Figure 27. Booneville dip section showing the Late Mississippian- and Early Pennsylvanian-age rocks. Datum *is* on the uppermost Lee member.

BOONEVILLE DIP SECTION

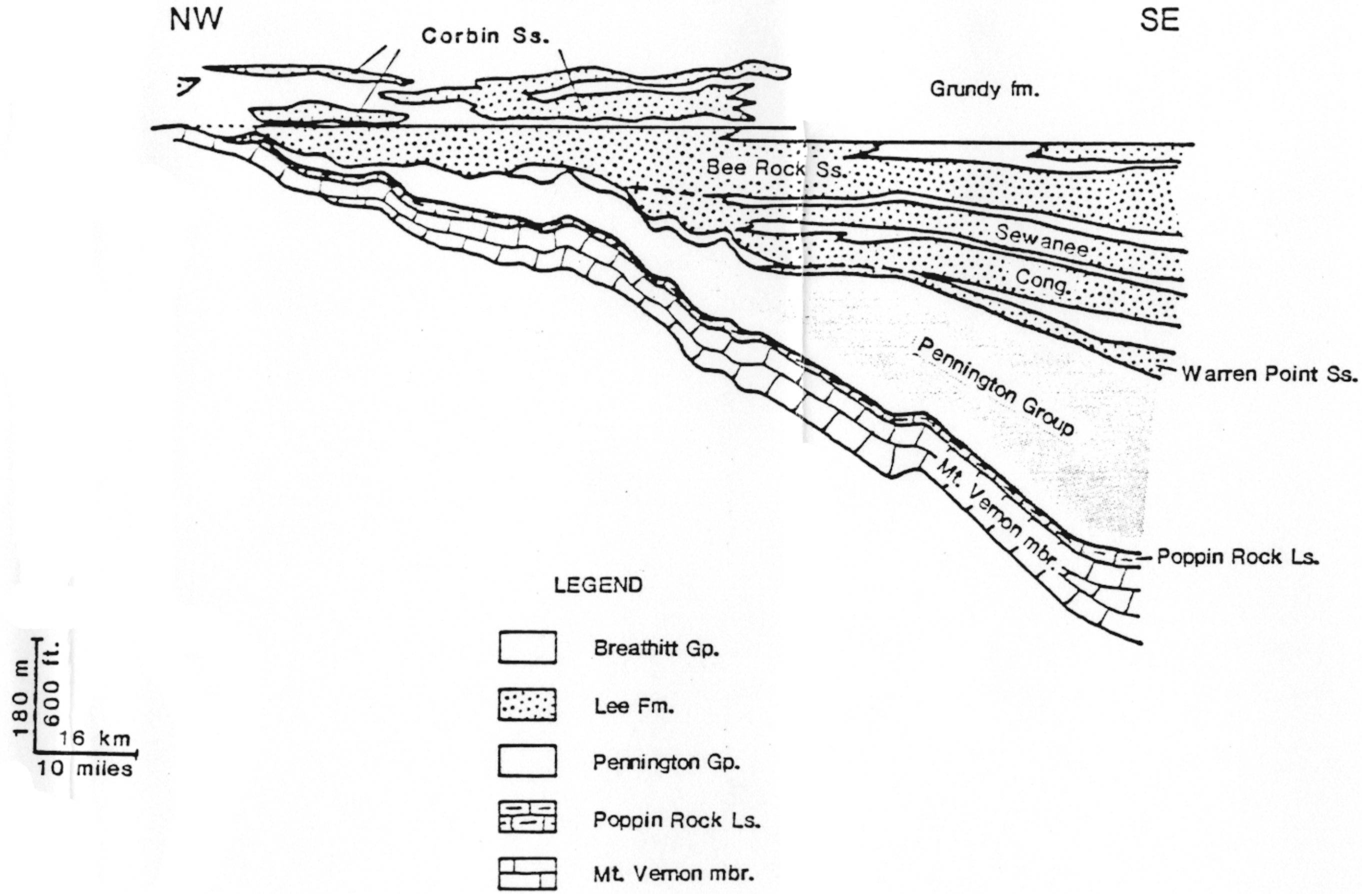


Figure 28. Lake City dip section showing the Late Mississippian- and Early Pennsylvanian-age rocks. Datum is on the uppermost Lee member.

