II. OBSERVATIONS *on the* NATURAL HISTORY of GUIANA : *In a Letter from WILLIAM LOCHEAD, Esq; F. R. S. EDIN. to the Rev. Dr WALKER, F. R. S. EDIN. Regius Professor of Natural History in the University of EDINBURGH.*

[*Read March 3. 1794.*]

DEAR SIR,

ALLOW me at present to trouble you with a few general observations on natural history, which I had an opportunity of making while on a botanical excursion, with my friend Mr ANDERSON, to the Dutch colony of Demerary. Guiana is a country but little known in Europe, though its animals and vegetables have added considerably to the catalogue of natural productions. It is not however the organic kingdom which I mean at present to touch upon ; all I aim at is to give you some idea of the face of the country, as leading to the knowledge of its formation and present state. It is not a field for the mineralogist, as its interior is unexplored. But to the geologist, who wishes to trace revolutions of the latest date, it is not uninteresting to contemplate such a recent and singular country as Guiana.

I NEED not inform you, that under Guiana is comprehended all the coast of South America from the Amazons to the Oroonoko ; that it trends nearly N. W. and S. E. ; that it is in general a very low and flat country, especially the Dutch or westernmost part of it ; and that it is watered by several rivers and creeks, which rise in a chain of mountains running nearly E.

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and W. and dividing Guiana from the inland parts of South America, which form the banks of the Amazons and its numerous branches.

Coast.—No coast can be more easy to make than that of Guiana. The changed colour of the water indicates foundings long before you make the land, and you may run on in seven fathoms before you can discover it from the deck. The bottom is at that distance a soft mud. All along the coast near Demerary, you have only ~~about~~ two fathom at a good league from the shore; to leeward of Essequibo, it deepens still more gradually. In standing off or on five or six miles, you will hardly deepen or shallow the water as many feet. When a high sea sets in upon such a coast, it is easy to conceive, that at a very considerable distance from the land it must be affected by the bottom. The interval betwixt wave and wave becomes more distinct. As they roll on in succession, the lower part is retarded, the upper surface accelerated, each billow of course becomes steeper and more abrupt, till at last it gradually ends in a breaker, when it has come to the depth of only a few feet. These *rollers*, as they are called, are the dread of seamen, especially betwixt Essequibo and Pomeroon, where the water is shallow, and the bearing of the coast very much north and south, exposes it fully to the action of the trade-winds. In small craft, those acquainted with the navigation do not hesitate to run along the coast, even among the rollers themselves; but vessels drawing from eight to twelve feet water, especially if the swell be heavy and it falls calm, can hardly get off. If anchor and cables fail, they drift on till they are fast in the mud, and there they will continue, sometimes for weeks together, before they go to pieces. The sea-water becomes exceedingly thick and muddy within a few leagues from the coast of Demerary, as much or more so than the Thames is at London. A stranger would naturally take this for the discharge of large
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flooded rivers after a rainy season. By and by I shall explain the true cause of it.

ON approaching the continent of South America, a change on the face of the *sky* will strike the attentive observer. The clouds become less distinct from each other, and the intervals between them less clear. They are blended into one another as it were, and suffused more generally over the atmosphere. They appear to be furcharged with vapour, or to have a stronger disposition to deposit it.

THERE is a particular prevailing appearance of the heavens within the tropics when you are at a distance from continents or very high islands, which has so often struck me that I wonder it has not been taken notice of. I call it a *tropical sky*, and thus describe it. The clouds in fine weather are in a single series or stratum, sailing away regularly with the trade-wind. They are small and distinctly separated from each other. The intervals or *sky* above them of a clear azure. The lower surface of the clouds is perfectly horizontal. As the temperature is commonly very equal over the sea, the condensation takes place every where at an equal height from the surface of the water. In the clouds that are over-head, you cannot indeed perceive this; but it becomes more and more visible as the eye recedes from the zenith. The lower limb of each distant cloud appears perfectly level and well defined, brighter than the superincumbent part. At a distance, nothing is to be seen but these limbs closer and closer in gradation one behind the other; and the whole horizon round resembles the roof of a stage, with an infinity of half dropt curtains as far as the eye can reach. In two voyages from Europe, I have met with this tropical sky as far north as Cape Finisterre. It came with a fair wind, which continued with us like a regular trade-wind, accompanied with the same appearance of the clouds, till we made the West Indies. In running down the trade-winds, every one has an opportunity of verifying this description, and must be struck with the beauties

