratigraphy.

LOWER TRIASSIC

Griesbachian

Anchignathodus typicalis *Assemblage*

The oldest Triassic assemblage includes species that are known to occur also in the youngest Permian. Sweet (1973) has pointed out that this assemblage evidently survived the Permo-Triassic extinction without significant change. This assemblage includes the name-giving species, *A. isarcicus, Neogondolella carinata,* and *Ellisonia* spp.; in the Great Basin it may be best developed in the Terrace Mountains of northwest Utah (Clark and others 1977). This assemblage is presumed to include the same fauna as Zone 1 of Sweet and others (1971). See figure 1 for names of all 21 Triassic conodont assemblages and plate 1 for illustrations of the name-giving conodonts of these assemblages.

Neogondolella carinata *Assemblage*

The name-giving species ranges above the upper limits of *A. typicalis* in the Terrace Mountains, Utah, and in the Crittenden Springs area, Nevada. It distinguishes an interval that apparently corresponds at least in part to Zone 2 of Sweet and others (1971).

TRIASSIC	UPPER	NORIAN	EPIGONDOLELLA BIDENTATA EPIGONDOLELLA MULTIDENTATA EPIGONDOLELLA ABNEPTIS
		KARNIAN	PARAGONDOLELLA POLYGNATHIFORMIS NEOSPATHODUS NEWPASSENSIS
	MIDDLE	LADINIAN	EPIGONDOLELLA MUNGOENSIS NEOGONDOLELLA MOMBERGENSIS
		ANISIAN	NEOGONDOLELLA CONSTRICTA NEOGONDOLELLA REGALE
	LOWER	SPATHIAN	NEOSPATHODUS TIMORENSIS NEOGONDOLELLA JUBATA NEOSPATHODUS COLLINSONI PLATYVILLOSUS
		SMITHIAN	NEOGONDOLELLA MILLERI PARACHIROGNATHUS ETHINGTONI PARACHIROGNATHUS/FURNISHIUS FURNISHIUS TRISERRATUS
		DIENERIAN	NEOSPATHODUS SPP. NEOSPATHODUS PECULIARIS
		GRIESBACHIAN	NEOGONDOLELLA CARINATA ANCHIGNATHODUS TYPICALIS

FIGURE 1.–Triassic conodont assemblages and their classification in the Great Basin.

Dienerian

Neospathodus peculiaris *Assemblage*

In the Crittenden Springs area, Nevada, and in the Terrace Mountains, Utah, *N. peculiaris* is a distinctive element. Sweet (1970a) did not report *N. peculiaris* occurring with *Neogondolella carinata* in West Pakistan. In fact, *N. peculiaris* evidently occurs there only in younger strata. *Neogondolella carinata* and *N. peculiaris* occur together in the Great Basin. This suggests that in Nevada and Utah, either *N. carinata* ranges into younger strata or *N. peculiaris* ranges into older strata than in West Pakistan. In the Dinwoody Formation of the Terrace Mountains, *N. peculiaris* occurs with *N. carinata* in the lower part of its range, but it also occurs in strata higher in the section without *N. carinata.* If these ranges are confirmed elsewhere, the joint occurrence of *N. peculiaris* with *N. carinata* may define a distinct interval in the lower Dienerian or upper Griesbachian, and the occurrence of *N. peculiaris* without *N. carinata* may indicate a younger Dienerian interval. Study of this problem is in progress.

Neospathodus *spp. Assemblage*

Several *Neospathodus* species occur in the Sublett and Terrace Mountains and evidently occupy an interval higher than the last occurrence of *N. peculiaris.* For example, *N.* n. sp. A. occurs in Idaho and Utah and has some characteristics of *N. pakistanensis,* except that the posterior end is strongly upturned as in *N. waageni* and *N. dieneri.* A few neospathodids from the Dinwoody Formation in the Sublett Mountains, Idaho, probably also belong to *N. pakistanensis.* This pattern suggests that this interval is equivalent to at least part of Zone 6 of Sweet and others (1971), and perhaps to parts of Zones 5 and 7, as well. This interval, which is represented in several parts of the Great Basin, is being studied by Paull.

