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BIOSTRATIGRAPHIC ZONATION OF THE PARK CITY GROUP

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BIOSTRATIGRAPHIC ZONATION OF THE PARK CITY GROUP

Abstract

Five biostratigraphic zones based on the distribution of brachiopods and conodonts are proposed for the Park City Group. They are: the Peniculauris ivesi-Neostreptognathodus prayi Zone, the Peniculauris bassi-Neostreptognathodus sulcoplicatus Zone, the Peniculauris bassi-Neostreptognathodus sp. C Zone, the Thamnosia depressa Zone, and the Yakovlevia multistriata-Neogondolella bitteri Zone. They range in age from Leonardian to Wordian.

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The biostratigraphic zonation proposed here is based on the ranges of brachiopod and conodont species (fig. 1). Samples for conodonts were collected at intervals of 3-5 m where practical. Large samples for brachiopods were collected at intervals usually averaging 7-10 m for the purpose of etching to obtain the silicified material. Crackouts were collected throughout the section and the data were augmented by field identifications. The lower part of the sequence is best represented by conodonts and the upper part by brachiopods; the zonation is slanted accordingly. Because our data are form a relatively small region, fossil ranges partly reflect basin-wide facies changes. These ranges will probably expand as data from other regions are added. The zones are Oppel-zones (Hedberg, 1976) with the exception of Zones 1 and 3 which are based on ranges of conodonts.

The time-stratigraphic subdivision of the Permian System proposed by Furnish (1973) is followed. Taxa without specific names are disignated by letters of the alphabet and conform to the usage of these names in the theses of Wardlaw (1974), Baird (1975) and E. Marcantel (1975).

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Peniculauris ivesi-*Neostreptognathodus prayi* Zone (1)

Based on the range of the conodont *N. prayi*, this zone is similar to the *Neostreptognathodus sulcoplicatus*-*N. prayi* Assemblage Zone of Behnken (1975, p. 292-293). In emending *N. sulcoplicatus* (Youngquist, Hawley, and Miller) Behnken (1975, p. 211-212; pl. 1, figs. 2, 4) included what we regard as *Neostreptognathodus* sp. D from the Pequop Formation of Steele (1960) and Arcturus Formation, thereby erroneously extending the range of *N. sulcoplicatus* to the Leonardian Stage of Furnish (1973).

Examples of *N. prayi* Behnken occur in the lower two-thirds of the Kaibab sections in eastern Nevada and western Utah, except in the Confusion Range section where they occur in the lower half of the formation. In addition to finding *N. prayi* in the Kaibab Limestone, Behnken (1975, p. 287) reports it from the upper part of the Arcturus and Pequop Formations, which are older than the Kaibab. Baird (1975) found *N. prayi* in the Toroweap Formation of southern Utah. In west Texas, Behnken (1975, p. 293) described *N. prayi* from the Bone Spring Limestone, Victorio Peak Limestone, and from the basal part of the overlying Cutoff Shale. He implies the *N. prayi* ranges from the upper Leonardian into the lower Wordian in age. This Wordian age assignment is apparently based on a report by Bissel (1964, p. 616-617, 620, 624)

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of Guadalupian ammonoids in the underlying Loray Formation, which has since proved to be erroneous (W. M. Furnish, oral commun., 1976). The occurrence of N. prayi in the Bone Spring and Victorio Peak Limestones strongly suggests a late Leonardian age for this zone.

Behnken (1975, p. 290) indicated that Neogondolella idahoensis occurs with N. prayi in the west Texas sequence. A broken fragment identified by Baird (1975) as N. cf. N. idahoensis was found in the upper part of the N. prayi Zone in eastern Nevada.

The brachiopod Peniculauris ivesi (Newberry) is common in the Toroweap Formation in southern Utah and northern Arizona. It sporadically occurs elsewhere from the upper part of the Pequop and Loray Formations in Nevada and one occurrence in the lowermost part of the Kaibab at Spruce Mountain in Nevada. All occurrences fall within the range of N. prayi.

