

the excitability of horses, but above this proportion the excitant action is certain. While some light-colored oats certainly have considerable excitant power, some dark oats have little. Determination of the amount of the principle present is the only sure basis of appreciation, though (as already stated) white oats are likely to be less exciting than dark. Crushing or grinding the grain weakens considerably the excitant property, probably by altering the substance to which it is due; the excitant action is more prompt, but much less strong and durable. The action, which is immediate and more intense with the isolated principle, does not appear for some minutes after the eating of oats; in both cases it increases to a certain point, then diminishes and disappears. The total duration of the effect is stated to be an hour per kilogramme of oats ingested.

#### FILARIA DISEASE.

THE rapid strides which our knowledge has made during the past few years in the subject of the filaria parasite have been mainly owing to the diligent researches of Dr. Patrick Manson, who continues to work at the question. In the last number of the *Medical Reports for China*, Dr. Manson deals with the phenomenon known as "filarial periodicity," and with the fate of embryo parasites not removed from the blood. The intimate pathology of the disease, and the subject of abscess caused by the death of the parent filaria, also receive further attention. An endeavor to explain the phenomenon of "filarial periodicity" by an appeal to the logical "method of concomitant variations" takes Manson into an interesting excursion which is not productive of any positive results; nor is any more certain conclusion come to with regard to the fate of the embryos which disappear from the blood during the day time. Manson does not incline to the view that there is a diurnal intermittent reproduction of embryos with a corresponding destruction. An original and important speculation is made with respect to the intimate pathology of elephantiasis, chyluria, and lymph scrotum, which is thoroughly worthy of consideration. Our readers are probably aware that the parent filaria and the filaria sanguinis hominis may exist in the human body without entailing any apparent disturbance. The diameter of an embryo filaria is about the same as that of a red blood disk, one three-thousandth of an inch. The dimensions of an ovum are one seven-hundred-and-fiftieth by one five-hundredth of an inch. If we imagine the parent filaria located in a distal lymphatic vessel to abort and give birth to ova instead of embryos, it may be understood that the ova might be unable to pass such narrow passages as the embryo could, and this is really the hypothesis which Manson has put forward on the strength of observations made on two cases. The true pathology of the elephantoid diseases may thus be briefly summarized: A parent filaria in a distant lymphatic prematurely expels her ova; these act as emboli to the nearest lymphatic glands, whence ensues stasis of lymph, regurgitation of lymph, and partial compensation by anastomoses of lymphatic vessels; this brings about hypertrophy of tissues, and may go on to lymphorrhœa or chyluria, according to the site of the obstructed lymphatics. It may be objected that too much is assumed in supposing that the parent worm is liable to miscarry. But as Manson had sufficient evidence in two cases that such abortions had happened, he thinks it is not too much to expect their more frequent occurrence. The explanation given of the manner in which elephantoid disease is produced applies to most, if not all, diseases, with one exception, which result from the presence of the parasite in the human body. The death of the parent parasite in the afferent lymphatic may give rise to an abscess, and the frequency with which abscess of the scrotum or thigh is met with in Chinese practice is, in Manson's opinion, attributable to this. Dr. Manson's report closes with an account of a case of abscess of the thigh, with varicose inguinal glands, in which fragments of a mature worm were discovered in the contents of the abscess.—*Lancet*.

#### THE SPECTRAL MASDEVALLIA.

(*M. chimæra*.)

OF all orchids no genus we can just now call to mind is more distinct or is composed of species more widely divergent in size, form, structure, and color than is this one of Masdevallia. It was founded well nigh a century ago by Ruiz and Pavon on a species from Mexico, *M. uniflora*, which, so far as I know, is nearly if not quite unknown to present day cultivators. When Lindley wrote his "Genera and Species" in 1836, three species of Masdevallias only were known to botanists, but twenty-five years later, when he prepared his "Folio Orchidaceæ," nearly forty species were known in herbaria, and to-day perhaps fully a hundred kinds are grown in our gardens, while travelers tell us of all the gorgeous beauties which are known to exist high up on the cloud-swept sides of the Andes and Cordilleras of the New World. The Masdevallia is confined to the Western hemisphere alone, and as in bird and animal distribution, so in the case of many orchids we find that when any genus is confined to one hemisphere, those who look for another representative genus in the other are rarely disappointed. Thus hornbills in the East are represented by toucans in the West, and the humming bird of the West by the sunbird of the East, and so also in the Malayan archipelago. Notably in Borneo we find bolbophylls without pseudo bulbs, and with solitary or few flowered scapes and other traits singularly suggestive at first sight of the Western Masdevallia. Thus some bolbophyll, for example, have caudal appendages to their sepals, as in Masdevallias, and on the other hand some Masdevallias have their labellums hinged and oscillatory, which is so commonly the case as to be "almost characteristic" in the genus Bolbophyllum or Sarcopodium. Speaking generally, Masdevallias, coming as most of them do from high altitudes, lend themselves to what is now well known as "cool treatment," and cultivators find it equally necessary to offer them moisture in abundance both at the root and in the atmosphere, also seeing that when at home in cloud-land they are often and well nigh continually drenched by heavy dews and copious showers.