Smithian

Above the Dienerian *Neospathodus* intervals and approximately equivalent to the Dienerian-Smithian boundary (Sweet and others 1971), a sequence of *Parachirognathus/Furnishius* faunas is well developed in the Great Basin. In many parts of the Great Basin, components of this fauna are the first conodonts found above the Permian-Triassic boundary (Collinson and others 1976). A widespread, well-developed sequence of *Parachirognathus/Furnishius* taxa was placed in a single zone by Sweet and others (1971), but detailed work by Clark and Rosser (1976) and Solien (1979) has demonstrated that the *Parachirognathus/Furnishius* Zone 7 (Sweet and others 1971), can be divided into three intervals. These intervals are distinguished throughout the Great Basin and include a lower interval of *Furnishius triserratus* without *Parachirognathus,* an intermediate interval with both *Parachirognathus* and *Furnishius,* and an upper interval in which *Parachirognathus* occurs alone or is the dominant taxon. These three intervals are widespread in the Great Basin (Clark and Rosser 1976). Solien (1979) and Solien, Morgan, and Clark (this volume) have proposed recognition of three formal zones based on their occurrences.

Furnishius triserratus *Assemblage*

The name-giving species occurs with *Ellisonia triassica, Pachycladina* sp., and *Hadrodontina* sp. in Utah. This interval includes strata from the first occurrence of *Furnishius* upward to the first occurrence of *Parachirognathus.*

One of the problems of Zone 7 (Sweet and others 1971, McTavish 1973) is that it may not directly succeed Zone 6. This is because *Neospathodus pakistanensis* s. s. has not been found directly beneath and in sequence with *Parachirognathus/Furnishius.* Also, *N. waageni,* diagnostic of the West Pakistan Zone 7 of Sweet (1970a), has not been reported previously in *Parachirognathus/Furnishius*-bearing strata in the Great Basin. Solien (1979) has reported *N. waageni* in the Thaynes Formation in Utah in association with the *Parachirognathus/Furnishius* assemblage, and all three species occur with *N. conservativus.* This is of particular significance because the *Parachirognathus/Furnishius* assemblage must be equivalent to a part of the *N. waageni* Zone 7 of Sweet (1970a) and because McTavish (1973) reported *N. waageni* together with elements of *N. conservativus* and *N. pakistanensis.* This latter occurrence suggests that the *Furnishius* (alone) assemblage may be equivalent in part to the *N. pakistanensis* Zone 6 (Sweet and others (1971) rather than to the lower part of the thick West Pakistan *N. waageni* Zone 7 (Sweet 1970a).

Parachirognathus/Furnishius *Assemblage*

The first occurrence of *Parachirognathus* marks the base of an interval of overlap of the two name-giving taxa that range through as much as 60 m of the Smithian in the Great Basin (Clark and Rosser 1976). In this interval, one taxon commonly dominates the other although either or both may be dominant in different parts of the zone. In the Weber River section (Clark and Rosser 1976, p. 298), *Parachirognathus: Furnishius* ratios range from 11:3 and 26:0 in the lower part of the interval to 0:86, 9:98, and 26:99 in the upper part of the zone. Ecologic factors have been used to explain the dominance (Clark and Rosser 1976).

Parachirognathus ethingtoni, Furnishius triserratus, Neospathodus conservativus, N. bicuspidatus, N. waageni, Neogondolella nevadensis, Pachycladina symmetrica, and *Ellisonia triassica* compose the taxa of this interval.

The stratigraphic position of *Neospathodus nevadensis* is of some interest. On the basis of large collections from West Pakistan, Sweet (1970a) suggested that *N. nevadensis, N. planata,* and *N. carinata* represented a single species, *N. carinata.* Sweet's expanded *N. carinata* included only Zones 1–4 (pre-Smithian) with maximum abundance in Zone 2. *Neospathodus nevadensis* (Clark 1959) is distinctly Smithian, however. This suggests that *N. nevadensis* can be used as a distinct taxon and that Mosher (1973) and McTavish (1973) were correct in recognizing it.

Parachirognathus ethingtoni *Assemblage*

This assemblage is distinguished by the presence of *Parachirognathus ethingtoni,* above the last occurrence of *Furnishius triserratus.* In this interval the name-giving species occurs with *Neospathodus bicuspidatus, N. conservativus, N. waageni, Pachycladina* spp., and *Ellisonia triassica.* Clark and Rosser (1976) reported isolated *Furnishius* occurring with *Parachirognathus* in two sections in this interval. More detailed work by Solien (1979) has shown that one of the sections (Salt Lake City) does not have this overlap, and we suspect that similar work on all sections would produce similar results. In some sections *N. bicuspidatus* is more abundant in this interval than *Parachirognathus,* but in most of the Great Basin *Parachirognathus* is more common. The upper boundary of the assemblage is defined by the lowest occurrence of *Neogondolella milleri.*

Neogondolella milleri *Assemblage*

A short-ranging assemblage dominated by members of the name-giving species, *Neogondolella milleri* occurs commonly with the maximum abundance of *Meekoceras* and *Anasebirites,* but ammonoids of this interval also range at least 60 m lower. In the Salt Lake City and Crittenden Springs localities, *N. milleri* is restricted to an interval 0.7 m thick or less.