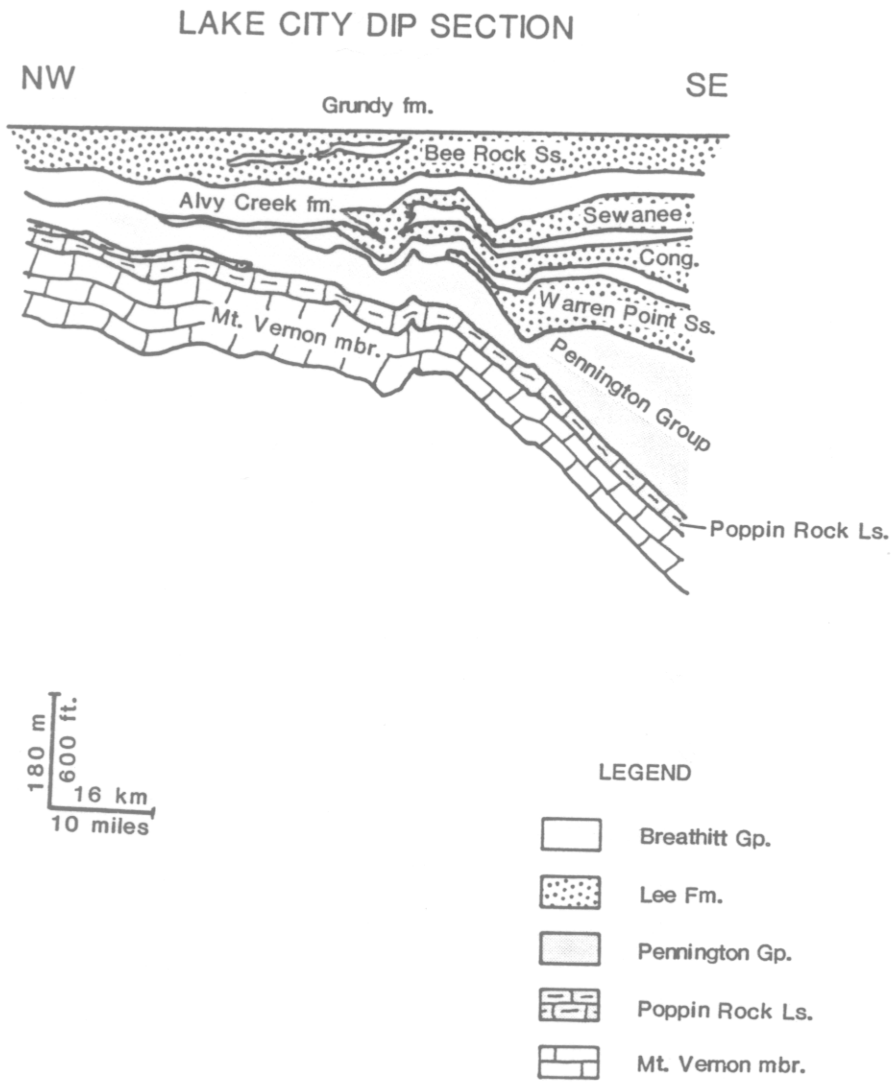

LAKE CITY DIP SECTION
NW
SE
Grundy fm.
Bee Rock Ss.
Alvy Creek fm.
Sewanee
Cong.
Warren Point Ss.
Pennington Group
Mt. Vernon mbr.
Poppin Rock Ls.
180 m
600 ft.
16 km
10 miles
LEGEND
Breathitt Gp.
Lee Fm.
Pennington Gp.
Poppin Rock Ls.
Mt. Vernon mbr.

Figure 29. Hazard strike section showing the Late Mississippian- and Early Pennsylvanian-age rocks. Datum is on the uppermost Lee member.

See dissertoversize331.pdf

Figure 30. Pineville strike section showing the Late Mississippian- and Early Pennsylvanian-age rocks. Datum is on the uppermost Lee member.

See dissertoversize332.pdf

Figure 31. Harlan strike section showing the Late Mississippian- and Early Pennsylvanian-age rocks. Datum is on the uppermost Lee member.

See dissertoversize333.pdf

formations are absent in the Lake City, Hazard, and Pineville sections, as well as in the Harlan section west of the Russell Fork fault (Figs. 15-18, 28-31). The upper part of the Pocahontas Formation is absent east of the Russell Fork fault in the Harlan section. In addition, the Princeton Sandstone is absent in the Hazard section (Fig. 16, 29). If the Pocahontas Formation and underlying units were originally extensive throughout the basin, the absence of these units to the west and northwest of the Pocahontas occurrence is an indication that erosional truncation also occurred in these areas. The original extent of these units, however, is not known.

Topographic Relief

An irregular or undulating contact at the discontinuity can be interpreted as topographic relief, which, in turn indicates an unconformity. Small-scale features suggesting buried topography and channel-form deposits are generally too small to be recognized at the scale of these cross sections and with the data density used to construct these sections. However, a small-scale undulating contact is recognized at the northwestern ends of the Grundy, Booneville, and Lake City dip sections (Figs. 26-28). At the northwestern parts of the dip sections, rocks adjacent to the discontinuity are exposed at the surface; the geologic quadrangles provide a greater density of information than is available for the subsurface parts of the sections. This small-scale undulating contact can be interptreted to be topographic relief.

