

Contributions to Physical Geography.

(From the Edinburgh Journal of Science, No. III.)

1. Description of the Falls of Gersuppah in North Canara.

THE following description of the falls of Gersuppah, in North Canara, appears in a letter, published in a Madras paper; they are represented to be the grandest in the world.

“The falls are situated at the distance of a mile to the west of a small village called Kodakainy, which forms the boundary of the Bilghy Talook, in North Canara, and lies contiguous to the Sagara district of Mysore, receiving a continual supply of water from twelve streams, which conjoin, as the name implies, at Bāringee, in Mysore; five of these pursue their course from Ramachendapoorah; four from Futtu Pettah, or the town of Victory, so named by Hyder; and the remaining three at Koodolee; and after being precipitated down the cataract, and then gently winding the current through a rugged way, which it has forced through the base of the mountains at the verge of their declivity, widens at Gersuppah, and forms a beautiful river, called Sarawati, navigable for sixteen miles for boats to the town of Honore, where it falls into the sea.

“Like most other places to which the natives have given names from something remarkable in their soil or site, this was called *Gersuppah*, because the ground, before the buildings had been erected, was covered with cashew-nut trees; *Ger*, signifying in Canarese, the tree of this description, and *Sooppoo*, a leaf.

“It was asserted by the bramin who accompanied me, in their usual exaggerated style, that the old city here contained, in its flourishing state, a lakh of houses, and I have no doubt, from the extent of the ruins, that its population may have been above half that number. Out of seventy-four temples called *Busty*, there remains but one, well constructed of granite, covered with a stone roof, where the *Chatour Mooke*, or four-fronted idol of the Jain caste (the then inhabitants) sits, surviving the homage of its long silent worshippers, a prey to the moles and to the bats.

“On leaving Gersuppah, we commenced the arduous undertaking of ascending the Ghauts. The pass here is neither so

steep, rugged, narrow, or so much intersected with conical loose rock as those in other directions through the same range; but is much longer, being fully twelve miles in continued undulations, so that the line of road (and it is surprising how it could have been first traced out) is disheartening, as well as unsatisfactory; for imagining that considerable progress has been made, descent and rise alternately succeed ere the long wished-for summit be gained, which occupies at the least six hours to accomplish.

"The morning having proved fair, seemed, independently of the solemnity of the day (Sunday), to fill our hearts with cheerfulness at the thoughts of making towards the scene from which we expected our curiosity to be so soon amply repaid for the distance we had come. The solemn silence that pervaded the thicket in our approach to it threw a lambent gloom on the mind; the noise, however, of the waterfall, bursting suddenly on the ear, soon enlivened our anticipations; but here again a momentary disappointment supersedes these eager expectations, for, standing on the bed of the rocks, not thirty feet distant, the eye can discover nothing to awaken amazement: a few steps, however, nearer, the stranger is so overwhelmed with the immensity of the dread abyss, that he requires some seconds to collect himself before he gets sufficient courage to make the attempt to examine the awfully grand view that presents itself beneath him—he feels as if he were looking into the brink of eternity! nor is the situation in which he is compelled to be seated to enjoy the sight less strikingly perilous; he has also to lie down horizontally and look perpendicularly over a projecting rock at the very edge of the immense basin, into a descent that the eye can scarcely fathom from its profundity, and beholds a dreadful chasm hollowed out by the weight of the dashing torrents, which cause to ascend from the white spray that they form below, volumes of vapour which, rising into the atmosphere, mingle with the clouds above the highest mountains in the neighbourhood, and buoyant upwards borne, would rather seem to be the smoke of *Ætna's* fiery bowl, than the subtle extricated particles from the whirlpool of an equally dangerous element. The spectator sees the heavenly bow with all its prismatic colouring and splendour, reflected downwards through the salient aqueous globules athwart the surface of the unfathomed gulf, in the perfectness of the mundane semi-arch.

