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Engraved by George Cooke

Mont Blanc.
(from the Valley of Chamouny, on the Side ascended by Saupierre)

AN ACCOUNT
OF
THE ATTEMPTS THAT HAVE BEEN MADE
TO ATTAIN THE SUMMIT OF MONT BLANC.

Written in the Year 1786.

[From SAUSSURE *.]

WHEN I was writing the preliminary discourse and the first part of this work, I looked upon the summit of Mont-blanc as absolutely unattainable. In my first excursions to Chamouni in 1760 and 1761, I had it published in all the parishes of the valley, that I would give a considerable recompence to whoever should find a practicable route. I had even promised to those who made unsuccessful trials to pay them for their labour: these promises were of no avail. Pierre Simon made one attempt at the Tacul side, and another at the side of the glacier of Buissons, but returned without any hope of success.

However fifteen years after, that is to say in 1775, four of the Chamouni guides attempted to gain it by the mountain de la Côte, this mountain which forms a ridge pretty near parallel to the glacier of Buissons, approaches to the ices and snows which continue without interruption to the top of Mont-blanc.

There is some difficulty to overcome before entering on these ices, and to cross the first crevices; but these first obstacles once surmounted, there remains no more than the length of the way, and the difficulty of accomplishing in one day the ascent and descent. I say in one day, because the people of the country think it not safe to run the risk of passing the night on these snows.

These four travellers got very well over the first obstacles; they then endeavoured to follow a great valley of snow, which appeared to conduct them immediately to the summit of the mountain. All appeared to promise them the most happy success; they had the finest weather imaginable, they neither met with openings too large, nor precipices too rapid: but the reverberation of the sun on the snow, and the stagnation of the air in this valley made them undergo as they said a suffocating heat, and gave them at the same time such a distaste for the provisions with which they were provided, that overcome by inanition and weariness, they had the grief to be forced to return the same way they went, without having met any visible insurmountable obstacle. It however appears that the efforts they had made were very great, for their strength was very much tried in this excursion, and from it they became more or less ill.

This disappointment however did not prevent three other of Chamouni guides from undertaking the same task, and by the same road in 1783. They passed the night at the top of the mountain de la Côte, crossed the glacier, and followed the same valley of snow. They had already got to a good height, and were proceeding courageously; when one of the boldest and most vigorous of the three was suddenly seized with an insurmountable propensity to sleep: he desired the other two to leave him and go on without, but they could not think of abandoning him, and leaving him to sleep on the snow; persuaded as they were that the heat of the sun would kill him: they therefore

* Voyage dans les Alpes, ii. 550.

renounced the undertaking and returned back together to Chamouni. For this propensity to sleep, produced by the rarity of the air, left him as soon as they had descended low enough to find themselves in a thicker atmosphere.

It is very likely that even if this overpowering propensity to sleep had not stopped these brave fellows, they would not have been able to have gained the summit of the mountain, for in effect though they had attained a great height, they had still a great way to go, the heat incommoded them excessively, a thing surprising at this height; they had no appetite; the wine and provisions that they took with them had no charms for them. One of them * told me seriously that it was useless to carry any provisions in this excursion; and that if he should make another trial by the same way, he would only take a parasol and a smelling bottle. When I figured to myself this tall and vigorous mountaineer grappling with the snow, and holding in one hand a little parasol, and in the other a bottle of *eau sans pareille*, this image had something in it so ridiculous and strange, that nothing could be more convincing to my mind than the idea he had formed to himself of the difficulty of this undertaking, and of consequence of its absolute impossibility for people who have neither the head or the joints of a good guide of Chamouni.

Yet M. Bourrit would again make another trial at the end of the season, he likewise slept at the mountain de la Côte, but an unexpected storm coming on obliged him to turn back just at the entrance of the glacier.

For my part, after the informations which I had received from those who had made the attempt at this side, I looked on the success as absolutely impossible, and this was the opinion of all the intelligent people of Chamouni.

M. Bourrit, who interested himself more than I did in the conquest of Mont Blanc, thought he ought to try it by some other side; he gained from all parts all the intelligence he could; at length he learned that two hunters in following some chamois had got on some ridges of rocks to so very great a height, that from the place to which they were come, to the summit of Mont Blanc, there remained no more than four or five hundred toises to get up by the declivities of snow which were not very rapid, and in so open an air that there was nothing to fear from that sort of suffocation, that had been found in the valley of snow which ends at the mountain de la Côte.

Charmed with this discovery, M. Bourrit ran to La Grue, the village where these hunters lived, and immediately engaged them to make another trial with him. He left the village the same evening, and arrived with them at break of day at the foot of some steep rocks which it was necessary to pass. The morning air was of an extraordinary keenness; M. Bourrit seized by the cold and overpowered by fatigue could not follow his guides. Two of those, after having left him with the third at the foot of the rocks mounted alone, not only to the top of the same rocks but very far on the snow: they said that they had reached to the foot of the highest summit of Mont Blanc, from which they were separated only by a ravine of ice, in which, if they had had more time and help they could have made stairs by which they might easily have got to the top.

As soon as this trial had permitted me to believe in the possibility of success, I resolved to make the attempt as soon as the season would permit; I charged two men of the neighbourhood † to watch near the mountain, and to give me notice as soon as the melting of the snows would render it possible. Unhappily they accumulated during the rigorous winters of 1784 and 1785, and those which have frequently fallen during the cold and rainy summer, which has succeeded this winter have retarded my departure till the middle of September.

* Jorasse.

† Pierre Balme and Marie Coutet.

I always prefer making these excursions with my guides only; but M. Bourrit, who was the first to make known this route, having desired that we should make this attempt together, I consented with pleasure. We took with us his son, a young man of twenty-one years of age, whose talents promise a most happy success, and whom the love of botany, and the grand objects of contemplation that our Alps present, has often conducted on the traces of his father.

I had reckoned on sleeping as high as possible under coverings in form of tents: but M. Bourrit had conceived the happy idea of sending two days before three men of Chamouni to construct for us under shelter of a rock, near the base of the Aiguille du Gouté, a sort of hut or hovel of dry stones; an excellent precaution which would secure us from the danger of a storm, if we should have the misfortune to meet one.

These dispositions made, we agreed to meet on Monday the twelfth of September at the village of Bionassay, situated about a league to the north-east above that of Bionnay, M. Bourrit and his son came there from the Priory of Chamouni, which is four leagues to the north-east of this village. I left Geneva the eleventh of September, and came in a carriage to Sallenche; and the next morning I went on horseback to Bionassay passing by St. Gervais and by Bionnay.

The village of Bionassay is situated in a very uneven valley, open to the south-east, and shut at all other sides. It is commanded by the glacier of the same name, and separated, at the north-east, from the valley of Chamouni by a small chain of slate and calcareous mountains.

I observed between Bionnay and Bionassay some remarkable stones, but I mean to give the lithological account of this little journey in another place; those details would too much damp the interest of which it is susceptible.

I arrived the first at Bionassay with Pierre Balme, who had come as far as Sallenche to meet me; we should have slept at this village, but as there was no inn there, I had asked at Bionnay which of the peasants of the place was in the best situation to entertain us, they directed me to the Conseiller de la Commune named Batandier. This honest peasant received me with great cordiality; and M. Bourrit coming in the evening from Chamouni, our host gave each of us a good little room, with a bed filled with fresh straw on which I passed a very good night.

The next morning I felt some uneasiness for the weather, the barometer not having mounted during the night more than the sixteenth of a line; which is much under what it rises to from evening to morning, when fine weather is perfectly settled. My observation, compared with that which M. Pictet made at Geneva, gives to the situation of Batandier's house four hundred and eighty-eight toises above our lake, and of consequence six hundred and eighty above the sea.

We had then still to mount one thousand eight hundred toises before we could get to the summit of Mont Blanc, but we had two days to perform it in: as the first day we were only to go as far as our hut. As its situation had been left to the choice of its constructors, we were ignorant of its height, but wished to find it placed as high as possible.

At day-break one of the Chamouni guides, who had worked at the construction of the hut, came to inform us it was almost finished, but that it would be necessary to take another piece of fir, to make the roof more solid. We ordered a man of Bionassay to carry one, and two others loaded themselves with straw, and two more with wood for firing. Others carried provisions, furs, and my physical instruments, and thus we formed a caravan of sixteen or seventeen people.

I had

I had hoped that we might have gone near two leagues on our mules, but it was with difficulty we could make use of them even for one. M. Bourrit the father even wished to go the whole way a foot.

We immediately mounted an easy slope by the side of a profound ravine, in which runs the torrent which issues from the glacier of Bionassay. Then a rapid ascent conducted us to a little plain below the glacier: we traversed this plain in its whole length: we then coasted the glacier for some moments, and we finished by leaving it and taking a strait north-east direction by a very rough but not too fatiguing slope, and without any danger.

All the upper part of this slope is called *Pierre-ronde*, without the origin of this name being known; for there is neither rock nor stone there remarkable for its roundness. This slope is free from wood, bushes; and almost all vegetation is covered only with fragments, and presents a most savage aspect. At the left are seen bare rocks which conceal the valley of Chamouni, and to the right, the rocks and ices of the base of Mont Blanc; for as for its head and shoulders, they are concealed by its low and projecting bases.

Although this ascent was long enough, I was always afraid to see the end of it and come to the hut, because I wished to get as high as possible the first day, and to make the most of the second, which would be the most interesting, but at the same time the most painful: thus, always counting for nothing the present fatigue, we ascended, almost without perceiving it, the seven hundred and forty-one toises which our hut lay above the village: we got to it about half an hour after one, although we had not set out till eight, and divers little accidents had made us lose more than half an hour of the time.

The situation of this hut was the happiest that could have been chosen in so wild a situation. It was joined to a rock in the bottom of an angle, sheltered from the north-east and north-west at about fifteen or twenty paces, above a little glacier covered with snow, from which issued a clear and fresh stream which answered every purpose wanting to our caravan.

Opposite the hut was the *Aiguille du Gouté*, by which we were to attack Mont Blanc. Two of our guides*, who had scaled the *Aiguille*, shewed us the ridge which we should climb. They even offered to take advantage of what remained of the day to reconnoitre the mountain, chuse the easiest route and mark steps in the hard snow: we accepted the offer with thanks. To the right of these rocks we admired a summit of snow called *la Rogne*, which appeared to us of a prodigious height, we were however told we should see it under our feet, from the *Dôme of l'Aiguille*. All the lower part of this high summit was covered with extremely rugged glaciers, which emptied themselves into that of Bionassay. At every moment vast masses of ice detached themselves from this glacier, which we could see fall, and precipitate themselves with a horrid crash and dissolve in clouds of dust, that the air raised by the fall of ice rose up like clouds to a surprising height.

Behind our hut was a small chain of rocks about forty-feet above it. I made haste to get up it, my travelling companions quickly followed me, and there we enjoyed one of the finest views I ever met on the Alps.

These rocks, whose height is one thousand two hundred and twenty-nine toises above the lake, and one thousand five hundred and twenty-two above the sea, are at the north-west side quite precipitous. There is seen under the feet the southern extremity of the valley of Chamouni, above which we were about nine hundred toises. The rest of this charming valley is shortened in the view, and the high mountains which border on it

* Gervais and Coutet.

appear to form a circus round it. The high points seen in profile subdivide themselves in a forest of pyramids which closes the bounds of this circus, and seem destined to defend the entrance of this charming retreat, and preserve its peace and innocence. From that side, the view extends to the Gemmi, which is known by its double summit which has given it that name. But I shall not undertake to give a detail of the immense heap of mountains which is discovered from this summit, let it suffice to say that it presents the most ravishing prospect to those who delight in such beauties.

