

the sliding movement demonstrated by Hopkins, we have, as it seems to me, adequate causes for glacier motion. What remains to be done is to connect the first of these causes with demonstrated principles of molecular physics, for which purpose many more experiments of the kind above mentioned will probably require to be undertaken.

Against the crawling theory, as an appreciable element in the problem, the verdict must, I think, be given, first, that it is highly improbable, secondly, that it is unnecessary. But whatever may be its fate, the services Canon Moseley has rendered to science by his contributions to the discussion, and by his investigation of the mechanical properties of ice, are beyond all question. To the recognition of those services I gladly unite the expression of my cordial thanks for the ready courtesy with which Canon Moseley has placed in the hands of an adverse critic all the materials for his essay.

THE LOFOTEN ISLANDS. By T. G. BONNEY, M.A., F.G.S.

A PAPER without a single mountain ascent may seem out of place in the 'Alpine Journal.' That mine has this defect is due not so much to want of will as to want of time and favourable weather. I spent a week in the islands, and four out of the seven days were too cloudy and rainy to allow of distant excursions; the remaining period only sufficed for carrying into effect the purpose which had more especially led to my visit. Still, though without any stories of climbs, this paper may, I hope, be useful to future climbers; for in writing it, I shall do my best to give a clear idea of the topography of the islands, and to mention a few things that I should have been glad to know before my journey. Though the voyage along the western coast of Norway, which has been pleasantly described by Mr. Tyrwhitt in the third volume of this Journal, is annually made by many travellers, all of whom are enthusiastic in their praises of the Lofoten scenery, none, so far as I know, have attempted to describe its features at all minutely; so that in planning a trip to them one is sorely at a loss to know where one ought to stop and what is best worth seeing, or to get any very clear idea as to the general physical geography of the country.* The weird beauty of the scenery seems to have so

* Mr. Campbell's paper (vol. iv. p. 1) is even more brief than is wont on this one topic. I cannot mention this paper without expressing

overpowered the beholders as to disqualify them for minute observation, and a Turnerian mystery is always present in their glowing pictures. Of this failing—if failing it be—I am conscious myself. I never found it more difficult to recall at the day's end the precise features of the country through which I had passed; all seems so strange and so overpowering, that though for the moment one feels as if a scene would be indelibly photographed on one's memory, it melts away like a dissolving view before the succeeding and no less entrancing impression. This difficulty, which the note-book to a certain extent overcomes, is heightened by the absence of good maps, the bewildering intricacy of the reefs and islets through which the steamer threads its way, and the difficulty of obtaining the names of the peaks. This paper, therefore, will, like its predecessors, leave much undone: all that I can hope is to make the task rather easier for any future explorer.

The Lofotens are an elongated cluster of islands, which, separated at one point from the mainland only by a narrow strait, trend gradually westwards until their most southerly outlier is some sixty miles away. Although doubtless forming part of the great chain which fringes the Norway coast southward from the Kvenanger Fjord, they are so far severed from it by the channel of the Vaags and And Fjords as to make one tolerably distinct group. The broadest part of this is at the upper end, where three large islands, Hindö, Andö, and Langö, whose irregular shores are fringed by hundreds of islets ranging in area from a few square yards to a few square leagues, form a dense cluster. Hindö is at once the largest, grandest, and nearest to the mainland, and lies on what we may call the principal axis of the group. South-west of this, severed only by a very narrow channel, the well-known Raftsund, is Ost Vaagö, followed in succession by Vest Vaagö, Flagstadö, and Moskenäsö, all preserving the same general direction, and parted from each other only by narrow straits. With the last the continuous chain of large islands ceases, but along the same line we find in succession two lonely groups, the principal islets in which are respectively denominated Værö and Röst.

The outline of the main islands is irregular beyond description; fjords run so deeply from opposite sides into Hindö and Ost Vaagö as to all but sever them. The whole group is really a partly submerged mountain chain, with the sea flowing up the

my admiration of its accuracy and general fulness. It is a *multum in parvo* of 'things not generally known' (by travellers) about Norway, and for purposes of reference is more valuable than most guide books.

principal valleys, and only the steep upper glens above water. Its crystalline axis corresponds roughly with that of the chain. By far the boldest scenery is in Hindö and Ost Vaagö, where the mountain outlines recall those of Chamouni or Dauphiné. Such parts as I have seen of Langö and the northern district of Hindö remind one more, in outline and colour, of the Cambrian and Cambro-Silurian regions of Wales, as do most parts of the islands south-west of Ost Vaagö. The crystalline rock is usually said to be granite, and possibly in some parts it may deserve that name; but I am convinced that in all the finest mountain scenery the rock, like the so-called Alpine granite, is only a highly metamorphic form of gneiss, which in hand specimens generally cannot be distinguished from granite—or perhaps I should say from syenite; for its constituents are commonly hornblende, feldspar, and quartz (the last not very abundant). I am informed that Andö, which I have not seen (except perhaps in the far distance), is in most parts uninteresting in scenery, but has recently become of considerable importance to Norway by the discovery of coal in a series of sedimentary deposits which occupy a trough in the crystalline rock.