"I should imagine the circumference of the crater, which is shaped like a horse-shoe, to be about a quarter of a mile. In front of its open end, a descending forest majestically slopes down from the mountains, making the effect of the whole truly sublime; and some fields at the top, to the left, give a singular

and pleasing combination to the aspect. Five separate bodies of water are hurled down this stupendous pool, the largest, at the N.E. angle, tumbles perpendicularly with its foaming current from the edge of the river, already described, clear to the bottom, in two distinct columns. At the next curve, and facing the position where we had a bird's-eye view of the whole, another large mass is seen to be propelled headlong; then aslant the hollow channel it has formed, and gradually enlarging its surface in its descent, is buried in the boiling depth in union with the other. A more gentle rill, passing immediately over the second fall, makes a striking variety to the rush of its noisy neighbours. The fourth cascade is more distinctly observed, without the same exertion, in its southern direction, skirting the rocky steep of this enormous basin, and being expanded by the obstruction it meets from some projecting irregularities of stone. Hundreds of pigeons, about the size of butterflies, were sporting over the spray. We had to move round to a rising mound at the south-west corner, where the precipitated floods flow off, to be enabled to have a full view of the fifth fall, whose rolling foam, like soap-suds, edging from the summit to the termination of a solid mass of laterite, of several hundred feet in altitude, flashes through scattered fragments that lie rounded at its agitated base, and seek their repose in the general outlet. On the right rise the stupendous bulwarks of the western Ghauts, towering in the pride of their primeval magnificence. Several attempts were made to ascertain the depth of this wonderful reservoir: one by letting out strong twine, to which a weight was suspended, but this plan did not succeed after 300 or 400 feet; so another experiment was resorted to, and frequently repeated, of throwing down a cocoa-nut, and timing it as long as it continued visible, which always gave the same result of eight seconds; and by my calculation, computing the centripetal force of the falling body to be at the rate of $15\frac{1}{2}$ Paris feet in a second of time, and increasing in proportion as the square of the distance, I make to be from my product, $965\frac{1}{2}$, or about 1030 English feet, as far as I think it possible to ascertain it with any degree of accuracy.

"The falls of Niagara, of the Montmorency, the Missouri, and Tuccoa, are remarkable for the vast expanse of the falling sheets that are precipitated down them; but their height, in proportion is very insignificant, with the exception of the first: neither do the celebrated falls of Gocauk, in Beejapoor, or that of Courtallum, in the district of Madura, exceed 200 feet in their descent; from which comparison it may be seen that those of Gersuppah are not unworthy of being recorded among the 'wonders of the world.'"—*Asiatic Journal*, vol. xxviii.

2. On the Climate of the Himalaya.

"I am only lately arrived from a trip through the old tract, viz. Kunáwar, which I had hoped would reward me with some consoling recompence for the sacrifice I made for its accomplishment; but I failed entirely in my object of establishing vaccination, owing to the folly and timidity of the Besáher Rajah. However, I have obtained some particulars in my journey, which, if not equivalent to the pecuniary losses I suffered, are at least interesting. The fossils and shells which occurred in my route are very strange objects. They are chiefly valuable from having myself seen them *in situ*. They comprise cockles, muscles, and pearl-fish, univalves, and long cylindrical productions, which are most singular objects. I found them lying upon the high land at 15,500 feet, in a bed of granite and pulverized slate; the adjacent rocks being at the same time of shell limestone. All the shells are turned into carbonate of lime, and many are crystallized like marble. I came upon a village at a height of 14,700 feet;—are you not surprized that human beings could exist at such an elevation? It was yet the middle of October, and the thermometer on two mornings was 17°; what it is at *this* season of the year, I cannot guess; yet the sun's rays felt oppressive, and all the streams and lakes which were sheated with ice during the night, were free and running by 2 o'clock. The finest crops of barley are reared here, and to irrigation and solar heat are the people indebted for a crop. The barometer gave for the highest field 11,900 feet of elevation; this verifies the observations, or rather inferences, on the limit of cultivation in the upper course of the Sutluj; and I think it quite possible, and even probable, that crops may vegetate at 16 and 17,000 feet. The *yaks* and shawl goats at this village seemed finer than at any other spot within my observation. In fact, both men and animals appear to live on and thrive luxuriantly, in spite of those speculations which had calmly consigned those lofty regions, and those myriads of living beings to perpetual ice and oblivion.

"On the North Eastern frontier of Kunáwar, close to the stone bridge, I attained a height of more than 20,000 feet, without crossing snow, the barometer showing 14,320, thermometer 27° at 1 P.M. Notwithstanding this elevation, I felt oppressed by the sun's rays, though the air in the shade was freezing. The view from this spot was grand and terrific beyond the power of language to describe. I had anticipated a peep into China itself, but I only beheld its lofty frontier all arid, and bare, and desolate. It was a line of naked peaks, scarce a stripe of snow appearing; yet every point had an

angle of altitude of a few minutes, some half a degree, and at a very considerable distance; this argues at least 21,000 feet." —*Gleanings in Science*, No. 4.