Peniculauris bassi-Neostreptognathodus sulcoplicatus Zone (2)

The base of this zone is marked by the lowest occurrence of N. sulcoplicatus (Youngquist, Hawley, and Miller), and Neostreptognathodus sp. B (Baird, 1975). The top of this zone is defined by the lowest occurrence of Neostreptognathodus sp. C (Baird, 1975). The N. sulcoplicatus Zone occurs in the upper Kaibab Limestone and presumably the lower part of the Plympton Formation of eastern Nevada

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and western Utah and in the lower two-thirds of the Kaivav at its type section in southern Utah. Youngquist, Hawley, and Miller (1951) first descrived this species from the lower Phosphoria Formation in southeastern Idaho. Clark and Ethington (1962) described N. sulcoplicatus along with Xaniognathus abstractus (Clark and Ethington) from the Meade Peak Member of the Phosphoria Formation in southeastern Idaho and Wyoming. Neogondolella idahoensis was also described from these rocks by Youngquist, Hawley, and Miller (1951) and Clark and Ethington (1962).

An important component of the Meade Peak conodont fauna, Neogondolella serrata (Youngquist, Hawley, and Miller), has not been reported from eastern Nevada or western Utah, probably because the phosphatic shale facies has not been adequately sampled. We, nevertheless, believe that the N. sulcoplicatus Zone in eastern Nevada and western Utah is equivalent to the Meade Peak fauna, which Furnish (1973) assigns to the Roadian Stage. This age assignment eliminates the problem posed by Behnken (1975, p. 290) that conodont species of "Roadian age" in Texas range into strata of "Wordian age" in Nevada.

The brachiopods Peniculauris bassi (McKee), Rugatia occidentalis (Newberry), Koslowskia sp., Meekella sp., Megousia eucharis (Girty), and Neophricadothyris sp. A are abundant in this zone. From the many sections of the

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Permian of the western United States examined by the authors, this seems to be the highest occurrence of Meekella and Koslowskia in the West. They are widespread, occurring throughout the Grandeur Member of the Park City Formation in Montana and Wyoming and in the Kaibab Limestone in Arizona and Utah and in the Concha Limestone in Arizona. Koslowskia is strictly a Pennsylvanian to Lower Permian form. P. bassi, R. occidentalis and Neophricadothyris are the dominant elements of the fauna of the Grandeur but also carry through the Meade Peak. Megousia eucharis is common in the Grandeur and Meade Peak. The highest occurrence of Peniculauris and Rugatia in the west Texas Permian is Roadian.

Peniculauris bassi-Neostreptognathodus sp. C Zone (3)

The base of this zone is determined by the first occurrence of Neostreptognathodus sp. C (Baird, 1975). Examples of this form dominate the conodont fauna of the upper 45 m of the type section of the Kaibab Limestone in southern Utah (Noble, 1928) and also occur in the lower part of the Plympton Formation in the Confusion Range in western Utah. The upper limit of this zone is not well defined because the top of the Kaibab in southern Utah is truncated by an unconformity and in western Utah the lower part of the Plympton is sparsely fossiliferous. For example, Behnken (1975, p. 293) reports a "very meager"

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condont assemblage from the lower part of the Plympton Formation including Neostreptognathodus clinei (Behnken). Further sampling, particulary in the Phosphoria and related rocks, is likely to narrow this gap. Brachiopods are poorly preserved in this zone. Peniculauris is the only identifiable brachiopod found so far from the lower Plympton. The Kaibab brachiopod assemblage and the conodont faunas typified by species of Neostreptognathodus became extinct at this time. The presence of Peniculauris and the age of the overlying brachiopod faunas indicates a Roadian Age for this zone. The upper boundary probably marks the Artinskian-Guadalupian boundary.

Thamnosia depressa Zone (4)

This zone is based on the nearly coincident ranges of Thamnosia depressa (Cooper) and Bathymyonia sp. A. T. depressa occurs in the limestone tongues of the upper part of the Plympton Formation, the limestone tongues in the Rex Chert Member of the Phosphoria Formation, and at El Antimonio, Mexico. Sphenalosia and "Echinauris" subhorrida (Meek), Derbyia sulca (Branson), Xestotrema pulchrum (Meek), and Hustedia sp. A start in this zone. The highest occurrence of Rugatia occidentalis is in the upper Plympton Formation. Rugatia, which is more common in the Great Basin than in west Texas, appears to have a longer range here than in west Texas; ranging into

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the lower Wordian equivalents.

