the auditory organ of the locust, although in the *Locusta viridissima* there are also others broadly clavate and surrounded by a plainly delimited, granular substance.

In *Termes flavipes* there are no external appendages to suggest an auditory function, as there are in the locust and in some other insects, there being here only a slight concavity of the wall over the internal organ, and two or three of the sensory pits scattered about the surface. If the similar organs among members of the Orthoptera have such a function, it seems not unreasonable to suppose that such may be the use of these appendages within the tibiæ of our common white ants.

But, however this may be, the legs of these insects merit careful investigation by some competent observer, so situated that he may have access to all the luxuries of modern microscopical research, most of which are at present beyond my reach, my paper being, therefore, necessarily superficial and imperfect.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

THE OSAGE RIVER AND THE OZARK UPLIFT.

MR. ARTHUR WINSLOW'S account of the Osage river and its meanders in *Science* for July 21, 1893, commenting on my previous suggestion concerning the development of that river in *Science* for April 28 of this year, has only lately come to my attention in looking over papers accumulated at home during vacation absence. It raises several questions on which discussion may prove of interest.

In explaining the existing meanders of the Osage and other deep-valleyed rivers of Missouri and Arkansas, Mr. Winslow maintains that the rivers had originally curved courses consequent on the form of the land on which they were initially formed; that these irregularities of flow are still perceptible, although they have been increased during the down cutting of the valleys; and that the down-cutting of the valleys and the general sculpturing of the region now going on is in consequence of an uplift that was essentially completed in Paleozoic time. I am not sure as to my correct understanding of the third point, although such appears to be Mr. Winslow's meaning.

The explanation that was suggested in my article included a long lost beginning of river development in Missouri; the attainment of an oldish topographic condition in the cycle of denudation preceding the present cycle; and an inheritance by the rivers of a meandering course, normally characteristic of the wide-open valleys of the preceding cycle, in the deep-sunk valleys of the present cycle.

Mr. Winslow's first point—that the existing meanders are simply exaggerations of initial consequent river courses—seems to me inadmissable for several reasons. In the first place, this involves the persistence through all of Mesozoic and Tertiary time of relatively trivial peculiarities of river courses, begun on the surface of the carboniferous strata about the close of Paleozoic time. It is certainly true that rivers are long lived, but it is very unlikely that the land history of Missouri has been so simple as to allow so extraordinary a perpetuation of relatively small river features. My reason for this opinion is not simply an *a priori* objection to the opposite view; but a careful examination of the developmental changes of other rivers. In Pennsylvania, for example, the changes in the course of rivers during a period corresponding to that of the land history of Missouri has been so great that I cannot think that the rivers of Missouri still maintain any close trace of their ancient initial courses down to these modern days. It is true that there has been much greater opportunity for variation of river courses among the tilted rocks of Pennsylvania than upon the nearly horizontal strata of Missouri; but to conclude that even in the latter region there have been no essential changes of river courses since the end of Paleozoic time implies to my mind altogether too passive a conception of post-Paleozoic time. It is impossible to say exactly what has happened, for the records are rubbed out; but to conclude that practically nothing has happened in the way of oscillation and warping and river change seems to me the most unlikely of all plausible conclusions.

In the second place, the postulate that the present meanders are directly descended from originally irregular consequent courses does not well accord with the distribution of deep meandering valleys in other parts of the world. They are not found in regions of one cycle of development; that is, in regions that are now in process of degradation following their first uplift. They characterize regions which for other reasons—of which more below—must be interpreted as having a composite topography; that is, having topographic features produced in two or more cycles of degradation. Moreover, the fact that the radius of the valley meanders is greater where the rivers have great volume is not consistent with the origin of the meanders from a control so irrelevant to river volume as the constructional inequality of the original land surface must have been.

Mr. Winslow's second point—that the existing meanders are increased in sinuosity over some former condition of meanders—seems to be an important correction to my brief explanation. It is a point that I had not in mind at the former writing; but in now recalling the form of the meandering valley of the North Branch of the Susquehanna in northeastern Pennsylvania, I see that the correction applies there as well as in Missouri. One might at first suppose that if a meandering river were uplifted, it would tend to straighten out its course, on account of gaining a stronger current; but it also seems possible that an even uplift with no change of grade (except by the action of the river itself in cutting down its channel towards the new base level) may even provoke an increased meandering, instead of straightening out former meanders. Professor J. C. Branner has in a letter called my attention to essentially this interpretation of certain deep meandering valleys in northern Arkansas.