which this sky presents at the setting of the sun. The inhabitants of the lower islands may also be well acquainted with it. In the higher ones, the attraction of the mountains ever forms sets of clouds of other appearances, as being produced by other causes. With our present knowledge of meteorology, hardly any other cause can be assigned for the phenomena above mentioned, than the constant equal temperature that every where prevails on the intertropical seas. One analogous fact however may be mentioned; the exceedingly small range of the barometer in the torrid zone. Does the same cause regulate so exactly the height of the clouds, and maintain the uniform suspension of the mercury? We might almost suspect it did, were it not well known, that the barometer varies as little upon continents, and in the vicinity of mountains, in these regions as elsewhere, though the condensation of vapours is in such cases much more irregular. Upon the continent you will frequently observe this tropical sky also, especially in fine settled weather; but much more commonly you will find the sky there, and even before you make the coast, covered with heavy large dark clouds in some places, and in others, at a greater height, the serene dappled sky, so often seen in Europe.

Winds.—THE *trade-wind* generally prevails all the day long, and on the sea-coast seldom fails even at night; but in less than fifty miles up the river it is a dead calm at night, and the breeze is not able to penetrate so far till towards noon. Still farther up we had whole days of a stark calm, and the heat very intense.

Dews, fogs and temperature.—THE dews, following the law which they generally observe, are very heavy when and wherever there is but little wind, and the hotter the day and evening, they fall the more copiously; they were of course more abundant up the river than near the sea-coast. The exhalations in the day-time
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from a hot and misty country covered with vegetables being very great, the condensation occasioned by the absence of the sun, and the cold accompanying that condensation, are in proportion. Near the coast the diurnal difference of temperature is but trifling, the constant trade-wind preserving in the air nearly the same medium of heat as in the body of the ocean; but far up the river the range of the thermometer was very great. The heat of the day was intolerable. In the shade it was frequently above 90° . This, when there is no breeze, forces you into the woods for shelter. Towards evening it cools; during the night the cold increases, and is greatest about five in the morning. The thermometer would then be from 72° to 74° . The body of the river being large enough to retain its heat, the evaporation goes on from its surface through the night, and is condensed into thick fog, which hangs over it, and is seldom dispersed before eight or ten next day. While the air was as above in the morning at 72° , the water along-side gave 80° to 83° , and seldom rose two degrees higher at noon-day. We had an opportunity of verifying an observation made by the few inhabitants who live far up the river Demerary, that when it feels very cool in the morning before day-break, they are sure of fine weather; when, on the contrary, it feels warm, they expect rain. They sleep in hammocks, and the houses they have are pervious enough to the air, so they are sensibly affected by any change in its temperature.

Seasons.—As to the seasons, it is not an easy matter, from the accounts given by the colonists, to ascertain them exactly. All seem to agree, that since cultivation has been somewhat extended, they are not so regular as before; that the dry season encroaches on the rainy, and that during the latter, they have often several dry days in succession. The account given by Dr BANCROFT was the one generally allowed; that it is dry about the equinox, and rainy about the solstices; that of consequence
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they have two wet and two dry seasons every year. We thought it difficult to reconcile this with the account given of the seasons of other countries in similar climates, and with what actually takes place in the Carib islands. I will give you my ideas on the subject. It is within the tropics a very general rule, that the vicinity of the sun brings the rainy season. To the northward of the line therefore this must be in our summer months. It is another invariable law, that as in lunar influences, so in the change of seasons produced by the sun, some time is necessary after the maximum of the cause to produce the full effect. The highest tides are not till two or three days after the full and change. The greatest heat of the day is two hours after noon, and the hottest months in Europe are July and August, not June, when the sun is highest. Among the West India islands, the full effect of the sun's vicinity is still later. I have found August, and more especially September, to be the hottest months in the year, and they are accordingly the height of the rainy season. It begins thus: No sooner has the sun come to the northward, and begun to be vertical among the islands in April and May, than his force is felt, the sky is more disturbed, the wind is more frequently from the southward and in squalls, and now and then there are heavy showers. In June the same effects continue, and increase in July, when the proper rainy season may be said to begin, and continues in force more or less till the middle of October. August and September, with part of July and October, when these effects are at their greatest height, are styled the hurricane months, and by the French *l'hivernage*. During them, the full force of the great luminary which distributes light and life, however necessary, seems sometimes too much for nature. She is oppressed and sickens; her respiration is disordered by intense heat; sometimes calms, sometimes heavy squalls; the agitated elements vent themselves in lightning, with thunder and torrents of rain, or are sometimes thrown out into those horrid convulsions, hurricanes,