Other conodonts of this assemblage include *Neospathodus waageni* (at its peak abundance and uppermost limit), *Pachycladina* spp., and *Ellisonia triassica.* The assemblage is considered to be uppermost Smithian (Sweet and others 1971).

Spathian

Solien (1979) pointed out that a significant break in conodont faunas occurs at the Smithian-Spathian boundary. In the Salt Lake City section, he found that with the exception of *Ellisonia triassica,* the faunas are exclusive with 11 species of the Smithian that do not reach the Spathian and seven species of the Spathian that do not occur in the Smithian. Solien (1979) compared this conodont disconformity to the Early Permian conodont crisis of Clark (1972). There is a change in lithofacies in the Great Basin at this time, and the conodont disconformity needs to be documented in other areas.

Platyvillosus *Assemblage*

In the most continuous Great Basin Triassic section studied to date, the uppermost Smithian *Neogondolella milleri* assemblage is separated by a covered interval from the next highest exposure, which contains *Neospathodus triangularis.* This 27-m-thick interval of no conodonts may contain a higher part of the *N. milleri* assemblage or a lower part of the *Platyvillosus* assemblage. As far as we know, these assemblages have not been found in succession previously (Sweet and others 1971). The succession established in the Thaynes Formation at Salt Lake City demonstrates that these assemblages are sequential but may be separated or may overlap by 27 m at most.

Elements of the *Platyvillosus* assemblage include *Neogondolella jubata, Neospathodus homeri, N. collinsoni,* and, in some areas, *Platyvillosus costatus.* This latter species evidently characterizes the lower part of the *Platyvillosus* assemblage in some areas, whereas *P. asperatus* is common in the upper part. *Platyvillosus asperatus* occurs through more than 43 m of the Salt Lake City section but not in the lowest exposures above *Neogondolella milleri.*

Neospathodus collinsoni *Assemblage*

The taxon referred to as *Neospathodus* n. sp. G by Sweet and others (1971) has recently been described as *N. collinsoni* Solien. This characteristic form appears first in the underlying *Platyvillosus* assemblage but reaches its maximum abundance above the highest strata bearing *Platyvillosus.* It occurs with the longer-ranging *Neospathodus triangularis, N. homeri* and *Neogondolella jubata,* all characteristic of the comprehensive *N. jubata* interval of Sweet (1970a) in West Pakistan.

Neogondolella jubata *Assemblage*

The base of this assemblage is above the last occurrence of *Neospathodus collinsoni.* Besides the name-giving species, *Neospathodus homeri, N. triangularis, Xaniognathus elongatus, Cypridolella unialata,* and *Ellisonia triassica* characterize this assemblage.

In the Salt Lake section, representatives of this assemblage range through more than 300 m of rocks. The upper beds of the Thaynes Formation at this section are part of a sequence of mixed terrestrial and marine sediments and contain only a few broken conodonts that cannot be assigned with confidence to any younger Triassic assemblage.

Neospathodus timorensis *Assemblage(?)*

The relationship of this assemblage of taxa to the older Lower Triassic sequence of assemblages in the Great Basin is uncertain. Sweet (1970a) recognized the *N. timorensis* assemblage as a distinctive zone on the basis of material collected from a single bed at one locality in the Salt Range, West Pakistan. An additional sample collected by J. W. Collinson and W. A. Hasenmueller from the upper Tobin Formation of Nevada is reported to bear the same taxa as the West Pakistan sample. We are uncertain of the precise sequence for this assemblage but assume that it occurs in the Great Basin at the top of the Lower Triassic.

MIDDLE TRIASSIC

Anisian

Neogondolella regale *Assemblage*

The oldest Middle Triassic has been defined in Nevada in the Humboldt Range on the basis of the name-giving species (Mosher 1970). The associated fauna is not well studied. The name-giving species has been reported outside Nevada in British Columbia. *Neogondolella mombergensis* also occurs in this interval.

Neogondolella constricta *Assemblage*

The name-giving species is abundant in *Gymnotoceras*-bearing strata in the Humboldt Range of Nevada, where it occurs with a few multielement species (Mosher and Clark 1965) and *N. mombergensis.* The late Anisian age has been confirmed by its occurrence in samples with *Ceratites trinodosus* in Austria (Mosher 1968a).