This zone is more less equivalent to the Neospathodus arcucristatus "Fauna" of Clark and Behnken (1971) from the upper Plympton Formation and basal Gerster Limestone at Palomino Ridge (Phalen Butte). The upper Plympton Formation contains a sparse conodont assemblage including N. arcucristatus, Ellisonia sp. A (E. Marcantel, 1975), and Anchignathodus sp. A (E. Marcantel, 1975 = A. minutus of Behnken, 1975).

Yochelson and Fraser (1973) report an unusually well preserved molluscan faunule form the unit 5 of the Plympton Formation in the southern Pequop Mountains. Silicified pelecypods from approximately the same horizon in the Spruce Mountain section are probably examples of the genus Schizodus (D. W. Boyd, written communication, 1975).

Kuvelousia leptosa Zone (5)

The base of this zone is determined by the first occurence of Kuvelousia leptosa Waterhouse, Ctenalosia fixata Cooper and Stehli, Waagenites sp. A and several other Gerster brachiopods. The range of K. leptosa is commonly equivalent to this zone. The zone ends with the first occurrence of several upper Gerster brachiopods such as Timaniella "pseudocameratus". K. leptosa is widespread occuring in all Gerster sections, the upper limestones of the Rex Chert Member of the Phosphoria Formation, the Franson Member of

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the Park City Formation, the Diablo Formation at Candelaria, Nevada and the Seven Devils Volcanics and related rocks, Oregon and Idaho. Kuvelousia is strictly an Upper Permian genus. Conodonts are rare in this zone. Only Neospathodus arcucristatus and Ellisonia sp. A occur. The range of Anchignathodus sp. A ends below this zone in unit 5 of the Plympton and the range of Neogondolella bitteri starts in the upper Gerster in the zone above.

Yakovlevia multistriata-Neogondolella bitteri Zone (6)

The base of this zone is determined by the first occurrence of the brachiopods Timaniella "pseudocameratus", Petasmetherus sp. A, Heterelasma sp. A, Echinalosia sp. A, Odontospirifer sp. A, Plectelasma sp. A and B, Hemiptychina sp. A and others. The range of the widespread and abundant Yakovlevia multistriata (Meek) is totally inclusive within this zone. Y. multistriata occurs elsewhere in the Edna Mountain Formation, Nevada and the upper part of the Franson and the lower par to the Ervay Members of the Park City Formation in Wyoming. T. "pseudocameratus" is also widespread occurring in the Edna Mountain Formation, in the Diablo Formation at Candelaria, Nevada, at Taylorsville, California, and in the Retort Phosphatic Shale Member of of the Phosphoria Formation in Wyoming. In west Texas, Yakovlevia occurs in Roadian and Wordian beds; Petasmetherus occurs in Lower Permian and Wordian beds of Furnish, 1973;

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Echinalosia occurs only in Wordian beds.

The name N. bitteri was proposed by Kozur (1975, p. 19-20) for the form assigned by Clark and Behnken (1971, p. 424, 434-435) to Gondolella rosenkrantzi Bender and Stoppel.

This zone is similar to the "Gondolella rosenkrantzi" Zone plus the Neospathodus divergens "Fauna" of Clark and Behnken (1971, p.428). Behnken (1975, p. 293) later combined the Neospathodus arcucristatus "Fauna" with the "Gondolella rosenkrantzi" Zone, because he found these two forms occurring together throughout the central Butte Mountains (30-mile Ranch) sequence. He suggested that the stratigraphic separation of these two forms at the Phalen Butte (Palomino Ridge) section was "ecologic" rather than biostratigraphic. We agree that the distribution of these forms is in part facies controlled, but the biostratigraphic overlap is slight in all of our sections, including the one from the central Butte Mountains.

