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BIOSTRATIGRAPHY OF THE MORROW GROUP OF NORTHERN ARKANSAS

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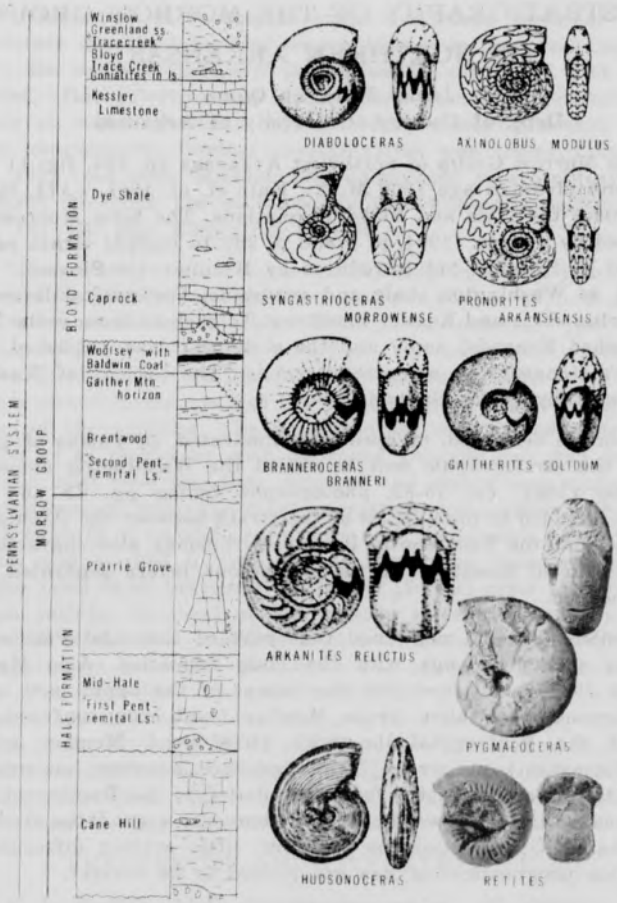
The Morrow Group of northwest Arkansas (p. 184, fig. 1) is of early Pennsylvanian age (300 M. Y., Kulp et. al. 1961, p.111, fig. 1) and includes the Hale and Bloyd Formations. The term Morrow was introduced by Adams (1904, p. 3 and p. 28) to include strata earlier described by Simonds but introduced by Branner (in Simonds' 1891, p. XIII) as Washington shale and sandstone, Pentremital limestone, coal-bearing shale and Kessler limestone. To each of these units Branner attached Simonds' name and the statement was published, over Branner's signature, as an introduction to "The Geology of Washington County" by F. W. Simonds.

Simonds described, mapped and illustrated, by means of photographs, the stratigraphic unit he called the Washington shale and sandstone (1891, pp. 75-82, photographs facing pp. 75 and 80). Simonds included in the unit all of the strata between the Archimedes limestone and the Pentremital limestone. Simonds also characterized the Pentremital limestone as two calcareous layers separated by a sandstone bed.

Henbest (1962) mentioned that part of Simonds' Pentremital limestone section belongs with the Hale formation. Also Henbest (1953, p. 1942) mentioned that the faunas of the upper part of the Hale Formation (Prairie Grove Member) had been confused with those of the Pentremital limestone (Brentwood Member of the Bloyd Formation) and wrote "This admixture, however, has probably made little difference in the fauna attributed to the Brentwood limestone because the Brentwood seems to represent a gradational change from Prairie Grove deposition with but little evident difference in age." This prognostication has not proved to be correct.