canes which seem to threaten instant dissolution. Guiana is happily free from these scourges of the Antilles. Their force has lately been partially felt at Tobago, which was thought beyond their reach. In Trinidad, the greatest storms they have hitherto experienced, do not deserve the name of hurricanes; and to the southward, on the main of America, they are utterly unknown. The difference then between Guiana and the islands is this: In the former, the rainy season sets in earlier, as indeed the sun is sooner vertical. Their principal rains are in the end of April, in May, June and July. They are also sooner over; for August, September and October, and I believe part of July, are commonly fair weather. But again, November in part, December, January and February, reckoned dry months among the islands, are in Guiana a second rainy season. The cause of this I take to be as follows: North-easterly winds, pretty stiff, cold, and bleak comparatively in these climates, are frequent among the islands during the winter months. They are well known by the name of Norths. They are often accompanied with rain, but it is not very heavy, nor thought of consequence enough to give the denomination of a rainy season. These winds we know to reach as far as the coast of Guiana; and there I have reason to believe they are productive of more rain than in the islands. The face of a large continent, and its effects upon the atmosphere, may very probably make them give up more of their humidity than they do among the Antilles, though, at the same time, their force and bleakness may not be so much felt. If this conjecture hits the truth, the following ought to be corollaries, and are left to future observation. In this rainy season, when the sun is near the southern solstice, their rains will be with pretty steady northerly breezes on the coast. They may be of longer continuance at a time, but they will not be so heavy as those of summer, and they will be chiefly on the sea-coast, and probably will not extend a great way up the country. It remains even a query with me,

whether the rain that accompanies the norths among the islands, especially those most remote from the line, be not generally in a greater proportion than is commonly supposed.

Country.—I WILL now endeavour to give you some idea of the face of the country. Though, as is well known, Guiana is flat and swampy, yet it affords to the attentive eye an interesting variety. The sea-coast is little, if at all, raised above the level of high water, and it continues at this level for many miles inland. It is properly an immense woody swamp, never dry in the driest season, covered with several feet of water in the wet. Next the shore, as far as the brackish water extends, it is covered with mangroves, which grow to a considerable height, and form a thick shade. They are elevated on their branchy intermingled roots from the bare wet clay or mud, on which there is scarcely one herb or plant, but which seems to be all in motion, from the prodigious number of crabs which make their holes in it. Further on, when the under-water is fresh, you meet with a new set of vegetables, principally small trees, which, from their situation, are obliged to adopt the habits of mangroves, having the bottom of their trunks supported three or four feet above ground by their ramified roots. Several climbing plants are mixed with them. Arunis, in great variety and profusion, emerge from the water, or embrace the stems of the trees; and several broad-leaved plants of the hexandria and triandria classes, assist the Arunis in forming an herbage. In all this low part of Demerary, there is not one tree of a large size, nor among them all above two or three species which can be applied to use as timber. Proceeding still up the river, its banks are found generally to raise themselves above the level of the water; and when you have gone up one tide, (betwixt twenty and thirty miles), they are so high, that there is no farther occasion for dams to keep the plantations from being overflowed at high water, as below;
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canals or ditches are sufficient to drain the land, which is still perfectly flat. The trees are here different in species and larger in size than below, and the woods are much more practicable. As they are drier, the ground has acquired a regular sort of surface, and there is neither that plexus of roots, nor the same number of vines, (the common name in the West Indies for all climbing plants), to entangle those who choose to traverse them. The soil here is generally a stiff, cold, reddish clay, mixed a-top with a portion of vegetable mould.