I chose this summit for my observatory, I suspended my hygrometer and my thermometer in the air to a stick which kept them in the shade, whilst I standing on the most projecting point of the rock measured with my electrometer the degree of aerial electricity. It is true that the cold north wind which then blew did not permit me to remain long in that situation, it was necessary to find out a milder temperature under cover of the rocks which surrounded our hut; but as soon as I had warmed myself, I returned again to enjoy the prospect and continue my observations. I will give an account of them in a chapter apart.

I had the chagrin of not being able to make an experiment from which I had promised myself much pleasure: that of the necessary heat to boil water at different heights. The physicians know the profound researches of M. De Luc on this subject, their precision and their exactitude leave no doubt of the results; nevertheless M. le Chevalier Shuckburgh thinks he has found out another rule.

It was interesting to repeat these experiments, particularly at such heights as no naturalist had ever attempted. For eighteen months I had been asking of M. Paul, a thermometer armed with a micrometer and adapted to a portative kettle: but the want of proper tubes, and the multiplied occupations of this excellent artist, had so retarded the execution of this instrument that it was not ready till the day before our departure. However it appeared to be in very good order, I tried it the same night and again with success at Bionassay; and I hoped it will succeed equally well every where else, but at the height of the hut the lamp destined to make the water boil would not burn; it was a lamp constructed on the principles of those that M. Argand had invented, but made in a hurry, and from a bad model: the tinder which served it as a wick burned at first very well: but presently this tinder turned into coal and afterwards went out, an accident which did not happen in a thicker air. Unhappily our apparatus was disposed in such a manner that it was impossible to make our water boil on a wood fire, the only one here in our power. After then having uselessly tried this apparatus a thousand different ways, I was obliged to give up the experiment, or put it off till another opportunity.

But the beauty of the evening, and the magnificence of the spectacle, which the setting sun presented from my observatory, consoled me for this disappointment. The evening vapour which, like a light gaz, tempered the sun's brightness, and half concealed the immense extent we had under our feet, formed the finest purple belt, which incircled all the western part of the horizon, whilst to the east the snows at the base of Mont Blanc coloured by this light presented the finest and most magnificent spectacle. In proportion as the vapour descended and became more dense, this belt became narrower, and of a deeper colour; and appeared at last of a blood red, at the same instant small clouds which rove above this chain, darted a light of such brightness, that they resembled flaming stars or meteors. When the night was quite set in I returned there; the sky was then perfectly clear, and without clouds, the vapours were only observable at the bottom of the valleys: the stars shining but without any tinkling, spread over the tops of the mountains an extreme feeble and pale light, but sufficient however to

distinguish the masses and the distances. The repose and profound silence which reigned in this vast extent, still heightened by the imagination, inspired me with a sort of terror; it appeared to me as if I had outlived the universe, and that I saw its corpse stretched at my feet. Sorrowful as ideas of this nature are, they have a sort of charm which can hardly be resisted. I turned my looks oftener towards this obscure solitude than towards Mont Blanc, whose shining and phosphorical snows still gave the idea of movement and life; but the keenness of the air on this isolated point presently forced me to retire to the hut.

The coldest part of the evening was three quarters of an hour after sun-set, the thermometer could keep no higher than two and a half degrees above the freezing point. An hour after it got a degree higher, and another in the night, still the fire afforded us great satisfaction; indeed we scarcely should have been able to have done without it.

But this hut, this asylum of such consequence to us, deserves to be described. It was about seven feet by eight, and four in height: it was inclosed by three walls, and the rock which it was attached to served for a fourth; flat stones placed without mortar formed these walls; and the same sort of stones, supported by three or four branches of fir, composed the roof: an opening of three feet square, left in the wall, served for an entrance. Two paillasse placed on the ground served us for beds; and an open parasol placed against the entrance served us at the same time instead of a door and curtains. M. Bourrit, and still more so his son, were incommoded by the purity of the air; they did not digest their dinner, and could not eat any supper. For my part, whom the pure air does not incommode, if I use no violent exercise, I passed an excellent night in a light and quiet sleep.

When the parasol was not before the door, I could see from my bed the snows, the ices, and the rocks situated below our hut; and the rising of the moon gave to this view the most singular appearance. Our guides passed the night, some squatted in the holes of rocks, others wrapped up in cloaks and blankets, and others sat up and watched by a little fire, which they kept up with a part of the wood we brought with us.

As M. Bourrit the year before, at the same season, and in the same place, suffered severely from insupportable cold at sun-rise, it was settled that we should not set out till after six o'clock. But as soon as day began to appear, I mounted to my observatory and there waited the sun's rising. I found the view still very fine, less singular however than at the sun's setting; the vapours, less condensed, did not form in the horizon a cordon so distinct and highly coloured, but in return I observed a singular phenomenon. It was formed of rays of a fine purple, which parted from the horizon to the west, precisely opposite the sun; they were not clouds, but a sort of thin vapour homogenous substance: these rays, to the number of six, had their centre a little below the horizon, and extended to ten or twelve degrees from this centre.

We had the precaution to take a warm mess of soup as a preventative against the cold; we then made an equal division amongst our guides of provisions, precautionary cloathing, and of my instruments, and in this manner set out at a quarter past six with the greatest hope of success.

Elevated as we were to one thousand four hundred and twenty-two toises above the sea, we had still one thousand toises to get up before we could attain the summit of Mont Blanc; in effect, the most exact measures allow this summit to be two thousand four hundred and twenty-six toises above the Mediterranean. Of these one thousand toises, we had to go about six hundred on the rocks of the Aiguille du Gouté, and the remainder on the snow.

This Aiguille, or high mountain, seen from the environs of Geneva, presents itself under a round form, straight before, and under the highest summit of Mont Blanc. The ridge of rocks which descend from it appear like blackish furrows. From our hut we could distinguish this Aiguille under the same aspect as from Geneva; but as we were very near it, it concealed from us the height of Mont Blanc; we only saw the sky above these rocks.

The rapidity of the *coulours*, or hollows, is so great, that it is impossible either to get up or down, and even if one should happen to fall, it would be found very difficult to retain one's self; one must either roll or slide to the bottom of the mountain.

This slope, by which we were to get up, as seen from Geneva, and also from our hut, appeared sharp and inaccessible; yet our guides assured us that on a near approach all these seeming difficulties would vanish: they even went so far as to say that the ascent from Bionnassay to the hut was more difficult and more dangerous than what remained for us to attain the summit of Mont Blanc. It may then be easily conceived with what courage and hopes we set out.

We began by traversing not a very sloping glacier, which separated us from the base of the Aiguille, and in twenty minutes came to the first rocks of the ridge by which we were to get on this base. This ridge is rapid enough, and the broken or disunited rocks of which it is composed do not offer a very commodious patch. However, we mounted them very gaily in an hour and some minutes: the temperature was such as we could desire: the air, between three and four degrees above the freezing point, was no colder than necessary not to heat us in ascending; we enjoyed the lively and encouraging pleasure to perceive our progress by the gradual decline of summits which not long before had appeared above us. I felt a most lively joy, and which perhaps may appear puerile, when after having ascended twenty-five minutes I came to discover the lake of Geneva; it was the first time I had found myself high enough on the bases of Mont Blanc to be able to perceive it. I had also the pleasure to find here two handsome plants, *aretia Alpina*, and *aretia Helvetica*. This last is extremely rare in the Alps of Savoy. When we had attained the highest part of the ridge, it was necessary to climb a steep slope of snow to get on the glacier which forms the plateau of the base of the Aiguille, and there, for the first time, we were assisted by the hands of our guides, who were always anxious to offer us their help. It was near three quarters after seven o'clock when we got on this plateau: we had flattered ourselves with the hopes of getting there sooner; and as we knew that this was but a small part of the whole of our undertaking, I thought I ought not to stop to observe the barometer.

We then passed right to the foot of the Aiguille, and were upon the point of getting to it, when we saw with much surprise a man, who did not belong to our caravan, ascending before us at the glacier of Bionnassay. But this surprise changed into a cry of joy of all the cavalcade, when we discovered him to be Guidet, the brave fellow who the year before had accompanied M. Bourrit, and had gone with Marie Coutet almost to the summit of Mont Blanc: he was not at home when we sent for him; he had not begun his journey till late in the preceding evening, had got up the mountain in the night, and came by the shortest cut into the track that he knew we should take. The guides the most loaded hastened to let him have his share of the baggage, and he gaily took his place in our rank.

The glacier that we were traversing touches on one of the ridges of the Aiguille of Gouté, which is by its rapidity impracticable. This ridge is separated from that which we were to follow by one of those rapid *coulours* of which I have already spoken: it was necessary to traverse this *coulour*: the snow which covered it was still frozen, and ex-

fively hard; happily Goutet and Gervais, who had passed there the day before in the afternoon, had found this snow softened by the sun, and had marked places in which we could put our feet. These traversings are what I most fear: if your feet fail, you have little hope of being able to keep up; but when you directly ascend or descend, if you fall it is easier to stop yourself. Guidet wanted to pass below us, in case our footing should fail, to which we would not consent, as the slope by which he had to pass in so doing was still more rapid and dangerous than where we were; and we followed the method I had used in descending the glacier of the Aiguille du Midi. Each of us placed himself between two guides, who firmly held the two extremities of one of their long sticks; this stick formed at the side of the precipice a sort of barrier on which we supported ourselves; this barrier moved with us, made our walking secure, and preserved us from all danger.

After having traversed this *coulair*, we attained the ridge of the rock we had to climb, and here it was that our task became difficult. We found this ridge incomparably more steep than that which had conducted us on the base of the Aiguille, the rocks of which it is formed being more incoherent, quite disunited by the injuries of the air; sometimes they rolled from under our feet; sometimes pieces came away in our hands when we laid hold of them; often not knowing where to lay hold, I was obliged to catch at the leg of the guide next before me. The ascent in some places was so steep, that sometimes this leg was level with my head: in addition to our troubles, the snow which had fallen two days before filled up the intervals of the rocks, and concealed the hard snow or ice which we found here and there under our feet. Often the middle of the ridge became absolutely impassable, in which case we were obliged to go by the sides of dangerous *coulairs* by which it was bounded; at other times we met interruptions in the rocks, and it was necessary to cross snow which covered slopes extremely rapid. All these obstacles augmented gradually in our approach to the summit of the Aiguille. At length, after five hours ascent, three of which passed on this fatiguing ridge, Pierre Balmat, who preceded me, seeing that not only the slope continually became more steep, but that we still found, as we advanced, a greater quantity of fresh snow, proposed that I should rest myself while he went before a little to examine what we should do. I consented with so much the more willingness, as I had not sat down since our departure in the morning: I had sometimes stopped to take breath, but always standing, supporting myself on the stick. As he advanced he kept calling to us to wait for him, and not to proceed farther till his return. After an hour's absence he returned, and informed us that the quantity of fresh snow higher up was so great, that we could not attain the summit of these rocks without extreme danger and fatigue, and that there we should be obliged to stop, because the top of the mountain, beyond the rocks, was covered with soft snow to the depth of a foot and a half, through which it was impossible to advance. His guêtres, covered as high as his knees, attested the truth of this report, and the quantity of snow all round us was also a sufficient proof of it. In consequence we agreed, though with regret, to proceed no farther.

The barometer, which I had tried during this halt, only supported itself at eighteen inches, one ligne, fourteen sixteenths, and the thermometer in the shade at two and a half. At this time the barometer, observed at Geneva by M. Pictet at one hundred and fourteen feet above the lake, supported itself at twenty-six inches, eleven lignes, thirty-one thirty-seconds; and the thermometer in the open air at fourteen degrees de Reaumur. This observation, calculated by the logarithms without regard to the temperature of the air, would give one thousand nine hundred and thirty-five toises above the sea. If we regard this temperature, in following the formula of M. De Luc, we should take

off seventy-two toises; but if we adopt the principles of naturalists, who have laboured to perfect M. De Luc's, we should make a much less considerable deduction. For, according to the Chevalier Shuckburgh, we should retrench but thirty toises; and according to M. Trembley, but twenty-eight; and so the height of the place where we stopt would be one thousand nine hundred and seven toises above the sea. Although I could not make these calculations on the place itself, as I did not know the height of the barometer in the plain, I well saw that we ought to be about one thousand nine hundred toises, and I told my fellow-traveller so; and in the chagrin we felt for not having been able to complete our enterprize, it was some consolation to us to know that we had been higher than any other known observer in Europe had ever been before.