As to Mr. Winslow's third point—that the present valley-making Missouri is the incompleted work of the denudation begun at the end of Paleozoic time—I cannot agree to this at all. Indeed, such a conclusion appears to me so improbable, and so contrary to both local and general evidence, that I fear it is not a correct statement of Mr. Winslow's meaning. He says: "The sculpturing of the topography [of Missouri] must have been uninterruptedly in progress from the end of the Paleozoic to the present time." He implies that the present altitude of the Osarks above the margin of the Tertiary strata in southeastern Missouri is the same as the altitude that the Osarks had above the waters in which the Tertiary strata were deposited; thus excluding all chance of tilting and local warping since that time. Differential movements have been determined even as late as in Tertiary and post-Tertiary time in the west; and there is good evidence of similar late geological movements in the Appalachians along the Atlantic slope. It therefore seems entirely improbable that Missouri should have taken an attitude at the close of Paleozoic time from which it has not since significantly changed and entirely impossible, if

it had done so, that so little advance in denudation of the uplifted mass should have as yet been accomplished. There is every indication that before the close of Paleozoic time, the region which we now call Missouri suffered many oscillatians of level, for its strata are varied in composition and are separated by slight unconformities. The unconformable superposition of the Cretaceous and Tertiary strata of the Mississippi embayment on the denuded surface of the deformed Paleozoic rocks indicates that changes of level and warpings occurred during and after Mesozoic time not far from the region under consideration. In the absence of direct evidence of actual stability, moderate oscillations of level through vertical distances of a few hundred feet, or perhaps as much as a thousand feet, with slight warpings involving slants of a degree or two, should, I think, be regarded as characterizing the post-Paleozoic history of Missouri, as well as its Paleozoic history.

Just when the post-Paleozoic oscillations occurred, and just what was their amount is not determinate; but the latest important oscillation of the series is the one to which I would refer the permission of the rivers to cut their present deep valleys. The various brief and subordinate oscillations associated with glacial invasions and deposits of loess are complicated beyond clear understanding at my distance from their local evidence.

But oscillations being neglected, if Missouri had had only one cycle of denudation since its uplift at the end of the Paleozoic, it could not still be a highland. If the present altitude of the Ozark uplift with respect to its surroundings had been taken at the end of Paleozoic time, as Mr. Winslow supposes, why is it not all consumed now? The sufficiency of subaerial erosion to reduce great uplifts to lowlands in less than the whole of post-Paleozoic time is, I believe, well demonstrated. I do not mean to say that this demonstration is generally accepted ; for curiously enough, there is a prevailing hesitation of belief on this subject. Geologists have not as a rule given the matter much attention, but this does not weaken the validity of its demonstration. Those who have carefully looked into the matter, are, I think, convinced of its correctness. Others with whom I have talked on this question, having their own special studies in other directions, have expressed a general incredulity about it, doubting that Mesozoic time was long enough to wear down mountains to peneplains; but their doubts have not taken the form of effective argument. Such doubts might have more value if we had not in many well-known deposits of stratified rocks, the direct evidence of the sufficiency of erosive forces to accomplish great results within definitely limited divisions of the geological time scale; and if we had not sufficient studies of land forms to show that even a part of post-Paleozoic time is long enough to baselevel uplifted masses. Referring only to examples with which I am personally familiar, I may mention the following districts as instances of effective base-levelling within determinate geological periods:

The plains of the upper Missouri, about Fort Benton, Montana, consist of Cretaceous strata, having a broadly rolling surface of slight relief over large distances; but here and there, surmounted by lava-capped mesas, or by necks and thick dikes of lava, whose present position can only be explained by supposing that the strata of the surrounding plains once rose at least as high as, if not higher than, these eminences. Yet this greater mass is now reduced to a peneplain; and since its reduction to a peneplain, it has been uplifted by a considerable amount, and the present trench-like valleys of the Missouri and its branches have been cut down two or three hundred feet. All this has happened since the deposition of the Cretaceous strata, of which the plains are there built. It is true that the strata of the plains are not particularly resistant; but neither are those of the Missouri plateau.

The Triassic formation of Connecticut and New Jersey has been base-levelled since it was faulted and tilted from its original horizontal position. Since it was base-levelled the resultant peneplain has been again uplifted, and its sandstones have been reduced to a second base-level, while its very resistant trap rocks retain, more or less perfectly, in their crest lines an indication of the altitude to which the older peneplain was elevated. The first work of denudation, by which even the trap sheets and the adjacent crystalline rocks were effectively base-levelled, was a post-Triassic work; the second denudation, by which only the weaker sandstones were base-levelled, is roughly dated as post-Cretaceous. The base-levelled sandstones are now trenched, in consequence of a late, or post-Tertiary, uplift.

In Pennsylvania the mountain ridges that are generally described as the remnants of the Appalachian or post-Carboniferous folding and uplift, cannot be legitimately so considered in the light of existing evidence. Their extraordinarily even crest lines, entirely out of accord with their folded structure, but closely in accord with one another, can be interpreted only as surviving indications of the peneplain to which the whole mountain system was reduced while the region stood lower than it now does; and the wide open valley lowlands between the ridges are the product of denudation since the uplift of the peneplain. These valley lowlands are trenched by the streams, in consequence of a still later uplift. The dates of these features are apparently identical with their relatives across the Delaware in New Jersey.