A few examples of N. divergens (Bender and Stoppel) were found near the top of our sections in the central Butte Mountains, Cherry Creek Range, Palomino Ridge and, possibly, the Medicine Range (E. Marcantel, 1975). This is the same interval that Behnken (1975, p. 293) includes in the Neogondolella "rosenkrantzi"-Neospathodus divergens Assemblage Zone. He also reports the brachiopod Xestotrema

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pulchrum (Meek) and elements of the conodont Xaniognathus tribulosus (Clark and Ethington). These conodonts in addition to the many species of brachiopods are also common in our section of the upper part of the Gerster Limestone, but N. divergens was not abundant enough in our collections to recognize this as a separate zone.

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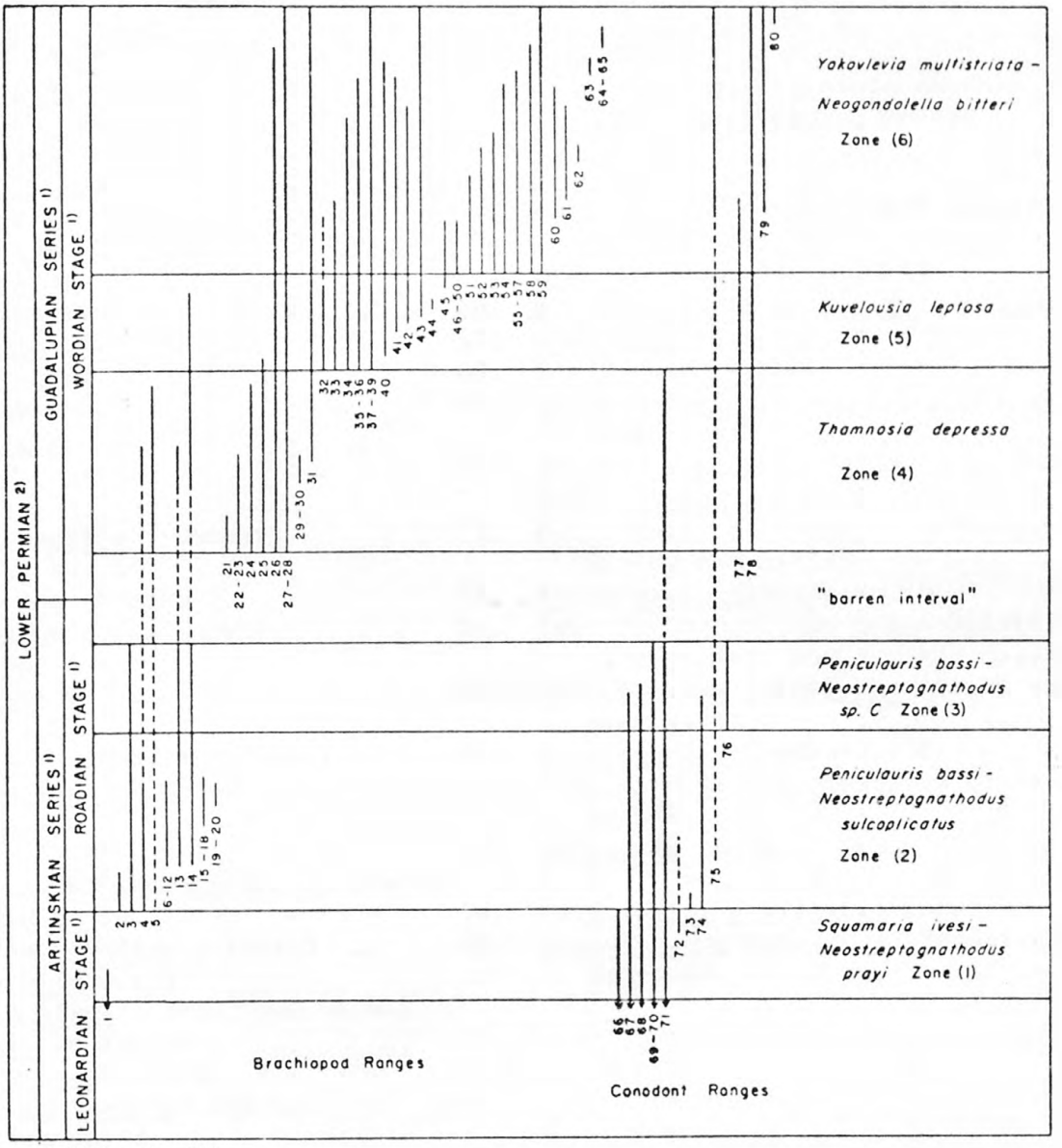

