

An Example of Lapiés in the Indiana Karst Region

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The purpose of this paper is to describe a small area of lapiés in central Lawrence County, Indiana, and to discuss some of the aspects of its origin as a feature typically present but rarely exposed in the Indiana karst region. The area was first pointed out to the writer by Dr. C. A. Malott in 1940. It was specifically mentioned by him as an excellent example of a species of karst feature in his comprehensive paper on karst forms in southern Indiana published in 1945. The present paper has resulted from a detailed study of this interesting example of a special karst surface, previously given but scant attention in Indiana karst studies, and has benefited from criticism offered by Dr. Malott, who read the original manuscript. The writer gratefully acknowledges his indebtedness.

Lapiés may be described as rugged, irregular, furrowed, grooved, fretted, etched, pitted, and otherwise dissolved surfaces of exposed limestone. It is best developed in pure, massive, jointed limestone. However, features similar to lapiés have been described in other rocks.

According to Cvijic (1924) it was as far back as 1893 that appreciation of the association of lapiés proper with limestone led to the classification of lapiés as a karst form. He said that lapiés were first observed and described in the limestone Alps in Switzerland where in the customs of German speech they were called *Karren* or *Schratten* and in the districts of French speech *lapiéz* or *lapiaz* or *lapiés*. The British, according to Wray (1922), North (1930), and Woolridge and Morgan (1937), have used the term *clint* to refer to such features. (It should be noted that the British term *clint* should not be confused with *klint*—any remnant of the unreduced portion of an ancient organic reef.) Wray (1922) also wrote that in Switzerland these barren limestone surfaces are known as *Karrenfelder*, and the grooved and trenched limestone pavements in the Jura Mountains are called *lezinnes*.

Opportunities to view exposed upper surfaces of the etched and weathered limestone beds are often quite limited in areas of low relief and humid climate. The deep cover of red, residual clay literally blankets the limestone belt of Indiana and other limestone areas in humid climates. The thickness of this blanket varies of course, and has been found from nothing to many feet. At a drill test on an upland near the village of Dogwood, Harrison County, Indiana, in 1946, the writer logged almost 60 feet of residuum before bedrock was encountered. Because of this residual mantle, good examples of natural exposures of limestone surfaces are relatively rare, and recourse must be sought in man-made excavations in order to view the detailed characteristics of the etched and weathered upper surfaces of limestone areas. In his well illustrated

article Cumings (1905) has presented excellent views of some artificially exposed corroded limestone surfaces, particularly in the Monroe County, Indiana, limestone quarry district.

The area described below is located adjacent to the Monon Railroad in Section 10, Township 4 North, Range 1 West, about one-third of a mile east of Indiana Highway 37, some $3\frac{1}{2}$ miles south of Bedford (Fig. 1).

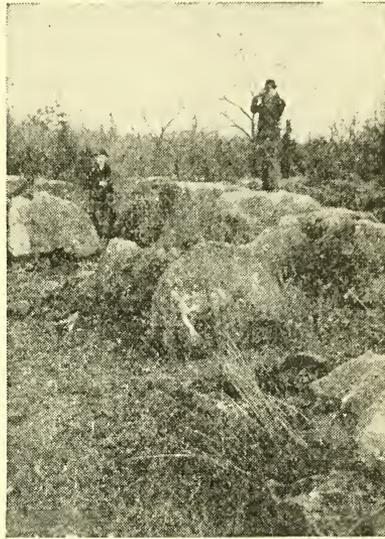
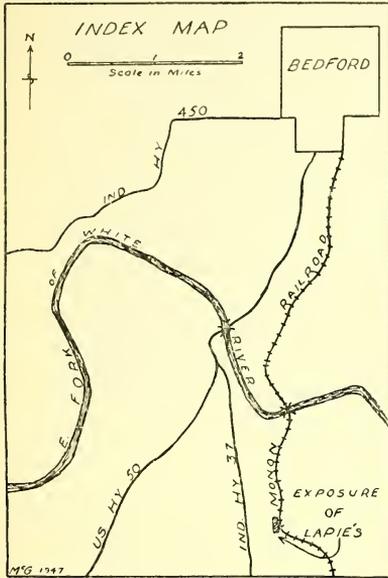


Fig. 1. Sketch map of portion of Lawrence County, Indiana, showing location of area studied.

Fig. 2. View of lapiés area showing the irregular rock surface.

