ART. LIV.—*On the Geology of the Delta, and the Mudlumps of the Passes of the Mississippi;* by EUG. W. HILGARD.

[Continued from page 246.]

II. *The Lower Delta and the Mudlumps.*

A glance at the map shows that in descending the Mississippi from New Orleans, we find a narrow strip of land only ¾ to 3 miles wide, dividing the river from the waters of the Gulf; from the head of Oyster Bay opposite Pointe à la Hache (about half way between the city and the head of the Passes), down to the mouths. Such, at least, is the case on the left bank; on the right, the "neck" begins a few miles below Fort Jackson. Down to the forts, the aspect of the "Coast" is generally pretty much the same, where its original character has not been lost by cultivation or encroachment of the river. Nearest the river, and highest above water level, are the sandy "willow battures," where the willow, mingled with and occasionally replaced by the cottonwood, forms the predominant growth. Beyond lies a belt of woodland, timbered chiefly with live-oak, magnolia, and cottonwood, often deeply veiled with long-moss; this belt embraces the richest and most durable soils of the "Lower Coast," and is mostly occupied by magnificent plantations of sugar cane and orange orchards. Beyond these, loom in the distance the sombre-hued, moss-curtained denizens of the cypress swamp, their tops forming a level platform sharply defined against the horizon. Between the swamp and the water's edge, seaward, there usually intervenes a zone of reeds, with here and there a stunted cypress, bay, or candleberry bush, where the salt water has but slight access.

While such is the general order of succession of these belts of vegetation where they coëxist, either or both of the two middle ones may locally be absent. Such is always the case where the "neck" is very narrow, as happens below the forts. Thence to the mouths of the passes, the willow batture and the reed marsh alone, with few exceptions, form the barrier between the river and the sea; it is traversed by numerous small bayous, some of which are in great part the work of the duck-hunters that supply the New Orleans market, and whose pursuit leads them to penetrate the marsh for the purpose of reaching the favorite resorts of their game. These bayous increase in frequency as we descend, and in approaching the mouths of the passes, the intervals between them become smaller, until they gradually become sheets of water dividing islands; and finally, just inside the bar, we have the latter resolved into numerous individual "mudlumps," dotting the surface of the sea, on both sides of the main channel.

Sir Charles Lyell remarks (Principles of Geology, 10th ed., p. 448), that the phenomenon of the mudlumps is without parallel, so far as known, in the delta of any other river. The same remark might, I think, appply to two other peculiarities, viz: the protrusion of the long neck of land into the Gulf; and the fact that, after failing to send out any branch of importance for a hundred miles the great river suddenly divides at one point into three widely divergent branches, the middle one of which (the South Pass), forming the direct continuation of the channel, is the smallest, and has long ceased to be navigable. Evidently, a strong extraneous obstacle alone could turn aside the powerful current, and permanently resist its erosive and undermining action. And now, the channel which carries the main current (the Southwest Pass), faithful to the old tradition, is rapidly pushing out into the Gulf its narrow bands of reedy marsh, without a branch of any consequence in ten miles from the head of the Passes to the light-house.

A glance at the coast lines, as well as at the intricate ramifications characterizing the deltas of the Rhine, the Po, the Danube, the Ganges, or the Hoang-Ho; or the broad inlets forming the mouths of the rivers of South America, will show the uniqueness of the Mississippi mouths; the Nile and the Lena alone exhibiting a general form at all analogous, yet very distinct in detail. For the islands off the Lena mouths are not "mudlumps;" and the tongue of land separating Lake Menzaleh from the Damietta branch of the Nile, is a mere sand-bar, exhibiting no analogy save that of form, with the remarkable "necks" of the Mississippi Passes.

It would be fair to infer, à priori, that some connection exists between the exceptional phenomenon of the mudlumps, and the exceptional form of the delta; and that such is really the case, can hardly be doubted upon a candid investigation of the facts. So far from being an unusual phenomenon, *the mudlump-formation appears to constitute the normal mode of progression of the Mississippi mouths;* not only at the present time, but for many ages past; perhaps ever since the broad flood of the Terrace epoch subsided into the present Mississippi.

The characteristic features of the mudlumps have successively been described and discussed by Sidell,* Forshey,† Chase, Beauregard and Latimer,‡ Thomassy§ and Lyell.‖ Yet as the phenomena are nowhere described in their entirety, I will here, as briefly as possible, recapitulate the important points.