It was a wild squally evening last June, when, after spending some rainy hours coaling in the harbour of Bodö, a village desolate even for Norway, we resumed our course northwards. The coast-line, generally so monotonous south of the Arctic circle, rapidly improves when that limit is passed, and north of Bodö rises more grandly than ever above the glacier-worn islets in the foreground. Fierce blasts from the north were driving along heavy storms of sleet and snow, and the rough sea which we traversed between the rocky breakwaters promised a stormy passage over the Vest Fjord. After a while the weather moderated a little, and some ghostly peaks, lit here and there by fitful gleams of sun, broke out through the rolling clouds in the western horizon. This was our first view of the Lofotens; these peaks (which we could not then identify) probably belonging to Moskenæsö, Værö, and Röst.

I would gladly have remained on deck during our passage towards them, but the cutting wind and rough sea drove me below. My companion, E. Walton, whose enthusiasm for his art renders him proof to most of the minor miseries of life, could not find it in his heart to leave such studies of storm-cloud, sea, and mountain, and even succeeded, by propping himself against the funnel, in making some useful pencil sketches, though from his account next morning it must have been no easy work. Sleep, however, was out of the question,

the restlessness which Alpine travellers have so often felt before a *grande course* was upon me; and as soon as the vessel ceased to roll I went on deck, to find a chilly grey morning with a drizzling rain. We were at Balstadt—the first station visited by the steamer—a little village on one of a group of islets at the southernmost corner of Vest Vaagö. Some bold conical hills rose abruptly from the sea, dull purple rock, with bright green streaks of verdure; but the morning was not favourable to the scenery, and at first I feared that here also, as in the more southern parts of Norway, I was doomed to be disappointed. It is very hard to be enthusiastic in a Scotch mist, on a cold morning at 3 A.M., so I turned into the saloon and had a doze. When, a couple of hours later, I came up again at Henningsvaer, my doubts vanished, and therefrom, notwithstanding a bitter wind and occasional driving storms of sleet and snow, that made winter clothing a necessity, and sketching a work of frozen fingers, the journey was one to be remembered with unceasing pleasure.

Passing Svolvaer, which I leave for the present, we came to the Raftsund. This has already been described by Mr. Tyrwhitt. Though he saw it in calm evening light and we in almost wintry storms, I can heartily endorse all his praise. Among so much fine scenery it is difficult to select, but I think that I was most impressed by the group of *aiguilles* on the western bank, which go by the name of *Hanötinderne*, and have been fairly depicted in Forbes' 'Norway,' page 63. There are a few huts on the same shore at which quarters might be found, but *Digermulen*, a little hamlet at no great distance on the opposite bank, seemed more promising. Several of the short steep glens which come down to the *sund* are barred by moraines close to the water's edge. In some cases, especially on the east (and less steep) side, there is a small alluvial flat behind the moraine; in one it forms a natural breakwater to a little harbour.

On issuing from the Raftsund, we pass the hamlet of *Hanö* on the left, situated either on a promontory of Ost Vaagö or on an islet close to the shore (I am not sure which). Here, as I was informed, very fair quarters might be found at the *landhandler's*, whose name is *Ness*. This would be an excellent station for exploring the Raftsund and the adjoining portions of Ost Vaagö and *Hindö*. The steamer now crosses a *sund* some miles broad to *Hassel*, or *Ulvö*, an island to the south of *Langö*, about ten miles long and four wide. Formerly its destination was *Steilo*, a hamlet on the south-eastern shore; now it makes for *Stokmarknæs*, a station on the eastern side of the northern shore. During this part of the voyage

the grandest parts of Hindö and Ost Vaagö are constantly in view, a crescent of peaks, extending for many miles and rising steeply above a landlocked fjord.