HALE FORMATION

Cane Hill Member. The Hale Formation was subdivided by Henbest (1953) into the Cane Hill and Prairie Grove Members. The Cane Hill section is composed largely of shale, siltstone and conglomerate lenses. In places sandstone lenses or calcareous bodies of considerable size and thickness occur. At the type locality chosen by Henbest (1962) near Evansville, Arkansas, there is a limestone conglomerate a few inches thick resting on the Pitkin Formation. About three miles south of this place at Davidson Post Office(abandoned) the conglomerate is as much as twenty feet thick and contains numerous fossils including goniatites. Above the conglomerate is a few inches of black, clay-shale, which at the type locality is



Diagrammatic stratigraphic column of the Morrowan section and some of the goniatites belonging in units of Bloyd and Hale rocks. Drawn by James E. Edson, Unversity of Arkansas; goniatite illustrations from James A. McCaleb, Pan American Oil Corp.; Robert Miller, (former U. of A. student). The *Hudsonoceras* is from Foord & Crick, catalog of British Cephalopods III, 1897, and is the type of *H ornatum* which very closely resembles *Hudsonoceras moorei*, Quinn & Saunders (1968), from the lower portion of the Can Hill Member of the Hale Formation.

more than twenty feet thick and contains thin stringers of hard, dark siltstone which weathers to brown. There are also some small disc-shaped concretions in the shale. The siltstone layers increase in proportion, upward, and the shale is superceded by flaggy siltstone beds. At Davidson the rocks above the shale tend to resemble the calcareous material below. At Fayetteville, Arkansas, in the Frisco R.R. cut east of the campus, the basal conglomerate lies on Fayetteville shale and there is no Pitkin limestone. Above the conglomerate is as much as twenty feet of black shale, very similar to that at the type locality. Likewise, the shale grades into flaggy siltstone and thin beds of sandstone with numerous conglomerate lenses, some of which contain an elaborate and distinctive goniatite assemblage. Among the goniatites which are light colored there are also a number of phosphatized fossils, some of which are jet black, while others have been altered to a soft blue-gray material. These are reworked from older deposits which presumably lay farther north. All these goniatites are of Pennsylvania age, or, to rephrase, they do not belong in Mississippian assemblages. Two from the basal conglomerate indicate that it also is Pennsylvanian in age and of course the intervening black shale cannot be considered otherwise. The phosphatic goniatites appear to be indigenous to the black shale section and occur in a few places in lenses of conglomerate or siltstone. Several goniatite collections from this horizon indicate the occurrence of *Syngastrioceras*, *Cymoceras* and a form probably not represented higher in the section which appears referable to *Homoceratoides*. This assemblage may indicate a distinguishable biostratigraphic zone in the lower part of the Cane Hill section.

The middle part of the Cane Hill section lacks the supposed *Homoceratoides* (except the reworked material) but contains *Reticuloceras*, *Retites*, and *Hudsonoceras* as well as longer ranging forms. This represents a second biostratigraphic zone in the Cane Hill sequence. The highest portion of the Cane Hill sequence has failed to yield *Hudsonoceras* but does contain some "advanced" components and may indicate a third biostratigraphic zone.

Cane Hill goniatites occur from the easternmost edge of Oklahoma to the eastern edge of Madison County, Arkansas, in some abundance. There is also some material from about fifteen miles south-southwest of Batesville, Arkansas, which contains goniatites of the basal Cane Hill biostratigraphic horizon. There is another locality on Lake Maumelle near Little Rock, Arkansas, which contains material referable to the second or *Hudsonoceras* biostratigraphic zone. Otherwise there are no known productive Cane Hill goniatite localities between Batesville and Madison County, although a section of siltstone and shale which may belong to the Cane Hill Member of the Hale Formation crops out in many places.