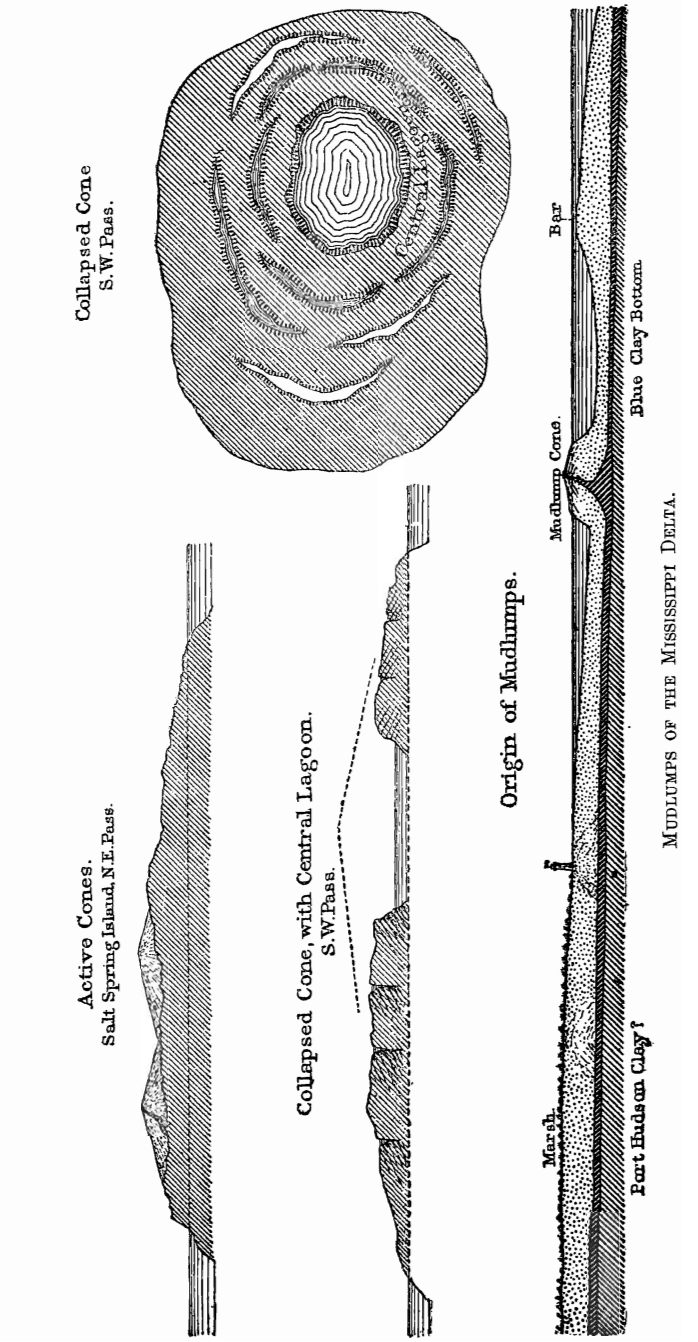
* Report to Capt. Talcott, 1839, in Humphreys and Abbott's Report, App. A.

† MS. Report, 1850.

‡ Report of the Board of Engineers for the Examination of the Mississippi; Congress. Doc. 1852–53.

§ Geologie Pratique de la Louisiane, 1860, Chap. VI.

‖ Principles of Geology, 10th edition, 1868; vol. 1, p. 449.



MUDLUMPS OF THE MISSISSIPPI DELTA.

The mudlumps originate in upheavals of the bottom, in the region lying between the extreme point of the mainland and the crest of the bar, at the main outlets of the passes. They all lie within a distance of from one to three miles from the axis of the main current, and nowhere extend into the bays intervening between the several active mouths. The pilots are under the impression that they form more frequently in the main channel than elsewhere; but allowance must be made for the natural infrequency of their observations outside of the latter; so that only the more obvious and remarkable changes of the bottom, when occurring outside of their regular range, would be likely to come under their notice. *A priori*, it would seem probable that inasmuch as the resistance to the upheaving force, other things being equal, must be less in deep than in shallow water, the lumps would rise more frequently and more rapidly in the channel than elsewhere. On the other hand, the denuding force of the river current must greatly diminish the chances of any such upheaved mass appearing above the surface, or even becoming manifest by a diminution of depth, when progressing slowly. Weighing these considerations against each other, I think a balance remains in favor of the pilot's opinion: the more as concurrent testimony goes to show that whenever the channel is changed, either by the accumulation of deposit or the interference of a mudlump upheaval, the old channel is promptly occupied by mudlumps *throughout* the abandoned portion.