The upland of the Appalachian plateau in western Pennsylvania is a surface of denudation, trenched by valleys. The upland is accordant in altitude with the even crest lines of the Appalachian ridges.

The Hudson River flows through its crystalline Highlands in a deep, steep-sided valley. Further up stream, above Newburgh, where the rocks are weaker, the valley is opened into a broad lowland. Both the gorge of the Highlands and the open valley lowland further up stream are the work of post-Cretaceous erosion, and probably of less than all of Tertiary time. The valley lowland is trenched, indicating a late Tertiary or a post-Tertiary uplift.

Examples of this kind might be increased in number from the western surveys, but I shall leave observers there to speak for themselves. They all teach one lesson, namely, that in rocks of moderate hardness Tertiary time was amply long enough to allow the formation of wide open valleys, even to produce peneplains of faint relief on such rocks as the Triassic sandstones of New Jersey, the Paleozoic shales and limestones of Pennsylvania, or of the middle Hudson valley. It was long enough to form narrow valleys in rocks of excessive resistance, like those of the Hudson Highlands.

Is not this conclusion applicable to Missouri? The rocks along the Osage are not of notable resistance. How, then, can its valley slopes be steep if they are so old as all of Mesozoic and Tertiary time! That measure of time has elsewhere easily sufficed to wear out highlands into lowlands, to uplift them again, and enter well upon their second effacement. How, then, can Missouri be still so little advanced in the sculpturing of its topography, except by reason of the relatively recent renewing of the task! It seems to me utterly impossible to explain the valleys of Missouri as a product of one geographical cycle; the product of sculpturing that has been "uninter-

ruptedly in progress from the end of the Paleozoic to the present time."

Having thus far taken the negative side on some of Mr. Winslow's propositions, I will now turn to the positive side of the argument in support of my own views.

Enough has been said to show my reasons for thinking that the initial courses of the drainage on the Paleozoic strata at the time of their first emergence are long since lost. Let me now consider the evidence of composite topography in the Ozark plateau, and the evidence that indicates an uplift between the production of the more gentle forms of the upland and the steeper slopes of the Osage valley and its fellows.

The Missouri reports frequently make mention of the relatively even surface of the upland country, and its contrast with the steep sides of the ravines in which the streams now flow. The upland is not level by any means, but has gentle swells and broad slopes, distinctly unlike the sharper slopes of the ravines. The process by which the present ravines are forming is not a direct continuation of the process by which the gentler slopes of the upland were formed. The former are incised in the latter; the latter have suffered little change during the excavation of the former. What, then, is the origin of the upland? It is not a constructional form; that is, it does not retain the form of strata deposited under water and simply uplifted into a land surface. It has manifestly been eroded, and thereby changed from its original constructional form. Under what conditions can a gently rolling surface be formed by erosion? Only as the penultimate result of long erosion, whereby the initial valleys have been deepened close to base-level and widened so as almost to consume the intervening hills; that is, the rolling upland must have gained an oldish topographic stage, when the erosive forces were acting with respect to a base-level different from that which now controls them, and with respect to which they are trenching deep valleys in the upland. The region must have stood lower when the wide rolling uplands were fashioned than it does now, when the upland is incised by steep-sided valleys. The change of elevation, by which the older cycle was closed and the present cycle was opened, was only long enough ago to allow the excavation of narrow valleys in rocks of moderate hardness; and hence, according to the time scale above indicated, this uplift was not longer ago than somewhere about late Tertiary time. The uplift revived the oldish streams that then flowed gently in wide open valleys, and the streams at once began their new task of cutting down their basins towards the new base-level. They have not yet done much in this new task.

It is only as a part of this new task that the Osage has cut down its meandering valley. Making all allowance for increase of meanders during the deepening of the present valley, the river must have possessed significant meanders when the down-cutting was begun. Such a conclusion is quite consistent with the conclusion of the preceding paragraph; for a meandering course is generally characteristic of an oldish river, such as the Osage was when it was flowing across the formerly lowland surface of what is now the upland. I am therefore constrained to think that more than one cycle of development must be postulated in explaining the course of the Osage through the Missouri plateau.

Regarding the relations of the meanders of the upper branches of the Osage on their open flood plains and those of the lower course of the main stream in its deep valley, I am not confident that the suggestion of my former article is correct. Mr. C. F. Marbut, lately of the Missouri Geological Survey, now a student in our Geological Department, and of whose topographical work Mr. Winslow made mention, tells me that the wide valleys of the upper Osage are confined to the weaker strata of the Coal measures; and that the narrower valley of the lower stream occurs in the harder lower Carboniferous and older Paleozoic rocks. This introduces a complication in the problem that cannot be safely solved at this distance from the field; but a review of the topographical maps with this fact in mind gives no reason for withdrawing from the conclusion that the region has been pretty well base-levelled before the existing valleys were cut in it.