THE sand-hills present to the admiring eye a scene very different from what it had been accustomed to below. The first you meet with upon the Demerary, is upwards of thirty miles from the mouth of the river, and on the right hand ascending, or on its western shore. There are of them further down in the country, but not close by the river-side. This one is the extremity of a ridge which extends to the westward several miles. As you ascend the river, you meet with many more of the same kind on both sides, whose direction seems likewise to be east and west, or nearly at right-angles with the average course of the stream. They vary from 50 to 100, 150, or 200 feet of perpendicular height above the level of the river and the intervening flat country. Their breadth and extent varies sometimes only a few hundred paces, sometimes many miles. Their length is great; with some interruptions, I have reason to believe they are generally continued from one side of the colony to the other, only intersected in different places by the rivers and their branches. They consist of a pure siliceous sand, so white that it dazzles the eyes, commonly fine grained and loose, but not unfrequently mixed with little strata of coarser pebbles, mostly quartz, and sometimes concreted into a proper sand-stone. In the last case, a black or reddish tinge is in many cases communicated to it, from clay, decayed vegetables, or other extraneous matter. There is no regular stratification to be found in it, more than what is common to all

sands, the produce of depositions of different dates, and as they are of different materials, thicker in one place, thinner in another, sometimes horizontal, but oftener inclined, and convex or concave according to circumstances. We could meet with no appearance of shells or other marine productions, but in a few places, pieces of broken vegetables buried in the sand where it was concreted. They were black as all the fossil vegetables that I have ever seen in sand-stone. Upon, and by the sides of the sand-hills, grows the most valuable timber of these colonies. The trees there are of a good size, and very clear of obstructing underwood or vines. The Wallabba, (*Parivoa grandiflora* of Aublet); the Sipiri or green-heart, (a new species of laurel); the Coumarou or Tonquæbean-tree, *Coumarouna odorata* of Aublet; the Mora, valuable for boat-timbers, and many others, whose wood is equally hard and beautiful.

CONTINUING to ascend the river, the sand-hills become rather more frequent, but the intervals still remain a perfect flat, though now several feet above the level of the stream, and the soil is still a stiff clay. Hitherto the river is deep all over, generally from two to five fathoms; the bottom is mud or clay, and the shores on either side at low water covered with ooze. About 130 miles up, however, or just before it begins to shallow, the bottom is covered with banks of a hard white or brown sand. It was a problem for some time whence all this sand originated in such a country. It was soon solved. Leaving here the vessel that had hitherto carried us, we proceeded in a canoe; and at about 160 or 170 miles distance from the mouth of the river, we met with the first proper hills of solid materials. The nearest to us was a rock of granite projecting into the stream, whose direction it gave a change to at this place, and it served for a landing-place to the highest piece of cleared land upon the river next to the post-holders. It was part of a low ridge of the same stone which crossed the country, probably to Berbia or beyond it, and was succeeded by many other series of hills

hills more inland, and as far as we could examine them, of the same materials. The granite was both of the red and the gray kinds, but chiefly of the latter. A number of seams or dikes crossed it here and there in all directions, not distinctly separate, but firmly united to the rest, making as it were but one body with it, and consisting of the same materials differently modified. Their component parts were generally smaller; they were more compact and closer in the texture than what surrounded them; and where they had been equally exposed to the action of the weather, they appeared to have borne it much better than the surrounding granite. The origin of the sand was now accounted for. This stone, in some cases exceedingly firm and durable, is in others very liable to decay; and the wash of these enormous chains of hills was able to furnish abundance of such sand as we had met with below. The granite afforded many varieties, indeed every shade, from large and distinct grained, to that whose component parts of felspar, schorl or quartz, were so small as to resemble pretty compact, compound lavas, or some of our mixed whin-stones in Scotland. All these varieties would be found at no great distance from each other. I brought some specimens, from Tiger's berg, a hill about 500 feet perpendicular height, which have every appearance of having undergone the action of fire. They resemble half-vitrified scoriæ, and would be taken for them, but that they were actually broken off from the granite, and discover all its parts in the fracture. The summit of this hill is irregular, with several pits and holes among the rocks. A little higher than it, and I suppose nearly about 200 miles from the sea, you meet what are called *the Falls*. They are only five or six rapids, within the space of a mile or two, formed by ledges of very close-grained gray granite that run across the river. There are breaks in each of them, through which the dextrous Indians are able, in their light canoes, to pass up at any season, even the driest; and when the river is swelled by

the rains, they become totally obliterated. Two days journey, or two and a half above this, is the great fall, where the stream comes over the face of a rock, as we were informed, twenty feet high.