Middle Hale. The lower Pentremital limestone of Simonds was thought by Henbest to belong in the Prairie Grove Member of the Hale Formation. Gordon (1965 p. 39-40) identified limestone on the west slope of East Mountain in Fayetteville, Arkansas as "the lower Pentremital limestone", which he said "is overlain by about forty feet of calcareous sandstone . . . which belongs in the Prairie Grove Member." Gordon described two goniatites from a conglomerate lense at the base of the "first Pentremital limestone near West Fork, Arkansas, as *Gastrioceras henbesti* and *textum.* These indicate an advanced or descendant species of *Retites*, one of the most abundant of the mid-Cane Hill goniatites. The assemblage contains no "true" Gastrioceras but does appear to represent the first appearance of *Pygmaeoceras* which has been encountered in abundance in three places at the top of the lower Pentremital limestone. One is at the East Mountain-type locality for the taxon, one is on Kessler Mountain, and the third is at (but below) the type locality of the Brentwood limestone and the Bloyd Formation. This also is the type locality for *R. henbesti* and is doubtlessly the very place where Simonds developed the idea of the binary nature of the Pentremital limestone (Brentwood Member of the Bloyd Formation). It is also evidently the place where Henbest conceived the idea that the Prairie Grove Member of the Hale Formation *grades* into the Brentwood. The position of the Prairie Grove sandstone is here occupied by dark shale as it is in both localities mentioned above. At the East Mountain locality *P. pygmaeum* occurs high in the shale, indicating its mid-Hale affinities. Thus the Prairie Grove strata does not grade into the Brentwood but in fact the whole of the Prarie Grove section is missing above the *R. henbesti* type locality. The mid-Hale section is rich in brachiopods and *Pentremites* and goniatites are quite scarce in most places. The rock is mainly limestone and may be from a few inches to forty or fifty feet thick. (Behind the I.G.A. Store at Evelyn Hills Shopping Center the contact of the Middle Hale and the Cane Hill strata is exposed in the wall of the excavation made for the store.) Twenty to thirty feet above the mid-Hale limestone a six foot layer of Prairie Grove ss. crops out and the Brentwood is exposed behind the "Colonial Village" above and south of the I.G.A. Store. Failure to recognize the mid-Hale stratigraphic unit has caused considerable confusion not only with respect to faunal distribution but also concerning the value of unconformities involved.

Prairie Grove Member. With a single exception the goniatite fauna of the Prairie Grove Member of the Hale Formation seems to be without complexities. The exception is a locality on Bradshaw Mountain near Green Forest, Arkansas. At this place one of the typical Prairie Grove forms, *Arkanites*, occurs in abundance at and above the contact with a Cane Hill lithic unit. *Arkanites* is in the lower part of a sixty foot calcareous standstone typically Prairie

Grove in aspect. In the base of the section a few *Retites* were recovered which *appear* to be reworked. The assemblage includes a completely exotic goniatite *Baschkirites*. Everywhere else the Prairie Grove assemblage involves principally *Arkanites* and *Gastrioceras s. s.* (first appearance).

Since the discovery at Bradshaw Mountain of *Arkanites*, an exceptionally distinctive taxon, this form has been encountered almost everywhere in Prairie Grove strata, from Bragg's Mountain near Muskogee, Oklahoma, eastward to the Snowball Quadrangle about sixteen miles west of Marshall, Arkansas. With the exception of the Bradshaw Mountain anomaly *Arkanites* occurs everywhere in association with *Gastriocearas* (undescribed) which is also quite distinctive in that most small specmens have a ventral furrow, all are cadicone, and all have strong ribs around the umbilicus. A rule of thumb criterion is that the first or second goniatite from any Prairie Grove locality will be *Arkanites*. Gordon (1965) did not report *Arkanites* and it appears that none of his collections actually were derived from Prairie Grove strata as here defined.

The north-south distribution of *Arkanites* in Oklahoma is from Bragg's Mountain to Caddo Village near Ardmore, Oklahoma, and in Arkansas from Bradshaw Mountain to the latitude of Cass, Arkansas, and Marshall, Arkansas.

The Hale goniatite assemblages are quite distinct from those of the Bloyd Formation but there is closer relationship than between Hale and Imo of the late Mississippian.