In the subsurface parts of all the sections (Figs. 25-31), the generally undulating contact between the upper and lower sequences can be interpreted as topographic relief, although this may be impossible to prove with the available subsurface information. Several of these larger features are described here. In the central part of the Hazard section (Fig. 29), an upward bend in the contact between the two sequences can be interpreted as a large hill with a relief as much as 300 feet. Sandstone lenses in the overlying sequence appear to be interupted by the hill, indicating that this topographic feature controlled subsequent deposition and facies.

In the western part of the Hazard section (Fig. 29), two downward bends of the contact can be interpreted as channels which eroded down into the Pennington Group. If this interpretation is correct, then their depth was about 100 feet. In the eastern part of the Pineville section (Fig. 30), a subsurface fault which displaced the Mississippian strata was discovered. Although it is possible that this fault was a growth fault during the Early Pennsylvanian and no topographic relief developed, it is also possible that the fault scarp was a topographic feature present on the erosional surface.

Differences in Dip

The actual dip of individual subsurface beds is impossible to determine from most subsurface records; although, dip can be inferred from the correlation of individual beds or members. An abrupt change in the amount of dip between overlying and underlying beds, especially at the scale of these cross sections (Figs. 12-18), would be expected in a regional unconformity.

An abrupt change in dip is recognized in the eastern halves of the Catlettsburg, Grundy, Booneville, and Lake City dip sections (Figs. 12-15). In the northwestern parts of the sections, a change in dip is not apparent at the scale of these sections. These northwestern parts correspond to the northwestern limb of the Central Appalachian basin, and as such, is an area which underwent much less subsidence than in other parts of the basin.

Progressive Onlap

Progressive onlap of beds over older beds may indicate an unconformable relationship between the underlying and overlying units. In the Lake City section (Fig. 28), the Warren Point Sandstone, the Sewannee Sandstone, and the Alvy

Creek-Bee Rock progressively onlap the Pennington Group to the northwest. In the northwestern parts of the Catlettsburg, Grundy, and Booneville dip sections (Figs. 25-27), the members of the Lee Formation become difficult to identify because intervening shale beds become very thin and discontinuous. Preliminary tracing of these discontinuous shale beds appears to indicate a progressive onlap of the Warren Point, Sewanee, Alvy Creek-Bee Rock, and the Grundy units over older rocks.

The features described above are geometric grounds for the interpretation of the discontinuity as an unconformity. The position of the unconformity in the cross sections indicate that it occurs between the Bottom Creek-Warren Point units and the Pocahontas Formation. As a result of the absence of the Pocahontas Formation over most of the Central Appalachian basin, the Pennsylvanian lithologies overlie unconformably the Mississippian lithologies. This relationship over most of the basin has led to the confusion that the unconformity is a Mississippian-Pennsylvanian unconformity, rather than a Lower Pennsylvanian unconformity.

Implications Involving An Unconformity

Type of Unconformity

There are basically two large-scale models for explaining the deposition of Carboniferous sediments in the Appalachian Basin. In one model, called the Barrier-Shoreline model, all adjacent Carboniferous units are interpreted to be parts of a large, regional facies continuum. All the lithologies represent separate facies in a large-scale environmental continuum with marine shales and carbonates of the Borden and Slade formations (traditionally considered as Mississippian) representing marine environments in one part of it, and the uppermost Breathitt Group, traditionally included in the Middle Pennsylvanian, representing the alluvial-plain environment in another part of the continuum. Transitions between open-marine and terrestrial environments include barrier-bar, lagoonal, and lower delta-plain environments. The quartzose sandstones of the Lee Formation are interpreted to represent deposition at a barrier bar or in tidal channels. In this model, the terms "Mississippian" and "Pennsylvanian" are facies terms, and the whole of the Carboniferous is interpreted to represent one large time-transgressive system of sediments with terrestrial facies encroaching over marine facies. An apparent regional unconformity is thus explained as a series of unrelated local unconformities that are commonly associated with particular environments, and therefore, with the base of particular lithofacies (Ferm and other, 1972, p. 6).

Another model, called the Tabular-Erosion model, supports only small-scale environmental facies variations involving a few units at a time (for example, Miller, 1974; Donaldson and Shumaker, 1979; Ettensohn, 1981; Chesnut, 1983; Ettensohn and Chesnut, 1985). In this model an unconformity separates two sequences, the Pocahontas Formation and underlying Mississippian units from the Pennsylanian units above the Pocahontas Formation. Major variations of this model primarily relate to the origin of the Lee Formation and include braided-fluvial (for example, Rice, 1984) and tidally-influenced fan-delta environmental interpretations for some of the sandstones of the Lee Formation (Nicholas Rast, 1985, personal communication). Englund and others (1985), Englund (1985, personal communication), and Cecil (1985, personal communication) suggested a regional unconformity but with a barrier bar-tidal channel origin for the Lee Formation. Wilson and Stearns (1960) favored a subaqueous marine sheet-sand origin. The common element in these variations of the Tabular-Erosion model is a regional unconformity separating the two sequences.