As regards the rapidity of the upheaval, it appears to vary from an almost secular rate, to that of several feet in 24 hours. It has been rumored that lumps had been seen to rise visibly, and burst open like a bubble, but I have been unable to trace the statement to any reliable source, and it is discredited by the pilots. The most rapid rise of which I have obtained reliable information was witnessed by Capt. Andrews, of New Orleans. He states that a steamer having run aground about nightfall inside the bar, her bow being on a mudlump in about $2\frac{1}{2}$ feet of water, he towed her off during the night, and in the morning found the imprint of her bow 18 to 24 inches above water, in the soft mud. Allowing for the possible maximum influence of tides in favor of the difference observed, the minimum rate of upheaval, according to these data, still amounts to one inch per hour. Nor is this the only case in which a rapid shallowing of the water has been observed as a consequence of the grounding of large vessels. This has usually been ascribed to the accumulation of deposit in the slack water so formed, and in many instances this may have been the true cause. But this explanation can hardly apply to the case detailed above, and it is reasonable to suppose that the shock of a grounding vessel may

in many cases prove "the hair that breaks the camel's back," when acting upon a portion of bottom just about to yield to the upheaving force, and therefore in a state of unstable equilibrium. Future observations, however, will readily settle the question.

Of authentic observations illustrating ordinary rates of rising, I quote the following remarks of Mr. H. L. Marindin, U. S. Coast Survey, who in 1867, while engaged in the survey of the mouths, at my request paid considerable attention to the phenomena of the mudlumps, and made an interesting report to me on the subject, dated June 20th, and accompanied by specimens.

"Since the first examination of the mudlumps on Southwest Pass Bar, there have appeared numerous lumps in the vicinity of the main channel, whose appearance cannot be attributed to other causes than the upheaval of the bottom by some unknown agency; since tidal observations made during the month of April, May and part of June, show no material decrease in the height of water in the river, other than the daily ebb of the tide. In one instance, also, on this bar, it has been ascertained from surveys made at different times, that where in the month of April a channel with fifteen feet of water existed, there is now a lump, doubtless still forming, with only six feet of water on it at the highest stage."

Making allowance for a possible accumulation of deposit, the rate of rise cannot, in this instance, be estimated at less than two feet per month; which, so long as the lump remains under water, seems to be no unusual amount. When, however, the surface of the water is once reached, the rising becomes slower or ceases altogether, owing probably to the greater weight acquired by the material upon its emergence. At least, I have failed to find much above tide level, any material which did not bear distinct evidence of its having been formed, not by river alluvion, but by the action of the regular mudsprings; which, if not now active upon all the lumps, have demonstrably been instrumental in forming the great majority of the masses now above water level.

I do not know that any one has ever witnessed the first outburst of a mudspring on a newly risen lump; but we find them in all stages of progress, from the islet bearing its first tuft of rushes, to the active cones glistening in the sunshine, and from time to time, when an unusually large gas bubble rises, spattering the liquid mud (which usually flows in a quiet stream) all over the slopes; then the half-extinct cone, in whose crater a little pool of salt water is at long intervals agitated by a gas bubble; then the extinct and collapsed cone, surrounded by a circular moat and Somma-like ring-wall; next, the old lump of

jagged outlines, whose disintegrated materials are rapidly yielding to the combined attack of rain, sunshine and waves, till something looking like a large stump of a tree is all that remains of an island of several acres; and finally the shoal, marked by dangerous rollers, whose surface, on a calm day, still exhibits the concentric markings corresponding to the several cones which originally built up the island.

I regret being unable at the present time, to present accurate sketches of these several stages of "the mudlumps' progress." I hope to do so hereafter, but for the present must confine myself to the approximate outline representations given in the plate, and a brief description of the several stages as observed by myself in 1857.

Nascent Lumps.—As regards the first, it is probable that a good many lumps never pass beyond that stage of development, for the reason that, so soon as the resistance is materially increased by the emergence of a portion above the surface of the water, the upheaving force seeks a vent elsewhere.