3. *Account of an Ascent of Mont Elbroutz, the highest peak of the Caucasus, by a Russian party.*

This ascent was performed in July last, by General Emmanuel, Professor Kupffer of Casan, M. Zenz, for physical observations, M. Menetrier, for zoology, and M. Meyer of Dorpat, for botany. They were guarded by 600 infantry, 350 Cossacks, and two cannons, and their baggage was carried by six camels and several carriages. The central chain of the Caucasus is entirely formed of porphyry. The plateau upon which Mont Elbroutz stands is from 8 to 10,000 feet high, stretching out in the direction of east and west. This plateau is torn up in all directions by narrow and deep vallies, and crossed in its middle, from east to west, by a crest of rugged rocks of a picturesque character, and whose summits are covered with eternal snow. On this crest, and nearly in the middle of its length, there is a large and deep excavation, the middle of which is occupied by a cone which might be supposed to be entirely covered with snow, did we not see here and there the naked rocks appearing through it. This cone is Elbroutz, whose height exceeds, by 3 or 4000 feet, all the surrounding mountains.

The party passed the night at the foot of this cone in a small hollow, sheltered by enormous blocks of black porphyry with white spots, in the middle of which was a small pool of snow water, but not a trace of verdure, and only a few lichens on the bare rocks.

Next morning, the 22d July, the party rose at 3 o'clock. The thermometer was at 30° Fahr. and the sky clear. They got upon the snow, and experienced the difficulties and debilities which have been so often described in accounts of similar ascents. Towards its summit Elbroutz presents a series of naked rocks forming a species of stair, which greatly facilitates the ascent. MM. Kupffer, Menetrier, and Meyer, were so exhausted, that they resolved to rest for some hours, but during this delay the snow had grown so soft by the heat of the sun, that it became necessary to return, lest the bridge of snow which crossed the chasm should be melted. M. Zenz, who had gone on without stopping, reached the last platform of rocks, and was removed from the summit only by an interval of snow. The causes which rendered the return of the party necessary prevented them from advancing, and out of fifteen or twenty persons, Cossacks and Circassians, who attempted to reach the summit, only one succeeded, viz. a Circassian of the

name of *Krillar*, who, inspired by the reward which General Emmanuel had offered, set off very early, and availed himself of the morning's frost.

The descent was extremely difficult from the cause already mentioned, and at seven o'clock in the evening they reached their camp on the banks of the *Malka*.

M. Zenz obtained the following results:

	French feet.
Height of the mineral springs of <i>Koustantirogorrk</i> ,	1,300
— of the limit of snow, -	10,400
— of the first station of rocks, -	13,600
— of the station of M. Zenz, -	14,830
— of the summit above M. Zenz's station, -	600
— total height of <i>Elbroutz</i> , -	15,400

The temperature of the air at the limit of snow was $9^{\circ} 6$ Reaum. (about 54° Fahr.) At the station of M. Zenz it was $1^{\circ} 5$ Reaum, ($35\frac{1}{2}^{\circ}$ Fahr.) while at the mineral springs it was 23° (81° Fahr.) at the time of the first observation, and 21° (86°) at the time of the second observation. The first of these observations gives 680 feet of difference of level for each octogesimal degree, and the second only 630 feet.

One of the most interesting results was a magnetic one. They found that the magnetic intensity decreased $0'',01$ upon $24''$ for every 1000 feet of elevation; a result which M. Kupffer considers as incompatible with the hypothesis of a magnetic nucleus which gives a much weaker decrease.—*Ann. de Chim.*, tom. xlii. p. 105.

4. Subterranean Hot Spring, called the Baths of Nero, Bay of *Baja*, near *Naples*.

At about thirty feet above the sea, we enter a passage cut out of the tufaceous rock, which conducts us to several apartments, which are occasionally appropriated to the service of the invalids who make use of the vapour-baths, and the necessity of partly undressing, which is abundantly enforced by the example of the *Custode* himself, together with his tales of wonder, seems to have allayed the curiosity of many visitors, who, in their books, have given us idle tales of danger. It cannot be denied that a first visit is a little startling in these subterranean dwellings of Pluto, and the supersaturation of the air with aqueous vapour gives it a peculiar and stifling feeling, and perhaps there are few who have not felt some disposition to return after advancing thirty or forty yards. The passage is narrow, perhaps not three feet wide, and on either hand are niches cut out in the tufa where patients may lie exposed to the force of the steam. At a distance of sixty paces from the entrance, during which the path is pretty level, and five or six feet high, the inconvenience derived from heat

