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TREE TRUNKS PRESERVED IN A VOLCANIC FLOW IN THE NORTHERN CAMEROONS

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ABSTRACT. An unusual occurrence of casts of trees trunks preserved in a Tertiary flow of olivine basalt is described from the French Cameroons, the mode of preservation is discussed, and the few hitherto known phenomena of a similar nature are described. Finally, a record of the microscopic examination of the material is given.

A unique occurrence[1] of tree trunks in a late Tertiary basalt flow was recently discovered by the writer on the roadside between Meiganga and Ngaoundere, Northern Cameroons, 17 kilometers south of the latter. Embedded within a porous lava flow consisting mainly of black and brown-red (oxydized) scoria are several well-defined and some less recognizable petrified tree trunks with a maximum length of one meter, 20 cm. and a diameter up to 60 cm. What makes them so remarkable is the mode of preservation—though the tree shape is evident, the material consists of porous lava and no trace of organic matter or internal tree structure can be found (plate 1).

Within volcanic agglomerates and tuffs all the world over, the Cameroons included, remnants of plants and trees are not uncommon, the process of preservation more or less resembling normal sedimentation. In a true lava flow, however, such preservation is rare, although there are several instances of it.

Best known is Macculloch's upright tree (often called the "fossil tree of Burgh") at Kinlochscridain, on the west coast of Mull, Scotland. Nearly 5 feet broad and 40 feet high, the cast is largely filled with breccia, consisting of lumps of white trap and charred wood. The lower part encloses a partially silicified semi-cylinder of wood glittering with quartz crystals. A. C. Seward and R. E. Holttum describe this material as charred wood, very friable in texture, the tissues relatively

[1] The outstanding importance of this discovery was pointed out by the writer to the appropriate authorities at Ngaoundere, Yaounde, Brazzaville, and the Ministère de la France d'Outre Mer, Paris, with the request that in the interest of science the locality be fenced in. When the writer, accompanied by Monsieur Nickles, Géologue principal du Service des Mines, Brazzaville, visited the locality half a year later, the place had been turned into a quarry for road repairs by the Chef de Région of Adamaoua, and thus this rare phenomenon had ceased to exist.

soft and not petrified. Though the preservation is far from perfect, the annual rings being well marked but crushed, the tree definitely belongs to the comprehensive genus of *Cupressinoxylon* (coniferous wood).

If we consider the rapid destruction of organic remains by excessive heat from a body in a crematorium to any organic matter dropped into a blast furnace, it is obvious that the preservation of wood texture is due to exceptional conditions. The Geological Survey of Scotland report (1924, pp. 111-113) refers to a "prominent bed of red ash" close to the tree, while in the case of the Tavool tree, an analogue of Macculloch's

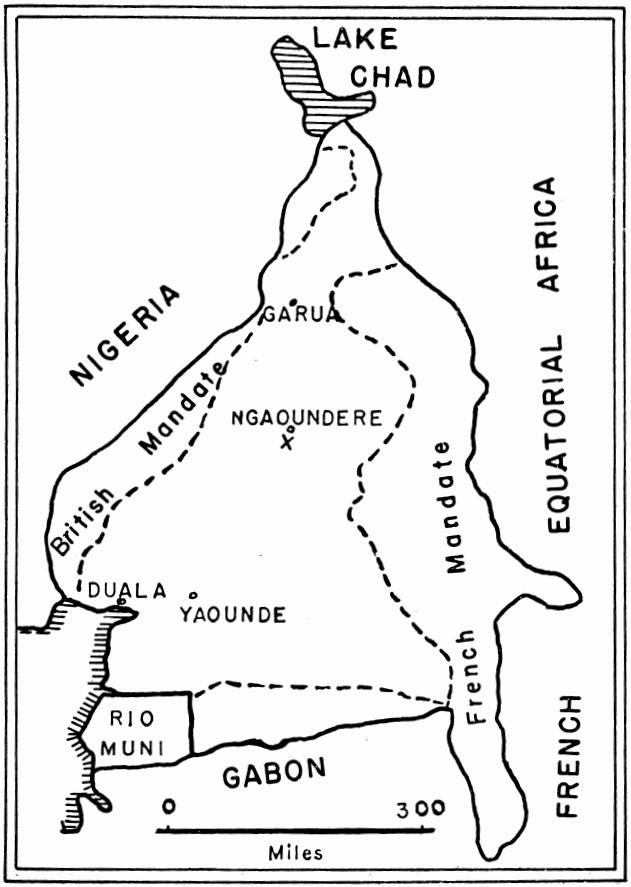

Fig. 1. Index map, showing location (X) of features discussed in text.

tree, near the north shore of Loch Scridain, Mull, the breccia is "rather more like an ash than a lava."