From Stokmarknæs the steamer returns through the Raft-sund, crosses the upper part of the Vest Fjord to Tranö, then returns to Kjöen on the coast of Hindö, from which it recrosses and goes up the Ofoten Fjord to Lidland, and then comes back to Lödingen, another station on Hindö, after which it runs along the coast of that island for several miles, through a *sund*, often very narrow, until after touching at Harstadhavn, well up on the east coast, it finally quits the Lofotens. During this zig-zag journey magnificent views are obtained, not only of the Lofotens, but also of the fine peaks of the mainland, one of which much resembles the Matterhorn as seen from Breuil, though of course on a smaller scale. As the squally day had gradually settled down into a tolerably fine evening, we greatly enjoyed this part; the whole being concluded with a lovely midnight sun at Sandtorv; and we were still more fortunate on our return from Hammerfest, when the view of the Lofoten peaks from the head of the Vest Fjord under an overcast sky about midnight, was one of the grandest effects of purples that I have ever beheld. The eastern coast of Hindö is fine, one peak (Haarbjerget?) seen from near Sandtorv being singularly beautiful in outline; but on the whole the mountains are hardly so grand as when seen from the neighbourhood of Stokmarknæs. Quarters of some kind or other might, I think, be obtained at all the above-named stations; Sandtorv and Harstadhavn would probably be the most convenient for explorers. Geologists will not fail to notice the fine raised beaches south of the former place.

A week after our former visit we were dropped by the steamer at Stokmarknæs. Pouring rain at 5 A.M., after sketching overnight into the small hours, is not enlivening, and we felt rather melancholy at leaving the 'Jupiter,' where we had found so many pleasant companions. The merchant's house, however, afforded us unexpectedly good quarters, and after some necessary delay we were shown into bedrooms spotlessly clean. The rain continued almost incessantly; Walton was quite ill, and I was very tired with the excitement and labour of the previous day, so that our first experience of land life in the Lofotens was not very cheerful. The next morning was less rainy, but heavy mists still hid the grand panorama of peaks, which had induced us to choose Stokmarknæs as our stopping-place. We got a little sketching of the lower islands, and rambled over the immediate neighbourhood. The village, a cluster of wooden

houses, half of them empty, stands on the edge of a low plateau which here intervenes between the sea and the fells, which are of a dull purple colour and very Welsh in outline. This plateau, a glacier-worn mass of crystalline rock, strewn with large boulders, is covered in most parts with bogs, which form in every depression. Walking, therefore, is tedious, devious, and uninteresting. Towards evening the weather improved, the mists broke, and by patiently watching the drifting clouds from our windows, we were able to accomplish our wishes and complete a sketch of the chain of Hindö.

The central part of this consists of three conspicuous masses; that on the left is a rugged ridge, which reminded me much of the Ailefroide in Dauphiné; the middle one is a flat snow-saddle, and on the right of it, separated by a mountain glen, is the third mass, also a bold ridge. A larger, longer valley, probably occupied by the Lanke Fjord, divides this last from another craggy 'grat;' and still farther away is seen a part of a third ridge which must be on the opposite side of the Ingels Fjord. The view is then closed by the hills at the north-eastern corner of Hassel, which protect the harbour on this side. The peak first named above rises over a high grassy headland, to the left of which a lower range is seen above Borö, which is a little island lying quite close to Stokmarknæs, and forming the other portal of its harbour.

From Stokmarknæs to Melbö, a farm on the southern coast of Hassel, is about a four hours' row, the views being magnificent the whole way. On arriving, we were most kindly received by the owner, Fru Coldevin, and her family, who did everything in their power to make us comfortable. Some of them understood a little both of English and of German—a great advantage, as my stock of Norse was even less than the peasant's proverbial hundred words. The information which we received from them determined us to change our plans and go across Ost Vaagö to Svolveaer, instead of returning through the Raftsund over old ground. As washing difficulties had obliged us to leave our luggage at Stokmarknæs, I returned thither next day to fetch it, leaving Walton to sketch. I was rewarded for doing this, as the morning was clear, and much was now plain that on the day before had been only very imperfectly seen through drifting mist.

The general plan of Ost Vaagö, so far as I have been able to make it out, is a central ridge with short, high spurs radiating from it, which break off abruptly on reaching the sea, being terminated, as is not unfrequent in the Alps, by peaks equal or superior in height to those on the main chain. Its coast-line

is much indented: in short, I believe that if that part of the *massif* of Mont Blanc which lies east of the monarch were depressed till the sea washed the Jardin (losing most of its snow in the process), it would have a general resemblance to Ost Vaagö.