Savannahs.—SAVANNAHS, ever since the discovery of America, have been known to occupy large spaces in the southern parts of that continent. They are to be met with abundantly in Guiana, and are of two kinds very distinct from each other, the *wet* and the *dry*. Of the former, many are extensive as the eye can reach, immense verdant plains occupying the whole face of a country, with or without a few straggling insulated patches of wood. In the dry season, they appear meadows of long grass or reeds, and are seldom practicable for any distance, for the bottom is very rarely dry. In the wet season, they are all one entire plain of water, over the surface of which the grass still rises, but which may be every where navigated in the courials or canoes. Towards the end of the drought, the Indians set fire to them. The young growth which succeeds attracts the deer, and the native, on the return of the half-deucalion days, pursues them in his little bark across their former plains. The soil upon these savannahs can neither be very deep nor very good; yet water may be always commanded, and labour and industry might convert these deserts into *rice-fields*. It is a question whether the days of slavery will ever see that event. The culture of this useful vegetable, which in the east has for ages been the standing food of millions, brings too moderate a return, at least in an infant colony, for the rapacious agricultural system of the West Indies.

THE *dry* savannahs are neither so frequent nor so extensive, yet we have passed through some of them several leagues in circumference. They are formed along the flats on the top of the sand ridges, and covered by a very thin coat of verdure. They resemble, exactly enough, some of the bare moors in Scotland.

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Many beautiful plants of the class gynandria are their chief ornaments, as is also the orchis, which grows in similar situations with you. Some Melastomas, and more Rhexias, supply the place, and bear somewhat of the habit of the *Ericæ*; for your Sedums and Saxifrages is the little Sauvagesia; and in hollows of the same savannahs, where moisture prevails, what I never could have expected to see within five degrees of the line, and not more than 50 or 100 feet above the level of the sea, the *Drosera* lifts its humble head from a bed of the *Sphagnum palustre*.

BESIDES these two kinds, there are also what we may denominate *half-savannahs*, formed upon the tops of sand-hills, higher and more irregular than in the case of those just described. Some of these are also very extensive. Few herbaceous vegetables are to be met with upon them. Broad spaces of arid sand are intersected by clumps of shrubery. Nothing grows to the height of a tree; but a particular set of plants, different from those in other parts of the country, find subsistence enough to rise to fifteen or thirty feet. How nature, after all her efforts, should have failed to induce a soil upon these, is surprising. It appears chiefly owing to the great porosity of the sand, which every where admits the decayed vegetable matter destined for that purpose, to be carried down through it, and filtered off by rain. Even those sand-hills which are covered by tall trees, still shew proofs of this. The trifling layer of mould formed upon them is exceedingly thin. When cleared they are very barren; and when you dig in them to a great depth, you still find small portions of black vegetable earth dispersed among the sand. What corroborates the above supposition, is the appearance of the springs. Abundance of these are found gushing out copiously round the verges of the hills; and notwithstanding the extreme whiteness and purity of the sand from whence they flow, there is not one in an hundred whose waters are limpid. They come out not muddy, but of a brownish colour, very much like the water which runs from
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peat-mosses, and they are certainly tinged by the same cause. The rotten leaves of trees, and other decayed parts of vegetables on the hills, instead of being collected on the surface to form soil, are washed down into the sandy strata by every rain ; so that the reservoirs of the springs, and the water which proceeds from them, is always coloured with these substances. There follows a corollary also from this general principle, and when compared with facts I believe it will hold good : The more the sand is concreted into stone in any of the hills, the more and better will be the soil upon them. Where clay in small beds, or in a certain proportion, is mixed with the sand, the vegetable mould will likewise be better retained.