Several points that Mr. Winslow makes regarding the

Tertiary beds of the Mississippi embayment and the gravels within the Missouri valleys, I shall not attempt to consider, as they should be seen on the ground before being discussed. As far as presented, they do not overcome the various lines of evidence which point to changes in the level of Missouri since its Paleozoic emergence; the last of these changes being the one in consequence of which the present valleys were cut in the denuded surface of the region. W. M. DAVIS.

Harvard College, Oct. 31, 1893.

COON CATS.

SEEING Mr. J. N. Baskett's note on page 220 of the current volume of *Science*, concerning coon cats, I venture to inform you that I was struck with the extraordinary appearance of one of these cats owned by Mr. Will Carleton, who had it with him in the Catskill Mountains the present summer. I asked him about the cat and he told me the same fable which Mr. Baskett relates, but he went on to say that of course the story was incorrect and that in his opinion this peculiar race of cats from Maine is descended from some Perisian or Angora breed brought down to Maine by early French settlers from Canada. I believe that this was surmise on Mr. Carleton's part, but it seemed reasonable to me and if you receive no more satisfactory explanation in reply to Mr. Baskett's question, you are at liberty to use this.

L. O. HOWARD.

Washington, D. C., November 9.

PUMP WATER.

IN America we often observe that the farmer, in his efforts to economize the steps of the housewife, digs his domestic well in close vicinity of his drains and outbuildings, but I have yet to see at home so pronounced a case of unsanitary surroundings as I observed in Germany a short time ago.

The top of a tall wooden pump, which crowned the family well, just peeped out from a huge manure heap which completely surrounded it. So large was the heap that the pump handle had to be operated by a rope, and the water was carried beyond the heap by a small trough.

WM. P. MASON.

Rome, Italy, Nov. 2.

COON-CATS.

IN answer to Mr. J. N. Baskett's question regarding "Coon-Cats" in your issue of Oct. 20, 1893, I would say that this cross-breed of animals has been known for many years, more particularly in the State of Maine. The error attributing these mongrels to a cross between our domestic feline, and the raccoon, *Procyon lotor*, is as general as it is ridiculous; for it stands to reason that animals of different families could not interbreed. The notion is about as ridiculous as a prevalent story among the ignorant that (cat) owls bear their young alive.

The subject of "coon-cats," or sometimes called mule-cats, has been repeatedly discussed in many papers, and it is now generally conceded that this hybrid is the result of an alliance of our domestic tabby with some Oriental feline—probably the Angora. This cross would show the long, bushy tail of the Oriental species. But Mr. Baskett is in error in supposing these animals plantigrade, and if he secures a skull, which he can easily do, he will find that the dentition is pronouncedly feline.

These cats are quite common in parts of New England, and may be purchased at a very reasonable figure, and according to the demands and the supply in the cat market. Few persons are able to distinguish between genuine Angoras and these hybrids, and many are the unsuspecting buyers who have paid a high price for a common "coon-cat" worth not more than two dollars.

MORRIS GIBBS.

EXCHANGES.

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For Sale.—A very fine telescope, length extended, twenty-five inches, closed, seven inches. Power twenty-five times. Good as new. Cost $25.00. Will sell for the best cash offer. B. S. Bowdish, Box 165, Phelps, N. Y.

For Sale or Exchange for last editions of Standard Works on Vegetable Anatomy or Physiology: Practical Zoology, Marshall & Hurst; Elements of Embryology, Foster & Balfour; Zoology, Macalister; Guide to the Study of Insects, Packard; Geological Studies and Shall We Teach Geology, Winchell. Also have duplicates of Experiment Station publications which would like to exchange for any not in my file. L. R. Jones, Burlington, Vt.

For exchange.- Skins of Aegialites nivosa, Ereunetes occidentalis, Xunnodramus Arldingi. A. rostratus, Chamara fasciata henshawi, etc., for native or foreign skins with full data. Send lists. A. W. Anthony, 2042 Albatross st., San Diego, California.

I have a Beck New National monocular microscope, accessories, microtome, mounting material and a large number of fine slides. Will exchange the whole or in part for a first class type-writer or photograph outfit. A. C. Gruhlke, Waterloo, Ind.

Offered sidebloom eggs of Bulimus oblongus and exotic land and freshwater shells in exchange for Helices not in collection. Send lists to G. K. Gude, 5 Gresbach Road, upper Holloway, London, England.

Would like to exchange 100 specimens of Canadian Indian Relics for a photo outfit. E. J. Waters, 33 Hoffman St., Auburn, N. Y.

Wants.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address, stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.