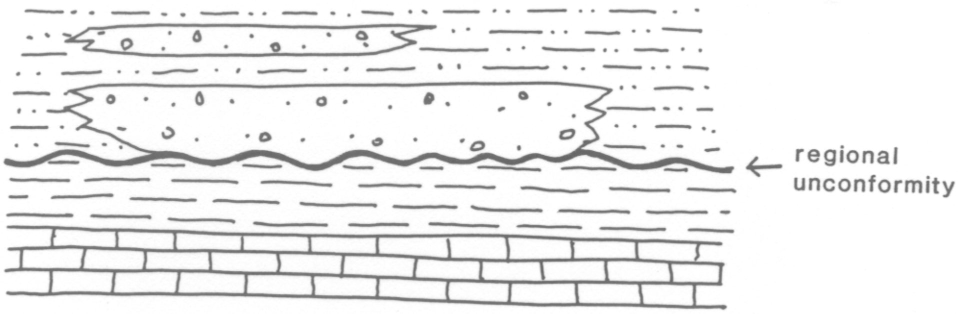
Various models that might explain the appearance of a regional unconformity are illustrated schematically in Figure 32. The traditional regional-unconformity model for the Carboniferous will be refered to as the Regional Unconformity model (Fig. 32a). In this model the unconformity is interpreted to have formed during a relatively short event on the scale of several million years or less. The term "event" is used here as a relative term and is not meant to imply that the unconformity is necessarily a synchronous event. It does imply, however, that any diachronous event would have had a shorter duration compared to that of the Carboniferous System.

The Barrier-Shoreline model favors a series of unconformities that are products of progradational processes, and therefore are time-transgressive. This concept will be refered to as the Diachronous-Series Unconformities model (Figs. 32b,c). In this model, erosion occurs only locally as channel scours during short periods of time. However, conditions leading to the local channel-scour unconformities are diachronous, and, therefore, the

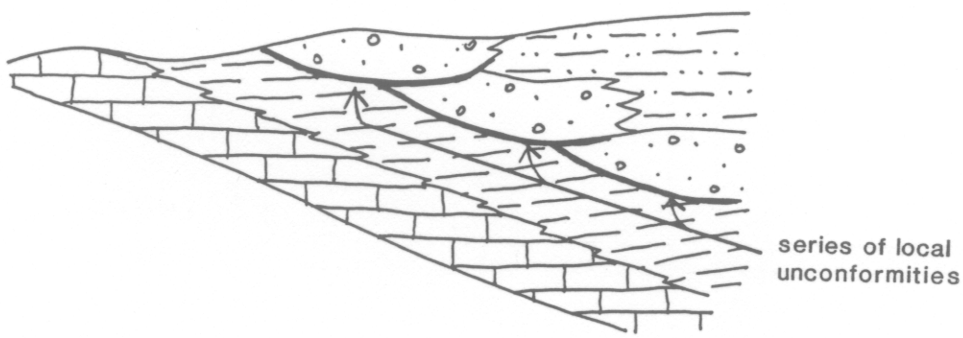
range for the whole diachronous series of separate and local unconformities represents a duration on the scale of tens of millions of years (or in this case, on the scale of the whole Carboniferous Period). Two variations of the Diachronous-Series Unconformities model

Figure 32. Unconformity models: (A) regional unconformity, (B) coalescing series of diachronous unconformities, and (C) unconnected diachronous unconformities.

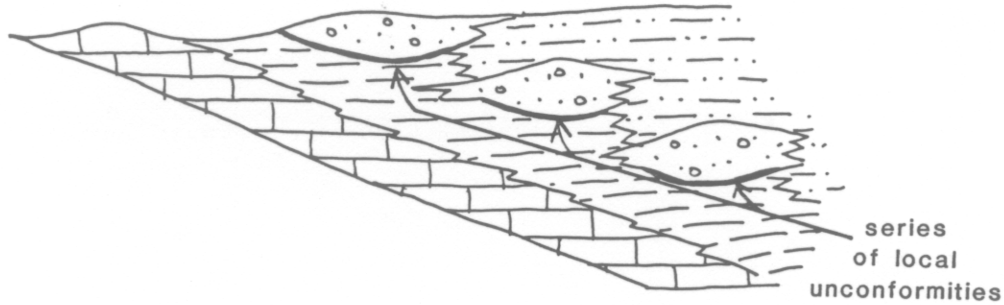
A.


regional
unconformity

B.


series of local
unconformities

C.


series
of local
unconformities