I observed the hygrometer, the electrometer, the structure of the rocks which surrounded us; I collected several samples of these rocks; we admired the immense extent of the prospect which presented itself to our view: to the south-west we could see the river Isère much beyond Chambéry, and our view to the north-east extended to Gemmi, and in this demi-circle, whose diameter is about fifty leagues, we darted above the highest mountains; we could see our lake at the left of the mole, and on the right the mountains of Abondance. The Jura alone terminated our horizon to the north-west, for we saw it even above the summit of the Buet, which was more than two hundred and seventy toises below us.

Meantime our guides pressed us to return. Although the thermometer in the shade supported itself only at two, five, and that the immediate action of the sun's rays made it only mount to four, seven, yet this same sun appeared to us extremely ardent, and when we stood still we could scarcely bear it without the help of a parasol. This made our guides fearful that the late snow, half melted by its rays, would augment the difficulty of the descent. It is known that dangerous ways are more difficult in descending than mounting, and we had passed some very bad in getting up. However, by walking with care, and the help of our guides, whose strength and courage were equally admirable we returned without any accident to the plateau of the base of the Aiguille of Gouté.

As I was no longer pressed for time, I observed the barometer at the border of the slope towards the lake, and its height compared, according to M. De Luc's method, with that which he then had, gives to this plateau one thousand four hundred and ten toises above our lake, or one thousand five hundred and ninety-seven above the sea, which makes about nineteen toises more than the summit of Buet. It was also a satisfaction to me to have found there a more convenient situation for divers experiments, more elevated than the Buet, and of an easier access also. This same elevation, calculated according to M. Trembley's formula, would be one thousand four hundred and forty-four toises above the lake, and one thousand six hundred and thirty-seven above the sea.

From thence I re-descended to the hut very slowly, and in observing at leisure the rocks over which I passed. On my arrival there I found M. M. Bourrit, who had gone before us, and who felt so little fatigued from the journey, that they were getting ready to descend to the village of Bionassay. This was the more surprising, as M. Bourrit the younger had been ill the day before, and indisposed all the night; M. Bourrit the father, always pre-occupied by the dread of the cold, from which he suffered so much the preceding year, had mounted and descended the mountain with furred shoes, in which his foot had no stability, and which rendered this excursion so much the more tiresome for him.

For my part, from having found myself so well the preceding night in the hut, I resolved to pass this night also in it; either to continue my meteorological observations, or to observe in my descent the nature and structure of the mountain, which I could not have done if I had left it the same day; for night came on before M. M. Bourrit had got half way down.

Immediately after their departure I went and placed my instruments on the rock which I called my observatory, I there still enjoyed the magnificent spectacle of the sun's setting; and after a very good night in the hut, I continued in the morning my meteorological observations: I compared with great exactness, by means of a level, the elevation of this rock with that of the mountains which appeared to equal it nearly in height. I then descended slowly in picking up stones, and stopped a good while to observe those which are carried down by the glacier of Bionassay. Here are found all those of which the Aiguille of Gouté is composed, I went to dinner at Bionassay, and from thence a horseback to sleep at Sallenche.

If this attempt should be made again, I think it would be necessary to erect the hut, where one should sleep, at least two hundred toises higher than ours, that is to say, at the very foot of the rocks of the Aiguille du Gouté; and thus attack those sharp and uneven rocks with all the vigour that a night's rest gives, and before the heat commences. I likewise think that if some guides were sent two or three days beforehand to form a sort of stairs in the most rapid slopes, or at least chuse the easiest passages; for our guides, almost as great strangers as we in those deserts, were often divided in their opinions in the rout we should take; yet nothing is less certain than that we had always taken the best. But whatever means may be imagined to facilitate this enterprize, it should not be hazarded in a year of great snow, but at a time perfectly safe, with muscular joints, and a head well accustomed to the sight of precipices.

FURTHER

FURTHER ATTEMPTS TO ASCEND MONT BLANC*.

I HAVE given in the second volume, Chap. 52, the history of the useless attempts that were made, to the year 1785, to attain the summit of Mont Blanc.

To complete this history, I ought to say a word of an excursion made for the same purpose in 1786. This excursion was not successful, though it certainly was that which determined Dr. Paccard and Jaques Balmat to undertake the one made at the end of the summer of the same year.

It may be remembered that the 13th of September, 1785, I had attempted with M. Bourrit, to scale Mont Blanc by the Aiguille du Gouté, but that we met with new fallen snows which forced us to stop at the height of 1935 toises above the sea.

As the obstacle that these snows had opposed to our design, appeared to us to be the effect of the lateness of the season, I resolved to repeat the attempt the following year, at a time when the new snows should be less formidable. In consequence, and to lessen as much as possible the fatigue experienced in the last journey, I ordered Pierre Balmat to erect a hut at the foot of one of the ridges of the Aiguille du Gouté, and as soon as the season would permit to make some excursions on that side, in order to chuse the most convenient route for me to take.

To execute this project, Pierre Balmat, Marie Coutet, and another guide, went the 8th of June, 1786, to sleep at our old hut at Pierre Ronde, and set out for it at break of day; they got up the same ridge that I had followed the preceding year, and attained, although with great difficulty, the summit of the Aiguille du Gouté, after having all successively fallen ill from fatigue and the rarity of the air. From thence by proceeding an hour on the snows in the same direction, they came to the height of the Dome du Gonté; there they found François Paccard and three other guides, with whom they had concerted this rendezvous, and who had passed by the mountain of La Côte to come to the same place, always believing that it could be only by the Aiguille du Gonté that the summit of Mont Blanc was to be attained; and they had divided themselves in two parties to make a comparative trial of the two routes which led to the summit of du Gouté. This comparison was entirely to the advantage of the route by the mountain de la Côte. François Paccard and his companions had arrived an hour and a half sooner, with much less fatigue and danger than Pierre Balmat, who had passed by the Pierre Ronde.

After having joined, they traversed a great plain of snow, and came to a ridge which unites the summit of Mont Blanc to the Dome of Gouté; but this ridge was found to be so narrow between two precipices, and at the same time so dangerous, that it was impossible for them to follow it, and attain the summit of Mont Blanc. They then examined at different parts the approaches to this summit, and the result of this search was, that it was absolutely inaccessible at least by the Dome of Gouté. They returned from thence to Chamouni by the mountain de la Côte, much discontented with their expedition, and harassed by a storm accompanied with snow and hail.

* Sauff. vi. 137, 4to.

But they did not all return; one of those who had followed François Paccard by the mountain of la Côte, was Jaques Balmat, since become famous by his ascent to the summit of Mont Blanc. He was not to be of the party in this excursion; he had joined Paccard and his party almost in spite of them. In returning from the Dome of Gouté, as he was not on good terms with the others he walked by himself, and kept apart from them to search for chrystals in a rock at some distance. When he wished to rejoin them or at least follow their traces on the snow, he could not find them; meantime the storm came, and being fearful to venture himself alone in the middle of these deserts in the storm and at the approach of night, he preferred squatting himself down in the snow, and there patiently wait till the storm should cease and the coming of day-light; he there suffered much from the hail and cold; but towards morning the weather cleared up, and as he had the whole length of the day to return, he resolved to consecrate part of it to the trying if he could not, among these vast and unknown solitudes, find out a way by which the summit of Mont Blanc might be attained. It was thus that he discovered that which has been followed, and which is certainly the only one by which it can be attained.

He did not immediately on his return to Chamounie make his discovery known, but as he found that Dr. Paccard had thoughts of making a similar attempt, he communicated the secret to him, and offered to serve him as a guide. The success of this enterprise has been made known to the public by the relations which have been given of it by Dr. Paccard and M. Bourrit.

What is remarkable in the discovery of this route is, that it is the same which presents itself the most naturally to those who view Mont Blanc from Chamounie, and is also that which those who made the first attempt tried, but of which they became disgusted by a singular prejudice. As it proceeded by a sort of valley between great heights, it was imagined too warm, and that it excluded the air too much. This valley is nevertheless very wide, and accessible to the winds, and the ices which form the bounds are not of that nature to heat it. But fatigue and the rarity of the air gave to those, who made the first attempts, this oppression of which I have so often spoken; they attributed this oppression to the heat and stagnation of the air, and they no longer endeavoured to attain the summit otherwise than by the known and isolated ridges, such as that of Gouté.

The people of Chamounie likewise had an idea that sleeping on the heights would be attended with death, but the trial made by Jaques Balmat in passing the night on them, banished this fear; and the impossibility of coming to it by the ridges forced them to take the most natural and apparent route.

JOURNEY OF SAUSSURE IN AUGUST, 1787.

DIVERS periodical works have informed the public, that last year in the month of August two inhabitants of Chomounie, Mr. Paccard a physician, and Jaques Balmat the guide, attained to the summit of Mont Blanc, which till then had been deemed impossible.

It was made known to me the next day, and I immediately set out to endeavour to follow their traces; but there fell so much rain and snow that I was forced to give up the project for this season. I commissioned Jaques Balmat to visit the mountain in the beginning of June, and to let me know as soon as the sinking of the winter snow should render it practicable. In the interval I went into Provence to make experiments by the sea side, with a design to compare them with those I proposed to make on Mont Blanc.

Jaques

Jaques Balmat in the month of June made two useless attempts, mean time he wrote me word he had no doubt but it might be done in the month of July. I then set out for Chamounie. At Salenche I met the courageous Balmat, who was coming to Geneva to inform me of his new success; the fifth of July he had attained the summit of the mountain with two guides, John Michel Cachat and Alexis Tournier. It rained on my arrival at Chamounie, and the bad weather continued three weeks; but I was determined to wait till the end of the season, rather than miss a favourable opportunity.

This opportunity so much desired came at last, I took my departure accompanied by a servant, and eighteen guides who carried my instruments and other necessary apparatus.

My eldest son was extremely desirous of accompanying me; but I was afraid he was neither strong enough nor sufficiently accustomed to excursions of this nature, therefore insisted that he should give up the design. He staid at the Priory, where he made, with much care, observations similar to those I made on the top.

Although it is hardly two leagues and a quarter in a direct line from the Priory of Chamounie to the summit of Mont Blanc, it takes eighteen hours to walk it, on account of the bad road, the turnings, and about one thousand nine hundred and twenty toises to get up.

To be perfectly at liberty in the choice of the places where I should sleep, I had a tent carried, and the first night I slept under it on the summit of the mountain of Côte, which is situated on the south of the Priory, and at seven hundred and seventy-nine toises above this village.

This journey is free from pain and danger, the ascent is always on the grass or on the rock, and the excursion is easily made in five or six hours. But from thence to the top, there is nothing but ice and snow to walk on.

The second journey is not the easiest. We had immediately to cross the glacier of the Côte to get to the foot of a chain of rock inclosed by the snows of Mont Blanc. This glacier is difficult and dangerous. It is intersected by large, deep, irregular crevices; and it is often difficult to pass them except over bridges of snow, which are sometimes extremely slight, and suspended over abysses. One of my guides had nearly perished here. He had gone the day before with two others to reconnoitre the passage, happily they had had the precaution to fasten themselves together by cords; the snow gave way under him in the middle of a wide and deep crevice, and he continued suspended between his two companions. We passed by the opening which had been formed under him, and I trembled at the sight of the danger he had run. The passage of this glacier is so difficult and winding, that it took us three hours to go from the top of the Côte to the first rocks of this isolated chain, though it is little more than a quarter of a league in a direct line.