Ladinian

Neogonodolella mombergensis *Assemblage*

The name-giving species occurs through the Middle Triassic, but in the poorly studied lower Ladinian strata of Nevada it is the most distinctive species. It defines an interval above the last occurrence of *Neogondolella constricta* and below the occurrence of *Epigondolella mungoensis.*

Epigondolella mungoensis *Assemblage*

Upper Ladinian rocks of the New Pass Range, Nevada, contain the name-giving species. It does not occur in younger Karnian rocks (Mosher 1968a). *Neogondolella mombergensis* occurs in this assemblage along with a few poorly defined multielement species.

UPPER TRIASSIC

Karnian

Neospathodus newpassensis *Assemblage*

Above the youngest Middle Triassic occurs an assemblage characterized by the name-giving species. It represents a significant change in conodont faunas because *Neogondolella* became extinct at this time, and several new taxa along with descendants of Middle Triassic *Epigondolella* appeared. Mosher (1968a) reported that this interval was poorly understood but that it occurs in sequence with the underlying *E. mungoensis* assemblage.

Paragondolella polygnathiformis *Assemblage*

The name-giving species occurs in younger Karnian rocks but evidently does not occur above the Karnian. It occurs in the upper Karnian with *Epigondolella primitia* and *E. abneptis* plus a few multielement species in Nevada.

Norian

Mosher (1968a) and Sweet and others (1971) pointed out that Late Triassic conodont faunas, and particularly those of the Norian, show no provincialism. Similarity coefficients for Norian species in the Great Basin and Europe suggest a slight decrease in faunal similarity in the youngest Triassic, however. This is based on a greater species diversity in the Austrian section. The decrease in species similarity could be a signal for the early stages of development of the modern North Atlantic (Clark 1977).

Epigondolella abneptis *Assemblage*

Mosher (1968b) concluded that the name-giving species was the descendant of *Paragondolella polygnathiformis* and that the division between the two zones was based on the last occurrence of the ancestor. The name-giving species occurs sporadically throughout the Upper Triassic along with a few multielement species.

Epigondolella multidentata *Assemblage*

Middle Norian rocks in Nevada are distinguished by the name-giving species, *E. abneptis*, and a few multielement species (Mosher 1968a).

Epigondolella bidentata *Assemblage*

The name-giving species is the principal conodont of the upper part of the Upper Triassic, and its extinction marks the end of conodont evolution in Nevada. Slightly younger conodonts survived in Austria, but even the Austrian forms were extinct by the Lower Jurassic.

TRIASSIC CONODONT PALEOECOLOGY

Current emphasis of Great Basin Triassic conodont studies is on paleoecology. Particularly well suited to facies studies are the Lower Triassic Thaynes Formation and its equivalents. We have determined that in the Thaynes, successive transgressional and progradational events deposited six distinct lithofacies that range from semi-marine dolomite-sandstone-evaporite deposits to thick normal-marine packstone-wackestone deposits. Deposition of the six lithofacies was cyclic, and conodonts occur almost exclusively in the marine parts of the cycles. This relationship is described in greater detail by Solien, Morgan, and Clark (this volume). It is of significance to general Triassic paleoecology to note that carbonate texture, an often used paleoecologic parameter, is important only in terms of its position in the environmental gradient, and not by itself. This aids in the understanding of conodont abundance and diversity and may answer questions that have been raised concerning Triassic conodont distribution by Clark and Rosser (1976).