Of all the cultivated Masdevallias, none are so weirdly strange and fascinating as is the species *M. chimæra*, which is so well illustrated in the accompany engraving. This singular plant was discovered by Benedict Roezl, and about 1872 or 1873 I remember M. Lucien Linden calling upon me one day, and among other rarities showing me a dried flower of this species. I remember I took up a pen and rapidly made a sketch of the flower, which soon after appeared (1873, p. 3) in *The Florist*, and was perhaps the first published figure of the plant. It was named by Professor Reichenbach, who could find for it no better name than that of the mythical monster Chimæra, than which, as an old historian tells us, no stranger bogey ever came out of

the earth's inside. Our engraving shows the plant about natural size, and indicates the form and local coloring pretty accurately. The ground color is yellowish, blotched with lurid brownish crimson, the long pendent tails being blood color, and the interior of the sepals are almost shaggy. The spectral appearance of the flower is considerably heightened by the smooth, white, slipper-like lip, which contrasts so forcibly in color and texture with the lurid shagginess around it. Sir J. D. Hooker, in describing this species in the *Botanical Magazine*, t. 6, 152, says that the aspect of the curved scape as it bears aloft its buds and hairy flowers is very suggestive of the head and body of a viper about to strike. Dr. Houghton, F.R.S., told me long ago that Darlingtonia californica always reminds him of a cobra when raised and puffed out in a rage, and certainly the likeness is a close one.

Grown in shallow teak wood baskets, suspended near the roof in a partially shaded structure, all the chimæroid section of Masdevallia succeed even better than when grown in pots or pans, as they have a Stanhopea-like habit of pushing out their flowers at all sorts of deflected angles. A close



THE SPECTRAL MASDEVALLIA.—MASDEVALLIA CHIMÆRA (Natural size).

glance at the engraving will show that for convenience sake the artist has propped up the flower with a stick, this much arrangement being a necessity, so as to enable the tails to lie diagonally across the picture. From tip to tip the flower represented is 9 inches, or not so much by 7 inches as the flower measured in Messrs. Backhouse's nursery at York.—*The Garden*.

#### SURVEY OF THE BLACK CAÑON.

It is rumored again that a survey is soon to be made through the heaviest portion of the Black Cañon of the Gunnison. For a long distance the walls of the cañon rise to the stupendous height of 3,000 feet, and for 1,800 feet the walls of the cañon are arched not many feet from the bed of the river. If the survey is successful, and the Denver and Rio Grande is built through the cañon, it will undoubtedly be the grandest piece of engineering on the American continent. The river is very swift, and it is proposed to build a boat at the western end, and provision it for a length of time, allowing it to float with the stream, but controlled by ropes. If the boat goes, the chances are that the baby road goes, too.—*Gunnison (Colo.) Review*.

#### THE ANCIENT MISSISSIPPI AND ITS TRIBUTARIES.\*

By J. W. SPENCER, B.A.Sc., Ph.D., F.G.S., Professor of Geology in the State University of Missouri.

PHYSICAL geology is the science which deals with the past changes of the earth's crust, and the causes which have produced the present geographical features, everywhere seen about us. The subject of the present address must therefore be considered as one of geology rather than of geography, and I propose to trace for you the early history of the great Mississippi River, of which we have only a diminished remnant of the mightiest river that ever flowed over any terrestrial continent.

By way of introduction, I wish you each to look at the map of our great river, with its tributaries as we now see it, draining half of the central portion of the continent, but which formerly drained, in addition, at least two of our great lakes, and many of the great rivers at the present time emptying into the colder Arctic Sea.

