

express complete volatilization, similar to that observed in the case of our sun.

The question then arises, Are all the mixed fluting stages really included among the objects already considered?

It will be remembered that in my former communication I adduced evidence to the effect that the mixed fluting stage was preceded by others in which the swarms were still more dispersed, and at a lower temperature. The first condition gives us bright hydrogen; the last little continuous spectrum to be absorbed, so that the spectrum is one with more bright lines than indications of absorption; and, in fact, the chief difference between the spectra of these swarms and of those still sparser ones which we call *nebulæ* lies in the fact that there are a few more bright metallic lines or remnants of flutings; those of magnesium, in the one case, being replaced by others of manganese and iron.

If my view be correct—if there are stages preceding those recorded by Dunér in which we get both dark and bright flutings—it is among bodies with spectra very similar to these that they should be found.

The first stage exhibited in the objects observed by Dunér is marked by flutings 7, 3, and 2 (omitting the less refrangible one not yet allocated), representing the flutings Mg, Mn, and Fe visible at the lowest temperatures.

The stars which I look upon as representing a prior stage should have recorded in their spectra the flutings 7 and 3 (without 2), representing Mg and Mn.

(To be continued.)

THREE DAYS ON THE SUMMIT OF MONT BLANC.

ALPINE men are already beginning to think of the work of the coming season. We commend to their attention the following notes relating to the experiences of M. Richard, who spent three days during the past summer on the summit of Mont Blanc, with a view to making a series of continuous meteorological and other observations. There are many Alpine men who might, if they pleased, follow his example without much inconvenience to themselves and with considerable advantage to science. The following is a summary of the record which M. Richard has contributed to *La Nature* :—

The summit of Mont Blanc is a station of the utmost importance to meteorology, since it rises to a great height (4810 metres), and overtops the whole Alpine group. But it had not hitherto been considered possible to remain there for any length of time. De Saussure, whose statue is erected at Chamounix, passed some days in 1788, on the Géant hill, at the height of 3510 metres. In 1844, Martins, Bravais, and Le Pileur, pitched their tent at the Grand-Plateau, 4000 metres high, and here they passed several days, and made numerous and important observations. Hitherto no explorer had remained on the summit of the mountain itself for any length of time; tourists making but a very short stay—usually only a few minutes. From these facts we can see the importance of the scientific expedition carried out in the summer of 1887, with great success, by M. Joseph Vallot, one of the most daring and able members of the Alpine Club. Having made, in 1886, a series of physiological observations, during the ascent of some of the highest peaks of the Alps, he determined to establish on Mont Blanc three temporary meteorological observatories, the first at Chamounix, 1050 metres high, the second on the rocks of the Grands-Mulets, 3050 metres high, and the third on the summit of Mont Blanc. He constructed meteorological sheds, and furnished each of them with registering instruments constructed by MM. Richard Brothers—a barometer, a thermometer, and a hygrometer. The instruments placed at Chamounix and the Grand-

Mulets were inspected every week, but those at the summit could not be reached for fifteen days, on account of bad weather. To superintend the lower stations he procured the assistance of M. Henri Vallot, a distinguished engineer, on whose competence and carefulness he could rely. At Chamounix, M. Joseph Vallot's plan was considered impracticable. He executed it, however, in company with M. F. M. Richard, one of the makers of the registers. No less than twenty-four guides were necessary, on account of

