AGE OF THE MALONE FAUNA

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The geological age of the Malone fauna, described in 1905 by Cragin,[1] has been a subject of considerable uncertainty. Chiefly on the evidence of ammonites, Cragin assigned the entire sedimentary sequence in the Malone Mountains and Hills to the upper Jurassic (Tithonian). More recently, however, Burckhardt,[2] Kitchin,[3] and Adkins[4] have agreed that while the ammonites described in Cragin's bulletin are Jurassic, some of the pelecypods (notably the Trigonias, which are closely allied to Valanginian species) prove the existence of Cretaceous strata in the Malone formation. Consequently Adkins proposed the formational name Torcer for the hypothetically Cretaceous fraction of the Malone, restricting the latter to include only beds of Jurassic age. Supposedly the emended Malone carried the Jurassic ammonites, and the Torcer the Trigonias and other pelecypods with Cretaceous affinities. On this supposition, the disputed pelecypods have been used for correlation in Arizona[5] and Mexico.

The writer spent the summers of 1934 and 1935 in the Malone area, mapping it with plane table on a scale of one inch to a thousand feet. Extensive collections of fossils gathered at both old and new localities were referred to twenty-five carefully measured stratigraphical sections. The work was accomplished with the generous cooperation of Prof. M. P. Billings, Prof. P. E. Raymond, Mr. J. Fred

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[1]Cragin, F. W., "Paleontology of the Malone Jurassic Formation of Texas", *U. S. Geol. Survey Bull. 266*, 1905.

[2]Burckhardt, Carlos, "Etude synthetique sur la Mesozoic Mexican", *Schweizer. paleont. Gesell, Abh.*, Vols. 49, 50, pp. 82, 83, 1929-1930.

[3]Kitchin, F. L., "So-called Malone Jurassic Formation in Texas", *Geological Mag.*, Vol. 63, pp. 454-469, 1926.

[4]Adkins, W. S., "The Mesozoic Systems in Texas", *Texas Univ. Bull. 3232*, p. 256, 1932.

[5]Stoyanow, A. A., "Occurrence of the Malone and Torcer Faunas at the Base of the Arizona Comanchean", *Science, n. s.*, Vol. 83, p. 328, 1936.

Smith, Jr., and Mr. Jack D. Boon, Jr., all of Harvard University, and Mr. C. C. Albritton of Dallas, Texas. Inasmuch as the results of this survey have a critical bearing on stratigraphical work in progress elsewhere, it seems advisable to enumerate some of them in advance of detailed accounts to be published later.

1. The interbedded limestone and gypsum constituting some 300 feet of the basal portion of Cragin's Malone formation are of Permian (Leonard) age.[6] Previously these beds have been variously regarded as Permian, Jurassic, or Cretaceous.

2. The Malone formation, again emended so as to include only beds of Jurassic age, rests unconformably upon the Permian strata, and attains a maximum thickness of approximately 1,000 feet in the area surveyed. The formation consists of a lower division of limestone conglomerate, sandstone, sandy shale, and impure limestone; and an upper division dominantly of impure limestone. All Trigonias described by Cragin,[7] with the single exception of *T. praestriata* Cragin, and all ammonities with the exception of *Kossmatia aguileri* (Cragin) are restricted to the lower division, the Kimmeridgian age of which is proved by the occurence of *Idoceras schucherti* (Cragin), *I. clarki* (Cragin), *Lithacoceras malonianum* (Cragin), *Aspidoceras laevigatum* Burckhardt and *Neobrites nodocostatus* Burckhardt.

Exogyra potosina Castillo and Aguilera and *Kossmatia aguilera* (Cragin) are the only species described by Cragin which are restricted to the upper division. The latter occurs at the top of the emended Malone formation along with *K. zacatecana* Burckhardt, fixing the age of the upper division as upper Portlandian. Here as at San Pedro del Gallo[8] there is no evidence for the presence of lower Portlandian beds.

It should be emphasized that all species described in Cragin's bulletin occur in beds either with or stratigraphi-

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[6]Okulitch, V. J., and Albritton, C. C., Jr., "*Malonophyllum*, A New Tetracoral from the Permian of Texas", *Jour. Paleontology*, Vol. 11, pp. 24-25, 1937.

[7]Cragin, *op. cit.*

[8]Burckhardt, Carlos, "Faunes Jurassiques et Cretaciques de San Pedro del Gallo", *Inst. Geol. Mexico*, Bol. 29, 1912.

cally below those containing the species of *Kossmatia* noted above. Hence the Malone fauna, despite its misleading pelecypods, is of Jurassic age as Cragin maintained.

3. The Torcer is redefined to include only the Lower Cretaceous fraction of the original Malone. This embraces a minimum thickness of 400 feet of limestone, sandstone, and shale, with a persistent basal chert-pebble conglomerate and quartzitic sandstone resting conformably on the Malone. The basal member contains the diagnostic *Neocomites cf. indicus* Waagen along with the foraminifera *Guembelina paucistriata* Albritton and *Anomalina torcerensis* Albritton.[9] *Ammobaculites subcretaceus* Cushman and Alexander occurs higher in the section. The top of the Torcer is not exposed in the Malone area.

The present studies have confirmed Cragin's views regarding the Jurassic age of the Malone fauna. In this connection it should be noted that units B, C, D, and E, of the Mesozoic sequence west of the Laguna district recently described by Kellum[10] are probably correlative with the Malone formation as here emended, and hence upper Jurassic rather than Lower Cretaceous.

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[9]Albritton, C. C., Jr., "Upper Jurassic and Lower Cretaceous Foraminifera from the Malone Mountains, Trans-Pecos Texas", *Jour. Paleontology*, Vol. 11, pp. 19-23, pl. 4, 1937.

[10]Kellum, L. B., "Evolution of the Coahuila Peninsula, Mexico, Pt. III, Geology of the Mountains west of the Laguna District", *Geol. Soc. America Bull.*, Vol. 47, pp. 1065-1070, 1936.