XXXVI. LICHENS AS WEATHERING AGENTS OF LIMESTONE

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The limestone of probable late Pennsylvanian age described in the following short paper is located on the summit of a hill in the western part of Section 23, T. 1 S. R. 2 W. in Murray County. The hill reaches an altitude of 1200 feet and lies immediately west of the Arbuckle mountains.

The limestone attracted the attention of the writer because of the many holes and irregular cavities developed in it. These holes, especially the large ones, appear to penetrate through the entire thickness of the bed, (3 to 5 feet) overlying a sandy shale. The limestone forms an aggregation of boulders and elongated angular fragments covering only a few acres. It appears to be only a remnant, capping the hill top, of a more continuous bed that at one time occupied the area.

The holes that penetrate the rock vary in diameter from less than an inch up to 12 inches. Only the larger holes reach entirely through the limestone bed. Those of smaller size extend through the smaller loose fragments. The larger holes appear to have grown until they coalesce with adjoining holes developing a system of long trenches or furrows that extend through the disintegrated bed.

The holes and furrows are obviously due to solution of the limestone and suggest a close resemblance to a particular karst form of topography known as lapies. The formation of lapies, as described by Cvijic,[1] is due chiefly to chemical erosion of pure

[1]Evolution of Lapies. J. Cvijic. Geogr. Review. Vol. XIV. p. 26-49.

limestone beds and in the karst lands of southeastern Europe are found at all altitudes from sea level to lofty mountain summits. The forms of lapies are numberless and varied. Particular kinds are those with furrows and holes in the rock. Lapies wells are characteristic forms. The mouth of the wells "is circular or elliptical in form, of 2-3 centimeters to 2-3 meters in diameter, while the maximum depth is 20 meters." In order to obtain an adequate idea of the great variety of lapies forms the reader should consult the well illustrated article of Cvijic above referred to.

The samples of limestone characterized by numerous furrows and holes, collected by the writer at the west end of the Arbuckle Mountains, were found on closer examination by a hand lense, to be lovered with vey minute holes obviously due to growth of lichens that we found on the rock. These holes could be seen to be about 1 to 10 mm. in diameter and many were at least as much as 10 mm. in depth and covered quite completely the surface of the rock including the inside of the holes down to a considerable depth.

The question then arose in the mind of the writer as to what extent the chemical solution and erosion of the limestone was due to the bio-chemical change wrought by the lichens, and other plant growths that grew on the limestone, and to what extent to the chemical change of ordinary meteoric water unaided by the action of acids developed by the plant growths.

It is a well recognized fact that various organic acids developed by plants are very effective in certain types of rock weathering and especially in the formation of soils, and yet geologic litrature contains very little of a quantitative nature concerning the problem. An examination of the literature on lichens[3] shows that certain kinds of lichens, those that grow on dolomite and limestone, may be very effective agents of weathering. Lichens may grow on all types of rock, from the most acid of igneous rocks to the most basic. Egeling found that a glass surface on mich lichens grew became roughened with minute cracks in which were organic and inorganic particles from which the lichen could secure nourishment. Glass is soluble in carbonic acid, developing a roughening of the surface and in the minute cracks the lichen hyphae can penetrate. This applies also to rocks in general.

[3] "Classification of Lichens," Bruce Fink. Mycologia, Vol. V. p. 152-155.

But lichens are especially abundant on limestone rocks. Bachman (See Fink's paper. loc. cit.) found that lichens growing on calciferous rocks penetrate from 200 to 12,000 or 14,000 microns into the rock, while the algae associated with the lichen may reach depths of 100 to 500 microns.

Lichens grow in the most exposed and arid situations; in the extreme polar regions these plants are practically the only vegetable form of life. They are able to withstand extremes of heat, cold and drouth without destruction. The lichen is able to grow as the associated algae supplies organic food substance and the fungas part of the lichen has developed a battery of acids which enable it to actually dissolve the most resistant rocks.

The growth of lichens is extremely slow and may take years before they arrive at spore-bearing stage. It is probable that some live for many hundreds of years. Their life consists of alternating periods of activity, when moisture is plentiful, and completely suspended development under conditions of dryness.

Lichens are known to produce a number of organic acids, including oxalic acids, and are readily soluable in water and these acid solutions should greatly aid in the solution of the lime rock. If the acid solutions were directed through the rock along certain channels started at the surface by small depressions made by lichen fruit, this continued action may be the explanation of the downward penetrating holes which extend through the rock.

In addition to the work of lichen acids in dissolving the rocks, the work of grasses and other plants that grow among the rocks where a sufficient soil has been developed may well be considered. The larger holes, those nearly a foot in diameter, have tufts of grass now growing in them, and the acids developed by the grass roots may have been important agents in forming the larger holes.

Because of the close association of lichen growths and the consequent development of small holes made by the lichen hyphae penetrating the limestone, it is believed by the writer, that a considerable part of the chemical solution and chemical erosion of the limestone should be attributed to the bio-chemical change wrought by lichen acids. In addition to the lichens as agents of weathering, organic acids formed by other plants, especially grasses, may have aided materially in the solution of the rock. The carbonic acid, derived from the atmosphere by falling rain, is dissolved in the groundwater that percolates downward through the limestone and this acid is well known to be a contributing

agent in the solution of limestone, but it is believed that the organic acids formed by plants, and especially by the lichens are the most important acids in effecting the weathering of the limestone above described.

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