region. We have also found well-defined membranous flaps protruding from the posterior opening of the branchiocephalic shield in *T. mickwitzi*.

But the most significant discovery was the finding of one and probably two pairs of jaw-like crushing plates in their natural position in two widely different species, *T. mickwitzi* and *T. schmidti*. In both species, they are definitely located on either side of a slit-like longitudinal mouth which is ventral in position, not terminal; and the jaws evidently work sidewise against one another, not forwards and backwards, as they do in typical vertebrates.

Moreover in *Dartmuthia* and *Trematapis* there are four pairs of conspicuous endoskeletal plates and processes arising from the inner lateral surface of the cephalic shield and pointed towards the mouth. They evidently serve, in part, for the attachment of four sets of muscles and clearly indicate that there are really four non-respiratory oral segments in front of and serially homologous with the eight respiratory gill segments. All this agrees with the location of the several pairs of oral arches (premaxillae, maxillae and mandibles) in the embryos of the higher vertebrates. It also agrees with the postulates and predictions of the arachnid theory of the origin of vertebrates.

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THE OCCURRENCE OF OLD MEADOW SOD UNDER THE NEW JERSEY BEACHES

A STUDY of the changes in the position of the shoreline of any coast is very important, but along the New Jersey coast such a study is of particular significance because of the immense amount of money invested in the summer resorts of that state.

There has been some difference of opinion in regard to the question of whether the coast of New Jersey is actually sinking at the present time. Some seventy-five years ago, Dr. George Cook, then New Jersey state geologist, presented evidence which he thought showed that the coast of Cape May County was sinking at the rate of two feet a century or one quarter of an inch a year. Others have expressed the same opinion.

More recently, however, it has been shown that the changes in shore-line may have been brought about by factors other than the subsidence of the land, mainly the erosive action of the waves and currents on the sand beaches. Dr. Douglas Johnson, who has studied the situation thoroughly, says that the evidence favors unusual stability of the land during the past few thousand years.

No matter which interpretation we accept, there still remains undeniable evidence of marked changes in the position of the shore-line along this coast. Cook in the report of the New Jersey state geologist for 1881 pointed out that at numerous places along the coast the wearing away of the beaches had exposed old salt meadow sod on the ocean shore. Since there is no such sod along the shore outside the beaches, this old sod must have grown there when it was a part of the meadow between the beach and the upland, thus indicating a considerable change in the position of the shore-line. At certain places in this sod were to be seen the stumps of old trees, suggesting that the region at one time supported an upland association.

In his volume for 1882 Dr. Cook says that there has been a common report that these meadow sods along the sea border, in some places which were uncovered by violent storms, were plainly marked with the tracks of horses, cattle and sheep. After the severe storm of September 21, 22 and 23, 1882, such tracks were plainly visible a few miles south of Harvey Cedars, Long Beach Island, N. J. They were found in a patch of old meadow sod about three feet below ordinary high-water mark. The sod was thickly marked with the tracks of horses and cattle. The horse tracks were of various but rather small hoofs and without shoes, and the cattle tracks were also of various sizes. The sod and tracks extended back under the hillocks of beach sand.

At that time (1882) that part of the beach had few if any domestic animals on it, but in 1690, when it was settled, horses and cattle were kept on the island which at that time extended considerably farther out to sea.

In the sod near these tracks were seen the stumps of numerous trees and bushes.

Some fifteen years ago, similar tracks of cattle, horses and birds were reported in sod near South Cape May, N. J., exposed after severe storms.

In the last few years patches of this old meadow sod containing the stumps of trees, roots of grass, etc., have been seen in several places along the beach in the vicinity of Cape May. After the heavy seas of early January, 1931, some three feet of sand was eroded from the beach at Cape May Point, exposing the old sod at several places. Stumps of red cedar trees and roots of various plants were seen. Near low-water mark, close to the Cape May Point Coast Guard Station, was seen very clearly the remains of an old corduroy road leading from the present shoreline out toward the sea in the direction of Prissy Wick Shoal, about one mile distant. Tradition says that less than one hundred years ago this shoal was above water and was separated from the present shoreline by low-lying land, and that it was possibly the site of the original Cape May Lighthouse. A study

of maps of the region in the time of the Revolutionary War shows that the land extended considerably farther out than it does at present, and that there was a road approximately in the position of the corduroy recently uncovered; it therefore seems quite probable that this corduroy road is the old road leading to the now submerged Prissy Wick Shoal.

