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On the Reproduction of Lost or Mutilated Limbs of Insects

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14. No red sandstones or shales were reported by Mr. Swan.

15. Below the sandstones of formation 13, granite was reached. Possibly this was quartzite (see Lake City well, formation 14), and so, formation 14 instead of 15. Unfortunately no borings are at hand.

The well was bored to increase the water supply at the grist mill. Flow, 1,000 gallons per minute of soft water. Total depth, 590 feet.

XII. The Mankato Well*—*C. W. Hall.*

Formation 1. Ordinary bowlder clay or till 290 feet.

2, 3, 4, 5, 6, 7 and 8. Wanting.

9. This formation is present beneath quarries and in all the surrounding bluffs. It is quite possible that a part of the material referred to formation 1 belongs here.

10. The borings at 380 feet show a dolomitic rock, possibly somewhat shaly. At 390 feet a green shale and sandstone comes in. Estimated thickness of this formation 160 feet.

11. The drillings from 450 feet to 850 feet show a clear white sand having at the top a slightly pinkish tint. Thickness of these white sands 400 feet and more.

12. At 915 feet a red shaly sandstone appears which may be the representative of this formation in the southwest.†

13. From 1,010 to 1,240 feet the drillings are entirely sands and rather coarse in texture. The color at 1,010 feet is pink, at 1,240 feet nearly white. Thickness not less than 230 feet.

14. At 1,265 feet a pink color comes in which at 1,340 becomes red. The red color with an occasional fading into pink continues to the bottom of the well. The drillings saved from 1,875 feet down to the bottom, seemed to show a fine red shale at every point. Total depth 2,204 feet. The well is not at present used for water supply.

[*Paper T.*]

On the Reproduction of Lost or Mutilated Limbs of Insects.—*O. W. Oestlund.*

The reproduction of a lost limb is a fact well known to take place among the lower arthropods, especially the crustaceans and spiders. Such a lost limb is not produced by a gradual growing out, as might be supposed, like the growth of a limb or twig of plants, but the growth is internal and the limb does not appear

*See further details by Warren Upham in Geol. and Nat. Hist. Sur. Minn. Final report vol. I. pp. 422 et seq.

†Another view is that this rock may represent the top of the Potsdam, and that here, near the margin of the Saint Croix sea, no shales corresponding to formation 12 of the Mississippi river valley were formed. In that case No. 11 above would stand for the entire thickness of the Saint Croix, or formations 11, 12 and 13. There is no sufficient geologic reason why the Potsdam may not contain white and gray sandstones as well as pink and red.

until after the next moult, when the same will expand and become filled with the fluids of the body just as all the appendages of insects are first formed within the skin of the pupa and on emerging from the same expand. Such a reproduced limb is easily distinguished by not acquiring the same size as the original, being always somewhat smaller.

The hexapods, or true insects, apparently make an exception, as there is no case on record, as far as known to me, where a lost or mutilated limb will be reproduced in comparison with the very common occurence of this among the spiders and crustaceans.

From the nature of the reproduction of a lost limb for the lower arthropods, which takes place only after a moult, it would follow that the same would not be reproduced if lost after the last moult has been passed. This is just the case with insects in the imago-stage, and we have only to show that such a limb can be reproduced if lost or mutilated previous to the emerging of the insect from the pupa, to put the hexapods on the same footing as the lower arthropods in this respect.

A fine specimen of *Tremex*, one of the "horntails" of the hymenoptera, that I had the good fortune to find some time ago, would seem to cast some light on this subject. It is apparently a five-winged specimen, the left fore-wing of which, from some cause or other, has become injured to such an extent as to be of no further use for flight; less than one-half of it is still left, torn up in threads hanging down the body. Along side of this torn wing there is a second one that has grown out to take its place. This additional wing has the characters of a reproduced organ, being smaller and the venation less perfectly developed. What still remains of the torn wing would indicate, on the other hand, that it would have been of the same size as the right fore-wing, if not injured. Both the hind wings show perfect development. Fig. 3.

Fig. 3.

Two explanations might be given for the condition of this specimen. If we suppose, in the first case, that the injury to the wing was received after the insect had emerged from the pupa, the new wing would then have been produced irrespective of moulting, a case which stands at variance with all known facts in regard to the reproduction of lost limbs of arthropods. On the other hand we may suppose that the injury was received while still

in the immature stage, and that the new wing was produced from internal growth, and ready to take the place of the injured one on the emerging of the insect from the pupa, thus analogous with the reproduction of lost limbs of spiders and crustaceans.

If this be the case, which appears most likely, we may draw the following conclusion: *All the arthropods, including true insects, are capable of reproducing lost or much mutilated limbs, if the same takes place previous to a moult or while yet in the immature stage.* From the difference in habit of true insects from the lower arthropods, we might also infer that the reproduction of a lost limb would more readily and often take place among the latter, while not absent in the former, as facts also show.

March 2, 1886.

[*Paper U.*]

SOME NOTES UPON THE MORE RECENT FOSSIL FLORA OF NORTH DAKOTA AND AN INQUIRY INTO THE CAUSES THAT HAVE LED TO THE DEVELOPMENT OF THE TREELESS AREAS OF THE NORTHWEST.—*John B. Leiberg.*

A most noticeable feature of the prairies of North Dakota, west of the Missouri river, is the immense amount of silicified wood scattered everywhere over the surface.

This, in a region now almost devoid of arboreal vegetation, naturally leads one to speculate on the causes that have operated to destroy this ancient forest growth and prevent any other from taking its place in modern times.

We find that the land is covered by a rich and fruitful soil, producing various kinds of herbaceous plants in great abundance, and the average rainfall is sufficiently large to warrant us in not classing the climate as arid.

Various theories have been advanced to account for this absence of forest covered areas in the Northwest: one of the most commonly accepted being that which ascribes the cause to the annually occurring prairie fires, consuming with the dry grass such seedlings as during the summer had found a lodgment.

For some portions of the western prairie region this theory is doubtless, in the main, the true one; but in the extreme Northwest, from the Rocky Mountains eastward, other causes have been