After having attained these rocks, we soon quitted them again to go up a winding valley full of snow, which stretches from north to south to the foot of the highest summit. This snow is intersected at different distances by enormous and superb crevices. Their lively and neat form shews the snow disposed of in horizontal beds, and each of these beds answer to a year; be the largeness of its crevices what it may, the bottom can no where be discovered.

My guides wished we should pass the night near some of those rocks which are to be met with in this route, but as the highest are six or seven hundred toises lower than the summit, I was desirous to get higher up. To do this, it was necessary to pitch our tent amid the snows, this I had much trouble to make my companions consent to. They imagined that during the night there reigned on these high snows an insupportable cold,

and seriously believed they should perish there. At last I told them, that for my part I was determined to do it with those amongst them on whom I could depend; that we would dig deep in the snow and cover this hollow with the covering of the tent, and there shut ourselves in together, and in this manner we should not suffer from the rigour of the cold. These arrangements having encouraged them, we pursued our course.

At four in the evening we got to the second of the three great platforms of snow which we had to pass, and there we pitched our tent, one thousand four hundred and fifty-five toises above the Priory, and one thousand nine hundred and ninety-five above the sea, ninety toises above the pike of Teneriffe. We did not attempt to get to the last platform, because there we should be exposed to the fall of avalanches.

The first platform by which we had lately past is not exempt from them. We had passed over two of these avalanches, which had fallen since Balmat's last journey, the broken remains of which covered the whole valley.

My guides immediately set about excavating a place where we might pass the night; but they very soon felt the effect of the rarity of the air*. These robust men, to whom seven or eight hours walking is in reality nothing, had hardly thrown up five or six shovels of snow when they found it absolutely impossible to continue; they found it necessary constantly to relieve each other. One of them who had turned back a little to fetch some water in a cask from a hollow, was taken ill in going, returned without water, and passed the night in the most agonising pain. Myself who am so accustomed to the air of the mountains, and who feel better in this air than in the plain, I was overcome with weariness in observing my meteorological instruments. This illness caused in us an ardent thirst, and we could not procure water but by melting the snow, for the water we had seen in coming up, was found frozen when they returned to fetch some, and the little chaffing-dish we had with us afforded a slow supply for twenty thirsty persons.

From the middle of this *plateau*, enclosed between the last summit of Mont Blanc, to the south, its high steps to the east, and the Dome du Gouté to the west, there is scarce any thing to be seen but snow; this snow is quite pure, of a dazzling whiteness, and on the high summits forms the most singular contrast with the almost black sky of these high regions. No living creature to be seen, no appearance of vegetation; it is the dwelling of silence and cold. When I represented to myself Doctor Paccard and Jaques Balmat arriving the first at the close of day in these deserts, without shelter, without succour, without even knowing that mankind could exist in those places they were attempting to get to, but continuing nevertheless boldly their career, I could not but admire their resolution and courage.

My guides always occupied with the fear of cold, so closely shut all the openings of the tent, that I suffered much from the heat and impurity of the air, occasioned by the respiration of so many people. I was obliged to get out in the night for the sake of taking breath. The moon shone with the greatest lustre in the middle of the sky of a dark ebony colour, Jupiter seemed to throw out strong rays of light from behind the highest summit to the east of Mont Blanc, and the reverberating light all over this extent of snow was so dazzling, that only the stars of the first and second magnitude were distinguishable. At length however we began to sleep, when we were awaked by the noise of a great avalanche, which covered part of the declivity that we should have to climb the next day.

At break of day the thermometer was three degrees below the freezing point. It was late when we set out, owing to the necessity we were under of melting snow for

* The barometer stood but at 17 inches $10\frac{3}{4}$ lines.

breakfast, and to have some to carry with us; it was no sooner melted than drank, and those people who religiously guarded the wine I had brought with us, continually stole the water I had in reserve. We began by ascending the third and last platform, then took to the left to get on the highest rock at the east of the summit. The declivity extremely slanted, thirty-nine degrees in some places, and every where borders on precipices, and the surface of the snow was so hard, that those who went first were obliged to break it with a hatchet before they could gain a footing. It took us two hours to climb this declivity, which is about two hundred and fifty toises high. Coming to the last rock, we took to the right inclining westerly to climb the last declivity, the perpendicular height of which is about one hundred and fifty toises. This declivity inclines only to twenty-eight or twenty-nine degrees and is not dangerous; but the air is so rarified that our strength visibly failed, as near the summit I could only go fifteen or sixteen steps without taking breath, I even felt now and then a sort of fainting which obliged me to sit down, but in proportion as I recovered my respiration, I felt my strength return; when recovered enough to proceed, I seemed as if I could get to the top at one stretch. All my guides in proportion to their strength were in the same situation. It took us two hours from the last rock to the summit, and it was eleven o'clock when we gained it.

My first looks were fixt on Chamounie where I knew my wife and her two sisters were, their eyes fixed to a telescope following all our steps with an uneasiness, too great without doubt, but not less distressing to them. I felt a very pleasing and consoling sentiment when I saw the flag which they had promised to hoist the moment they observed me at the summit, when their apprehensions would be at least suspended.

I could now enjoy without regret the grand spectacle I had under my eyes. A light vapour suspended in the lower regions of the air, concealed from my sight the lowest and most distant objects, such as the plains of France and Lombardy; but I did not much regret this loss. What I had just seen and what I saw in the clearest manner, is the whole of all the high summits of which I had so long desired to know the organization. I could hardly believe my eyes, it appeared to me like a dream, when I saw placed under my eyes those majestic summits, these redoubtable Aiguilles, the Midi, the Argentiere, the Geant, whose bases even had been for me of such difficult and dangerous access. I seized their relation to each other, their connection, their structure, and a single glance cleared up doubts that years of labour had not been able to dissolve.

During this time my guides pitched my tent, and set out the little table on which I meant to make the experiment of the ebullition of the water. But when it was necessary for me to dispose of my instruments and observe them, I found myself every moment obliged to suspend my work, and attend only to my respiration.

If it is considered that the barometer was then only at sixteen inches one line, and that thus the air had little more than half of its ordinary density, it may be comprehended that it was necessary to supply it by the frequency of inspirations. When I was perfectly quiet, I only felt a slight pain at my breast; but when my attention was fixed for some moments in continuation, and particularly when in stooping, I leaned on my stomach, I was obliged to rest during two or three minutes, to recover myself again. My guides felt the same sensations. They had no appetite; and to say the truth, our provisions, which were all frozen, were not in that state calculated to excite one; neither did they care for wine, or brandy, indeed they had found that strong liquors increased this indisposition, without doubt by increasing the quickness of the circulation. It was fresh water only that did them good, and afforded them pleasure; but time and trouble were wanting to make a fire, without which we could not have any.

I nevertheless remained at the top till half after three, and although I lost not a single moment, I was not able in these four hours and a half, to make all the experiments I have frequently made in less than three hours at the sea side. I made however with care the most essential ones.

I got down easier than I expected. As the motion in descending does not press the diaphragm, it does not confine the respiration, and one is not, therefore, obliged to stop so often to take breath. The descent from the rock to the first platform was nevertheless very difficult by its great steepness, and the sun shined with such brightness on the precipices beneath us, that it needed heads well accustomed to such sights not to be terrified. I again slept on the snow two hundred toises lower than the preceding night. There it was I became convinced that it was the rarity of the air which incommoded us on the summit; for if it had been from weariness we should have been much sicker after this long and dangerous descent; but, on the contrary, we supped with a very good appetite, and I made my observations without any obstruction from indisposition. I even believe that the height where this indisposition begins is fixed, beyond which it is impossible to proceed farther. For my own part I find myself very well at one thousand nine hundred toises above the sea, but as soon as I get higher I feel myself indisposed.

The next day we found the glacier of the Côte changed by the heat of these two days, and still more difficult to pass than it was getting up. We were obliged to descend a declivity of snow, inclined to fifty degrees, to avoid a crevice which had opened during our journey. At length at half after nine we found ourselves approach the Côte mountain, very happy to find ourselves again in a place where we were not afraid of it sinking under our feet.

There I met Bourrit who wanted to engage some of my guides to go up again with him; but they found themselves too fatigued, and wished to rest themselves at Chamounie. We descended very gaily to the Priory, where we got to dinner. It was a great pleasure to me to have them all return safe, and well with their eyes and face in the best possible state. The black crapes with which we had provided ourselves, and with which we covered our faces, had perfectly preserved us from the temporary blindness, and chapped and burned faces often occasioned by the reverberation of the snow, which those who had gone there before us had felt.

Details of the Journey.

IN going from the Priory to Mont Blanc, by the Côte Mountain, you must begin by following the road to Geneva, as far as the village of Buissons, and then take the path which leads to the glacier of that name. But at the foot of the declivity which leads to this glacier, you turn to the right which leads to the hamlet of the Mount.

This hamlet is situated on a hill of gypsum; on the surface of this hill are seen hollows, some in the form of funnels, others on the contrary have only a narrow orifice, and widening farther in. I was shewn one in a field scattered over with bushes, the opening of which was but a foot wide, but farther in its diameter was ten or twelve feet of a spherical form. Without doubt, these hollows are made by the waters which dissolve, and draw with them the gypsum which forms the hill, whilst the vegetable earth, withheld by the roots of grass and bushes, rests suspended above these cavities. As to the spherical form of these cavities, it is difficult to explain; neither are those geometers who give the account.

A little

A little beyond the Mount we began to ascend, in pursuing the borders of the torrent which issues from the glacier of Taconay; there instead of fixed rocks we only find wrecks, displaced rocks, composed of quartz, of mica, of *shistæ* hornblende, or of ferruginous horn stone, which dissolves in the air, and changes into oxide of iron of a rusty colour. These fragments have frequently a rhomboidal form.

Soon after are seen to our left yellowish rocks, which decompose, and whose nature is the same as those fragments. As to their structure and situation, they are, in general, conformable to the other works of Chamounie.

In proportion as we got higher we found the horn rock abound more in these fragments, nevertheless one meets some fine knots of granite of felspar, of an almost black grey, mixed with white quartz; of quartz crossed with threads of amianth and others.

This ascent is extremely wild, at the bottom of a narrow valley, with the glacier of Taconay in front, bristled with flakes of ice, not clear and white, like those of Buissons, but soiled by a black mud, and intersected with rocks of the same colour: but in getting up higher we discovered above this glacier, clear and sharp-edged snows of the *Dôme of Gouté*.

Till within half a league beyond the hamlet of the Mount, you may go on mules for about two small leagues from the Priory; but all the rest on foot.

Soon after we got above the glacier of Taconay, some part of the way became difficult; we then met with a clear fountain of fresh water, where the guides already fatigued with their loads took some rest.

There we faced the glacier of Taconay, remarkable for the different colours of its ices, which at our side on the right bank is muddy and black, whilst on the opposite bank they are transparent and white.

The rocks on both sides are the same as those I have above described; they divide frequently into oblique angled parallelepipeds; their situation and structure are also the same.

In getting up higher we found harder grey rocks, resembling veined granites, with lengthened knots and veins of quartz, parallel to their beds and layers. Afterwards we got nearer the glacier, and climbed a sloping declivity to the Moraine, whose ridge we followed for some time; we soon after left it entirely by getting higher on the mountain to the left.

Half an hour after having quitted the glacier, we came to the foot of a pretty high sharp rock, which guards a narrow and deep cavity, from which there is no way of getting but by scaling this rock; this passage is called the *Mapas* or *bad step*: they had placed a ladder there for me, on a supposition I should want it, but as I was unwilling to give my guides a bad opinion of my intrepidity, I passed on without touching it.

