

## Algal Origin of the "Birdseye" Limestone In the McLish Formation

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The McLish formation of the Simpson group was named by C. E. Decker from outcrops in the Arbuckle Mountains, where it is widely distributed. It consists of a basal sandstone member 50 to 250 feet thick and an upper limestone member 100 to 400 feet thick. From paleontological evidence Decker (1, p. 30) assigned to these beds a middle Ordovician (Chazyan) age.

The upper member of the McLish formation is composed typically of bioclastic echinodermal limestone, interbedded with shale, in the southern and western parts of the Arbuckle Mountains. Northward from the Mill Creek syncline, which roughly bisects the Arbuckle Mountains, bioclastic echinodermal limestone is uncommon and the fine-grained, calcite-flecked "birdseye" (Fig. 1) limestone is the most abundant rock type. This "birdseye" limestone is probably the most distinctive and easily recognizable rock in the Arbuckle Mountains, even small fragments of it being stratigraphically identifiable.

The principal distinction of the rock is the presence of irregular flecks and masses of clear calcite that reflect light as isolated sparkles. Decker (1, p. 26) commented on this feature as follows: "Some of this calcite occurs in worm borings, in gastropod shells, and in other types of organic openings." Recent studies on which this paper is based indicate that the calcite-filled openings are of several different types, including the interiors of molluscan shells, interstitial space between fragments of clastic limestone, contraction cracks, tectonic veins, and irregular spaces within the calcite precipitated as encrustations of blue-green algae (family Spongiostroma). These primitive plants furnished most of the openings and provided most of the calcium carbonate of which the "birdseye" limestone is built. Organically higher forms of algae, including spherical colonies of *Girvanella* and *Hedstromia*, also are present and even locally abundant, but as compared to the Spongiostroma they contribute insignificantly to the building of the thick "birdseye" limestone sequence.

According to Johnson (2), the Spongiostroma have contributed abundantly to the formation of limestones in the geologic column. They did not secrete calcium carbonate in their cell walls but precipitated it partly within the plant and partly as encrustations around growing surfaces. On the death and decomposition of the plant, the precipitated covering remained and preserved the organic form chiefly as a mold. The plants ap-