It is hard to say whether the view of this island from Melbö or that of Hindö from Stokmarknæs is the finer. Perhaps for general effect the latter bears the palm, but the individual peaks in the former are certainly superior. First, going westward from the Raftsund, comes a jagged range of crags, the broken outline of which (though no one rises pre-eminently above the rest) is singularly fine. Beyond this is a fine snow-covered summit, which for want of a better name we designated Mont Pourri, as its form somewhat reminded us of our Tarentaise friend; and behind this, probably on the main ridge, lay a sharp rocky peak that for similar reasons we named Mont Emilius. High up on the spur connecting these two peaks, and partly enclosed by them, lies a glacier, or perhaps, more correctly speaking, a *névé* of considerable breadth but no great length, smooth in its upper part, but a little crevassed as it approaches some precipices, above which it terminates abruptly. These descend to the dark waters of the Hegraf Fjord, part of the central valley which divides Ost Vaagö into two distinct mountain groups. On the opposite side of this fjord lies a singular bell-shaped mountain, with beautifully smooth precipices. Another inlet, the Mor Fjord, flows under the western side of this, so that it occupies a kind of promontory. Between the Mor Fjord and the next in order, the Grundför Fjord, is a pyramidal mountain with a very precipitous face on the north; to the south-west of which, facing our Mont Emilius, is another bold bluff. The peaks beyond this are of a less interesting character.

Of these mountains, I imagine that the first and fourth could be ascended without much difficulty; and the glacier basin, from which probably the second could be attained, appeared easily accessible from the upper part of the Hegraf Fjord, but the precipices of the 'Bell' looked very unpromising from every point of view that I obtained. Melbö would of course have to be the head-quarters, though its distance by water (more than two hours at the least) would be a great inconvenience, and would on every excursion involve keeping the boatmen waiting for the whole day. Still, as I believe that none of the peaks, though they look almost any height, exceed three thousand feet, the time required for an ascent could not be very long, and happily in these latitudes night in summer is only a name.

There are indeed a few fishers' huts dotted about the shores of Ost Vaagö, but I should be sorry to take up my residence in any of them.

The island of Hassel appears to consist almost wholly of high bare fells, generally separated from the sea by a narrow and often boggy shelf of land, which evidently has been raised above the water at no very distant epoch. These fells are well stocked with *ryper*, and the shooting is owned by an English gentleman, whose party take up their quarters at Fru Coldevin's. As the shooting season had not yet begun, she was able to accommodate us; later in the year there might be no room. It is impossible to speak too highly of the kindness of this family; their house is a model of a large Norwegian farm, comfortably furnished, possessing even a sewing-machine and a piano, slight deficiencies in the latter being justly excused on the plea that the tuner came from Bodö!

As at Stokmarknæs, the very unsettled state of the weather prevented us from any extended rambles by abridging our sketching time; the distance also from the principal mountains was a hindrance to any expeditions among them; we therefore determined, as soon as we had got what we wanted, to make our way to Svolvær, where we should be on the shore of Ost Vaagö, and thus better able to make use of any fine intervals.

We bade adieu to our kind hosts on a misty drizzling morning, and were rowed by a couple of men across the Hassel Fjord. The clouds generally shrouded the peaks, but at times they lifted and produced some very grand effects. It took us rather more than an hour to cross the fjord, from which we had a good view of the fine precipice which the ocean surge has hewn out from the south-western corner of Hassel Island. We then, after threading the usual fringe of islets, rowed up the winding channel of the Hegraf Fjord. This is one of the most beautiful spots that I have ever seen, even, I think, more picturesque than the Raftsund. The peaks were unhappily too often shrouded by the mist, which at times descended in heavy rain; but now and then some fantastic aiguille would break out. Vast boulders and jointed crags of granitoid rock descend to the water's edge; every cranny and shelf is green with moss and herbage, or feathered with tufts of fern. Sometimes the tide ripples against the great walls of inaccessible precipices, at others long slopes of verdure intervene. The birch, with a few mountain ash, grows up these for several hundred feet, but the trees appear rarely to exceed twelve feet or so in height.

From Melbö to the head of the fjord is about a two hours'

row; as it is approached the valley slightly opens, and indications of a raised beach are visible about fifteen feet above the present water-mark, and four moraines may be traced in succession near the landing-place, which is some 200 yards below the point where the water shallows away into a marsh. At some former period this valley must have been a sea strait, just like the Raftsund; even now the pass is simply a bog, rather more than a mile from shore to shore, and some 500 yards or so across, with occasional mounds of moraine or fallen rock; and the highest point on the excellent carriage-road, which has lately been made across it, is hardly fifty feet above the water. Our boatmen obtained a couple of barrows at a neighbouring cottage, and wheeled our luggage across to the head of Oxnæs Fjord. Several cottages stand by the shore, from the nearest of which we hired another boat and two rowers. This fjord is wider, and, so far as the clouds allowed us to see, less grand in scenery than the other; its shores, however, are much more inhabited, cottages being dotted all along the shelf of land which, as usual, intervenes between the mountains and the water. As we descended, the rain, which had vented itself in a steady pour, gradually abated, and drizzled off at last into a tolerably fine afternoon. Towards the mouth of the fjord the mountains again become very grand, and on rounding the headland which separated us from the harbour of Svolvaer we came in for a heavy ground swell, over which our boat rode like a cork, and a grand sight it was to watch the long green rollers speeding landwards and breaking in surf on the rocks.