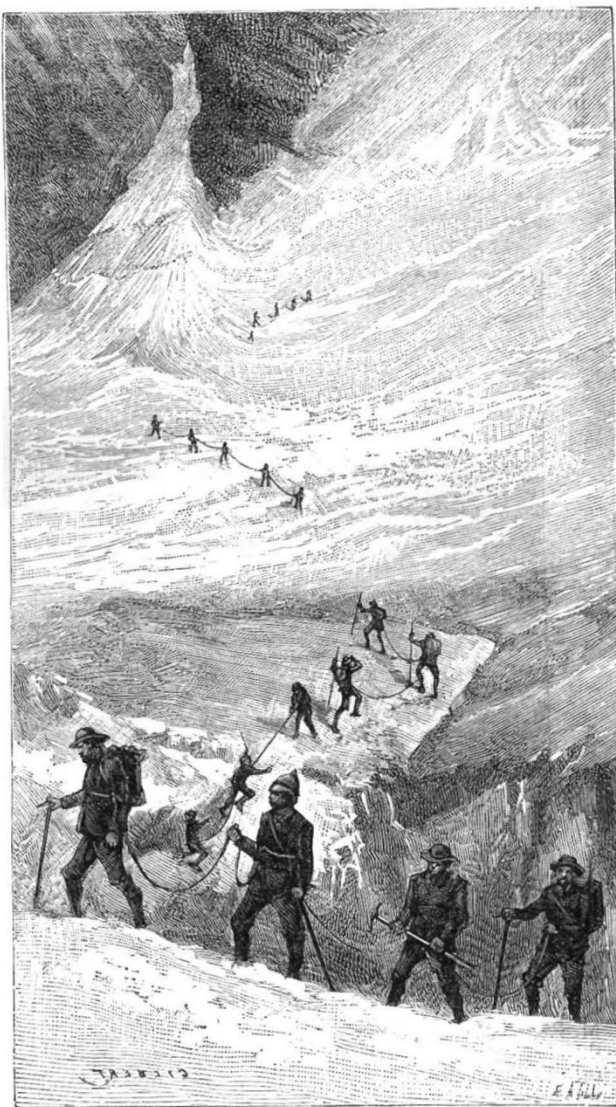


FIG. 1.

the great weight of the baggage (250 kilogrammes). At midday, July 27, 1887, they began the ascent to the Grands-Mulets. On account of the late start, the party, overtaken by night, arrived at the Grands-Mulets at 10 o'clock. Getting to bed at 11 o'clock, the travellers set out again the next morning at 3, after a light meal.

M. Richard then proceeds to tell the story of the journey and of the time spent on the top of Mont Blanc. The ascent from the Grands-Mulets is difficult, but not very dangerous when the snow is good. Crevasses have

to be crossed by ladders, and very steep banks of snow must be struggled through. They arrived at the Grand-Plateau at 7 o'clock, and stopped there for refreshment and repose. At the Tournette rock, one of the bearers was forced to stop from fatigue, and to give his load to one of the more robust, and about 3 o'clock in the afternoon they arrived at the summit. All the guides but two deposited their burdens on the snow, and immediately took their departure. When ascending the last hill, M.M. Vallot and Richard were attacked by mountain-sickness, and for some hours did not recover. M. Richard compares the shape of the mountain-top to a pear cut in two and resting on a plate, the stalk of the fruit well representing the narrow ridge by which one ascends. Between this ridge and the dome, which measures scarcely more than 20 metres in diameter, is a small indentation, in which they fixed their tent. Having driven the stakes into the snow, they secured the tent by a long rope. None of them had at that time the strength or courage to

arrange the baggage. They were compelled to take shelter from the wind, and having refreshed themselves with a little soup, made with melted snow and preserved bouillon, they stretched themselves on the ground, with their heads on the boxes of instruments and the cooking-utensils.

Overcome by his efforts in erecting the tent, M. Richard fell asleep; but during part of the night M. Vallot made gallant efforts to fix his instruments, but he was at length compelled by the snow to return. After some hours of sleep, the cold woke M. Richard, and, fearing the effects of the carbonic acid gas engendered by the breathing of four persons, with the consent of the others he allowed some air to enter, and, lighting a lantern, placed it on the ground, believing it would be extinguished before there would be any danger of suffocation. However, the wind which raged outside kept the tent well ventilated, and froze them to the marrow. About 4 o'clock they all went out of the tent and watched the sun rise—a sight which,



FIG. 2.