Rivers.—I WILL next give you what general observations I have been able to make upon the rivers and creeks of this part of America. The course of nearly all those of Guiana is from south to north. They originate in a chain of hills running east and west, which separates Guiana from the country on the Amazons, and likewise gives rise, on its south side, to the numerous branches which fall into that river. The Demerary is a considerable stream, equal, if not superior to the Thames ; yet it is by no means among the largest of them. The Essequibo is five times larger at its mouth, forming a whole Archipelago of islands ; but its stream soon divides, and, on account of rocks, shallows and rapids, none of its branches are navigable so high up as the former. Most of the particulars I am now to give you must be understood as applying to the Demerary. The bar, if it may be so called, is common to this with many other rivers, which discharge themselves into a shallow sea ; but still with circumstances in the present case which distinguish it from others, where the bottom is not mud but sand. It does not run like a single narrow ridge, across, or nearly across the mouth of the river, but it is of great extent, and is properly a continuation of the mud-bank which runs all along the coast. To the east and west, and for two miles or more in the offing, you
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have ten or twelve feet water with the utmost uniformity, and standing in with the mouth of the river open, you neither deepen nor shallow till you enter it, when you find two, three, four or five fathom, and it continues to average that depth for a long way, so that any vessel which can enter, may, for draught of water, proceed up the river for 100 miles or more.

THE mouth of the Essequibo, from the sand-hills and rocks being very near it, is exceedingly different. Three large islands present themselves in a breast, and divide its entrance into four channels. The length of these islands is with the current, south and north; and from the tail or north end of each of them, as also from the banks of the main on either side, run out sand-banks to a good distance. They are perfectly firm, quick in very few spots, and the body of them is above the level of low water. On the outside of them you have the continuation of the mud-banks and shallow water as above, only that the entrance of these channels is still shallower than that of the Demerary. The stream of this river runs very brown and muddy, and the sea is stained with it for some leagues off. A stranger naturally imputes this to the washings of a large flat country, or the stirring up of the muddy bottom by the tides. The latter may in part be a cause, though I believe it contributes to it but very little, and the former, in a state of uncultivation, none at all. On ascending forty miles or so, you find the water clear again, or rather of a darkish hue, and so it continues above that. I was at first at a loss how to account for this; but, from a number of circumstances, was soon led to conclude, that the thickness, and light brown colour of the water near the mouth of the river and on the coast, were almost entirely the effect of cultivation. Numberless ditches and canals have been opened by the inhabitants, which are receiving or discharging water every tide, and each particular piece on a plantation is every way intersected with open little drains, which communicate with these ditches. In digging and hoeing this clayey soil, much of it is suspended in

in the water, and carried off by the current of the tides. Nothing can be more certain, than that all up the river, and in all the creeks which discharge themselves into it, the colour of the water is constantly clear or blackish, even in the rainy season, when it is swollen. On considering these circumstances, I have been led to this general conclusion, which is submitted to the proof of observation in different parts of the world. The reddish brown colour, so common in freshes of rivers, in Europe, and we may add every where, is almost entirely the effect of cultivation; and the natural colour of rivers, even in the highest and longest continued floods, where all the country is still in woods or pastures, is ever that of a very dark brown, or blackish, pretty much like that of the streams which rise among peat-mosses, but rather more diluted. It is comparatively very clear, and deposits but a trifling sediment. The other is thick and opaque, and its sediment copious. Thus is man, in his little workings, made, in a small degree, one of the engineers of nature. We cannot doubt, that entire strata will owe to him their existence, accumulated in a series of ages at the bottom of the sea, and destined, in future revolutions, to act a more distinguished part. It may be curious too to consider the differences that may be expected betwixt the strata formed by these different depositions, which may be supposed between them to have been the origin of most of the clays upon our globe. Clay, earth or loam, stirred up by the labourer, gives rise to the one; minutely decayed parts of vegetables form the body of the other.

It must also be observed, that clearing the ground along the coast, by cutting down the trees, and opening ditches for the discharge of water, has exposed the land very much to the washing of the sea. The roots of the mangroves formed a plexus able to resist its force; and the former equal, and very slow deepening of the water, prevented its making a strong impression

impression on any place. The discharge from the ditches at low water cut out channels in the mud, and left the sides of these channels more exposed to the returning waves, which here beat continually upon a lee-shore. We find therefore on the coast, that the sea has made here and there considerable encroachments, which generally begin on the west side of the canals or ditches, as being the most acted upon by the waves. The mouth of the Demerary itself furnishes us with a strong instance. That river is now nearly twice as wide as it was when the country first began to be cleared; the sea and the stream together having since that swept away a large portion of land from the western shore.