The soil blanket at this locality is thin, but the rocks in the main area were exposed by removal of the soil cover, probably to make the adjacent railroad fill in 1849 or 1850. After much of the surface soil was removed artificially, rainwash and off-flowing waters have removed much of the remainder of the residual clay and small rock particles which filled joints, cracks, and other openings and revealed a ragged, irregular rock surface with local relief from a few inches to six feet or more (Fig. 2). To this surface Malott (1945) applied the term lapiés, and in view of this and the fact that the term lapiés has been adopted by many of the text books, such as Lobeck (1939), Cotton (1942), and von Engeln (1942), the writer wishes to retain the French rather than British, German, or Serbian term for this and similar features of karst expression.

The area studied was over 500 feet long and 200 feet wide, comprising about $2\frac{1}{2}$ acres. Only a portion of the lapiés area is represented by the

accompanying sketch map (Fig. 3). The exposed rocks are all Salem limestone. The Salem here is generally massive, jointed, coarse, fossiliferous and oölitic limestone with little show of bedding. The residual material lying between and around the bedrock exposures is a deep, red clay, tough and sticky when wet, with occasional silicified fossils and chert fragments, commonly referred to as *terra rosa*. The most striking feature of the area is the ridge-like elongation of the outcrops which tend to align themselves in a general east-west direction which parallels a well-developed joint system in the dip direction of the rock formations. (It is interesting to note that this same phenomenon has been observed in

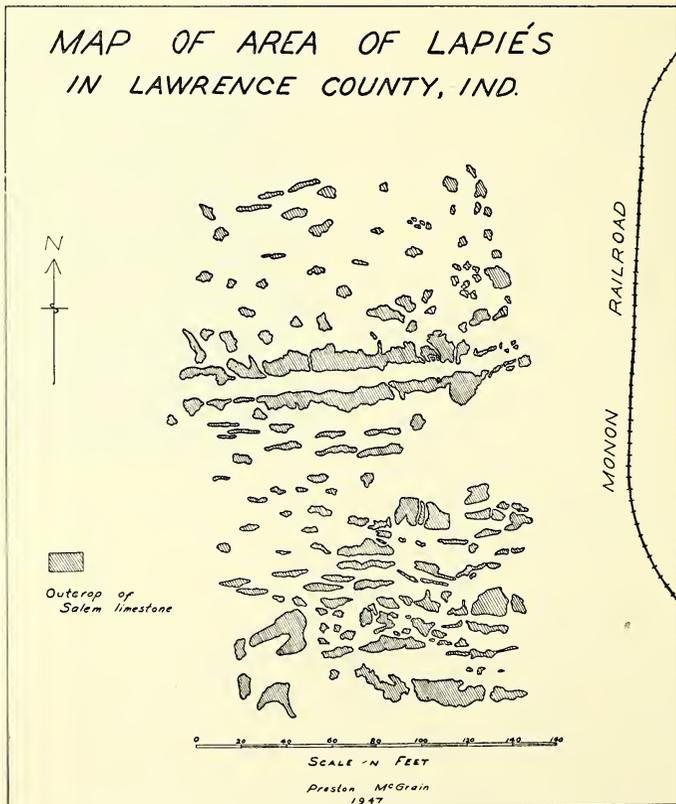


Fig. 3. Sketch map of portion of lapiés area near Bedford, Indiana. The ridges of Salem limestone are in general parallel to a well developed joint system in the dip direction of the rock formations.

numerous Salem limestone quarries.) One looks in vain for any alignment of the etched-out remnants in a north-south direction, and little or no suggestion is found of a joint development in a north-south or strike direction. The largest feature in the area is a wide, clay-filled joint which

extends almost the full width of the area (Fig. 4). It is 5 to 9 feet wide and the floor is 6 feet or more below the highest limestone ridges which form the sides. The British term for solution joints is *grykes* or *grikes* while the Serbians have used the word *bogaz* for the deeper fissures. According to official British sources, *bogaz* is used for the more trench-like

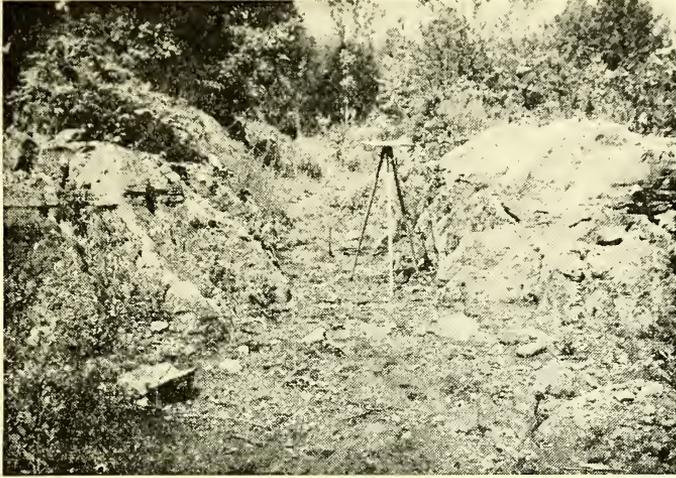


Fig. 4. View of bogaz or grike. At this point the rock walls are 6 feet above the clay floor.

