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I

Tertiary Forest-floor with Erect Stumps lately Exposed in Sendai.

By

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With Pl. I & II.

The geology of the environs of Sendai is apparently simple but very interesting. Among many other interesting geological problems, the mode of formation of the lignite seams, found well developed especially in Mukoyama, facing the city of Sendai beyond the Hirosegawa, attracted the attention of Prof. H. Yabe, soon after his coming to our Geological Institute in April, 1912. He soon found many erect carbonized stumps of wood in close connection with the lignite seams, at many places and especially in the narrow but very deeply cut valley called Tatsunokuchi. He further noticed the importance of the underclay almost regularly underlying these lignite seams, with numerous rootlets usually vertical to the upper stratification plane and branching downward. Thus he confirmed the autochthonous formation of these lignite seams.

Usually these erect stumps of wood are found rooted in a bed of underclay, piercing the overlying lignite seam and covered either by fluviatile sand and gravel or volcanic tuff. There are about 10 lignite seams in Mukoyama and in connection with nearly all of them are found such erect stumps; but these stumps, especially the big ones, are found most often at that horizon of lignite underlying a thick deposit of tuff, now usually known among us by the name of Hirosegawa tuff.

The cloud burst of Aug. 26 and 27, 1913, caused a disastrous flood

over an extensive area in the northern part of Honshu, resulting in immense damage to property and innumerable physiographic changes of land. At this time, the water of the Hirosegawa, flowing by the city of Sendai, along its south-western border, swelled also in an unusual manner, some 5-6m. higher than usual according to the breadth of the valley. It is not my purpose in this place, however, to mention the great damage done. But one of its effects—a quite unexpected one—I think, is geologically noteworthy; namely in this flood, the river bed became here and there almost completely deprived of the thick alluvial deposit, sand and gravel having been swept away by the flood and accumulated elsewhere, and what had previously been hidden under the thick covering is thus now uncovered. In this way, at a point about 250 m. to the west of the university grounds, and just below the bridge Koeji came to light a Pliocene forest-floor with many erect stumps of wood well preserved.

The annexed sketch map (Pl. II, Fig. 2) in 1:2500 shows the place where this natural exposition took place; along the eastern cliff of the valley, we see the thick Hirosegawa tuff and an underlying lignite seam together with the sand and shale beds in regular succession; all these beds inclining but little downstream, the lignite seam and the underlying sand and shale soon sink down below the surface of the river bed, which, after the flood, for a while bore only a thin covering of sand and gravel.

On the ground, within some 600 sq. m. (Fig. 2), there are found exposed 5 large stumps of wood and many other smaller ones; on the sketch map the position of only the larger ones is plotted, numbered 1-5 in the order from north to south. Stump No. 1 is the largest of all, measuring 4.05 m. in circumference; it stands vertically in the Hirosegawa tuff near its base. Although its direct connection to the lignite seam is not visible, yet I think this is beyond doubt. No. II stands some 35 m. apart from the preceding

nearly to the south ; it measures 3.20 m. in circumference ; this and the following three are cropping out of the river bed through a thin layer of alluvial sand and gravel, appearing as if recent stumps still living. No. III is about 15 m. distant from No. II to the west, and No. IV about 30 m. from No. II a little west of south. No. V, some 20 m. apart from No. IV and about 80 m. from No. I to the south, is the second largest, being 3.5 m. in circumference ; this is shown on Fig. 1. Pl. II.

All of these stumps as well as numerous smaller ones are partly carbonized and partly silicified ; their preservation is very excellent, even examined under microscope ; and year rings are distinct macroscopically, without any trace of much obliteration under pressure of the overlying deposits ; in some examples, bark also is found preserved. The larger stumps are mostly hollow inside.

The extension of the fossil forest-floor, thus actually exposed along the stream, is very limited ; but we have good reason to believe there is a further extension under the water of the Hirosegawa, for children swimming in it tell me of many similar erect tree stumps on the bottom of the stream some 200-300 m. below the spot I have referred to.

Huge erect stumps in the Tatsunokuchi being likewise preserved in the Hirosegawa tuff, the evidence for the wide extension of the forest-floor seems quite certain. By this not only is Prof. Yabe's opinion verified regarding the terrestrial autochthonous origin of the lignite seams or at least of that underlying the Hirosegawa tuff,¹ but also his view that the Hirosegawa tuff is probably subaerial

1) Similar erect tree stumps are not seldom in European browncoal seams ; a very magnificent instance found in the Miocene browncoal mine of Maria Nordwestfeld in Nieder-Lausitz, Silesia, is given by Prof. H. Potonie in his *Lehrbuch der Pflanzenpalaeontologie* p. 344. Prof. J. Rein also once reported the occurrence of a big tree trunk in the oligocene browncoal seam near Liblau in Rheinland. In both cases, the trunks are known to belong to bald cypress, *Taxodium distichum* (Mitteil. d. Deutsch. Dendrolog. Ges. No. 16, 1907. pp. 117-118).

deposit, is rendered more and more plausible.

Explanation of Plates I and II.

Pl. I. Fossil forest-floor lately exposed in the Hirosegawa under the Koeji bridge ; the slightly inclined dark line to the left of the children is the outcrop of the lignite seam underlying the thick Hirosegawa tuff, while the deposit beneath the seam is underclay. Further 4 large tree stumps are visible in the photograph.

Pl. II.

Fig. 1. The stump No. 5.

Fig. 2. Sketch map of the place where the fossil forest-floor is exposed.

On the other hand, very little attention has been paid hitherto to the mode of the formation of the browncoal and lignite seams so widely distributed in our country, Mr. S. Matsuda probably being the only one who has made some definite contributions on the subject ; namely he found a slender tree trunk several miles east of the town of Shirakawa in the province of Iwaki, rooting in underclay and standing perpendicular to the stratification plane through the overlying lignite seam, sandstone and shale (Jour. Geol. Soc. Tokyo. Vol. VI, 1899. p. 30.)