Beyond the *Mapas* we were obliged to pass by some narrow corners on high sharp ridges.

We then followed an uneven ridge, with the precipice to the right, and very uneven fields to the left; after that we climbed a slope to a cavern, where I slept the 20th of August 1786, when, immediately after Doctor Paccard's journey, I endeavoured, by following his steps, to attain the summit of Mont Blanc. But in the night there happened such a storm of rain and snow, that I was obliged to return sorrowfully, and put off the attempt till the following year.

Each of these journeys took me about four hours, without including rest, from the Priory of Chamounie to this cavern.

The summit of this rock, to the north-west of this cavern, presents a very fine prospect: it forms one of the heights of the narrow ridge of the *Côte* mountain, which separates

parates the glacier of Taconay, from that of the Buissons. The neck by which it is passed is about six hundred toises above the Priory of Chamounie. From this ridge is seen the two glaciers just mentioned, and which lay immediately under our feet, all the valley of Chamounie, to the defile de Balme, and the two chains which border this defile: farther on is seen the tower d'Ai, and the Aiguille of Midi, which over-tops St. Maurice, as well as other heights at a greater distance. From the opposite side is seen the mountain beyond the glacier of Taconay, which bears the name of this glacier, and the trenches of the beds of this mountain. These beds shew with the greatest regularity their position. Finally, in the same direction the profile of the Aiguille of Gouté also offers the same position of beds.

But the most singular point of view is that of the ridge itself, on which we stood, seen at its full length from the north-west side. Great blocks of rocks with sharp angles, boldly and singularly heaped on each other, crown the summit of this ridge, and present the most wild and fanciful aspect; the smiling and beautiful parish of Ouches appears divided by these sterile rocks, and forms with them a striking contrast.

One of these blocks, which is sharp angled, projects very much over the precipice, and is called from its shape, the *bird's beck*. It is said, that a shepherd, who laid a wager to go and seat himself on the point of this beck, actually got to it, and sat on it, but that in moving to come away, he lost his equilibrium, fell, and was killed upon the spot.

The rocks of this part of the ridge are for the most part of schistus, composed of black hornblende, and white felspar*. There is frequently found in the crevices of these rocks, translucent little crystals, of felspar a little inclining to green.

It was twelve when we came to this ridge; I stopped half an hour to give my guides time to dine. During this time I amused myself with the sight of some people a great way beneath me, who were crossing with great difficulty, supported by their guides, the lower plateau of the glacier of Buissons, and who very probably were proposing to themselves at their return to make a pompous recital of their undertaking, and the risks they had run.

I looked, but looked in vain, on the second platform, for two of my guides, who had flattered themselves with the expectation of getting before us to the ridge, where we were, in passing by this platform of the glacier, which in effect presents a more direct route to the Priory. But as some of the way is very bad, we were very uneasy at not seeing them. They however rejoined us, but very late.

After having crossed this ridge, we continued to ascend obliquely, between the glacier of Buissons and the top of this same ridge, the rocks of which are always of veined granite, here and there mixed with beds of *siénite schiste*, or of a foliated rock, composed of bladed hornblende, and felspar. The beds of these rocks are always in the same situation.

We passed under a deep cavern, where Jaques Balmat, in his preceding journey, had concealed the ladder which was to assist us in crossing the crevices of the glacier, likewise a pole to make use of in very bad places. He found the ladder, but the pole was stolen; it is singular that thieves should find their way to such a place; however, it cannot be said they were highway robbers.

We also passed by the foot of the Aiguille de la Tour, which is the highest point of this ridge. We afterwards climbed some granite veined rocks, always situated in the same

* *Siénit schiefer* of Werner.

manner; and we arrived, at three quarters after one, at the summit of the Côte mountain, at the place where we were to pass the night.

The first journey took us but six hours and a half from the Priory to our sleeping-place.

This sleeping-place consisted of a great heap of blocks of granite, among which my guides hoped to find shelter, and where Dr. Paccard and Jaques Balmat had slept the first night of their expedition. These blocks have been forced there by the glacier which is very near, and which is to be crossed to make a way to the summit of Mont Blanc. And there it is we quitted the firm ground to embark on ice and snow to the end of the journey.

The crossing of the glacier in the morning while the snow is hard is to be preferred, as it becomes much more difficult when the heat of the sun has softened the snow.

This is what Marie Coutet found under whom the snow gave way, when he went to reconnoitre the way we should go the next day. Happily, as I have said in the abridged relation, he rested suspended by the cords which fastened him to his two comrades, who had accompanied him. At their return we were all eager to have an account of the expedition; as soldiers are to ask the spies of an army news of the enemy's situation. Marie Coutet, with great seeming indifference and even gaiety, told his story; notwithstanding which, his recital cast a shade of sorrow on the countenances of his hearers; the most heroic smiled at it, but the rest viewed it in a more serious light. Mean time nobody talked of returning there, but, on the contrary, began to look out for a place of shelter to pass the night: some went to my old lodging, where they hoped to be warmer; others fixed themselves between the blocks of granite, for my part, I slept under my tent with my servant and two or three of my ancient guides.

The next day, 2d of August, notwithstanding the interest we all had in setting off early, there arose such difficulties among the guides in the arrangement and division of their loads, that it was half after six o'clock before we set out, each fearing to load himself, less from fear of the hardship, than of sinking in the snow by the weight of himself and load, and by this means fall into a crevice.

We got on the glacier, opposite the blocks of granite under which we slept; the entrance on it was easy enough, but we soon found ourselves entangled in a labyrinth of rocks of ice separated by large crevices, in some places opening very wide, in others covered either wholly or in part by the snow, which sometimes forms a sort of arches underneath, and which are sometimes the only resources in one's power to get over these crevices; in other respects it is an uneven ridge of ice which serves as a bridge to cross over. In some places, where the crevices are quite empty, we had to go down to the bottom and get up at the other side by stairs cut with a hatchet in the very ice: but in no part is the rock found or seen*; and sometimes after having got to the bottom of these abysses, surrounded with almost perpendicular walls of ice, you can hardly conceive how you shall get out again, however as long as they walked on the ice, though ever so narrow the ridges, and flanting the declivities of it are, these intrepid Chamouniards, whose head and feet are equally firm, appear neither afraid or uneasy; they talk, laugh, and defy each other in jest; but when they pass over these slight roofs suspended over deep abysses, they walk in a most profound silence; the three first tied together by cords, about five or six feet distance between them; the others two by two holding their sticks by the ends, their eyes fixed on their feet, each endeavouring to place exactly and lightly his foot in the traces of the one before him. Above all it was after we had seen the place where

* Their bottom is always of snow or ice.

Marie Coutet had fallen, that this sort of fear increased; the snow had quite given way suddenly under his feet and formed round him an empty space of about six or seven feet in diameter, and discovered an abyss to which was seen neither bottom nor sides; and that in a place where no exterior danger appeared. When after having got clear of some of these suspicious snows we found ourselves on a rock of ice, the expressions of joy and serenity shined on all our countenances, and our jokes and good humour returned. We then held a council on which way we should take, and grown bold by success, we exposed ourselves with the greatest confidence to new dangers. It took us three hours to cross this redoubtable glacier, although hardly a quarter of a league in breadth. From this time we had only to walk on snow, often rendered extremely difficult by the very great slants of the declivities, and sometimes dangerous when these declivities bordered on precipices: but in this case at least we had no dangers to encounter but what we saw, and where we ran no risk of being swallowed up, without either strength or address being of any avail to us.

In going from this glacier, we were obliged to climb one of those declivities of snow extremely sloped, after which we had to pass to the foot of the lowest and most northerly rock of a small chain of insulated rocks, in the middle of the ices of Mont Blanc.

This chain runs pretty near from north to south, and is entirely composed of primitive foliated rocks, the elements of which are of blackish or greenish plates of hornblende, of felspar, of *plombagine*, with a little quartz and mica.

There is found there also a greenish stone, brilliant enough, translucent, fibrous and schistose, pretty hard, fusible by the blow-pipe, in a globule of 0.3, line of green glass, translucent, of a greasy lustre. This substance agrees much with the *steatite asbestiforme* of St. Gothard; but its parts are finer, it is more brilliant, harder, more fusible, and produces a clearer glass. But except another species is made, I cannot compare it to any other.

As to the rest, the felspar, which forms a part of the composition of these rocks, is of the sort which I call fat, because it has a fat and oily lustre. All the rocks of this chain have their beds situated like those of the Côte mountain, according to the general law of the Chamounie rocks, but are inclined low.

This chain at the eastern side is separated from the *Aiguille du Midi*, and some mountains, which join this *Aiguille* with Mont Blanc by an extremely wild glacier, almost wholly composed of *seracs*.

The name of *serac*, in our mountains, is given to a sort of white compact cheese, taken from whey, and pressed in a sort of rectangular cases, where it takes a cubical form, or rather rectangular parallelipidus. The snows at a great height frequently take this form when they freeze, after having in part imbibed water. They then become extremely compact; in this state, if a thick bed of this hardened ice comes on a declivity, and should, as it often happens, slide down in a body on this declivity; and, in so sliding, if some parts of the mass should not go equally with the rest, their weight forces them to break in pretty near rectangular fragments, some of which may measure fifty feet, and which, by reason of their having no mixture, are as regularly formed as if they had been chiseled.

On the faces of those great parallelipids is seen one of these beds of snow accumulated from year to year, and passing gradually from the state of snow to that of ice, by the infiltration and successive freezing of rain and other waters which result from the superior beds after melting.

We had also at our right great heaps of snow into this form of *serac*, and we should have been obliged to pass between their intervals with much difficulty and danger, had it

it been ever so little later in the season, but a bridge of snow which would have melted in a few days, served us to cross an enormous opening, and saved us the trouble of passing amid the *seracs*.

We rested ourselves some moments in the shade of some rocks of the isolated chain, of which I have spoken higher up.

We then went to the west, after which we again approached it at the place where the year before I had the hut erected with the intention of sleeping there, but, as I have already mentioned, bad weather prevented me from getting there. In other respects, this station had been badly chosen, being too near the first; as it is not more than one hundred and twenty toises above the top of the Côte mountain; so that we should have had nine hundred toises to ascend the third day; whilst, on the contrary, it was necessary for several reasons to leave the smallest portion for the last.

The nature of the rocks which compose this part of the insulated chain is still the same; and there is besides observable some argillaceous schistus of the nature of slate, and some schistose granite rocks with some knots of quartz; the situation of their beds is always the same, but approaches nearer to the vertical. There, and higher up, this chain is frequently interrupted by snows; the points of these rocks project like little islands or shelves from the sea of snow which covers this vast region. My guides caused me to lose a great deal of time here under the pretext of breakfasting and resting; their intention was to delay our journey, that we should not be able before night to venture ourselves on that part of our way where we should meet no more rocks, and where we should be obliged to sleep on the snow. We did not set out again till eleven o'clock, although we arrived about nine.

I again found the *Dispenzia Helvetica* in flower on these rocks.

We had from thence a glimpse of the lake across the valley of Abondance from the first rocks; but in continuing to ascend saw it still better, we could even very well distinguish the town of Nyon. The mountains of Faucigni appearing lower and lower before us, *l'aiguille percée* of Reposoire was that which kept longest in sight, owing to its nearness to us, and its projecting summit in a distant horizon, for we could only call the view of those completed over which we could see the Jura. Every victory of this sort was a subject of joy to the whole party: for nothing animated and encouraged us more than a distinct view of the progress we made.

After an hour's walk we came to an immense opening, along which we had to coast. And although a hundred feet wide, we could perceive no bottom to it.