\* This lecture was delivered in the Chapel of the State University, at Columbia, as an inaugural address on January 10, 1883, and illustrated by projections. The author has purposely avoided the very lengthy details of scientific observation by which the conclusions have been arrived at relating to the former wonderful condition of the Mississippi, and the subsequent changes to its present form; as a consideration of them would not only cause him to go beyond the allotted time, but might, perhaps, prove tiresome.



history of the earth and its inhabitants into five Great Times; and these, again, into ages, periods, epochs, and eras.

At the close of the first Great Time—called Archæan—the continent south of the region of the great lakes, excepting a few islands, was still submerged beneath a shallow sea, and therefore no portion of the Mississippi was yet in existence. At the close of the second great geological Time—the Palæozoic—the American continent had emerged sufficiently from the ocean bed to permit the flow of the Ohio, and of the Mississippi, above the mouth of the former river, although they were not yet united.

Throughout the third great geological Time—the Mesozoic—these rivers grew in importance, and the lowest portions of the Missouri began to form a tributary of some size. Still the Ohio had not united with the Mississippi, and both of these rivers emptied into an arm of the Mexican Gulf, which then reached to a short distance above what is now their junction.

In point of time, the Ohio is probably older than the Mississippi, but the latter river grew and eventually absorbed the Ohio as a tributary.

In the early part of the fourth great geological Time—the Cenozoic—nearly the whole continent was above water. Still the Gulf of Mexico covered a considerable portion of the extreme Southern States, and one of its bays extended as far north as the mouth of the Ohio, which had not yet become a tributary of the Mississippi. The Missouri throughout its entire length was at this time a flowing river.

I told you that the earth's crust had been worked over to a depth of many miles since geological time first commenced. Subsequently, I have referred to the growth of the continent in different geological periods. All of our continents are being gradually worn down by the action of rains, rills, rivulets, and rivers, and being deposited along the sea margins, just as the Mississippi is gradually stretching out into the Gulf, by the deposition of the muds of the delta. This encroachment on the Gulf of Mexico may continue, yea, doubtless will, until that deep body of water shall have been filled up by the remains of the continent, borne down by the rivers; for the Mississippi alone carries annually 268 cubic miles of mud into the Gulf, according to Humphreys and Abbot. This represents the valley of the Mississippi losing one foot off its whole surface in 6,000 years. And were this to continue without any elevation of the land, the continent would all be buried beneath the sea in a period of about four and a half million years. But though this wasting is going on, the continent will not disappear, for the relative positions of the land and water are constantly changing; in some cases the land is undergoing elevation, in others, subsidence. Prof. Hilgard has succeeded in measuring known changes of level, in the lower Mississippi Valley, and records the continent as having been at least 450 feet higher than at present (and if we take the coast survey soundings, it seems as if we might substitute 3,000 feet as the elevation), and subsequently at more than 450 feet lower, and then the change back to the present elevation.

Let us now study the history of the great river in the last days of the Cenozoic Time, and early days of the fifth and last great Geological Time, in which we are now living—the Quaternary, or Age of Man—an epoch which I have called the "Great River Age."

It is to the condition of the Mississippi during this period and its subsequent changes to its present form that I wish particularly to call your attention. During the Great River age we know that the eastern coast of the continent stood at least 1,200 feet higher than at present. The region of the Lower Mississippi was also many hundred feet higher above the sea level than now. Although we have not the figures for knowing the exact elevation of the Upper Mississippi, yet we have the data for knowing that it was very much higher than at the present day.

The Lower Mississippi, from the Gulf to the mouth of the Ohio River, was of enormous size flowing through a valley with an average width of about fifty miles, though varying from about twenty-five to seventy miles.

In magnitude, we can have some idea, when we observe the size of the lower three or four hundred miles of the Amazon River, which has a width of about fifty miles. But its depth was great, for the waters not only filled a channel now buried to a depth of from three to five hundred feet, but stood at an elevation much higher than the broad bottom lands which now constitute those fertile alluvial flats of the Mississippi Valley, so liable to be overflowed.

From the western side, our great river received three principal tributaries—the Red River of the South, the Washita, and the Arkansas, each flowing in valleys from two to ten miles in width, but now represented only by the depauperated streams meandering from side to side, over the flat bottom lands, generally bounded by bluffs.