Either the mud or gas-spring breaks out beneath the water, and becomes perceptible only by the more or less regular and localized evolution of bubbles on the outskirts of the lumps; a very common phenomenon in the neighborhood, not only of new and active lumps, but also about extinct ones, which are in course of demolition by the waves. On the extensive sandy shoal off Stake Island, on the Southwest Pass, such subaqueous gas-springs may be observed in great numbers.—Or it may happen, that another portion of the bottom, now offering less resistance than the mudlump, will, in its turn, give way before the upheaving force, till the same degree of emersion is obtained, or a vent is opened.

I have been unable to ascertain how high any mudlumps can rise bodily above the water without the appearance of a vent. As much as three feet has been observed with certainty; but unless the fact that it is a new upheaval be historically known, it must be extremely difficult to ascertain it, unless, by actual access to the interior, it can be shown that its surface strata are old river deposits, which can readily be distinguished from those formed by mudlump vents. Yet these might, during the elevation of the lump, have been removed by the current. At all events, I have failed to find on the surface of any lump much above tide-water, anything like true river alluvium; the visible material being either such as is now formed by active vents, or, (as on the lower slopes), that which obviously results from the disintegration of the former, being altogether devoid of structure.

It is said that lumps sometimes sink from view again after bare emergence. I know of no authentic example, but it

seems likely enough that upon the formation of a large vent elsewhere, such a thing might happen; especially if, as I think probable, mudsprings and mud-cones form *beneath*, as well as above the water.

Active Cones.—In the second stage, that characterized by the formation of the active eruptive cones, mudlumps offer an aspect so strikingly like that of the mud volcanoes of Tuscany, as to stagger the observer's geographical consciousness. The most striking example of the kind existed, at the time of my visit, off Pass à l'Outre, on the south (right) side of the channel. The island* is about an acre in extent, and besides the active vents (of which there are seven), we perceive on the southern portion the remnants of long extinct craters, in various degrees of advancement toward old age and degradation, and partially covered with vegetation.

The cones on the north or channel side, at a distance, present a glistening surface, and those possessing a central vent only are very regularly and smoothly conical. Of these there are four, the diameters of the bases ranging from eighteen to fifty feet, and their elevation from one to two and a half feet above the general level of the island; making the angle of the slope from 5° to 8° only, instead of 25° to 35°, as given in the published sketches. I have seen no undisturbed cone whose slope exceeded about 12°. The slope is, of course, essentially a function of the thickness and character of the mud; which in the present instance flows from the circular basin at the summit, 4 to 8 ins. in diameter, in a regular, creamy stream, interrupted occasionally only by a gas bubble; which, if the mud be thick, spatters it about to some extent. The mud-stream varies from 3 to 4 gallons per minute in the largest (eastern) cone, to a pint or two in the less active ones; sometimes, in running down the sides, it spreads over as much as $\frac{1}{3}$ of the circumference, but usually forms a stream 4 to 8 inches wide, serpenting down the slope between banks formed by its own solidification, as does a lava stream. As these banks grow in height by drying, on the edge of the crater, they gradually compel the mud to rise higher before it can flow off; whereupon, after a while the column overflows at another point of the circumference, where the same play is then repeated. In the meantime, the previous mudstream has an opportunity of consolidating, drying more or less, and undergoing a variety of chemical changes dependent upon the character of the water and the duration of the exposure to the air, which manifest themselves in changes of color and consistency; by these the individual streams are distinctly defined from one another. Each one forms, of course,

* It was named Marindin's Lump by the crew of the U. S. Coast Survey Schr. Varina, and I shall allude to it under that designation.

a more or less irregular portion of a conic surface, the cross section being more or less lenticular.

There results, as may be supposed, a very peculiar structure or stratification, unlike anything usually seen outside of volcanic districts, unless, perhaps in the somewhat analogous case of the lee side of dunes. It may roughly be compared to the upper half of an onion. It is needless to say that, once seen, it cannot readily be mistaken for anything else; and its absence must be held as proof conclusive of an absence of genetic analogy.* The thickness of the layers rarely exceeds $1\frac{1}{2}$ inches; their colors vary from dark mouse-color and bluish gray, through dun and buff, to rust-color and red; the materials, from hard, plastic clay, always containing a great deal of fine silex and more or less coarse sand, to sandy clay and, rarely, clayey sand; the selvedges are frequently marked by iron rust and mica scales. Where, as is frequently the case, neighboring cones are confluent at their bases, the structure is of course complicated in a manner readily imagined.