The moment we were standing on its edge resting ourselves, admiring its depth, and observing its beds of snow, my servant, by I do not know what heedlessness, let fall the stand of my barometer, which he held in his hand; it slid with the rapidity of an arrow on the slanted wall of the opening, and fixed itself at an immense depth at the opposite side, where it continued vibrating, like the lance of Achilles on the banks of the Scamander. I felt a very lively movement of concern, because it not only served as a prop to the barometer, but also to a compass, a telescope, and many other instruments which fastened on it; in a moment some of my guides, sensible of my concern, offered to go for it, but as my fear of exposing them to too much danger prevented my consenting to it, they protested there was no danger, and immediately one of them passed a cord under his arm, and the others let him down to where it was, he drew it away and brought it back in triumph. I had a double uneasiness during this operation: first, the danger of the suspended guide; next, as we were within view of Chamouni, from whence with a telescope all our movements were perceivable, I thought that if at this moment our friends had their eyes fixed on us, they would, without doubt, think one

of us had tumbled into the abyfs, and that the others were getting him up. I have been fince informed, that happily at this moment they were not looking at us.

We were obliged to crofs this fame opening on a dangerous bridge of fnow; after which, by a very floping declivity of fnow we came to one of the rocks of the insulated chain, where I fleep the day of my return from the fummit, and for that reafon I called it the rock of Happy return; its height is one thoufand feven hundred and eighty toifes.

We arrived there at half after one, and dined in the fun with a good appetite, but much regretted the want of water, when one of the guides thought of a very ingenious method to procure fome: they threw fome balls of fnow againft the rocks expofed to the fun, part of which flicking melted by the heat of the rock, and we faved it by little and little as it fell; to relieve themfelves they threw the fnow-balls by turns, and formed a fort of well, which fupplied us with as much water as we wanted.

This rock, as well as that which is more to the fouth, and the laft of this insulated chain, is like the others compofed of primitive fchiftofe rocks, mixt with quartz, hornblend, and felfpar, with knots, fome of pure quartz, others of granite rocks. The higheft fhew fome veins, fome of black hornblende pretty near pure; others of white *felfpar*; but an oxide of iron which comes from the hornblende diffolved, gives to all thefe rocks a yellowifh caft. The beds of thefe fchiftufes are alfo fituated according to a former obfervation, but are almoft vertical.

This insulated rock, in the midft of fnow, appeared to my guides a delightful place, an ifland of Calypfo; they could not prevail on themfelves to quit it, and feemed determined to pafs the night there. In the abridged relation has been feen what trouble I had to make them leave it.

From thence in an afcent of about thirty-five minutes we attained the firft great platform of fnow which prefents itfelf in this route. The declivity of this platform is from ten to twelve degrees, but it is a plain in comparifon of the declivities we had climbed.

At our left lay the Aiguille du Midi, which began vifibly to lower to our right; the Dome of Gouté, where the diffolved hornblende predominates. The fummit of this dome cut almoft a fharp point on our fide, covered with a roof of fnow, half circular, like the arch of a bridge, and crowned by a continuation of thofe enormous blocks of fnow of a cubical form which I have named *feracs*, prefented the moft fingular and magnificent view. Before us the fummit of Mont Blanc, the object of our undertaking, ftill appeared to us of a prodigious height; at its left, the rocks which we call its ftairs, and fome very fuperb pieces of fnow, which by the dazzling of the fun appeared ftrikingly fingular and beautiful.

It took us twenty minutes to traverse this platform; and this time appeared long to us, for fince the laft voyage of Jaques Balmat, it had been covered by two enormous avalanches of *feracs*, which fell from the Dome of Gouté; we were obliged to crofs over thefe avalanches under the continual fear of being overtaken by others. I had however the pleafure of obferving thofe *feracs* which we feldom have an opportunity of viewing near us. I meafured fome which were more than twelve feet every way; the bottom, or that part which had united with the rock was formed of white, tranflucid ice, and more compact than ordinary ice. The oppofite fide which had been originally the top, was ftill of fnow, though a little hardened, and there is feen in the fame block all the fhades between thefe two extremes. We were furprifed to find that feveral of thefe blocks had arrived there without being diffigured, and even that they had ever come there, for the Dome of Gouté, from which they were detached is at a great diftance, and the declivity is not very flanting: without doubt they had flied in the morning on the

the snow which had been frozen and hardened by the cold of the night, and their own velocity had been very great.

From this platform we were an hour ascending a declivity of thirty-four degrees, which brought us to the second platform where we were to sleep.

We had at first long and serious deliberations respecting the choice of the place we should fix the tent under which we were all to collect to encounter the cold of the night, of which the guides had formed to themselves so frightful an idea. Besides the cold we had two other dangers to guard against, the one from above, the other from beneath: the business was to choose a situation which should screen us from the danger of the avalanches which might fall from above, likewise from that of crevices concealed by superficial snow. The guides trembled at the thoughts of this snow loaded with the weight of twenty men collected in a small space, and softened by the heat of their bodies melting and giving way all of a sudden, and swallowing us all up in the middle of the night. A frightful crevice whose winding we had traced in coming to this platform, and which might have extended, for what we knew, to the place immediately under us, proved at least the possibility of such a supposition. However, we found at about one hundred and fifty yards from the entrance of the platform a place which appeared to us secure from all those dangers. There they set about shovelling the snow away, and fixing the tent over the place they had made for it. In the abridged account I have related the indisposition my guides felt here from the rarity of the air.

After some moments of repose Marie Goutet and two others went on the Dome of Gouté to look for the stones covered with glass bubbles, that I have described in the second volume, and brought back some very fine ones, and one among others very remarkable in its having sprinkled on its surface the bubbles of a colour analogous to the part of the corresponding stone, blackish or greenish upon the hornblende, and whitish on the felspar; which proves clearly that they have been formed by a superficial fusion of the rock, and of consequence that thunder has produced them; in fact, by what other means could this effect be produced on the surface of a rock surrounded by snow? The same guides afterwards went to examine the declivity we had to get up the next day. They returned satisfied with having found covered with snow a crevice, which in the preceding journey had given them a good deal of trouble to get over; but the declivity by which we were to ascend appeared to them extremely abrupt, and formed of very hard and slippery snow, and I saw clearly by this account that they were in doubt of my being able to get up it.

On mountains free from snow, and whose heights does not exceed one thousand or one thousand two hundred toises it is very pleasant to get in good time to a sleeping place; the coolness of the evening refreshes you after the fatigues of the day, and you sit down on the grass or on a rock, are amused in observing the gradations of the light, and the changes which almost always accompany the setting of the sun, and twilight.

But in high mountains covered with snow the close of the day is extremely painful, one cannot tell where to place one's self; if you sit still you are frozen, and fatigue joined to the rarity of the air deprives you of strength and courage, necessary to warm yourself by exercise. This is what we felt in the situation we were now, to which we came about four o'clock. We were all frozen with cold; and waiting with the greatest impatience till the tent was fixed; as soon as it was, we all got into it, and in a short time the babbling of the guides and the nausea of those who were sick, forced me to leave it.

I hastened supper as much as possible. Afterwards they had great difficulty in fixing themselves in such a manner as they might be able to pass the night; I was allowed to stretch myself in a corner; but as for the rest they could only sit down on the straw

between each other's legs; and the air corrupted by the respiration of twenty persons crowded into so small a space occasioned our passing the bad night of which I have spoken.

The next day we soon traversed the second platform, at the entrance of which we had passed the night; from thence we ascended to the third, which we likewise soon crossed, and in half an hour came to the great declivity, by which in drawing to the east, we got upon the rock which forms the left shoulder of the top of Mont Blanc.

At the beginning of this ascent I was out of breath by the rarity of the air; however by resting a moment every thirty or forty paces, but without sitting down so far recovered my breath, as to be able in about forty minutes to get to the entrance of the avalanche which had fallen the preceding night, and which we had heard from our tent.

There we all stopped for some minutes in hopes that after having rested our lungs and legs, we should be able to get over the avalanche pretty quick and without resting to take breath, but in that we deceived ourselves, the sort of weariness which proceeds from the rarity of the air is absolutely insurmountable; when it is at its height, the most eminent peril will not make you move a step faster. But I infused fresh courage into my guides by repeatedly telling them that this place was really the least dangerous, because all the loose snow of the heights above us had already come away.

Beyond this avalanche the declivity became continually more sloping, and on our left bordered on a frightful precipice; it was necessary to get over a pretty large opening, the passage of which was incommoded by a rock of ice, which forced us to the border of the declivity. The foremost guides had cut steps here and there on the hard snow as they went on; but as they had left the spaces too long it was necessary to take such long steps that one ran the risk of missing ones footing, and sliding without remedy to the bottom. At last, towards the top the thawed surface became thinner; then it broke under our feet, and underneath it eight or nine inches of crumbled snow, which rested on a second crust of hard snow, into which we sunk to the calves of our legs, after which we slid down the side of the precipice, to which we were only held by the upper crust, which thus found itself loaded with a great part of the weight of our bodies; and if it had broken we should infallibly have slid to the bottom; but I did not think of the danger, my resolution was taken, I determined to go on as long as my strength would enable me, and I had no other thought than that of advancing with a firm step.

It is said when you walk on the border of a precipice you should not look at it, and is true to a certain point; but the following advice is the result of my long experience. Before you engage in a dangerous passage you should begin by contemplating the precipice, until you get quite familiar to it, and it has lost its force on the imagination, and you can look at it with a sort of indifference; meantime you should study the way you should go, and mark as you may say your steps: after which the danger is no more thought of, and you only think of following the prescribed way. But if you cannot bear the sight of the precipice and accustom yourself to it, give up the enterprize, for if the path be narrow, it is impossible to look where to place your feet without looking at the precipice at the same time: and this sight if taken unawares dazzles you, and may prove your destruction; this rule of conduct in danger appears to me applicable to moral as well as natural cases.

I employed there, and in other dangerous situations the manner of helping one's-self by the guides, which appears to me the surest, for him who employs them, and the least inconvenient for those who help him; it is to have a light but strong, stick, eight or ten feet long; two guides placed the one before and the other behind, keeping the stick by the

the side of a precipice, the one guide at one end, and the other at the other, and yourself in the middle, with this walking fence you support yourself as occasion requires; this neither incommodes nor tires the guides, and may serve to support themselves in case one of them should slip or fall into a crevice. It is in this attitude that the Chevalier Mechel has represented me in the large coloured plate that he had engraved from our caravan in the middle of the surrounding ices.

At length in two hours and a half, reckoning from the place where we slept, we attained the rock that I call the left shoulder of the second stairs of Mont Blanc. In this place there opened to my view an immense horizon and quite new, for the summit being at our right, nothing concealed from our view the whole of the Alps on the side of Italy, which I had never before seen from such a great height; but I reserve this detail for the following chapter. There I had the satisfaction to see myself certain of attaining the summit, since the remaining ascent was neither very sloping nor dangerous. We here stopped to eat a bit, seated on the borders of this magnificent terrace; but the bread and meat we brought with us were frozen; yet the thermometer had never been lower than three degrees below the freezing point, and these aliments, shut in and covered in a dosser carried on a man's back, ought to have been a little preserved from the cold by the heat of his body. I am persuaded that on the plain in the same degree of cold these aliments would not have been frozen, and very likely that there even a thermometer shut up in a dosser would not be lower than 0; but in this rarified and constantly renewed air, the bodies or substances impregnated with water undergo a very great evaporation, and on that account imbibe the cold more than the dry ball of a thermometer: at nine in the morning, the thermometer was at half a degree above 0, and my hygrometer at fifty-nine. The naked rocks that we met there, and which form two sorts of black and projecting ridges, which are very well seen from the borders of our lake, to the left of the highest summit of Mont Blanc, are of granite, here reduced to scattered fragments; there, in solid rocks divided by pretty near vertical fissures, the direction of which is conformable to that which generally reigns in these mountains, that is to say, from N. E. to S. W., and which in consequence I looked upon as beds.