and difficulty in breathing is greatest, for we afterwards turn pretty sharply to the right, and, descending gently, breathe a more tolerable atmosphere, though nearer the source of heat. After going about sixty paces farther, I reached the hot spring, and, by keeping my head near the ground, I found that I could have remained a considerable time without much inconvenience. The pool of water there formed seemed to have accumulated in a passage originally cut to a greater length, since the water rose to the roof from its slanting direction. From the confusion of the moment, and the apparent unnaturalness of a spring hotter than the hand can bear, I put my finger into it, but rapidly withdrew it, with a sensation nothing short of the heat of boiling water. I held in my hand a mercurial thermometer of Cary's, which I dipped into the spring, and reading off the indication by the light of a torch carried by our guide, with as much deliberation as possible, I found it to be $183^{\circ}.5$. I had reason to believe, however, from previous observation, that at this part of the scale it would require a reduction of 1° ; I therefore placed the temperature at $182^{\circ}.5$. It was on the 11th December, 1826. This observation is the more valuable, that, as far as I know, it is the only one affecting accuracy yet given to the world. Most authors have asserted that the water boils; and Romanelli distinctly asserts that its temperature exceeds 80° Reaumur, though it is obvious enough he could never have tried it. Breislak, with great moderation says, "La chaleur qui y regne a une grande intensité; l'obscurité du lieu, et la vapeur qui s'attache à la surface de tous les corps, empêcheut de la mesurer avec precision, mais elle passe les 60 degrés de Reaumur." But 60° R. = 167° Fahr. so that Breislak comes below the mark.

It is not surprising that the idea of so great a heat as this should have been alarming to those unacquainted with the powers of animal life to withstand intense heat, when we reflect that the time is not very long past when the experiments of Blagden and Fordyce put this question in its true light. The most intense heat, however, sustained by these gentlemen seems to have been in dry air, which has far less effect on the body than an atmosphere loaded with steam, which, by condensing on the body, parts with a large share of its caloric. These experimenters, however, found far less inconvenience than they expected from the great temperature. Their bodies when exposed to steam of a moderate temperature became inflamed, the pulse much quickened, but the heat of the body little affected. In passing to the cold air they felt little inconvenience, probably from the excess of moisture and perspiration which defended the pores of the skin from the

rapid effects of cold. The degree of perspiration in the heated baths varied very much in different persons, and was greater in the dry than vapour stoves. Dr. Fordyce having remained fifteen minutes in a vapour stove at a temperature of 130° (greatly lower than that of Nero's Baths,) his pulse rose to 139, and he was much more affected than by dry air of a greatly higher temperature, which he justly imputed to the heat given out by the steam, and to the want of evaporation from the body, the air being in a state of saturation with moisture. All the general phenomena experienced at the Stufe di Tritoli are similar to those observed in the cases of artificial experiment. The inflammation of the skin where exposed to the steam is remarkable, and gives those who merely see the guide return from the bottom a great idea of extreme temperature. The streaming of condensed moisture from the body has likewise the appearance of natural and excessive perspiration, in which respect, however, as I have remarked, people are very different. In my own case, the perspiration was considerable, independant of condensed vapour. The extreme narrowness of the passage, and the nearness of the approach of the subterranean source of heat, preserve in these singular and obscure grottos the most regular and intense temperature, so that it is more insupportably hot at the turn of the last branch, sixty paces from the spring, than over the very steam as it rises from the water itself. The water is brackish, but seems wonderfully little mixed with adventitious matter. Fish boiled in it has no disagreeable taste. I regret that I have no analysis to give of its contents. According to the custom of the place, the guide takes some water in a pail from the spring and puts fresh eggs into it, and, carrying them to the open air, notwithstanding this effectual cooling, they are in four minutes very pleasantly boiled. On leaving the baths, I felt not the slightest disagreeable effect from almost immediate exposure to the open air between 50° and 60° , but, on the contrary, on re-embarking at the foot of the hill, experienced a delightful sense of warmth over my whole body.

The quackery of guides and guide-books seems to have deterred our natural observers from inspecting this curious spot, so near approached to that surprising focus which has maintained its intense temperature so many centuries, with unabated vigour, without any indication, direct or indirect, of that mysterious fuel by which it has been fed, and which affords so remarkable a subject of speculation in this age of geological inquiry.*

* Neither Professor Daubeny nor Mr. Scrope, our two principal volcanic writers, seem to have visited these stoves.