fissures, sometimes quite shallow in depth, but of considerable length though narrow in cross-section. The surfaces of the individual ridges, mounds, and hummocks have been sculptured in a variety of ways (Fig. 5). Many are rounded and are massive appearing. Some are fluted; on

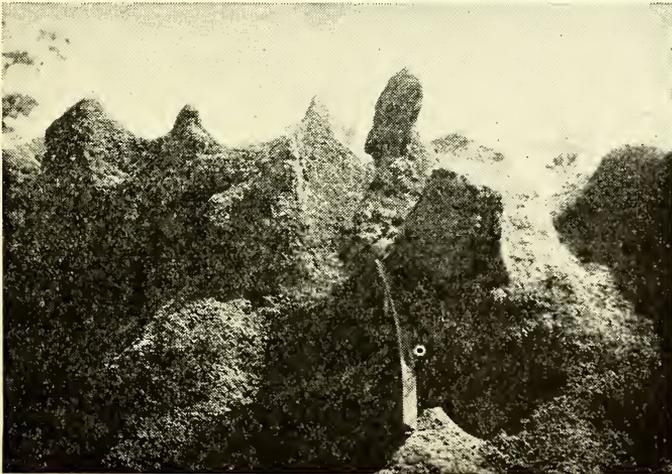


Fig. 5. View of the sculptured surface of one of the limestone ridges.

others small fractures appear to be responsible for the development of a network of small trenches separated by sharp ridges and pinnacles. Such a terrain is difficult to cross.

The strikingly rugged surfaces of lapiés have attracted attention wherever they have been viewed, but some important aspects of the development have not been clearly set-forth. Cvijic (1924), in his classical paper on lapiés, emphasized that the origin and development of this karst form were dependent upon the limestone surface being laid bare. He contended that lapiés are much more extensive where the surface is not covered, but he did recognize that the features of lapiés could develop beneath a cover of dead vegetation or soil residuum. The lapiés described herein was fully developed beneath a soil cover. The soil cover was excavated to the top of the bedrock surface and the clay filling in the joints and cracks was removed by the corrosive action of rain wash. This process is continuing at the present, deepening the *bogaz* or *grikes* and revealing other limestone surfaces. Thus the origin of the lapiés is due to the dissolving effects of meteoric waters charged with carbon dioxide which percolate through the residual mantle and reach the underlying rock. Here the descending waters are concentrated along pre-established joints and other fractures and grooves, enlarging them many times, and forming the other individual features which characterize the lapiés surfaces of limestone areas. Hence, it is believed that lapiés features are commonly developed beneath a soil cover and are of widespread occurrence in limestone areas, though hidden under the soil mantle. When the soil is removed they become conspicuous and attract attention. When once uncovered they are subject to surface weathering and modification. It is possible in areas of low relief that lapiés features developed beneath the surface and then exposed may be so modified in time that they will become inconspicuous or even largely destroyed.

References

- Cotton, C. A. (1942) *Geomorphology: an introduction to the study of landforms*, Whitecombe & Tombs Ltd., Wellington, New Zealand.
- Cumings, E. R. (1906) *Weathering of the Subcarboniferous limestones of southern Indiana*, Ind. Acad. Sci., Proc. 1905, p. 85-100.
- Cvijic, Jovan (1924) *The evolution of lapies, a study in karst physiography*, Geog. Review, vol. 14, p. 28-48.
- von Engel, O. D. (1942) *Geomorphology: systematic and regional*, The Macmillan Co., New York.
- Lobeck, A. K. (1939) *Geomorphology: an introduction to the study of landscapes*, McGraw-Hill Book Co., New York.
- Malott, C. A. (1945) *Significant features of the Indiana karst*, Ind. Acad. Sci., Proc. 1944, p. 8-24.
- North, F. J. (1930) *Limestones, their origins, distribution, and uses*, Thomas Murby & Co., London.
- Wooldridge, S. W. and Morgan, R. S. (1937) *The physical basis of geography: an outline of geomorphology*, Longmans, Greene & Co., New York.
- Wray, D. A. (1922) *Karstlands of Western Yugoslavia*, Geol. Mag., vol. 59, p. 394-409.