As regards the gas evolved (which is in all cases inflammable), the small proportion its bulk bears to that of the mud simultaneously ejected (about $\frac{1}{2}\frac{1}{5}$ to $\frac{1}{3}\frac{1}{6}$ at Marindin's Lump), at once does away with the impression mostly entertained, that the gas bubbles bring up the mud with them. The latter comes up with a steady flow, evidently the result of static pressure, and is only from time to time agitated by a gas bubble, larger or smaller according as the mud is more or less consistent. We sometimes find, about extinct cones especially, lively gas springs in which the proportion of gas is considerably greater, than happens in any active cone that has come under my observation; but in that case, it is almost always accompanied only by *water*, as though its source were above the stratum which furnishes the mud. For, a glance at the river deposits forming around the lumps, at once shows that they are totally different from the fine, clayey material of which the cones are formed; nor is it credible that the mere passage of a current of water and gas through such deposits, or in fact, *any consolidated materials*, should produce such a perfect, creamy mixture as that ejected from these craters.

Extinct Cones.—Good examples of cones whose activity has nearly or quite ceased, may be seen off the Northeast Pass. Here the material is somewhat sandier and firmer than the mud ejected at Passe à l'Outre. While at the latter place it was difficult to reach the craters without being hopelessly

* Vide Thomassy's remarks on the Five Islands, etc., Géol. prat. de la Louisiane, chap. viii. With even less show of reason, a similar origin has repeatedly been claimed for the low circular mounds which dot a large part of western Louisiana. They consist exclusively of unstratified sandy materials, and are doubtless the result of animal activity—probably of the large ant.

bogged, they can readily be reached almost dry shod at the Northeast Pass. Here, also, the top layers were peeling off in large concave "flakes," from the effect of sun-cracks and drying; such a surface again overflowed by mud would add another singular feature to the structure of the cones, which may also be noticed in many sections of ancient ones.

The vent of a large cone in this region (see Plate) formed a basin about 8 inches diameter, containing a puddle of salt water covered with an iridescent ferruginous pellicle, disturbed at long intervals by small gas bubbles. Evidently, the resistance in the large cone, elevated about 10 feet above the water level, had become too great for the ejection of mud; in consequence whereof, a lively little cone was glistening and bubbling at a level several feet lower, near the foot of the old cone. *But the testimony of the pilots goes distinctly to show, that the active cones become more lively, and dormant cones resume their activity, at high stages of water in the river.* At the time of my visit, the water was at an unusually low stage.

Collapsed Cones.—The cones, especially the larger ones, appear to be unable to survive for any great length of time the cessation of activity. The change that occurs seems to be, in all cases, a sinking of the central portion, often to such an extent that its place becomes occupied by a pool or lagoon, surrounded by a circular rim whose strata incline *away* from the center at angles invariably much steeper than is found in any recent cones, from 20° to as much as 45°. Outside of this first rim there mostly appears a series of concentric crevasses, sometimes several feet in width and in depth; and the annular segments thus brought to a level by a subsidence, also exhibit the singular feature of a *steeper* inclination of the lines of deposition, than is found in any cones now forming. The seeming anomaly of this fact caused me to observe the phenomena closely; but I have been unable to find an exception to the rule; and I have been led to doubt whether in some cases, instead of true eruption cones, these collapsed areas and their surroundings may not be the remnants of the original upheaved "bubble." The objection to this interpretation is the character of the material, which, excepting in a few cases on the Southwest Pass, is altogether unlike the present river deposits, both in structure and composition.

A most perfect exemplification of a large central lagoon (100 feet by 75) surrounded by an elevated rim and several successive, concentric "moats," also in part filled with water, occurs on one of the numerous mudlumps S.W. of Stake Island, on the Southwest Pass (see Plate). The central portion does not always, however, sink out of sight; sometimes a conical mound is still observable, as the center of the more or less circular,

concentric crevasses, which a close inspection shows to exist on almost all lumps not too far advanced towards decrepitude. Many islands exhibit several such centers and systems of crevasses, indicating, probably, the previous existence of cones, sometimes several hundred feet in diameter, greatly exceeding the largest now in a state of activity, both in diameter and original height.