M. Richard says, was worth all the pains and fatigues they had endured. The thermometer, when placed on the snow, stood at 19° C. below zero. The sun rose, and it was a most marvellous sight. As the day-star shone out, rosy clouds enveloped the snow-clad tops of the surrounding mountains; little by little, the shadows in which the rocky peaks emerging from the snow were clothed disappeared, leaving the peaks covered with the richest tints. The clouds below sometimes appeared like a rough sea, with its waves dashing against a rocky shore, and sometimes like a thick veil thrown over valleys by the night. Then these clouds dissolved into air under the influence of the sun's rays, seeming to disappear as if by magic, leaving no other trace of their existence than a light mist clinging to the sides of the mountains.

They now began to put their instruments into position. The large actinometer, made by M. Violle, was placed on a small table; and the others—the actinometers of Arago

and M. Violle, the thermometers, and the Fontin barometer—being fixed (Fig. 2), M. Vallot at once commenced his observations. Then they made their tent more comfortable with a floor of double-tarred cloth, and, above this, a mattress, hard, no doubt, but to them a very welcome addition. The tent was 4 metres square, and 1.50 metre high. The health of the party was not very good: M. Richard and one of the guides suffered from severe headaches, with feverish symptoms. The least effort, even ordinary movement, caused such fatigue that they were compelled to lie down during a great part of the day. They had a visitor the first day, in the person of Baron Munch, coming from Courmayeur, in Italy, into Chamounix, who was amazed to find sojourners on the top of Mont Blanc. The second night was not so trying as the first: they had pillows, which were softer than the pots and pans, and they thus had a most refreshing sleep. The tent was very picturesque. M. Vallot had brought

for the party gutta-percha snow-boots, which they put on over fur-lined boots. Thanks to this precaution their feet were kept free from frost-bite. Their leather shoes were of no use; they had been dried in the sun and hung on a string stretched aloft across the tent. On this string at night were also hung the glasses which are always necessary to protect the eyes from ophthalmia in those regions. M. Vallot had also brought coverings for the ears and neck, and linen masks to preserve the skin of the face. Equipped in this manner the aspect of the travellers was curious and even terrifying (Fig. 4). The tent with the various articles hung up, with the boxes of provisions, the blazing stove, and the boiling soup, had a most picturesque appearance (Fig. 3).

The second day was spent in making observations. The provisions were almost neglected; they never had an appetite during their stay. The different preserved meats, though very tempting, did not entice their numbed stomachs, and twice each day they took

nothing but a little preserved bouillon, in which a small piece of cheese had been broken. Their drink was warm coffee; on the first day tea had made them ill, and they never could take it again during their three days' sojourn: the guides, however, drank a little of it.

On July 30, the observations began at sunrise. Towards 10 o'clock the little colony received a second visitor, an Englishman, who, on his departure, wished to take away with him some letters dated from the top of Mont Blanc. A yellow-beaked crow settled herself time after time near the observers. The guides declared that her presence was a sign of good weather; but it did not prove so. Towards 2 o'clock enormous clouds began to form on the side of Mont Pelvoux; then their colour changed; the gloom turned to darkness; and while the weather remained fine over Chamounix, the valley of Aosta and the Savoy Alps were soon hidden by a terrible thunderstorm. A furious wind drove the observers into the tent. It was 4 o'clock, and they had almost made up their



FIG. 4.



FIG. 3.

minds to descend, but as there was not time to put all their instruments in safety, they decided to remain and weather the storm. They held the ropes of the tent, and piled snow all around it to keep it steady. Towards 9 o'clock, M. Vallot having gone out, found himself surrounded by electrical clouds, which played around his clothes and his head, but he escaped any actual shock. During the hours that they thus anxiously passed in the tent they were compelled to close the last opening to prevent the snow from getting in. But the time was not spent without profit. M. Vallot made some physiological diagrams. The beatings of the pulse, of the carotid, &c., were to have so much the more interest because they would differ from those which would be obtained when but a short stay is made, the travellers now having been two days at the summit. These observations made them forget their troubles. At last, about 2 o'clock in the morning, the tempest passed away, and, although the

wind continued to blow violently, they got a refreshing sleep.