The Mississippi from the east received no important tributaries south of the Ohio; such rivers as the Yazoo being purely modern and wandering about in the ancient filled-up valley as does the modern Mississippi itself.

So far we find that the Mississippi below the mouth of the Ohio differed from the modern river in its enormous magnitude and direct course.

From the mouth of the Ohio to that of the Minnesota River, at Fort Snelling, the characteristics of the Mississippi Valley differ entirely from those of the lower sections. It generally varies from two to ten miles in width, and is bounded almost everywhere by bluffs, which vary in height from 150 to 500 feet, cut through by the entrances of occasional tributaries.

The bottom of the ancient channel is often 100 feet or more below the present river, which wanders about, from side to side, over the "bottom lands" of the old valley, now partly filled with debris, brought down by the waters themselves, and deposited since the time when the pitch of the river began to be diminished. There are two places where the river flows over hard rock. These are at the rapids near the mouth of the Des Moines River, and a little farther up, at Rock Island. These portions of the river do not represent the ancient courses, for subsequent to the Great River Age, according to General Warren, the old channels became closed, and the modern river, being deflected, was unable to reopen its old bed.

The Missouri River is now the only important tributary of this section of the Mississippi from the west. Like the western tributaries, farther south, it meanders over broad bottom lands, which in some places reach a width of ten miles or more, bounded by bluffs. During the period of the culmination, it probably discharged nearly as much water as the Upper Mississippi. At that time there were several other tributaries of no mean size, such as the Des Moines, which filled valleys, one or two miles wide, but now represented only by shrunken streams.

The most interesting portion of our study refers to the

ancient eastern tributaries, and the head waters of the great river.

The greater portion of the Ohio River flows over bottom lands, less extensive than those of the west, although bounded by high bluffs. The bed of the ancient valley is now buried to a depth of sometimes a hundred feet or more. However, at Louisville, Ky., the river flows over hard rock, the ancient valley having been filled with river deposits on which that city is built, as shown first by Dr. Newberry, similar to the closing of the old courses of the Mississippi, at Des Moines Rapids and Rock Island. However, the most wonderful changes in the course of the Ohio are further up the river. Mr. Carll, of Pennsylvania, in 1880, discovered that the Upper Alleghany formerly emptied into Lake Erie, and the following year I pointed out that not only the Upper Alleghany, but the whole Upper Ohio, formerly emptied into Lake Erie, by the Beaver and Mahoning Valleys (reversed), and the Grand River (of Ohio). Therefore, only that portion of the Ohio River from about the Pennsylvania-Ohio State line sent its waters to the Mexican Gulf, during the Great River Age.

Other important differences in the river geology of our country were Lake Superior emptying directly into the northern end of Lake Michigan, and Lake Michigan discharging itself, somewhere east of Chicago, into an upper tributary of the Illinois River. Even now, by removing rock to a depth of ten feet, some of the waters of Lake Michigan have been made to flow into the Illinois, which was formerly a vastly greater river than at present, for the ancient valley was from two to ten miles wide, and very deep, though now largely filled with drift.

The study of the Upper Ancient Mississippi is the most important of this address. The principal discoveries were made only a few years since, by General G. K. Warren, of the Corps of Engineers, U. S. A. At Ft. Snelling, a short distance above St. Paul, the modern Minnesota River empties into the Mississippi, but the ancient condition was the converse. At Ft. Snelling, the valleys form one continuous nearly straight course, about a mile wide, bounded by bluffs 150 feet high. The valley of the Minnesota is large, but the modern river is small. The uppermost valley of the Mississippi enters this common valley at nearly right angles, and is only a quarter of a mile wide and is completely filled by the river. Though this body of water is now the more important, yet in former days it was relatively a small tributary.

The character of the Minnesota Valley is similar to that of the Mississippi below Ft. Snelling, in being bounded by high bluffs and having a width of one or two miles, or more, all the way to the height of land, between Big Stone Lake and Traverse Lake, the former of which drains to the south, from an elevation of 993 feet above the sea, and the latter only half a dozen miles distant (and eight feet higher) empties, by the Red River of the North, into Lake Winnipeg. During freshets, the swamps between these two lakes discharge waters both ways. The valley of the Red River is really the bed of an immense dried-up lake. The lacustrine character of the valley was recognized by early explorers, but all honor to the name of General Warren, who, in observing that the ancient enormous Lake Winnipeg formerly sent its waters southward to the Mexican Gulf, made the most important discovery in fluvial geology—a discovery which will cause his name to be honored in the scientific world long after his professional successes have been forgotten.