Degradation and Disappearance of Lumps.—The direct action of the waves, unassisted by atmospheric agencies, produces but little effect upon the yielding, but tough and coherent material of the cones. The heaviest breakers and rollers spend their force in vain against the clay shoals which render most of the lumps so difficult of access. The unwary will often be tempted by the deceptive, rock-like aspect of this material, to jump into the shallow water and wade ashore; but a plunge knee-deep into the apparent solid will frequently reward his temerity. Yet so long as this mass, which shows plainly the peculiar, concentrically banded mudlump structure, remains constantly covered with water, the waves rolling over it produce but little impression.

Not so with the portion that projects above water, which is alternately exposed to rain, sunshine, and the wash of waves. Especially where the material is clayey, these agencies combined soon produce a change in which the structural as well as the paleontological characters of the original material are totally obliterated. A rain falling upon a fresh surface of the latter, causes it to swell; then, upon exposure to sunshine, it will contract into prismatic cleavage-forms. A slight rain, or the spray itself, will then cause the extreme surface to crumble into, and partially fill up, the cracks; when the swelling consequent upon a thorough wetting, by either rain or waves, will force them to open still more, while streamlets of fluid mud follow each retiring wave; which, perhaps, has thrown up, and left high and dry in the cracks, a dozen species of shells, entirely foreign to the mudlump mud itself. It is thus that the structureless, tough soil of the general surface, and of the beach of the mudlumps, is formed; and to it alone apply the descriptions given of the mass of the mudlumps, by Sidell, Thomassy and Lyell, as a "homogeneous, tenacious mud."

A frequent repetition of this process involves, of course, not only a rapid direct degradation of the lump, but it causes it to be cleft into fragments by rents gradually progressing from above downward, which rapidly increase the surface exposed to attack; and eventually, some large wave, in retiring, carries down with it a huge prismatic slice, leaving behind an almost vertical cliff. This is carried away in its turn, and thus, attacked from all sides, an island of considerable size, after

passing through a variety of middle stages in which it strikingly resembles masses of trap or basalt, magnified into distant mountains by the peculiar optical delusion prevailing in the region,* is finally reduced to what, at a distance, appears to be the stump of a tree. At last, some storm sweeps away this last monument of the disappearing lump, and white-capped rollers alone mark, thereafter, the higher points of the mud-shoal.

I have best observed these phenomena of disintegration in every stage of progress, among the mudlumps off the Northeast Pass, where the fanciful, cliff-like forms, figured by Thomassy, Sidell, and Lyell, may be seen to perfection.

It is said that there are no mudlumps off South Pass or Grand Bayou; a statement which may require to be taken with a grain of allowance, but agrees with the general impression that the mouths discharging the largest amount of water, also exhibit mudlump activity on the most extensive scale.

The Southwest Pass is the main outlet at the present time; the area inside the bar is thickly studded with mudlumps, chiefly west of the channel; and as before stated, lumps have risen there repeatedly under the eyes of the pilots and survey parties. Yet there is not there, at the present time, a single *active* cone, so far as I am aware; although salt water and gas springs are of frequent occurrence, both on and around the islands. There is a marked difference between the river deposits as well as the mudlump materials of Passe à l'Outre and Southwest Pass, the latter being decidedly more sandy, and sand bars taking the place of the mud flats off the former. Whether this circumstance (the natural result of the greater swiftness of the current in Southwest Pass), is connected with the absence of active cones, it may be too early to discuss. Some very lively springs on a large mudlump off Stake Island on that Pass, in which the gas emitted is about equal in bulk to the water, rise in small basins excavated at the foot of a large cone which must have been 15 to 18 ft. high; but the material they bring up is so very sandy that the water runs off perfectly clear.†

Mudlumps in the Marshes.—I have before remarked, that at the present time, the upheaval of mudlumps on the passes, and subsequent silting up of the shallows between them (by river deposit, as well as by the degradation of the lumps themselves,) seems to be the normal mode of progression of the delta. The more advanced portions of the narrow bands of shore now

* Caused probably by a faint bluish haze, through which an island a quarter of a mile distant and 15 feet high, appears to be a wooded mountain with rocky escarpments, and at its foot a wide spreading city—which suddenly resolves itself into a row of grave white pelicans perched on the beach and taking wing at the approach of a boat.

† See analysis of the water of these springs, below; marked "S. W. Pass, I."

forming along each one of the passes, are historically known to consist of mudlump-chains; and in the absence of any plausible presumption to the contrary, as well as of any parallel example in other rivers, it is reasonable to surmise, that not only the shores of the present passes, but also the neck, *at least* from Pointe à la Hache down, owes it formation and peculiar features to the same agencies.