Svolvaer is a straggling hamlet, built partly on the ends of an irregular promontory from Ost Vaagö, partly on some low islets of rock. On one of them was our stopping-place, at the house of a *landhandler* named Berg. The accommodation was passable; but the situation of the house is very inconvenient, for the islet is a mere patch of rock, and as there is no regular ferry system, it is troublesome to get to and from the mainland. Here also clouds and rain deprived us of the greater part of another day; but on the second morning they broke up, and gave us a thoroughly good time for sketching, and there is no lack of subjects about Svolvaer. On the south-west the view is bounded by the magnificent cliffs and aiguilles of Vaagekallen. This mountain, which occupies the south-west corner of Ost Vaagö, rises very precipitously to a height of between three and four thousand feet above the sea. For grandeur and beauty of outline it will bear comparison with even the finest Alpine peaks, and unless its cliffs are very deceptive, or it is accessible from the north, anyone who tries to climb it will find

no easy work. To it succeeds a line of bold bare fells, patched with snow, terminating in a precipitous and quaintly jagged ridge which overhangs the harbour on the north; this bears collectively the name of Svolveer Fjeld. Many parts of it could doubtless be reached without any difficulty beyond that which bogs might offer. Over the end of this range rise the magnificent crags of Store Molla, a mountain island, no unworthy pendant to Vaagekallen. Farther east, Lille Molla, another precipitous ridge, towers up from the sea; yet farther away is Skraaven; and beyond it is the distant mainland, a line of blue mountains and primrose-tinted snowfields.

Next morning early the 'Hakon Jarl' picked us up, and we steamed once more under the magnificent precipices of Vaagekallen. Our enemies, the clouds, were again gathering on the mountains, but we saw enough to convince us that the general scenery of the coast from Henningsvaer to Balstadt is inferior to that of Ost Vaagö and Hindö; there is, however, near the latter station one fine craggy range, probably that marked Skottind on the map, which occupies a position similar to that of Vaagekallen. The clouds provokingly settled down upon the peaks as we steamed across the Vest Fjord, which was in an unusually placid mood. I was, however, able to make out the general topography of this part of the islands, and for the benefit of future travellers may as well note it down. As you cross from the mainland you have in front part of Ost Vaagö, Vaagekallen being the most conspicuous object; then, in a long line, Vest Vaagö, Moskenæsö, and Flagstadö, to the south-west of which lie three peaks marking the site of Værö, and yet more distant are the lonely hills of Röst.

I have spoken strongly of the wonderful grandeur and beauty of some parts of the Lofotens. At the same time I doubt whether they are suited for mountain excursions. The principal peaks, though diverse enough in form when seen from below, are about the same height; hence the views from their summits would be less varied than from their bases or from lower and more distant points. There are no rich woods on the slopes, as in the Alps, no large snowfields, no great glaciers; * the summits would command little save bare snow-patched rock and the wide plains of the sea. This, though striking in the narrower fjords, would, I think, be a poor exchange for the

* We saw, as we thought, a glacier on one of the highest peaks of Hindö, visible from the upper part of the Vest Fjord, and a snowfield or glacier much farther to the south, of which we did not again obtain a view.

green valleys and dark swells of the pine forests. The peaks, in a word, should be looked at from below, not from above. The country, then, seems to me one for the traveller rather than for the mountaineer; for the artist above all. The naturalist also might find plenty to do; the flora, though less striking than I had expected, would probably reward a more careful search; and I think the dredge would be likely to produce some interesting results: though, owing to the still waters within the reefs and the slight tides, little is thrown up on the shore, I could see that life was abundant enough as far down as the eye could distinguish objects. The bed of the sea, at a depth of perhaps from two to four fathoms, was often studded thick with nullipores and echini. Fish are of course abundant, and probably ryper would be found in all the islands. I am not aware that there is any larger game. To thoroughly explore the Lofotens with comfort would require a yacht; and anyone fortunate enough to own one will, I think, find a summer not ill spent in excursions among their numerous fjords and glens.

ERRATUM.

In the last number of the 'Alpine Journal,' p. 382, line 25,
for 'volcanic art' read 'volcanic ash.'