The felspar which enters into the composition of these rocks is white bordering on grey, or on green, or on a reddish colour; it gives by the blow-pipe a glass, from which may be obtained globules of 0, 6, transparent, without colour but full of bubbles.

This felspar is sometimes pure, covered or even mixed with a grey substance verging on sea green; without brightness, earthy, brittle, stripped with a grey whiteness. This substance appears to be of an earthy steatite; it is difficult to get fragments of it free from felspar; those which I have been able to separate, have melted by the tube into green-glass, translucent and of an extremely fat aspect. They discolour on the fibres of sappare, and dissolve it with effervescence.

The whitish half transparent quartz, which enters into the composition of this granite, appears fattish on breaking; a fragment of a fifteenth of a line in length, by a thirtieth in thickness or of 0,067, on 0,033, fixt at the extremity of a loose thread of sappare, became quite round at the flame of a blow-pipe, in losing a little of its transparency which under this volume appeared perfect, and formed in itself some bubbles in its interior. This quartz is then more fusible than rock crystal, in the proportion of 0,035 to 0,014.

These granites are frequently mixed with hornblende, sometimes blackish, sometimes bordering on green.

There is also seen here chlorite often of a green colour, sometimes in nests, and even in thick masses. It is tender but not crumbly; of a very fine grain, and its small parts
seen

seen through a microscope, appears like small blades very translucent, of a clear green, but they have not the regularity of those of St. Gothard which I have described. This fossil, as well as the hornblende, appears to supply in these granites the place of mica, which only shews itself in very small and scarce blades.

Some of these granites appear rotted, there are observed in them small cavities of an angular, irregular form full of a rusty brownish dust. In breaking these granites there is found in their interior parts small brown pyrites tarnished on the outside, but brilliant and of a very pale yellow inside, and whose fragments are attractable by the loadstone. It is from the mixture of these pyrites that these cavities are formed. My guides found some fragments of these same granites, in which are seen cubical pyrites of three or four lines in thickness, which on breaking appear very brilliant, and of a brassy high coloured yellow; they do not alter on being exposed to the air.

On these rocks are also found some quartz with some veins and nests of delphinite or green schorl of Dauphiné; it is but confusedly crystalized, but to be distinguished by its swelling under the blow-pipe, and the black and refractory scorix into which it changes.

In some places these granites degenerate into irregular schistose rocks, formed of quartz and felspar, without any mixture of mica, and whose beds are separated and covered with clay of a nut-brown ferruginous colour, and melts into a black glass.

In these same granite rocks are inclosed a layer of granitel, almost entirely composed of black and shining lamellar hornblende, and of grey felspar translucent, of the colour of rusty iron at its surface.

To conclude, my guides found in these rocks a palaiopetre or primitive petrosilex of a grey colour bordering on green, translucent at a line thick and even to 1, 2; scaly or shelly on breaking, hard, interiorly mixed with spots of a deep green, which are scarcely visible but by a glass, and which appear to be of steatite; and also with some spots of pyrites, which in dissolving stain of a rusty colour the places near it. This stone in melting turns to a green glass like that of felspar.

After having rested and examined these rocks, I resumed my journey about nine o'clock. As I had measured from Chamounie the heights of the parts of the mountain, I knew that I had not more than about one hundred and fifty toises to go, and that by a declivity of not more than twenty-eight or twenty-nine degrees, on a firm and not slippery snow, free from crevices, and distant from precipices, I therefore hoped to attain the summit in less than three-quarters of an hour; but the rarity of the air prepared me difficulties greater than I could have foreseen. I have observed in the abridged relation, that towards the latter end, I was obliged to take breath every fifteen or sixteen steps; mostly standing supported on my stick, but obliged about every third time to sit down; this necessity of resting was absolutely insurmountable; I endeavoured to overcome it, my legs failed me, I felt a swooning, and I was seized with a dazzling quite independent of the power of the light, as the double crape which covered my face perfectly screened my eyes. As it was with extreme concern, that I thus saw the time pass that I had hoped to dedicate to the making of my experiments on the summit, I made several attempts to shorten my rests; I endeavoured for example not to exert my full strength, and to stop at every four or five steps, but I gained nothing by it; I was obliged at the end of fifteen or sixteen steps to rest as long as if I had done it without intermission, what is remarkable is that I did not feel this great uneasiness till eight or ten seconds after I gave over walking. The only thing which did me good and increased my strength was the air of the north wind; when in ascending I had my face turned to that side, and strongly inhaled the air coming from thence; I could without stopping go twenty-five or twenty-six yards.

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The generality of these sensations felt by the twenty people of which our party was formed, and the details which I have given in my abridged account, cannot leave any doubt respecting the cause of these phenomena. They besides perfectly agree with what is known as to the necessity of the air, and even of an air of a certain degree of density, for the preservation of animals of a warm nature.

Pretty near the middle of this ascent we passed near two small rocks, projecting over the snow. The highest of them had been lately shattered, and its fragments thrown over the fresh snow to the distance of several feet. And as assuredly no body had been there to blow up this rock with powder, or break it with an iron bar, there can be no doubt but it was produced by thunder. Yet I could not discover any glassy bubble. In the abridged account I have said that it proceeded from its constituent parts being extremely refractory; but this is an error, for I have since then seen fragments from the rocks of the Dome of Gouté, which are exactly of the same nature of the one now in question, and which are covered with glassy bubbles. This difference proceeds rather from the greater or less violence of the stroke they have received, or of the less or greater moisture then contained in them. Among these scattered fragments were seen leaves of granite in masses more or less thick, whose great faces were pretty near parallel to each other.

The lower rock presents the form of an horizontal smooth table, its length from north to south six feet six inches, and its breadth four feet from east to west. This table sinks into the snow from above or from the west; but from the lower side or from the east its border rises four feet eight inches six lines above the snow. It is a solid block without any visible separation. I carefully took its dimensions that it might be known hereafter if it should increase or diminish.

These rocks, situated near two thousand four hundred toises above the sea, are interesting on account of their being the highest of our globe examined by naturalists; Messrs. Bouguer and Condamine had been on the Cordilleres to an equal and even some toises greater height than our rocks (two thousand four hundred and seventy toises): they did not understand stones, but as they say they have sent a great many cases full of specimens from the mountains on which their trigonometrical operations had conducted them, I should have been very desirous to have these specimens examined by judges.

The deceased Duke of Rochefoucault, a man as much distinguished for his knowledge as his virtues, and who has been the innocent victim to the troubles of a country for which he had made and would still have made the greatest sacrifices, was willing at my request to examine these rocks with the greatest care and attention, either at the Jardin du Roi or at the Academy of sciences, of which he was a member, but he could neither find them nor gain any intelligence of what was become of them.

The scarcity of specimens of rocks situated so high, and the consequences that might be drawn from their nature in different systems of geology, engage me to give a particular description.

They are granite in mass, where hornblende and steatite take the place of mica, which is there rare, a bright sun and a magnifying glass are necessary to be able to distinguish some white and bright scales; it is even doubtful if these brilliant particles, which it is impossible to take off, are really mica.

Felspar is the prevailing part of these granites; it evidently forms about the three fourths of their mass. Their crystals, pretty near paralleloepid, vary in size; some are seen an inch in length and six lines broad. They are of a dull white, feebly translucent, of little lustre, of the sort I call dry; they yield by the blow pipe a transparent glass, but with bubbles, of which may be formed balls of 6, 8, 1, and of consequence fusible at 70 degrees of Wedgwood. On the file of sappare the bubbles dissipate, and there remains a transparent

transparent milky glass, which subsides without penetrating or dissolving. These crystals of felspar appear here and there of a tarnished green, caused by a slight mixture of steatite which covers them.

The quartz which forms a little less than the fourth of the mass, is grey bordering on violet; uneven in breaking, brilliant in places, not scaly but conchoid. Its fusibility is pretty near the same as that of other granitic quartz.

The hornblende, which forms too small a portion to be of much account, is black bordering on green; it shews some tendency to a scaly and brilliant form, but is ofteneft twinkling and almost earthy. It fuses into a black bright glass, cavernous in its interior, and which on the thread of sappare passes to a bottle brownish green, changes colour afterwards, and dissolves with some effervescence which proves a mixture of magnetical earth.

The earthy steatite likewise forms a very small part of those granites.

All these granites have their natural divisions covered with a green or black crust. This is an earth resembling the chlorite, of a blackish green, shining a little at its exterior surface, but of a clearer and more earthy green in the fractures, brittle, the streak greyish green, turning brown under the blow-pipe, then giving a button = 0, 3, or fusible at the 189th degree of Wedgwood. This button has a metallic aspect, a little unequal, and of a little tarnished or iron melted colour; and not only this button but all the parts that the power of the flame has made brown, are very strongly attractable by the loadstone. A small fragment tried on the file of sappare, infiltrates immediately like ink into the pores, then turns to a tarnished brown, and at length entirely loses its colour, but without appearance of dissolution.

The green cement which covers other parts of this granite in their spontaneous divisions is less obscure, shining enough, transluclid, soft and a little greasy to the touch, brittle and easily streaked into grey, changing by the blow pipe into a transluclid glass, which becomes transparent on the file of sappare, and dissolves it, but without ebullition. This cement appears to be of the nature of steatite; I was not able to procure any pieces large enough to measure its fusibility.

The latter part of the ascent between these little rocks and the summit was, as might be supposed, the most difficult for the respiration; but at length I gained the long wished for point. As during the two hours this painful ascension cost me, I always had under my eyes almost every thing to be seen from the summit, my arrival on it was not attended with that surprise one might imagine. The greatest pleasure I felt was that of seeing my great uneasiness at an end; for the length of this struggle, the recollection of the still poignant sensations the difficulties this victory had cost me, caused me a great deal of irritation. The moment I had got to the highest top of the snow with which this summit is crowned, I trod upon it with a sort of anger rather than felt a sentiment of pleasure. Besides my object was not solely the getting to the top; I wanted there to make observations and experiments which would make this undertaking valuable; and I was very much afraid I could make but a very small part of what I had proposed; for I had already found even on the platform where we slept, that all experiments attended with care, caused fatigue in this rarified air, and that because without thought you hold your breath; and as it is necessary to supply the rarity of the air by the frequency of respiration, this suspension caused a sensible uneasiness, and I have been under the necessity of resting and taking breath after having observed an instrument of any sort, as one should do after having got up a steep hill. Still the sight of the mountains gave me a sensible satisfaction, of which a more particular account will be seen in the following chapter.

But before the contemplation of those distant objects I should say a word of the form of this summit, and finish the description of the rocks nearest to it.

The top of Mont Blanc is not a plain but a sort of lengthened ridge, directed from east to west, pretty near horizontal in its highest part, and lowering at the two extremities in angles of from twenty-eight to thirty degrees. This ridge is so uneven towards its summit, that two persons cannot walk a breast; but it widens and rounds in descending to the eastern side, and takes towards the west the form of a projecting roof, directed to the north. All this summit is entirely covered with snow; not a portion of rock to be seen till you go seventy or eighty toises lower down.

Of the two fronts of the ridge, that to the north is of the most rapid descent, and becomes afterwards still more so, and terminates by joining frightful precipices. To the south on the contrary this slant is gentle, and lower down forms a cradle, rising itself in a contrary way to the south, where it forms above the Allée Blanche a pretty high point, under which is a projecting roof of snow, and under this roof are the rocks which I saw from the heights of Cramont, and took for the summit because they concealed the real summit covered with snow. This projection to the south is the cause that when the summit of Mont Blanc is viewed in profile from the eastern or western side, for example, from St. Bernard or Lyons, there is seen beneath it a sort of hook turned upwards towards the south which conceals it.