BLOYD FORMATION

Several biostratigraphic horizons are distinguishable in the Bloyd Formation. These include two horizons in the Brentwood Member of the Bloyd Formation and one in the Dye Shale-Kessler Members, as well as a probable "Trace Creek" horizon.

Brentwood Member. The Brentwood Member of the Bloyd Formation is a limestone unit ranging to as much as twenty feet thick. The strata crop out principally in Washington County, Arkansas where the Brentwood limestone is overlain by a shale interval and a supervening limestone to conglomerate unit prevoiusly unrecognized and which contains goniatites here called Gaither Mountain assemblage.

The Brentwood limestone contains rare *Cymoceras* (a form abundant in the Hale assemblages) and equally rare *Bisatoceras secundum* (typical of the Gaither Mountain goniatites). Both contain *Brannerоceras* (confined to Brentwood-Gaither Mountain assemblage) and *Syngastrioceras morrowense* which ranges through the entire Bloyd section.

Cymoceras occurs in the Union Valley Formation of southeast

Oklahoma, indicating direct and close affinity with Brentwood rather than younger assemblages (Quinn, 1962, pp. 116, 120).

The Gaither Mountain goniatites are like those of the Brentwood except that the genus *Gaitherites* is abundant, *Cymocreas* is absent, and *Bisatoceras secundum*, rare in Brentwood, is also abundant. *Proshumardites* is a component of Gaither Mountain assemblages but rare in the Brentwood.

The Gaither Mountain biostratigraphic unit appears to be much more extensive than the Brentwood. In the north-south direction it is expressed at Gaither Mountain near Harrison, Arkansas, and at Long Pool, near Dover, Arkansas, a distance of about sixty miles. *Gaitherites* occurs in a limestone near Webber's Falls, Oklahoma, at approximately the same latitude as the Long Pool site. The Gaitherites limestone crops out along the Frisco Railroad one-half mile south of Woolsey, and in the bed of West Fork of White River, one-half mile south of the Brentwood type loca.ity Gordon (1965, p. 242, USGS Loc. 2849) confused juveniles of *Gaitherites* from this place with *Cymoceras*. At the Brentwood type locality the Gaitherites limestone has not yet been isolated. Henbest (1953, p. 1943) expressed the idea that younger strata were deposited on a truncated surface which may have obliterated the Gaither Mountain horizon just at this place. Farther east on Porter Branch of White River it lies twenty-seven feet below the Baldwin coal and about an equal distance above the Brentwood proper. The unit can be traced eastward to the area of Limestone, Arkansas, where Pryor (unpublished M.S., 1967, p. 57) collected *Gaitherites* from a thick, brown, sandy sequence of rocks not otherwise identifiable. It appears that the strata containing *Gaitherites* thickens to the south and east of Gaither Mountain and is the principle unit in the beds Glick, Frezon and Gordon (1964) have called Witts Springs Formation. To the west, in Madison County, the Gaither Mountain horizon is represented by a thin stratigraphic unit between the Brentwood limestone below and the Winslow Formation above. The rock is siltstone, conglomerate (in places with cobbles), and lenses of limestone and sandstone or calcareous sandstone. In many places the position of the Gaither Mountain horizon is marked by a weathered zone or unconformity or a paleosoil horizon. In Washington County the Gaither Mountain horizon tends to range from ten to thirty feet thick and be composed principally of limestone rich in fossils. The Webber's Falls, Oklahoma, locality is in algal limestone. The Long Pool occurrence is a coarse conglomerate with a calcareous matrix.

Woolsey Member. The Brentwood-Gaither Mountain section of the Bloyd Formation is separated in places from supervening strata by a thin bed of coal and some associated sediments. Henbest, 1953, indicated that this part of the Bloyd is represented by continental deposits which he called the Woolsey Member of the Bloyd Forma-

tion. The continental interval is terminated upward by a limestone unit, conglomeratic in places, which Henbest called informally "cap rock". The cap rock is the basal unit of Henbest's (1962, p D43) Dye Shale Member of the Bloyd Formation.