We have seen how rapidly and completely the joint action of the waves and atmospheric agencies accomplish the degradation of elevated lumps to the common level of the tide; and where the nature of the materials is such as to yield readily to these destructive influences, it would be unreasonable to look for vestiges of ancient lumps above that level. Such is the case, as before mentioned, on Northeast Pass and its branches.* But the sandier nature of the mudlump mass on Southwest Pass enables it to resist much longer, so that some of the larger and more elevated islands there seem destined to retain, more or less permanently, their present form. For the same reason, perhaps, the Southwest Pass furnishes the one prominent example of the existence of an active and characteristic mudlump, in the level marsh on the right of the channel, about five miles below the Head of the Passes, and seven above the mouth (light-house); distant 1½ miles from the river bank, and about one mile from the beach of West Bay. Double-headed Bayou, or one of its channels, passes within a few hundred yards of this lump; which is so difficult of access that it has been very rarely visited, though plainly visible from the hurricane deck of passing steamers, from which I have examined it with the telescope.

According to Thomassy,† the pilot Ben. Morgan, who has visited it, describes it as being "a regular truncated cone, 20 to 25 feet high and 300 in circumference, spouting at intervals from its summit masses of clayey and sandy mud, which overflows all around."

From the Pass, it now appears as a slightly irregular, conical hill, which, judging from the extent to which it projects above the highest reeds, is about 18 to 20 feet high at most. On its eastern side there is a second cone about half as high, with a very regular slope not exceeding 30°, while that of the large one is at least 45°. A whitish sheen which extends from the summit of the larger cone toward the smaller one, I interpret as a white salty efflorescence; but on the south slope of the smaller

* Col. Sidell mentions a mudlump cone, 18 feet high, on the north side of the Northeast Pass, in the marsh. It has probably succumbed since his visit, as in passing the spot I was unable to perceive any elevation, nor was it known to the pilots.

† Géol. prat. de la Louisiane, p. 56. I shall designate this cone as "Morgan's Lump."

cone, the glittering of a flowing mudstream was unmistakable. Inasmuch as in Morgan's account of his visit the smaller cone is not mentioned, it is presumable that it has been formed since, by a lateral eruption; the old cone having, perhaps, reached the extreme limit of height to which mudlump force can raise its materials.

The steep slopes of both the old and new cone are suggestive as to the influence of sandiness on that feature, and the explanation of the steep inclination of strata, observed chiefly on Southwest Pass.

It is my impression that another cone exists in the marsh about two miles south of these. It is almost screened from view by the reeds, but the telescope shows it to be distinctly conical. It does not seem to have attracted notice heretofore.

But if mudlump cones are scarce in the marshes, the same is not true with reference to the salt and gas springs, which are reported to be quite abundant by the hunters—the only men whose occupation leads them to "thread the pathless waste" of reedy marsh, otherwise seldom visited, save by surveying parties, and alligators. These springs are found on or around all mudlumps, of whatever age; even on the shoals left behind by disintegrated lumps, where they issue under water, sometimes altering perceptibly the character of the water in the immediate neighborhood. The Southwest lighthouse was originally built on a mudlump separated from the mainland by a bayou; this is now filled up, but salt springs still issue at several points in the marsh near the foot of the tower. It is obvious that the gradual accumulation of deposit is not likely to check lively springs, possessing sufficient head to rise, hydrostatically, above the level of the alluvium; though in many cases they may lose themselves in the sandy strata.

I have not had an opportunity of ascertaining whether or not salt springs are known to exist in the marshes near the Forts, and above. I fully expect to find, however, that they do exist, though, for obvious reasons, they will become less and less abundant as we ascend the river. At New Orleans, as already stated, gas and salt water are reached, and brought to the surface with considerable vehemence, by bores varying from 31 to 56 feet;* and I have no difficulty in believing in the correctness of the impression made upon Col. Sidell, that the foundations of the New Orleans customhouse were located upon a mudlump.† That such obstinate resistance as that of the "Head of the Passes" to denudation can hardly be attributed to a mass of river deposit, I have already intimated. A large mudlump mass has, probably, first caused the deflection.

[To be continued.]

* See above, p. 245.

† Lyell's Principles of Geol., 10th ed., p. 552.