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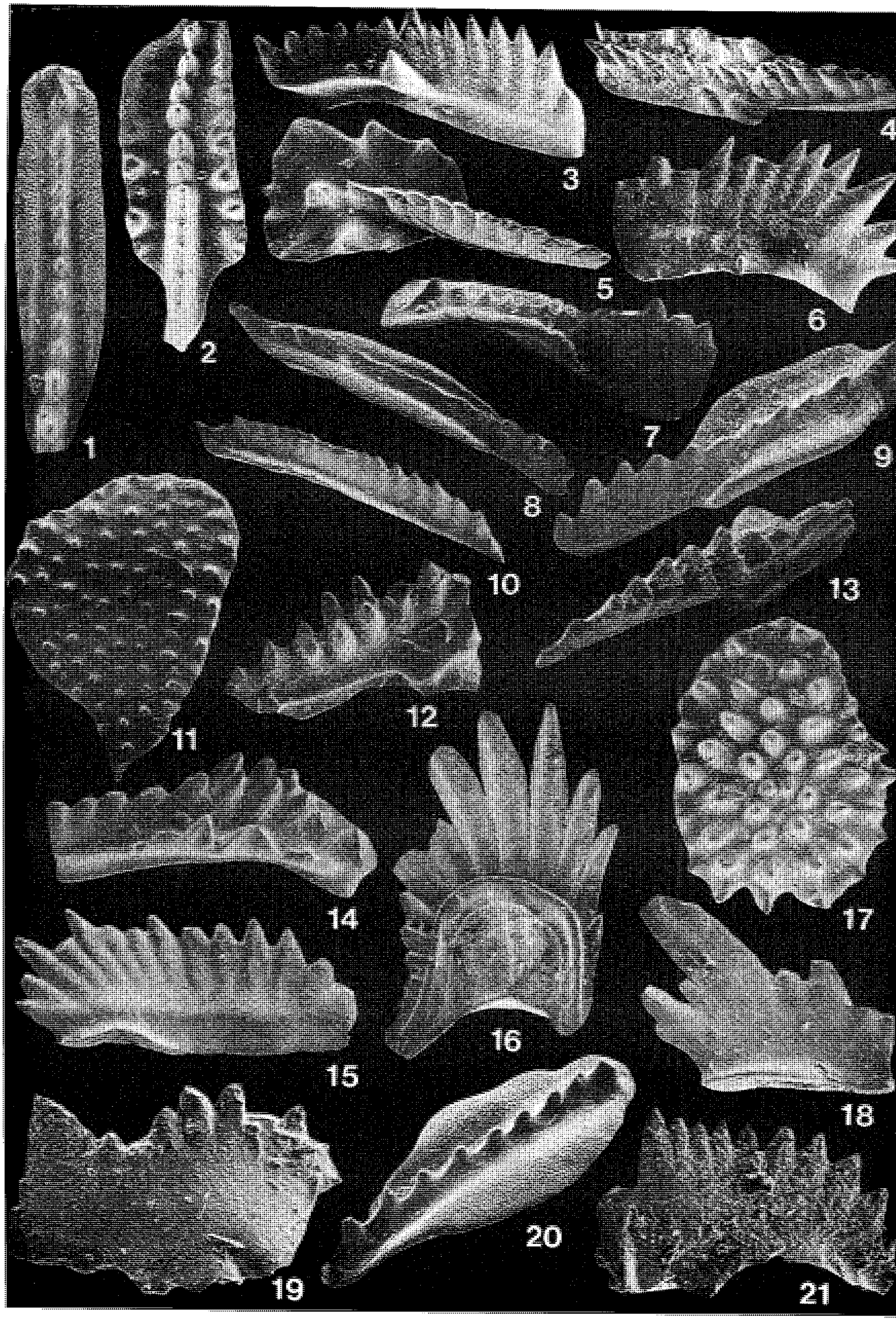
EXPLANATION OF PLATE 1

Figure 1.—*Neogondolella constricta* (Mosher and Clark), upper Anisian, Nevada, X75; Figure 2.—*Epigondolella mungoensis* (Diebel), upper Ladinian, Africa, X75; Figure 3.—*Epigondolella bidentata* Mosher, upper Norian, Austria, X105; Figure 4.—*Epigondolella multidentata* Mosher, middle Norian, British Columbia, X75; Figure 5.—*Epigondolella abneptis* (Huckreide), lower Norian, Nevada, X105; Figure 6.—*Neospathodus newpassensis* Mosher, lower Karnian, Nevada, X100; Figure 7.—*Paragondolella polygnathiformis* (Budurov and Stefanov), upper Karnian, California, X70; Figure 8.—*Neogondolella mombergensis* (Tatge), lower Ladinian, Germany, X60; Figure 9.—*Neogondolella jubata* Sweet, upper Spathian, Utah, X80; Figure 10.—*Neogondolella regale* Mosher, lower Anisian, Nevada, X65; Figure 11.—*Platyvillosus asperatus* Clark, Sincavage, and Stone, lower Spathian, Nevada, X130; Figure 12, 13.—*Neospathodus collinsoni* Solien, lower Spathian, Utah, 12, X90, 13, X100; Figure 14.—*Neogondolella milleri* (Müller), upper Smithian, Utah, X80; Figure 15.—*Neospathodus* sp., upper Dienerian, Idaho, X50; Figure 16.—*Parachirognathus ethingtoni* Clark, middle Smithian, Utah, X45; Figure 17.—*Furnishius triserratus* Clark, lower Smithian, Nevada, X50; Figure 18.—*Neospathodus peculiaris* Sweet, lower Dienerian, Nevada, X20; Figure 19.—*Anchignathodus isarcicus* (Huckriede), lower Griesbachian, Utah, X95; Figure 20.—*Neogondolella carinata* (Clark), upper Griesbachian, Utah, X80; Figure 21.—*Anchignathodus typicalis* Sweet, lower Griesbachian, Utah, X95.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