Whilst I was employed in making these observations, Jaques Balmat offered to look for some bits of those rocks which I have just mentioned, and of which the turned-up point above the Allée Blanche is formed. I eagerly embraced his proposal. As he had been well rested and felt himself hearty, he set out very eagerly in a run, but he soon found his breath fail, and to recover it was obliged to extend himself at full length on the snow, however he recovered, and with a steady pace resumed his intention and brought me three stones of the following sort.

1. Some granites perfectly like those before described.
2. Some sienites or granitelles, that is to say, rocks composed of layers of black hornblende and white felspar, also laminar, but both in such small quantities that I may as well give these rocks the name of *trapp*, after the definition that I have before given.
3. A primitive petrosilex or *palaiopetre* of a grey pearl hue, translucent at the thickness of two thirds of a line, of a scaly fracture in great and small scales, hard enough to produce sparks of fire, but yet yielding into grey strakes by a strong point of steel. With the blow pipe may be formed globules of 0.45; which indicates the fusibility of the gross matter at 126 or 130 of Wedgwood. This is a grey half transparent glass, with bubbles, which on the file of sappare gains in transparency and subsides, but without penetrating or dissolving, and even without freeing itself entirely from its bubbles.

This *palaiopetre* encloses veins from one to three lines in breadth, which cross each other under different angles, and small nests of leek-green hornblende, confusedly crystallized, or in lamina seldom straight, or in moderate sized fibres.

The highest accessible rocks to the north and under the summit, are those which are strewn with glass bubbles, and of which I have for the first time made mention in the second volume of these travels, but which merit a more exact description.

1. Granitelle (*syenit* of Werner) composed for the most part of white felspar, almost opaque, of a laminar fracture, but not very distinct, and of hornblende of a greenish black, laminar and brilliant in crystals, often by themselves, although often of undetermined forms, of the size of from one to two lines. The fusibility of this felspar is the same as that I have described; and that of this hornblende is of 90 degrees of Wedgwood, answering to a ball of the diameter of 0.6.

2. The same granitelle, but in which hornblende predominates, having but very little felspar. This stone in some places takes a schistose texture.

It is understood that between these two numbers may be found intermediate varieties.

3. Schistus of a greenish grey, tender, composed of *cornéenne*, or according to Werner of schistose hornblende, in some places strait, in others waving, something brilliant on their greatest faces; and of white felspar in very small blades intermixed with the *cornéenne*.

This schistus is often found adhering to Nos. 1 and 2. It is fusible into globules of a clear bottle green glass colour, mixed with white spots of the diameter of 0.7, which indicates the 8.1st degree. It is principally on this schistus that the glassy bubbles are seen; some are of a pretty clear green, and others of a dark bottle green. But in it is also found pure black hornblende, and there the bubbles are black. They are also found though more rarely in the white felspar, and there they are whiter and a little more translucent than the stone from which they have been lifted up, by the caloric detached by the thunder.

Geological Observations.

The first thing that struck me in the view of the whole of the high summits under my eyes, from the top of the highest among them, is the sort of disorder which reigns in their disposal.

When from our plains, or even from the tops of the summits adjacent to Mont Blanc, for example, from Brevent or Cramont, one considers the chain of which Mont Blanc forms a part, it appears that all these colosses are ranged in a line; and from this appearance is called a chain. But when you take a bird's eye view of them, the illusive appearance vanishes entirely. In fact, the mountains, particularly those to the north of Mont Blanc, in Savoy and in Switzerland, appear sufficiently joined to form a sort of chain. But the primitive ones do not shew themselves under that appearance; they seem distributed in great masses or in groupes of a varied and fanciful form detached from each other, or at least appear to be only joined by chance without any regularity.

Thus to the east the Aiguilles of Chamouni, of Courtes, of Tacul, the tops of which mixed with rocks and snow, and separated by glaciers, offer the most magnificent spectacle, form a triangular group almost detached from Mont Blanc, and only united by its base.

In like manner to the south-west, the Mont Zuc, the Rogne, and the other primitive mountains on the North of the top of the Allée Blanche, form also a sort of triangular group, separated from Mont Blanc by the valley of the glacier of Miage; and which is likewise united only to Mont Blanc by the base of the mountains which close this glacier to the north.

And lastly, Mont Blanc itself forms an almost insulated mass, the different parts of which are not in the same line, and do not seem to have any agreement in situation with the two other groups.

In taking a still further view, I was confirmed in the same observation; the primitive mountains of Italy and Switzerland which I was near enough to view, only presented to my sight groups or masses separated without order or regular form. I did not see the appearance of chains except in those whose distance was too great for the sight to take in.

This observation excludes all idea of a regular formation, or at least it must be traced back to an epoch anterior to that which has given them their present form.

Yet notwithstanding this irregularity in the forms and distributions of the great masses, I observed some resemblances, as positive as important in the structure of their parts. All that I could distinctly see, appeared to me to be composed of great vertical leaves,

leaves, and the generality of these in a like direction, pretty nearly from north-east to south-west.

I had above all a great pleasure in observing this structure in the Aiguille du Midi. In Chapter XVIII. of the second volume is seen with what trouble and danger I attempted to make the tour of the base of this Aiguille, to study its form; and with what regret I found my eager curiosity opposed by inaccessible walls of granite which surround its base. Here I saw it under my feet, and described at my ease all its parts.

The second day of the journey, on arriving at the border of the platform on which I passed the night, I saw to the north-east a little below me some broken pinnacles; I asked Pierre Balmat what they were; and when he informed me what I presently discovered myself, that it was the summit of the Aiguille du Midi, I felt a satisfaction difficult to describe.

In continuing to ascend I did not lose sight of it, and I am certain that like the Aiguilles of Blaitiers it is entirely composed of magnificent plates of granite, perpendicular to the horizon and in a direction from north-east to south-west. Three of these plates separated from each other form the summit, and similar ones gradually lessening as they rise, form the south front at the side of the Col du Geant.

I believe then it was an illusion when in observing from bottom to top, it appeared to me to be composed of plates applied round an axis like the leaves of an artichoke; or at least if there are some leaves disposed in this manner, they are only the lowest ones; for in diving as I may say into its interior, I saw all its leaves perfectly parallel to each other.

I have given the details of this summit as an example; all those which I could see distinctly appeared to me pretty near in the same form and direction. If there were some exceptions they were local and of little extent.

This great phenomenon explains itself, as I hope to shew in the theory, by the *refoulement* or eruption which has raised those beds originally horizontal.

But another question which I ardently desired to resolve, is to know if these great plates preserve the same nature from their bases, which I had long known, to their summits, which I had not yet seen so near. I was fully satisfied; I found that the summit of these peaks, as well those which we laid hold of, and of which a description has been given in the foregoing chapter, as those which we found near enough to examine distinctly the substances of which they are formed, are without doubt like their bases, of granite, granitelle, of veined granite, and other stones of the same class.

This circumstance is so important for the theory, that although I might have observed it on mountains less high, and that it appeared most probable for the others, it gave me extreme satisfaction to make it general by a direct observation.

In effect this proves the remarkable property of mountains in vertical beds, which is that their nature is the same from their base to their summit, be the height of their summits what it may. On the contrary, in those whose beds are horizontal, or at least nearly so, the nature of the same vertical part of the mountain is seen to change in proportion to its height. The Buet, for example, rests on a primitive base, whilst its summit is secondary. The Furela del Bosco has its bottom of hard veined granite with the grain large; and in proportion as one gets higher these granites are seen to degenerate into foliated rocks, of a quite different nature. The same observation is verified as we shall see, on Mont Rose and Mont Cervin.

This difference holds good with the difference of the cause which has given to these different sorts of mountains the situation and form they now have.

In those which have vertical trenches, each trench is one and the same bed, in the proper sense of this word, and not the production of any accidental fissures, as some naturalists have pretended.

These beds were originally horizontal, and have only been raised by a revolution of our globe: it is then very natural that each of them may have preserved to its utmost height the same nature it had from its first formation.

On the contrary, the mountains divided into horizontal trenches have only been raised by an accumulation of different beds or layers, composed of crystallizations, or deposits the nature of which varied according to the diversity of matter contained in the waters where they have been formed.

From this theory it follows, that the central rocks of a mass all composed of vertical beds, such as Mont Blanc, ought to have been originally buried in ground of a very great depth. In effect, if it is supposed either by a rising up, as I think, or by the rupture of the crust of the old earth, as M. De Luc believes, that these beds, horizontal in the beginning, are become vertical; more, if it is supposed that the bottom of a valley, that of Chamouni for instance, be the ancient surface of the coat, it will follow from hence that the horizontal distance of the valley of Chamouni to a part which answers to the summit of Mont Blanc, should be pretty near the measure of the thickness of the crust which has been ruffled up or broken, and that in consequence the summit of Mont Blanc, whose actual height is about a league above the surface of our globe, had been originally buried two leagues below the surface.

It should not be then in the subterraneous depths of the mines of Poland or Northumberland, but on the summits of mountains, in vertical beds, that it is necessary to study the nature of the primitive world, at least as far as we could attain.

This idea has given, in my mind, a great interest to the specimens that I have taken from the highest rocks of Mont Blanc, and has engaged me to describe them with great care; I always regard them with new pleasure; I study them, I interrogate them; and methinks that if they could answer my questions, they would unveil to me all the mysteries of the formation and revolutions of our globe.

I was still more confirmed in those ideas when, in considering the rocks nearest to the summit, I recollected that the greatest number of them contained no mica, and that the others contained only scales of it, so scarce and small, that by none that I broke off could I determine their reality. For it is a fact, that the matter torn asunder by the subterraneous fires at the bottom of the earth to a great depth, very rarely contains mica. M. de Dolomieu met only one micaceous rock in the matter vomited by Mount Etna, and I have not seen any in the volcanos of Auvergne or Brisgaw; yet I have seen some in those of Vesuvius, as has M. Nose in the lavas of the Lower Rhine; but it is because the subterraneous fires do not always take at the same depth the substances they throw out: it is sufficient for my observation, that the mica is much scarcer in the bowels of the earth than at the surface.

It would have been natural to think that the highest summits of the Alps should be found near their centre, or at least towards the middle of the breadth of the mass of primitive mountains; yet it is not so. From the summit of Mont Blanc is seen that to the south; on the side of Italy, there are many more high summits than to the north, on the Savoy side; so that this high summit is found near the northern border of the whole of the primitive mountains. So also is the view finer and more interesting on the side of Italy, for the secondary mountains to the north, terminated by the blue and monotonous line of the Jura, present neither variety nor grandeur; and our plains, even

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our lake, seen obliquely through the vapours of the horizon, present only feeble tints and few distinct objects. On the contrary, on the southern side, the horizon concealed by the high summits, varied in their groups and forms, mixed with rocks and snows, and intersected with green valleys, presents a whole equally singular and magnificent. But above all, as I have already said, the aiguilles and the glaciers of all the environs of Mont Blanc, formed in my mind, all at once, the most ravishing and instructive spectacle.

In fine, from this fine observatory I seized at one glance, or at least without changing situation, the whole of the grand phenomenon that I had before seen in detail, that of the raised beds of the mountains at the side of Mont Blanc, and the high summits of its neighbourhood. Such, towards the north, were the mountains of Reposoir, those of Pailly, of Servoz, the Buet; those to the south, the Col-Ferret, Great St. Bernard, and then the chain of Cramont, the summit of which is not seen, as I have already said, from the summit of Mont Blanc, but of which the after-part is seen to border the Allée-Blanche, and then to join itself to the Tarentaise mountains.

Farther on, at the other side of these sharp-pointed chains against Mont Blanc, are seen some whose edges are turned the other way, according to the law I have made known in the first volume, and all these phenomena perfectly agree with the system of *refoulement* or eruption, of which in other places there are so many proofs.

I have thus happily finished these observations. I began with them under the apprehension that the sudden coming of a cloud, so frequent in those high places, might have enveloped me, and deprived me of the power of accomplishing what I had most at heart.