1) Of Furnish, 1973

2) The U.S. Geological Survey does not recognize the Roadian - Wordian boundary as the Lower Permian - Upper Permian boundary as some American workers do. The Wordian-Capitanian boundary is recognized as the division.

Fig. 1. Generalized range chart of brachiopod and conodont species from the Park City Group.

Key to figure 1

1. Peniculauris ivesi (Newberry)
2. Lissochonetes sp. A
3. Peniculauris bassi (Mckee)
4. Derbyia sp. A
5. Rhynchopora taylori Girty
6. Neophricadothyris sp. A
7. Megousia eucharis (Girty)
8. Meekella sp.
9. Echinauris sp. A
10. Quadrochonetes sp. A
11. Kozlowskia sp.
12. "Cancrinella" sp.
13. Rugatia occidentalis (Newberry)
14. Composita cf. C. parva Branson
15. Waagenoconcha sp.
16. Neospirifer sp.
17. Spiriferellina?
18. Cenorhynchia sp.
19. Phrenophoria sp. A
20. Liosotella?
21. "Echinosteges"
22. Sphenalosia sp. A
23. Dielasma sp. A
24. Thamnosia depressa (Cooper)
25. Bathymyonia sp. A
26. Derbyia sulca (Branson)
27. Xestotrema pulchrum (Meek)
28. Hustedia sp. A
29. Spiriferellina sp. A
30. Thamnosia sp. A
31. "Echinauris" subhorrida (Meek)
32. Kuvelousia leptosa Waterhouse
33. Waagenites sp. A
34. Dyoros sp. A
35. Dielasma cf. D. phosphoriensis Branson
36. Cleiothyridina sp. A
37. Bathymyonia nevadensis (Meek)
38. Composita mira Girty
39. Ctenalosia fixata Cooper and Stehli
40. Cleiothyridina sp. B
41. "Grandaurispina" sp. A
42. Sphenosteges hispidus (Girty)
43. Phrenophoria sp. B
44. Cenorhynchia sp. A
45. Spiriferella scobina (Meek)
46. Phrenophoria sp. C
47. Petasmetherus sp. A
48. Rostranteris sp.
49. Girtyella?
50. Heterelasma sp. A
51. Plectelasma sp. A
52. Echinalosia sp. A
53. Waagenites sp. B
54. Odontospirifer sp. A
55. Cenorhynchia sp. B
56. Plectelasma sp. B
57. Hemiptychina sp. A
58. Quadrocnonetes sp. B
59. Timaniella "pseudocameratus"
60. Yakovlevia multistriata (Meek)
61. Liosotella delicatula Dunbar
62. Heteralosia sp.
63. Kochiproductus sp.
64. "Grandaurispina" cf. "G." arctica (Waterhouse)
65. Dielasma spatulatum Girty
66. Neostreptognathodus prayi Behnken
67. Neostreptognathodus sp. D
68. Neostreptognathodus clinei Behnken
69. Xaniognathus abstractus (Clark and Ethington)
70. Ellisonia festiva (Bender and Stoppel)
71. Anchignathodus sp. A
72. Neogondolella idanoensis (Youngquist, Hawley, and Miller)
73. Neostreptognathodus sp. B
74. Neostreptognathodus sulcoplicatus (Youngquist, Hawley, and Miller)
75. Xaniognathus tribulosus (Clark and Ethington)
76. Neostreptognathodus sp. C
77. Neospathodus arcucristatus Clark and Behnken
78. Ellisonia sp. A
79. Neogondolella bitteri (Kozur)
80. Neospathodus divergens (Bender and Stoppel)