Creeks.—A NUMBER of creeks fall into the Demerary on both sides, but so small that they bear no proportion to the size of the river. You can hardly distinguish their mouths in the woods which overhang the banks. They are so narrow that it is difficult to run a small boat in them; yet you will find in them throughout from two and a half to four fathom water, and they run winding so far back that it will take five, six, eight hours, or more, to carry you up to their heads, where they terminate in small streams from among the sand-hills. The banks of the creeks at their mouths are of the same height as those of the river close by, from five perhaps to twelve feet above the water in the dry season. As you ascend the creek, you might naturally expect to find them rise. It is however the very reverse; they become gradually lower and lower, till at last all round them is a swamp; and the trees on each side in like manner become smaller and smaller, and of different species from what they were. It is now in short exactly a mangrove swamp, with this difference, that the water is quite fresh, the vegetables are not the same, and there are abundance of arunis and other low herbaceous plants. A little higher up,

you lose the wood altogether, and find yourself in a beautiful deep canal, winding through a spacious wet savannah, which is sometimes many leagues in circumference. The first time we went up one of these creeks, (called Camouni), I was surprised at this appearance, and thought it must be a mere local circumstance peculiar to it. We found afterwards the same in one or two more instances, and were satisfied upon enquiry, that it is common to them all. It was natural to look for an explanation of this phenomenon, and I soon found it in one of those laws, which probably extend to all rivers subject to frequent inundations. It has been observed, in particular, of the Ganges *, that the banks of that river are higher than the adjacent lands at a distance from the stream, owing, no doubt, to the annual depositions of mud, &c. during the swell of the river. Apply the same rule to the Demerary, and the difficulty will be solved. The wet savannah behind, and the swampy woods around them, are the body of the low country at its natural level, scarcely a foot or two above the sea. Whatever additional height the land has in the vicinity of the river, from the time you have ascended about twenty miles or so, is all acquired. It has arisen from the sediment of the river during the rainy season, when the country is overflowed so as that all the lower part of it is under water. This deposition must be always more copious, in proportion as it is nearer the stream, where additional quantities are always brought, and where it is kept in motion both by the current and the tide. Every thing which we afterwards saw confirmed this theory, and nothing more directly than the canals which run out at right angles from the river. Some of these extend four miles inward, and they prove to a demonstration, that the land becomes lower and lower the farther you recede from the

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* Account of the Ganges, &c. Phil. Transf. 1781, by M. RENNEL.

the river. The maps of the colonies confirm it; for in all of them the main body of the low land of Guiana is laid down as savannah, and the woody country, which a stranger or superficial observer would suppose to be the whole or much the greater part of it, is in fact only a border on the sides of the rivers and of the sea, but of considerable breadth, more or less, in proportion to the size of the adjoining river, or, which is generally the same thing, to the acquired height and extent of the soil on either bank. It followed as a consequence, and, as far as we had opportunities of observing, we found it to be the case, that the low land was somewhat higher, and continued so farther down, about the Essequibo than the Demerary; the woods consequently were of greater extent. We found, besides, in the soil adjoining the Essequibo, at least upon the east side, a mixture of sand. The river is full of sand-banks; and it appears, that the finer parts of even this less suspensible substance are raised by the floods and carried among the adjacent woods to be deposited with the mud. The Mahayka, a small river or creek which falls into the sea about twenty or thirty miles to the eastward of the Demerary, though it runs a long way up the country, and spreads into many branches, has but a very narrow, and often interrupted border of wood upon its banks; it runs through an immense savannah, and so do its branches, with little or no wood, till they approach the sand-hills. The Deltas of the river of Oroonoko, and its numerous mouths, make a figure even in the map of the world. It is to be regretted, that its noble stream has been so long hid from science. What I learned in Trinidad from a gentleman, who had sailed from its mouth to the Angusturas, about 300 miles up, confirms and illustrates, in the fullest manner, the above general rule. The western mouths of it opposite Trinidad, are navigable only for launches drawing six or seven feet wa-