It seems to the writer that pre-existing explosive material, tuff or ash, acted as a "thermal cushion" neutralizing the heat effects in the same way as does a layer of asbestos around hot pipes. This theory is supported by the orientation of the basalt columns which, in accordance with the well-known laws of consolidation, arrange themselves at right angles to the surface of cooling. It is obvious that here a considerable "unit of low temperature" existed. The Survey report states in the case of Macculloch's tree "everywhere the columns are at right angles to the junction line and thus most arresting combinations are produced, including rosettes and fringes." And of the Tavool tree, "as the columns approach the mass of vegetable matter, they seem to tilt up away from it."

The second instance of preservation in lava was pointed out to the writer by Dr. Campbell Smith of the British Museum (Natural History) who showed him two interesting specimens originating from São Miguel, Acores. One was a cylindrical hollow of a small tree trunk which had been burnt away within porous basaltic lava, resembling a honeycomb, which had enclosed coal. Pieces of the original coal are believed to have been found, but unfortunately they could not be traced.

Of this locality the late Professor C. Gagel merely states that within the walls of the funnel-shaped depression of Furnas, São Miguel, thin, leaflike strata of lignite have been found, roughly 300 meters above sea level, and a threefold change-over from trachytes to trachydolerites and basaltic lava, thus resembling the Sete Cidades.

While observing the hollow created by the destruction of the organic matter, the writer pondered: "What exactly would happen if in a later effusive phase the hollow was filled in with molten lava, in a similar way as the casts of the dead of Pompeii have been artificially reproduced with plaster of Paris?"

It was Professor W. T. Gordon of King's College, University of London, who kindly drew the attention of the writer to a phenomenon very closely resembling the tree trunks of Ngaoundere.

Henry M. Cadell has on several occasions, spread over 35 years, described the occurrences of plant remains, including

tree trunks and branches, in an olivine basalt of Carboniferous age, "the matrix surrounding the fossil consisting of a crystalline massive volcanic rock," within the Bo'ness coalfield of West Lothian, Scotland.

According to the examining scientist, M. R. Kidston, the "outer surface might be described as an imperfectly preserved specimen of *Knorria*, which however might have originated from a *Lepidodendron* or a *Lepidophlois*."

With the exception of a thin coating of iron oxide and perhaps a little carbonaceous matter mixed with it, the upper part of the original plant is entirely replaced by crystalline calcite.

Later, after 1910, further specimens were obtained, one standing vertically in the whinstone. None of the specimens showed any internal structure: "They were externally sharply defined and composed internally of well-crystallized quartz and calcite, or of amorphous quartz in thin chalcedonic laminae, evidently deposited slowly in an empty pipe from which, after the lava had consolidated round it, all the original wood had entirely disappeared."

The same author found in the Museum of Morelia in the state of Michoacan, Mexico, a block of scoria or spongy basalt full of charred heads of maize, the shape of which was perfectly natural and unaltered. Some centuries ago a cultivated field of ripe maize in the neighborhood had been overwhelmed with lava which has cooled so quickly around the heads of corn that they had not had time to burn away before the matrix became solid.

Different instances, according to H. H. Cadell, have lately been recorded of lava streams on Etna, Kilauea and other volcanoes which have overflowed forests and consolidated around standing trees without destroying them. During recent eruptions of Vesuvius and Etna the lava has been seen to consolidate around erect trees in the same way. The correspondence with the tree trunk occurrences at Ngaoundere is nearly perfect. We must assume that the latter first formed a hollow caused by pre-existing wood having been burnt away; so far the origin is identical.

