their occurrence in the ancient vertebrates except that their course of growth is modified by the histology of ancient bone. In the absence of definite lamellæ the mycelia often seek out a lacuna, enter it and growing out along the direction of the brief canaliculi, expand both the lacuna and canaliculi until the entire structure is disrupted and the canals meet other canals growing out from adjoining lacunæ. In modern human bone the mycelia very often follow the interlamellar spaces, but ancient bone has seldom any definite spaces of this kind and more often is to be regarded as an osteoid substance. That the appearances described for the enlarged lacunæ are not normal is easily checked by a study of normal lacunæ in the adjacent material. A single microscopic field will show both normal and invaded lacunæ. The canals, from 2–4 *micra* in diameter have an undulating course and offer easy channels of entrance to invading bacteria.

The presence of these thread moulds would seem to indicate that the piece of bone showing them was preserved in a moist sandy or muddy place close to the shore, thus agreeing with our previous conceptions of the preservation of fossil material. It is difficult to see how the moulds would find entrance if the material were embedded under sand or silt in deep water. The ancient Egyptian mummies, buried for thousands of years in the dry sand of Nubian deserts do not show such canals, nor do the Cretaceous vertebrates from Kansas show them. Seitz has figured them, though apparently did not recognize their nature, in the bones of Labyrinthodonts and dinosaurs, and I have seen evidences of them in sections from the vertebra of an American sauroped dinosaur.

The bacteria doubtless have entered the bone along the course of the *Canals of Roux* and may be detected at first by the beady, nodular appearance of the canal. Often the bacteria, in *Bothriolepis,* for instance, have invaded a canaliculus which the *Mycelites* did not find. The small clumps, or nodes, may clearly be regarded as colonies of bacteria and doubtless as a form of the *Micrococcus,* described by Renault in the canaliculi of Permian fish bone. The beady appearance of an invaded *canal of Roux* or canaliculus recalls exactly the picture of the invaded dentinal tubules in cases of human dental caries. We are, of course, in this case, as in the case of other ancient phenomena, arguing from the known to the unknown. Here is an ancient situation which parallels a similar modern situation and the argument is sound because on it for over one hundred years we have built the science of paleontology.

These conditions can not be regarded as disease in any sense, but are rather to be regarded as the agents of decay in ancient times. They are the agents of decay and disruption at the present time and from present evidences the same agents of decay have been at work for many millions of years, at least since Devonian times.

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VIBRATION RATE OF THE TAIL OF A RATTLESNAKE

THROUGH the courtesy of Professor H. R. Dill, curator of the natural history museum, opportunity was offered to make a brief study of the rate of vibration of the tail of a diamond back rattlesnake, *Crotalus Adamanteus.* This specimen came from Texas on September 15, 1918, but had been in captivity for some time previously. Its age is not known, as that can not be accurately determined from the number of rattles, some of which are known to have been broken off, and two of the nine or ten remaining are in poor condition. A new rattle is formed with each moulting, a process which has occurred twice during the nine months that the animal has been in the laboratory; the second moulting occurred six months after the first. The snake is about five feet four inches in length and rather thin, since it refuses food. It accepts water, however, and in the latter part of March two sparrows were forcibly fed to it. It is exceedingly alert and vigorous, and frequently strikes at any object that is near its wire cage. It has learned some discretion, and does not risk the resultant bump against the wire unless

rather strongly provoked. Its fangs are intact.

With the aid of two assistants, Mr. Ledieu, who kept the head out of mischief, and Mr. Bunch, who manipulated the apparatus, it was possible to secure a fairly accurate short time record. A Deprez marker, together with a suitable time indicator, was adjusted to trace upon a smoked drum. With one method of recording a small mesh cap of copper wire was fitted over the rattles and connected with a flexible wire through a battery, the marker, and a curved brass plate. Touching the wire cap to the brass plate completed the circuit. With slight provocation vigorous movement resulted and the writer would hold as far back from the tip of the tail as possible and still be able to direct the tip so that it would strike the plate with each complete vibration. Fearing that the cap might be heavy enough to retard the motion, we tried again using a double strand of very fine copper wire wrapped twice around the rattles bringing this wire in contact with the plate as before. The average time of fifty-three consecutive vibrations, with the first method, was 30σ (1σ.001 sec.) with a mean variation of 10σ. The corresponding result for twenty-five vibrations by the second method, was 28σ, with a mean variation of 3.5σ.

To the writer two surprises are contained in this record, the first being the relatively great variability in rate of movement, the extremes ranging from about 10σ to 50σ. After attention was directed to the variations in speed, they become marked even to the unaided ear, although no distinct rhythm can be detected.

The second unexpected result is that the pitch of the tone produced does not depend upon the speed nor upon the constancy of the tail vibration but upon the natural resonance of the rattles themselves. The pitch of this tone, as determined by two musicians with a very keen sense of pitch, and checked with accurately tuned forks, is between C and C♯; the tone is expressed, therefore, by about 128 to 135 vibrations per second. Very marked changes in rate of tail, from the fastest that could be produced by marked provocation, to the almost quiescent state, did not cause a fluctuation of the pitch beyond this approximate half-tone. The tone itself is exceedingly complex however, and it might conceivably vary with the number and size of the rattles. It was possible to detect, but not to identify, certain overtones.

The popular impression that the rattler uses his rattles as a warning that he is about to strike is regarded by Mr. Dill as quite erroneous. This snake, when striking normally does so first and rattles afterward, if at all. It will, for instance, strike at a bird placed in the cage, rattle, then strike again. It appears that the rattle is rather to terrify than to warn. It is also used as a defensive mechanism. The instinct to vibrate the tail is not peculiar to the rattlesnake, but is common to many other species, as, for instance, to the non-venomous king snake and the blue racer.

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A TICKET TO ST. LOUIS

I am a schoolmaster. I am not earning a living for myself and family, though my position is counted a good one. I shall be a schoolmaster till I die: I have chosen teaching as my service, and am too old to change. My three sons will not be schoolmasters.

Before the war I was able to make ends meet. I could then devote all my time and energies to the duties of my position. Then came increase of passenger rates, and a war tax added, and I and my family have since stayed home. I even bought several liberty bonds and my children bought war savings stamps at the beginning.

Then came also increased freight rates and of cost of food, and I and my boys began gardening. Then came also increase of wages and decrease of competence in artisans, and I and my boys began doing our own repair work —carpentry, plastering, roofing, ditch-digging, etc. But, staying always home, and raising beans, and fixing spouts is not what I am paid for doing, nor does it get the best results from the long training I have had. And ever since the close of the war I have been vainly hoping to be allowed to devote my time again to my