ter. At and opposite them, the bottom is shallow and muddy, and the coast a low mangrove swamp, resembling, in all respects, that of Guiana. You must ascend those branches several days before you reach the main stream; and in doing so, you find the same phenomena as in ascending the Demerary, but in a still greater degree. At first you have the mangrove, or some similar swamp, and behind it on both sides for about twenty leagues, the land, if you can call it so, hardly emerging from the water. Afterwards the ground appears; and, as you go up, rises still higher and higher on the banks above the common level of the stream. The trees become, in the same manner, of different species, and much taller than they were below. The channel in which you are, from being wide, grows narrower by degrees. It is from about one and a half to three-fourths of a mile broad near the entrance; and, when it joins the main stream, is not more than about 200 yards. It has then acquired a considerable depth, and the banks may be about twenty feet high. Along the main stream of the river, or Boca de Nafios, the gradual rise, and other circumstances attending it, are quite similar. All this height of the bank, I can make no doubt, is entirely acquired ground, formed by the sediment of the floods, greater near the streams than at a distance from them; and though I have no knowledge of the nature of the land in the deltas and their vicinity, I would not hesitate to say, that great part of the interior body of each island, and most probably of the main on either side, where it is low country, consists of nothing else than wet savannahs.

Floods.—BEFORE we leave the rivers, it may be proper to take notice of their *floods*. In no instance of a large river does the universal law within the tropics fail, that they annually overflow their banks for a certain season. What was a prodigy
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in the Nile during the infancy of science, is now a well known phenomenon to every inhabitant of a continent in the torrid zone. From the situation of the river Amazons, it amounts to a certainty, that the Demerary, Efféquebo, and other rivers of Guiana, cannot originate very far up in the continent of South America. This is confirmed by what I could learn of the rise and duration of the floods of these two rivers. Enquiring about them at the plantations below, is to little purpose, for there the floods are hardly discernible; but by the postholder and the settlers farthest up, I was informed, that they are there sensible enough, and that, independent of all partial swells from accidental rains, the Demerary generally rose every year in the month of June, and continued high through July and part of August. The rise there, upon the whole, might be about twelve feet; it is sufficient to lay the level parts of the country under water, and to render the woods, that cover them in several places, passable in canoes. We could have wished for more exact information. This, however, was sufficient to prove, that the rivers did not rise very far inland, else the floods would have been later in the year; but at the same time that they were of extent enough to follow the rule of all considerable intertropical rivers, so as to have a flood in the rainy season, that is, in the months when the sun is upon the same side of the line on which they have their origin and course.

THE great Oroonoko, I have been informed, begins to rise a little in May, it continues increasing through the summer months, and the inundation is at its height in September. At that time, as far up as the Angaituras, the rise is about forty feet perpendicular above the low water-mark. It diminishes as you descend till about the mouth, where it is only a very few feet.

Tides

Tides are of the utmost consequence to the inhabitants of the coast of Guiana. They enable them to drain a country which otherwise could never have been cleared, and they ascertain their journeys which are made by water up and down the rivers, and even along the coast. At the mouth of the Demerary, it is high water at about half past five, at new and full moon. The rise in spring tides, a little way up, is twelve feet, or more, above low water-mark. The tide runs very rapidly near the mouth of the river, seldom less than four or five miles in the hour. It continues to run with force for a long way up, and was sufficient, without wind, to carry us up or down at 150 miles from the mouth. Above that it becomes feebler; and for a considerable distance below the rapids, though there is a sensible rise and fall of two or three feet, yet, even in the dry season, the current is constantly down, only more gentle during the rise or flood, and there also the continuance of the rise is very short, not more than two or three hours.

SOME observations upon the *Soil* of the different parts of the country, may be the subject of a future communication. I will only add at present, what I think has more than conjectural foundation, *viz.* That this most recent of countries, together with the large additional parts still forming on its coast, appear to be the productions of two of the greatest rivers on the globe, the Amazons and the Oroonoko. If you cast your eye upon the map, you will observe from Cayenne to the bottom of the gulph of Paria, this immense tract of swamp, formed by the sediment of these rivers, and a similar tract of shallow muddy coast, which their continued operation will one day elevate. The sediment of the Amazons is carried down thus to leeward (the westward) by the constant currents,
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which set along from the southward and the coast of Brasil. That of the Oroonoko is detained, and allowed to settle near its mouths, by the opposite islands of Trinidad, and still more by the mountains on the main, which are only separated from that island by the Bocos del Drago. The coast of Guiana has remained as it were the great eddy or resting-place for the washings of great part of South America for ages ; and its own comparatively small streams have but modified here and there the grand deposit.

W. LOCHHEAD.

III.