But whereas in the case of Bo'ness the hollow was infiltrated by mineral solutions, probably of a hydrothermal nature, during the post-volcanic phase, in the Cameroons the hollows were

filled by a later lava flow. When and in what manner the breaking-up process of the tree trunks took place, as they are found today in irregular chunks without orientation, is difficult to say. To the writer it seems likely that the whole process of being submerged under a lava flow necessarily involved a certain amount of dislocation.

Though silicified wood occurs abundantly within the Northern Cameroons, the expert examination of a thin section by Mr. P. M. Game of the British Museum (Natural History) rules out any possibility of such material having given rise to the tree trunks as found in their present state. Mr. Game determined a portion of the questionable tree trunks as a fine-grained, vesicular olivine basalt containing brown hornblende and showing a faint flow structure. A thin section showed the following minerals (in order of abundance):

Augite occurs in idiomorphic equidimensional crystals, giving characteristic eight-sided sections formed of the (100) (010) and (110) faces. The largest crystal is 0.4 mm. The mineral is faint brownish-grey and nonpleochroitic; several sections show twinning (sometimes repeated) on (100); optic axial angle is meduim to large and the sign positive; the mineral shows distinct dispersion.

Amphibole, a brown hornblende which forms idiomorphic to subidiomorphic crystals showing the characteristic prism faces and cleavages of the group, the acute angle of the prism cleavages being truncated by (010); cross sections are therefore six-sided. The crystals are commonly from 0.1 to 0.2 mm. in diameter (*i.e.* of the same dimensions as the pyroxene). The mineral is strongly pleochroic: α pale straw-yellow. $\beta = \gamma =$ deep reddish-brown. The optic axial angle is approximately 90 degrees. The extinction in vertical sections is straight or nearly so.

Plagioclase in laths averaging 0.1 mm. in length, showing slight parallelism in places, is difficult to determine exactly on account of its smallness, but is probably labradorite.

Olivine, though less abundant than the pyroxene and amphibole, forms relatively larger crystals — up to 0.6 mm. in length. These are mainly idiomorphic, with somewhat stumpy habit. Most of the crystals are perfectly fresh though sur-

Plate 1

Fig. 1. General view of lava flow containing tree trunks.

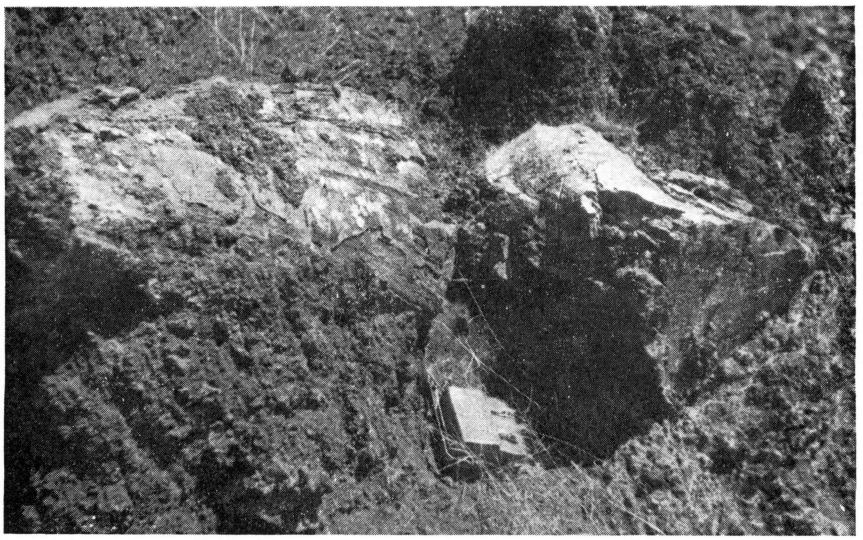

Fig. 2. Cross view of a section of tree trunk in lava flow.

rounded by a thin outer rim of iron oxide. The olivine is of a colorless magnesian variety with an optic angle of approximately 90 degrees.

These minerals are set in an opaque groundmass, extensively altered to hematite and pitted by roughly spherular vesicles from 0.1 to 0.2 mm. in diameter, which form from a quarter to a third of the whole rock. No infilling mineral was seen.

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