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Jennings cited Easter Cave entrance doline as an Australian example of a solution doline. This article presents evidence that the doline was formed by collapse of soil, not solution of limestone.

Easter Cave is situated five miles northwest of Augusta in the southwest of Western Australia. The cave is developed in Pleistocene eolianite formed by the lithification of a calcareous coastal dune. Weathering has developed a profile of yellow-orange sandy residual soil overlying a hard capping of kankar which grades down into a sandy lime-cemented cross-bedded aeolian calcarenite. Numerous vertical kankar-walled soil-filled solution pipes perforate the kankar layer and extend a few feet down into the eolianite. Easter Cave was initiated by solution at or just below the water table, about 120 feet below the surface. The writer believes that in the vicinity of the present entrance, the cave migrated upwards by roof-collapse until it intersected a cluster of solution pipes. The soil which had been filling and overlying the pipes fell through into the cave. At the surface, the thick layer of soil rapidly eroded to form a funnel-shaped doline around the pipe. Jennings, on the other hand, believed the doline to be formed of limestone by water percolating through a thin layer of soil towards the pipes. In his cross-section (see Figure 1 of this article) Jennings showed the walls of the doline formed of limestone.

To choose between these hypotheses it is necessary to determine the configuration of the soil-kankar interface: according to Jennings' hypothesis it should be conical and only a foot or two beneath the ground surface, whereas according to the hypothesis presented here the interface should be approximately horizontal. Recently a post-hole digger was used to determine the thickness of solution soil. The appliance could penetrate as much as 13 feet of soil, and if the kankar horizon was reached it could be recognized by scrapings from it. The results are shown in Figure 1.

The cross-sections strongly support the hypothesis that the doline was formed by soil falling through solution pipes into a cave that was enlarging upwards by collapse. As expected the soil-kankar interface has minor undulations, but there is no major depression to indicate that the doline was formed by solution. The doline is typical of several others in the vicinity which are believed to have formed in the same way. These include the entrance dolines of Jewel Cave and Deondeenup Cave. It should be noted that the largest solution pipe in the Easter Cave doline has been enlarged to allow tourists to enter, and therefore it cannot now be taken as a typical solution pipe.

The problems of the origins of the doline and solution pipes are independent. However, very little has been published on the origin of solution pipes in eolianite, so that a few observations will not be out of place. Fairbridge introduced to Western Australia the term 'solution pipe' for similar structures at Point Peron, and suggested that they were formed by solution by water that accumulated in depressions in an impervious kankar cap. However, his suggestion does not seem to fit the pipes in Easter Cave doline, because they appear to be situated on a slight rise in the kankar surface. Jennings suggested that tap-roots of trees could be important in localizing the solu-

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According to this article

Figure 1. Comparison of interpreted cross-sections of Easter Cave entrance doline.

According to Jennings (1966)

Figure 1. Comparison of interpreted cross-sections of Easter Cave entrance doline.
tional effects of vadose water. However, I believe that solution pipes can develop without any concentration of vadose water. One instructive exposure is a cutting on Caves Road, nine miles north of Easter Cave. At this locality solution pipes are forming in a dune that is old enough to be weakly lithified and to have formed two to three feet of residual soil, but which is not sufficiently old to have developed a kankar cap. The sand-filled pipes are about one foot across and have only weakly-cemented walls. The pipes contain roots about one-quarter of an inch in diameter, usually arranged close to the edge of the pipe. The upper surface of the limestone is extremely irregular, and the pipes can be regarded as involutions in the soil-limestone interface, probably caused by the attack of the limestone by exudates from the bundles of roots. Similar solution of limestone by root exudates has also been recognized by Wall and Wilford in Malaya. The limestone beside Caves Road is porous and there is no indication of concentration of vadose water above the pipes. It is possible that, after a kankar cap has developed, vadose water might be concentrated and modify some favourably situated solution pipes, but I believe the process has yet to be demonstrated.

I wish to thank my wife and Messrs J. R. Williams and P. Henley for assistance in drilling and surveying the auger holes, and Mr J. N. Jennings for commenting on the manuscript.

REFERENCES


APOLOGY

The footnote on page 163 of the paper by R. J. Johnston and P. J. Rimmer, 'The Competitive Position of a Planned Shopping Centre' (Vol. X, No. 3, March 1967), does not express fully the part in the Chadstone study which was played by the Society of Monash University Geography Students. The idea of the project originated with this group and they were responsible for the organization of interviewers throughout the week. The authors of the paper are, of course, deeply indebted to the student body for the part which they played in the study, and apologize for not spelling out their gratitude in the original paper.