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The Origin of the Extra-Morainic Till

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The trough of the Missouri has been formed since the advent of the Ice Age. Lake Cheyenne lingered till the waters from the great ice-sheet replenished it. Above Yankton the Missouri owes its present course, and possibly its existence, to the influence and interference of the ice-sheet. The distribution of pre-glacial lacustrine deposits, and the drift and loess, the character and height of the terraces the continued corrosion of the bottom of the trough to the present time, all sustain these conclusions.

THE ORIGIN OF THE EXTRA-MORAINIC TILL.

BY PROF. J. E. TODD.

(Abstract.)

This paper treated particularly of the morainic till of the Missouri Valley. To explain the origin of this till, there are two theories acceptable; one that it is sub-glacial, the other, that it was formed at the bottom of a glacial lake, gradually filling with debris brought from a glacier and the shore, by ice-rafts.

The sub-glacial theory is favored by (1) its close resemblance to till unquestionably sub-glacial. (2) striae on the underlying rocks, (3) the presence of osar-like ridges. (4) its difference from the reddish bouldery clay, often found above it, which is certainly of sub-aqueous origin, and (5) the thickening, and greater elevation of this till, near its outer margin, as along the east side of the Big Blue in Nebraska, suggesting an imperfect moraine.

Against these points, respectively, it was urged: (1) Close examination, not infrequently, reveals traces of stratification, by differences of color, and in the distribution of pebbles and boulders. (2) Striae are the exception, even on similarly prominent surfaces. They, in some cases, show on the same surface directions diverging 60 degrees, and

with equal freshness. Their direction sometimes does not harmonize with their glacial origin. (3) The osar-like ridges are sometimes found on the outer slope of the outer moraine, and so related to channels across it as to indicate their contemporaneous or subsequent formation, and therefore cannot furnish evidence for an ice-sheet, which must have long antedated the moraine. (4) Notwithstanding the differences between the till and red clay, the former has been found to sometimes to pass gradually into the latter, and thick strata of the latter often present the same features and structure as the former. Therefore the relation of these formations to each other seems to favor sub-aqueous deposition of the former, rather than otherwise. (5) The thickened and elevated till does not exhibit the knob-and-basin structure common in moraines, and may be rationally referred to debris accumulated by bergs stranding on a shelving shore.

After replying thus to the arguments for the first theory, the following points were urged in favor of the second, or glacio-natant hypothesis:

1. Moraines and traces of ancient drainage channels found attending areas, which have been certainly glaciated, are not found attending the drift under consideration.
2. The rare and slight disturbance of underlying formations forbids the idea that the region has been occupied by an ice-sheet.
3. The slight proportion of local material, in the extra-morainic drift, indicates the same.
4. The evident former horizontality of the western margin of the drift, and the absence of drift at a higher elevation anywhere outside of the principal moraine.
5. The difficulty of conceiving an extension of an ice-sheet over the extra-morainic till, without violating well recognized conditions of glacial motion.
6. The filling of Lakes Agassiz, Minnesota and Dakota, with till to a considerable extent, argues strongly by analogy that Lake Missouri may have been similarly filled.
7. The correspondence of the upper limit of the drift in Nebraska to the upper bouldery terrace of the Missouri above

the mouth of the Niobrara, indicates that the drift mentioned was deposited under water.

8. The relation of the till to certain deposits of volcanic ashes which in some cases are below the drift, and in other localities are in it and above the till, suggests a possible demonstration of the sub-aqueous origin of the till under consideration. This ash deposit was made in still water. If there was but one deposition of volcanic ashes (and there is no proof yet known that such was not the fact), the evidence would be complete.

DIRECTIVE COLORATION IN ANIMALS.

BY PROF. J. E. TODD.

(Abstract.)

The paper was the outgrowth of observations made on the Western plains. It is published in full in the *American Naturalist* for 1888.

While recognizing the validity of protective, ornamental and typical coloration, as defined by Darwin, Wallace, Belt and others, the writer claimed that a very considerable amount of coloration in animals remained unexplained. For such as are of service somewhat after the manner of distinctive badges and uniforms to troops, or as signal flags and lights to boats and cars, he proposed the name *directive coloration*.

The following synopsis presents the principal features and applications of the principle.

Directive coloration is that which is in any way useful to a species by assisting in mutual recognition between individuals, or by indicating one to another their attitude and probable movements. To this head are referred:

1. Marks and tints promoting recognition at a distance, to guide in straggling flights, or to bring stragglers together, [A].

2. Those indicating the attitude of body, and its probable movement. [B] in darkness; [C] in close movements of