Technical Papers

Phreatic Floor Slot in Model Cave, Nevada

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Scour troughs, or floor slots as they are commonly called, are of frequent occurrence in limestone caves. They are found incised into both the clay and the bedrock of cave floors; in some cases, because of the solvent power of the generating waters, they are more likely to have excavated the limestone rather than the unconsolidated sediments.

Fidlar (*1*) and Malott (*2*) describe types of floor slots generated by gravity streams in the caves near Marengo, Ind., and numerous other descriptions can be found in the cave literature. Both Davis (*3*) and Bretz (*4*) in their studies on cave origin summarize many occurrences of the feature. Bretz accepts such floor slots as reliable evidence for the former presence of gravity streams that invaded caverns that for the most part had been previously excavated under phreatic or sub-water-table conditions. All the floor slots that have thus far come to my attention resemble in their behavior the familiar scour troughs of surface streams, and all travel consistently downgrade.

I wish to introduce a different type of floor slot—one that does not follow a consistent downhill course but rather rises and descends with the undulations of the floor of the cave passage. It occurs in Model Cave, situated on the east slope of the Snake Range, White Pine County, Nevada, within 2 mi of Lehman Caves National Monument. The slot emerges from beneath the water-table pools at the deepest point in the cave (approximately 2000 ft from the entrance) and pursues a winding course throughout the extent of the cave, dividing where the passage divides and climbing where it rises. The passage and the slot, by means of a series of roller-coasterlike undulations, finally attain the elevation of the entrance and former point of discharge, fully 100 ft above the innermost source. A short abandoned *thalweg* connects the cave entrance with perennial Baker Creek, and it was by this anomalous tributary that the cave was first discovered. Although the slot is occasionally obscured by silt and debris, it is for the most part conspicuously carved into the stratified floor deposits consisting of mud, sand, gravel, cobbles, bone, and charcoal.

Cross sections of the passage and the slot were measured at intervals averaging 5 ft through the length of the cave; and by examining these, it was observed that the slot is deeper and narrower where the passage is more constricted. For example, the slot is 1 ft wide and 1 ft deep where the passage cross section is 12 ft^2; and where the passage measures 150 ft^2, the slot is 8 ft wide and only 2 to 3 in. deep. Such a relationship is expected if we assume that the slot was generated by the current in a filled conduit carrying a corrasive load: maximum velocity and, hence, greatest cutting power would be developed in the zones of smallest cross-sectional area.

No apparent relationship is found between the dimensions of the slot and the slope of the floor. The slot transects both sand bars occurring at the crests of the rises and gravel deposits trapped in the troughs. In the mapped portion of the cave, the maximum upward gradient that the current had to overcome is 25 deg; maximum down-slope, 45 deg. Even steeper slopes are known in the unmapped regions. The serpentine path of the slot appears to be determined by the locus of the apex of the ceiling, to which it corresponds, except where deflected by bedrock. Eddies have locally generated potholes in the sand of its walls and floor. Solution flutes in the marble of the ceiling occur throughout the length of the passage and possess slip-off slopes consistently oriented toward the mouth of the cave, thus indicating flow in that direction. Similarly, asymmetric ripple marks in the floor sands have their steep faces directed toward the cave mouth. Both of these features are accompanied by sand bars and imbricated pebbles oriented in the same direction. All these phenomena are reliable indicators of flow upward along the passage in the manner of the limestone artesian channels of Fuller (*5*), the "sub-water-table streams" of Bretz (*4*), and the pressure channels (Druckleitungen) of the European scholars (*6*).

A period of submerged solution of the marble along two limbs of a syncline was evidently followed by episodes of gravel deposition and quiet silting. During the latter, many portions of the cave became filled with mud, remnants of which still exist. All these deposits have been dissected by the floor slot, which, in turn, has become covered with a thin veneer of recent mud derived from the presently fluctuating water body observed at the far end of the cave. Because of its rising course, the slot could not have been generated by a conventional gravity stream, but rather it must represent excavation under conditions of phreatic flow. It is suggested that the slot represents the track along which the bottom load of this current was dragged during the final period of scouring.

From the foregoing discussion it is concluded that floor slots in caves should not be accepted indiscriminantly as criterions of vadose conditions. Undoubtedly other similar artesian conduits containing floor slots have been entered in other localities; but unless the investigator had the good fortune to be the first to enter them, the chances are that the subtle flow indicators and the slot itself had been obliterated by previous explorers.