General Warren considered that the valley of Lake Winnipeg only belonged to the Mississippi since the "Ice Age," and explained the changes of drainage of the great north by the theory of the local elevation of the land. Facts which settle this question have recently been collected in Minnesota State by Mr. Upham, although differently explained by that geologist. However, he did not go far enough back in time, for doubtless the Winnipeg Valley discharged southward before the last days of the "Ice Age," and the great changes in the river courses were not entirely produced by local elevation, but also by the filling of the old water channels with drift deposits and sediments. Throughout the bottom of the Red River Valley a large number of wells have been sunk to great depths, and these show the absence of hard rock to levels below that of Lake Winnipeg; but some portions of the Minnesota River flow over hard rock at levels somewhat higher. Whether the presence of these somewhat higher rocks is due entirely to the local elevation, which we know took place, or to the change in the course of the old river, remains to be seen.

Mr. Upham has also shown that there is a valley connecting the Minnesota River, at Great Bend at Mankato, with the head waters of the Des Moines River, as I predicted to General Warren a few months before his death. At the time when Lake Winnipeg was swollen to its greatest size, extending southward into Minnesota, as far as Traverse Lake, it had a length of more than 600 miles and a breadth of 250 miles.

Its greatest tributary was the Saskatchewan—a river nearly as large as the Missouri. It flowed in a deep broad cañon now partly filled with drift deposits, in some places, to two hundred feet or more in depth.

Another tributary, but of a little less size, was the Assiniboine, now emptying into the Red River, at the city of Winnipeg. Following up this river, in a westerly direction, one passes into the Qu'Appelle Valley—the upper portion of which is now filled with drift, as first shown by Prof. H. Y. Hind. This portion of the valley is interesting, for through it, before being filled with drift, the south branch of the Saskatchewan River formerly flowed, and constituted an enormous river. But subsequent to the Great River Age, when choked with drift, it sent its waters to the North Saskatchewan as now seen. There were many other changes in the course of the ancient rivers to the north, but I cannot here record them.

As we have seen, the ancient Mississippi and its tributaries were vastly larger rivers than their modern representatives. At the close of the Great River Age, the whole continent subsided to many hundred feet below its present level, or some portions to even thousands of feet. During this subsidence, the Mississippi States north of the Ozark Mountains formed the bed of an immense lake, into the quiet waters of which were deposited soils washed down by the various rivers from the northwestern and north central States and the northern territories of Canada. These sediments, brought here from the north, constitute the bluff formation of the State, and are the source of the extraordinary fertility of our lands, on which the future greatness of our State depends. However, time will not permit me to enter into the application of the facts brought forward to agricultural interests. But although this address is intended to be in the realm of pure science, I cannot refrain from saying a word to our engineering students as to the application of knowledge of river geology to their future work. The

subject of river geology is yet in its infancy, and I have known of much money being squandered for want of its knowledge. In one case, I saved a company several thousand dollars, though I should have been willing to give a good subscription to see the work carried out from the scientific point of view.

I will briefly indicate a few interesting points to the engineer. Sometimes in making railway cuttings it is possible to find an adjacent buried valley through which excavations can be made without cutting hard rock. In bridge building especially, in the western country, a knowledge of the buried valleys is of the utmost importance. Again, in sinking for coal do not begin your work from the bed of a valley, unless it be of hard rock, else you may have to go through an indefinite amount of drift and gravel; and once more, in boring for artesian wells, it sometimes happens that good water can be obtained in the loose drift filling these ancient valleys; but when you wish to sink into harder rock, do not select your site of operations on an old buried valley, for the cost of sinking through gravel is greater than through ordinary rock.

In closing, let us consider to what the name Mississippi should be given. In point of antiquity, the Ohio and Upper Mississippi are of about the same age, but since the time when in growing southward they united, the latter river has been the larger. The Missouri River, though longer than the Mississippi, is both smaller and geographically newer—the upper portion much newer.

Above Ft. Snelling, the modern Mississippi, though the larger body of water, should be considered as a tributary to that now called Minnesota, while the Minnesota Valley is really a portion of the older Mississippi Valley—both together forming the parent river, which when swollen to the greatest volume had the Saskatchewan River for a tributary, and formed the grandest and mightiest river of which we have any record.—*Kansas City Review*.

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