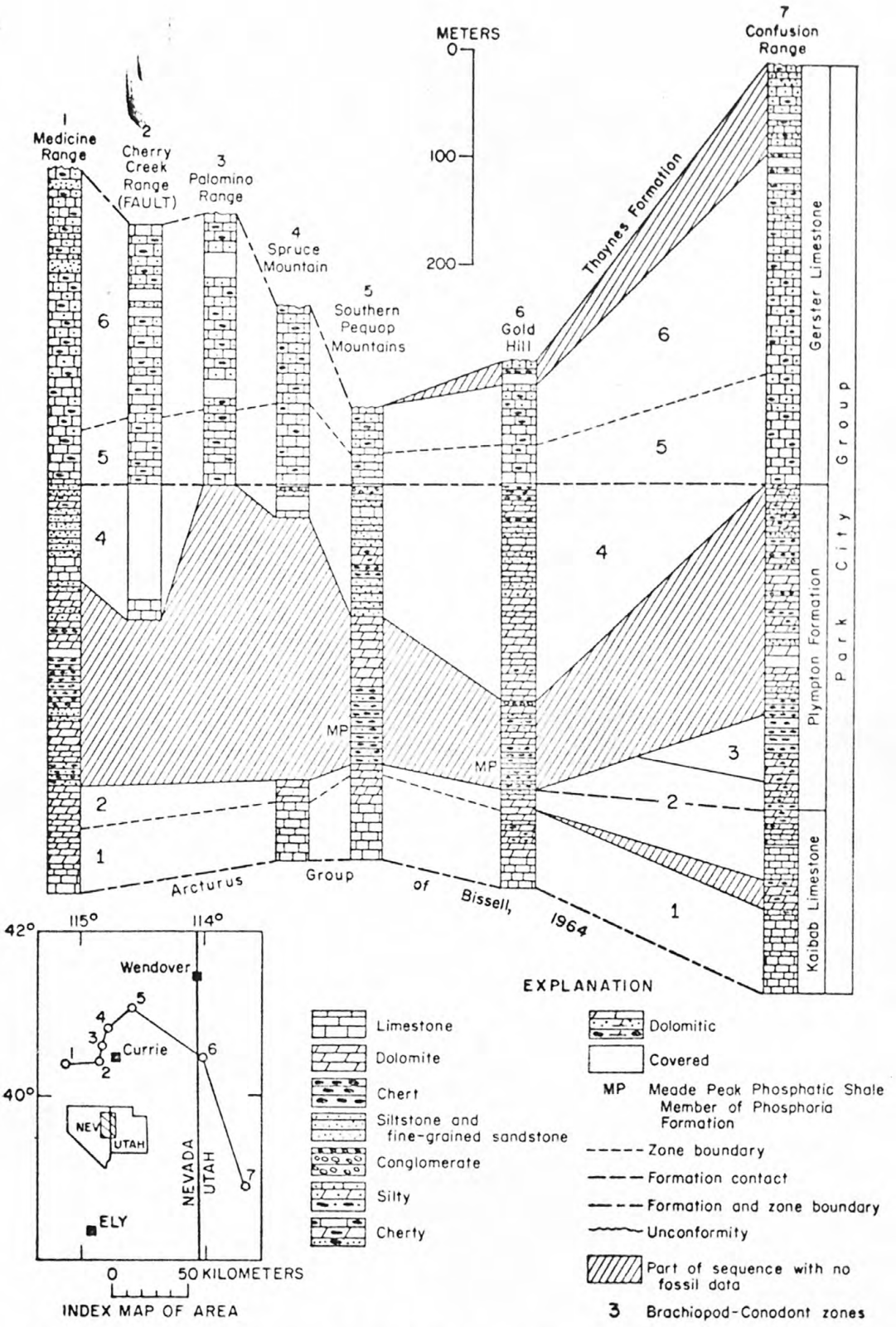

Fig. 2. Distribution of biostratigraphic zones in the Park City Group.