The initial studies of Model Cave were conducted as part of the field program of the Western Speleological Institute and were sponsored by O. H. Truman. Completion of the survey of this somber but

highly instructive cave hinges on the behavior of the water table that controls the depth to which one may penetrate.

References

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Pyretogenic Effect of Lysergic Acid Diethylamide

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Whereas most of the ergot alkaloids exhibit oxytocic or peripheral autonomic effects, lysergic acid diethylamide (LSD) shows little or none of these actions but rather a hallucinogenic effect (*1, 2*). In studying the effects of LSD in intact normal rabbits marked hyperpnea was noted. This led to a consideration of the possibility of the existence of increased body temperature, which was indeed found to be the case (*3*).

Most experiments were carried out on unanesthetized and otherwise untreated animals. The agent was supplied in ampuls containing 0.1 mg/ml and was administered either subcutaneously or intravenously without dilution. No significant difference was observed in the amount of the fever, but the time of onset and duration of action were somewhat shortened with the intravenous route of administration. A rise

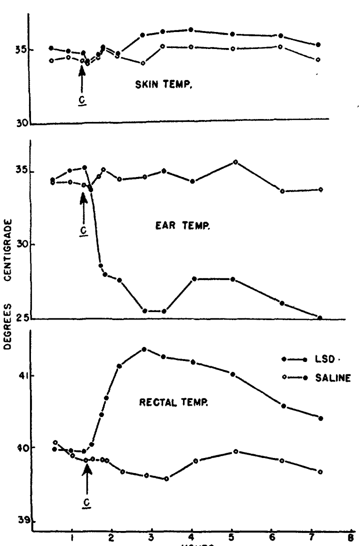

Fig. 1. Skin, ear, and rectal temperatures of a rabbit receiving 50 μg/kg of LSD subcutaneously and a control rabbit receiving an equivalent volume of saline.

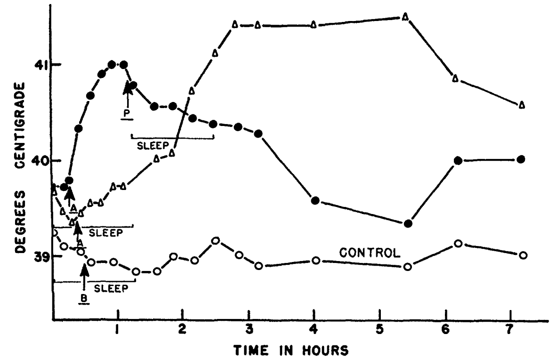

Fig. 2. Effect of the administration of anesthetic doses of sodium pentobarbital of 30 mg/kg intravenously on the pyretogenic effect of 50 μg/kg LSD administered intravenously. In the curve indicated by triangles the pentobarbital was given at the height of the LSD effect. The lower curve is the rectal temperature of a control rabbit receiving pentobarbital only. Sleep indicates the period during which righting reflex was absent.

in rectal temperature was produced in rabbits, dogs, and cats, but the rabbit was most markedly affected and, hence, was used for certain subsequent experiments. Subcutaneous injections of 50 μg/kg of LSD in the rabbit produced a rise in rectal temperature within 10 to 20 min. The peak effect was reached after 2 to 4 hr. The total duration of the pyretogenic action was 7 to 9 hr.

Preliminary experiments were carried out in an attempt to clarify the mechanism of the pyretogenic action. In addition to rectal temperature, surface temperature of the skin and the ear was measured by a McKesson's model 205 Dermalor in several rabbits. The skin temperature was measured from a shaved area approximately 4 in.^{2} on the back of the rabbit. Figure 1 is a typical response from such as experiment. Skin temperature did not change significantly from that of a control rabbit, but the ear temperature fell markedly. This latter effect persisted throughout and far beyond the pyretogenic effect. This led to a consideration of the possibility that the rise in rectal temperature might be due to a vasoconstriction of the rabbit ear preventing radiation and raising the internal temperature. To test the role of the rabbit ears in the control of body temperature, the ears of a normal rabbit were clamped with hemostats. There was no change in rectal temperature during a period of 6 hr. Hence it is not likely that the pyretogenic effect of LSD is the result of this vascular effect.

Attempts were made to lower the LSD-produced fever by the administration of antipyrine, dihydroergotamine. Hydergine, and dibenamine. These were without effect. Sodium pentobarbital administered intravenously in doses of 30 mg/kg did affect the LSD-induced fever. Figure 2 shows this marked antagonism. Previous administration of this dose of sodium pentobarbital prevented the pyretogenic response of LSD for as long as the animal was anesthetized. Administration of this dose of pentobarbital at the height