AP. NO.1 CHIPMAN  
11-1S-2E

GLOBE NO.1 CARR  
29-3N-2W

CALIF. NO.1 ROLLER  
36-4N-3W

WALKER NO.1 MOORE  
17-4N-3W

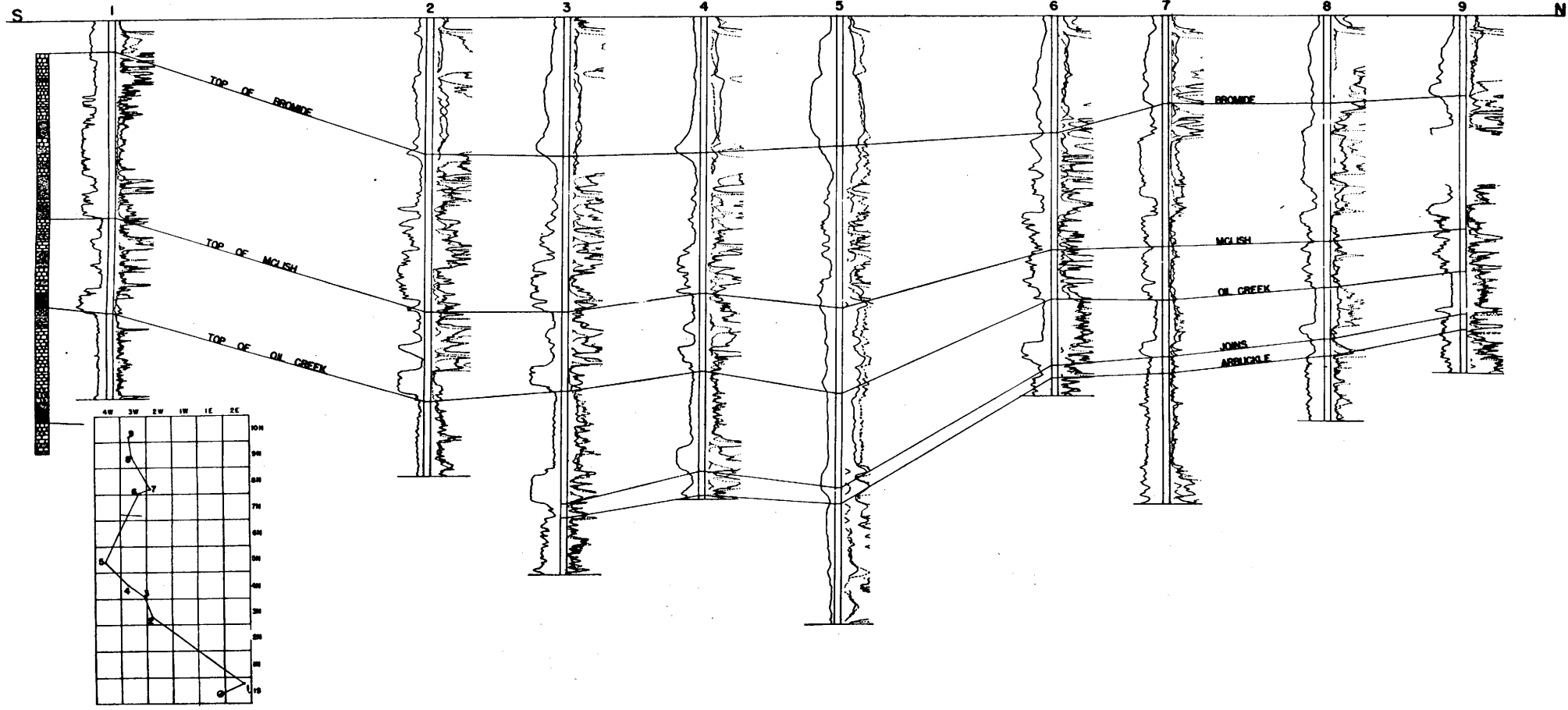
CITIES SERVICE NO.8-1 LAWSON  
22-5N-4W

DANNOI CALDWELL  
35-8N-3W

CARTER NO.3 JOHNSON  
30-8N-2W

SING. NO.1 ROSE  
21-9N-3W

MIDCON. NO.3 HARRIS  
29-10N-3W



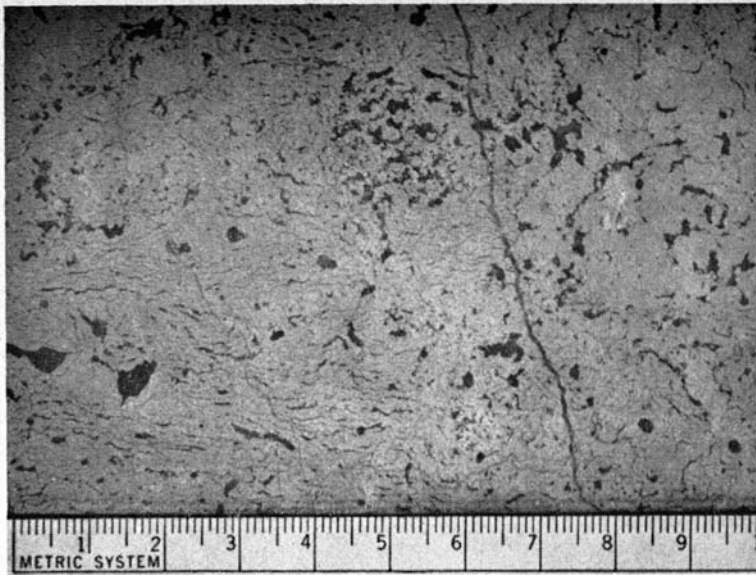


FIGURE 1. Polished Section of Typical "Birdseye" Limestone from the McLish Formation, Showing Calcite Fillings and Subparallel Arrangement of Algal Crusts.