Dye Shale Member. The section included in the Dye Shale Member of the Bloyd terminates upward in the Kessler limestone, which, as Henbest (1953, p. 144-5) pointed out, closely resembles the cap rock and has been consistently confused with it. The cap rock is never more than a few feet above the coal and the Kessler limestone is as much as seventy feet higher in the section. Where the coal is missing and one or the other of the limestones is not exposed, identification can only be based on proximity of the Brentwood-Gaither Mountain below or the Winslow Formation above.

The goniatite assemblage appears to range from the cap rock through the Kesseler limestone without discernible change. The taxa are quite distinctive. They include *Pseudoparalegoceras*, a form abundant in younger Pennsylvanian rocks; *Axinolobus*, confined to the Dye Shale assemblage, *Diaboloceras neumeyeri* which extends into the Trace Creek Shale above the Kessler limestone, and *Syngastrioceras* which does not occur above the Kessler limestone.

Trace Creek Member. The Trace Creek Member of the Bloyd Formation (Henbest 1962, p. D44) is a black shale unit of limited extent insofar as know which has furnished goniatites from a single locality on Lee Creek three miles west and two miles south of West Fork, Arkansas, in Washington County. The goniatites are *Pscudoparalegoceras*, *Diaboloceras neumeieri* (type locality for the species), *Boesites* and perhaps some other unidentified taxa, as well as such perennials as *Pronorites*. This assemblage is distinguished by the total absence of *Syngastrioceras*, an abundant form in all the earlier Morrowan. Absence of *Axinolobus* further emphasises the uniqueness of the Trace Creek assemblage. Palynological material from this locality also indicates a Morrowan aspect. Elsewhere this black shale is superseded, or its position occupied, by black shale of the Winslow formation which has furnished no goniatites but has a Westphalian B aspect insofar as the palynological data is concerned (H. Sullivan and R. Mischell, personal communication).

SUMMARY

The Morrow group of northwest Arkansas is early Pennsylvanian and includes the Hale and Bloyd Formations. The Hale Formation has been subdivided into the Cane Hill and Prairie Grove Members. The Cane Hill rocks are mostly black silty shale and flaggy siltstone with considerable conglomerate in places, especially along the northern border of outcrop. There are also extensive sand bodies of tabular or lensoidal shape some of which are calcareous and contain numerous fossils. The goniatites *Reticuloceras*, *Retites* and

Hudsonoceras occur with longer ranging forms. Above the Cane Hill section is an unnamed unit (the lower or first Pentremital limestone of writers) which contains advanced Cane Hill taxa, the longer ranging forms and *Pygmaeoceras pygmaeum*. The rocks of the unnamed unit are mostly limestones with vast numbers of brachiopods and numerous blastoids (*Pentremites*). Above this unit the Prairie Grove Member of the Hale Formation crops out in many places but appears to be somewhat discontinuous. The Prairie Grove rocks are mostly medium sandstones and reef limestones containing fossils in places including the goniatites *Arkanites* and *Baschkirites*.

The Brentwood Member of the Bloyd Formation lies unconformably on the Hale section and is mostly limestone containing the goniatite *Branneroceras* among others. Above the Brentwood limestone is an unnamed limestone section containing the goniatite *Gaitherites*, as well as *Branneroceras* and others. The upper part of the Bloyd Formation is separated from the lower part by a discontinuous coal horizon. The upper Bloyd contains the Dye Shale and Kessler Members which show a partially unique goniatite assemblage including *Axinolobus*, *Diaboloceras neumeieri* and *Pseudoparalegoceras*.

Kessler rocks are succeeded by a black shale which retains *D. neumeieri* but the assemblage is distinguished by the loss of *Syngastrioceras* and the appearance of *Boesites*. This unit has been described as the Trace Creek Member of the Bloyd Formation but the black shale of the type locality appears to belong in the Winslow rather than the Bloyd Formation.

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