

THE CLIMATIC INTERPRETATION OF TWO EARLY ORDOVICIAN MUD-CRACK HORIZONS.*

By E. M. KINDLE.

A mud-crack horizon which has not been previously reported occurs in the Grenville section on the Ottawa river. This horizon which is exposed on the north bank of the river immediately above the Canadian Northern railroad bridge is in the upper part of the Beekmantown formation. Its relationship to the associated beds is indicated in the section below which was studied by the writer in company with Dr. M. E. Wilson.

Section above C.N.R. bridge at Hawkesbury.

- a. Sandstone with coarse sand and fine gravel in upper part and fine sand in lower. Numerous vertical worm tube impressions (Base of Chazy) ----- 2'
- b. Thin bedded limy shale (top of Beekmantown) ----- 2'
- c. Dark grey fine grained limestone with botryoidal fracture ----- 8'
- d. Coarse textured grey limestone full of small fossils ----- 1'6"
- e. Thin bedded shaly limestone ----- 3'
- f. Heavy bedded grey limestone and covered 10'
- g. Thin bedded grey argillaceous and magnesian limestone with mud-crack throughout the upper 4' Resembles sandstone when weathered ----- 6'

Between *a* and *b* of this section there is probably a disconformity. All of the Ottawa valley sections show a rather abrupt change in lithology at this horizon. The change in fauna is equally marked.

The very sharp and clearly defined character of the fossil mud-crack in bed *g* of this section is its most noteworthy feature. The mud-crack polygons exhibit a rather unusual and significant feature in their upturned margins. Many examples of this mud-crack show the unwarping margins of the polygons rising above the centre as much as 1/4 inch. Associated with these is a surface structure suggesting raindrop impressions.

It has been shown experimentally¹ that this type of mud-crack results from the dessication of fresh water mud and that flat or slightly downwarped polygons develop from saline mud. Since mud-crack with upwarped margins is produced only in fresh or brackish water muds we must conclude that this mud-crack horizon represents intertidal mud-flats which were covered at high tide by relatively fresh waters comparable perhaps with those of the upper Baltic sea. The reappearance of a marine fauna in the section a few feet above the mud-crack horizon appears to indicate the return of normal marine conditions. The relatively fresh or slightly brackish water conditions under which these mud-cracks were formed point toward their development in lagoons near a shore which contributed an abundance of river water to partially land-locked arms of the sea. Such a land must have had a moist climate or at least not an arid one.

Another mud-crack horizon occurs about 100 feet higher in the Ontario Ordovician section at Kingston in the Pamela limestone. Cushing² has reported this horizon in New York and the writer has described its peculiar features at Kingston.³ Attention is directed to it here because it suggests climatic conditions near the close of Pamela sedimentation just the opposite of those indicated by the Grenville mud-crack. The flat polygons of the Pamela mud-crack horizon show features which have been interpreted⁴ as the product of a highly saline condition of the calcareous mud in which they were developed. Sea water would be likely to develop the high degree of salinity represented by the Kingston mud-crack only in an arid climate.

It seems therefore that a relatively arid climate prevailed during late Pamela time in the lands adjacent to the Ontario sea. This arid climate succeeded a cycle of moist climate in late Chazy time if the inference which has been drawn from the character of the mud-crack is correct.

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¹Kindle, E. M. Some factors affecting the development of mud-cracks. Journ. Geol., vol. 25, 1917, pp. 140-142.

Separation of salt and saline water and mud. Bull. Geol. Soc. Amer., vol. 29, pp. 479-483, 1918.

²Bull. N.Y. State Mus. Nat. Hist. No. 145, p. 76, 1917, pp. 135-144.

³The Ordovician Limestones of the Kingston Area. Rept. of the Ontario Bureau of Mines, vol. 25, pt. 3, p. 8, 1916.

⁴Kindle, E. M. Some factors affecting the development of mud-cracks. Journ. Geol., vol. 25, 1917, pp. 140-142.

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