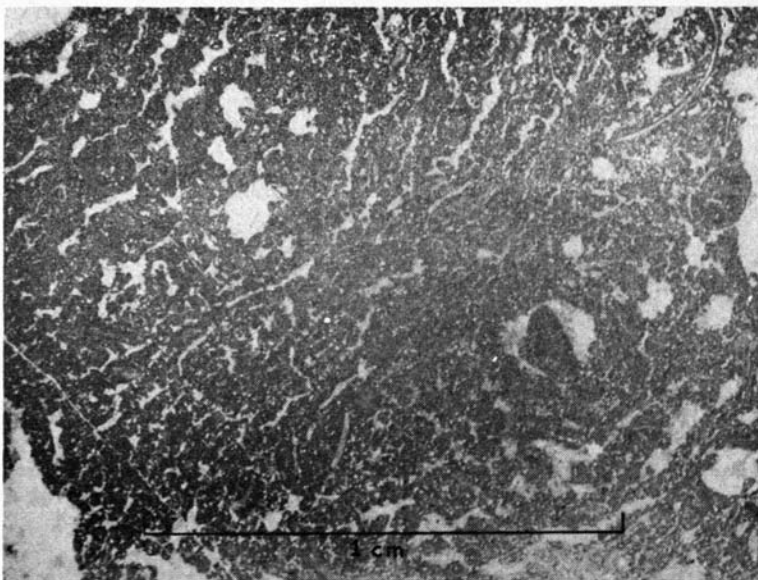
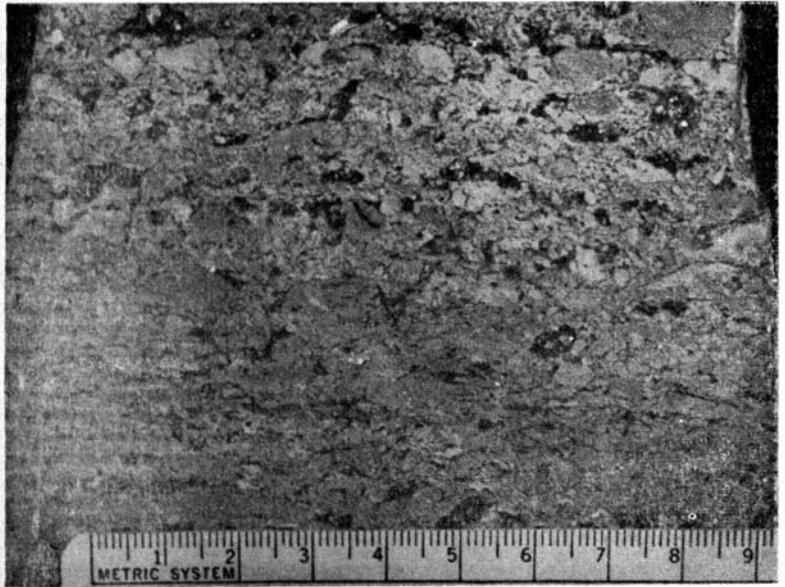


FIGURE 2. Photomicrograph of Figure 1, Showing Fine-grained, Algal-precipitated Calcite Forming the Main Body of the Rock, and the Coarse-grained Clear Calcite That Filled Irregular Openings. A small *Girvanella* is shown within the dotted ring.

parently consisted of very fine filaments that developed irregular, arching, matlike layers. As the mass was extremely porous and susceptible to solution, the precipitated calcite recrystallized rapidly and generally retained no microstructure. Some show well-defined cabbage-like colonies, on which form-genera have been established, but others lack distinctive growth form and have not been generically named.

Blue-green algae without well-defined and consistent growth form characterize the "birdseye" limestone of the McLish formation (Figs. 1, 2). The internal structures of typical McLish algae are practically identical with those of well-recognized algal colonies in the Arbuckle limestone, and are believed by J. Harlan Johnson, who kindly examined the writer's slides, to be representatives of the family Spongiostroma.

The precipitated  $\text{CaCO}_3$  in the matlike algal layers imparted a considerable degree of compactness and rigidity to the growing mass. If unmolested by storms, the algae grew upward through a thickness of 1 or 2 feet, each algal layer building on the calcitic framework of dead and dying older algae. Filling of the irregular openings of this framework probably began as soon as the gelatinous algal material decomposed. The sea water, already saturated with  $\text{CaCO}_3$ , as a result of intensive algal photosynthesis on the growing sea bottom, remained in the openings and was replenished by circulation with the main body of sea water through an interconnected maze of irregular passageways, thus bringing about complete filling of the openings with calcite.



**FIGURE 3.** *Clastic Phase of "Birdseye" Limestone, Showing Calcite Fillings in Interstitial Areas Between Subrounded Limestone Fragments and a Few Spheroidal Colonies of Girvanella.*

By filling the voids in the originally porous and structurally weak algal framework, the precipitated calcite filling bound the mass together into a competent layer that resisted compaction from the weight of overlying beds. The algal molds were thus preserved and now probably appear much as they did while the plant was living. Without this early calcite

filling, it appears likely that the fragile crusts would have been broken and distorted merely by compaction from younger sediments, and little space would have remained for later filling by calcite.

Before the time of calcite filling, the algal framework was not sufficiently rigid and strong to survive storms. Many times storm waves penetrated to the sea bottom and broke the calcite encrustations into pieces which were rounded by attrition and arranged into cross-bedded layers. Following storms, suspended clay commonly settled over the layer and ultimately formed a shale lamina. The lime-sand beds were rather well sorted and thus contained interstitial voids, which were filled by precipitated calcite in much the same manner as openings in algal crusts (Fig. 3).

#### REFERENCES CITED

1. DECKER, C. E., AND C. A. MERRITT. 1950. The stratigraphy and physical characteristics of the Simpson Group. Oklahoma Geol. Survey Bull 55.
  2. JOHNSON, J. HARLAN. 1951. An introduction to the study of organic limestones. Colo. Sch. Mines Q. 46 (2).
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