On April 6, 1931, the road was again exposed, this time more distinctly. On a patch of sod, about one tenth of a mile west of the log road, were seen several horse footprints. As far as can be learned, this patch of sod had not been uncovered for at least several years. This locality is about one half a mile distant from the one near South Cape May where the tracks had been seen some fifteen years previously.

The fact that these tracks were of shod horses, while those reported by Cook at Harvey Cedars were of unshod animals, suggests that these tracks may not be quite as old as those previously seen. Nevertheless, the fact that these tracks have persisted in this sod superimposed by a thin layer of sand and covered by the sea twice a day seems interesting and suggestive of how fossil tracks are actually preserved. These horse tracks may possibly be regarded as "fossils in the making."

A more detailed and illustrated account of the occurrence of this meadow sod beneath the New Jersey beaches will be published elsewhere in the near future. This preliminary note is published in the hope that some one may report similar occurrences elsewhere.

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TWISTED TRUNKS OF APPLE TREES

THE recent discussion relative to the twist in the trunks of certain trees has been interesting. I have carefully examined apple trees in orchards from Iowa and Minnesota to New York and Pennsylvania, and have noted that a large percentage of old trees are strikingly twisted. The twist has nearly always been to the right. The variety of apple does not seem to make any difference. It is more likely a matter of age. At least it is more readily seen in the older trees. Soil and position of the orchard does not change the character of the twist. In some orchards nearly 100 per cent. of the trees were twisted. It probably has nothing to do with wind or weather, but is more likely a form of tropism. A great many climbing plants twist in the same direction. Many species of trees also twist the same way. So far as I have observed, a twist to the left is rare. I have been told that in the southern hemisphere the twist is dominantly to the left. If this is so, then the condition is surely the result of the influence of sunlight and position with respect to the equator. In this respect it is like the trade-winds. I am strongly inclined to believe that the twist is the direct result of the influence of sunlight, similar to the turn of the sunflower and the leaves of the compass-plant of the western prairies.

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EARLY UTILITARIAN APPLICATION OF TWIST IN TREES

THE twist in the grain of coniferous and deciduous trees discussed by Chas. K. Wentworth in SCIENCE, February 13, and by Arthur Tabor Jones in the issue for March 27 was advantageously adapted to the service of agriculture in America in the 18th and the early part of the 19th centuries. Trees having a left-hand twist were then used in the construction of the mold-board portion of the so-called "wooden plow" of that period.

The length of the mold-board was determined in a measure by the angle of the grain twist since its strength depended upon the extent to which cutting across the grain of the wood became necessary in the shaping of its warped surface. The length of the wooden mold-board was, for this reason, considerably greater than that of the present day all metal plow. Clearly enough a large size hardwood tree having a close left-hand twist was greatly prized by the plow maker as he was able to secure from such a tree the raw material for the mold-boards of several plows.

When the mold-board, land-side, handles and other portions of a plow had been assembled all parts that came into contact with the soil in plowing were armored, or as it was then termed "plated," with thin wrought iron straps and plates formed to fit the wooden parts to which they were riveted. At that time all bolts and their nuts were hand made and were, therefore, more costly than hand-made rivets and key-bolts.

The occupation of "wooden plow" making was entirely confined to the individually owned small-shop period of American manufacturing industry. The plow maker, assisted, possibly, by one or more apprentices—men legally bound by agreement (articled) to his service for a period of years—performed every portion of the work. He selected the twist grain trees in the woods, cut and hauled them to his shop, attended to the proper seasoning of the wood and in the actual manufacturing operations became carpenter and blacksmith in turn. He marketed his finished product and for the most part received therefor other goods in exchange rather than real money.

One of these early American "captains of industry" was a Nathaniel Edwards, who was born June 21, 1752, Haverhill, Mass., and who died June 14,