They decided on the following day, July 31, to continue their observations till 9 o'clock, then to bring everything into the tent, and to redescend to Chamounix. The guide Payot was suffering from a violent head-ache, with a high fever, and was compelled to keep his bed, but about 11 o'clock he bravely offered to descend at once, and even desired to carry his knapsack. M. Vallot had not given orders for help to be sent to take their baggage away; they therefore left the greater portion behind them in the tent; still there were many things that could not be left. These were divided into bundles, and, with a last glance at the magnificent view, they began the descent. The guide Michel had warned them that this would be very difficult, since last night's storm would have obliterated all traces of the usual paths. And so it was found to be. After the Grand-Plateau, the

journey was most dangerous. At this height it had rained, and the snow had become so soft that they often sank to the waist in it. In the rapid slopes, where they were forced to descend zigzag, the snow slipped from under their feet, but, after much care and fatigue, they arrived at the Grands-Mulets. A good meal, a denser air, and a milder temperature, soon restored them to their usual health. Towards 7 o'clock they came to Chamounix, where they received an enthusiastic welcome.

It had thus been proved that it was quite possible to live and make observations at those high altitudes. The greatest danger is in the violent storms that burst almost without notice, and which may become terrible tempests against which any temporary observatory would not stand. M. Richard says that the results of the observations will be published when the papers have been inspected and classified.

THE PHOTOGRAPHIC CHART OF THE HEAVENS.

WE reprint from the *Observatory* for May the following article by the editors:—

The "Bureau du Comité international permanent pour l'exécution photographique de la Carte du Ciel" has published, amongst other more technical papers relating to this subject, one by Dr. Gill, of a very remarkable character, to which we wish to draw attention. Most of those who attended the Conference understood that the work in contemplation was to make a photographic chart of the heavens, to take pictures of the stars by photography, showing, with the greatest care, the appearance of the heavens as they are at the present time, in order that at a future time these pictures might be used, by comparison with other pictures taken under similar conditions or directly with the sky, to determine the many questions that could be dealt with in this way—to enable, in fact, the astronomer of the future to have the sky of his past and his present to deal with. That this was so will be seen from a consideration of the three following resolutions which were agreed to unanimously by the Conference:—

"1. The progress made in astronomical photography demands that the astronomers of the present day should unite in undertaking a description of the heavens by photographic means.

"2. This work should be carried out at selected stations, and with instruments which should be identical in their essential parts.

"3. The principal objects are (a) to prepare a general photographic chart of the heavens for the present epoch, and to obtain data which will enable us to determine with the greatest possible accuracy the positions and the brightness of all the stars down to a given magnitude (the magnitude being understood in a photographic sense to be defined); (β) to provide for the best means of utilizing both at the present day and in the future the results of the data obtained by photographic means."

These were the fundamental resolutions; others, recommended by the two sections into which the Conference divided, were adopted as explanatory of the first. Amongst these was one in which it was decided to take "a second series of plates down to the 11th magnitude, in order to insure greater precision in the micrometric measurement of the reference-stars, and render possible the construction of a catalogue." We have stated these fundamental resolutions at length as bearing on the question of a catalogue of stars, for the paper by Dr. Gill contains the astounding proposition of cataloguing no less than 2,000,000 stars; that is to say, Dr. Gill gravely and seriously proposes the establishment of a Central Bureau, consisting of chief, assistants, secretaries, and a staff of measurers and computers, to take the photographs and *measure* them, and make a catalogue,

the work to go on for twenty-five years at a cost of 250,000 francs, or £10,000, per annum, or for fifty years at 150,000 francs.

It is quite true that this is only a proposition that Dr. Gill makes; but if such a proposition is possible in face of these direct resolutions of the Conference, it is quite time that everyone interested in the success of the work the Conference met to consider (that is, the photographic chart of the heavens) should bestir himself and see that the proposed work is not endangered by such astounding proposals.

To tack on to a work such as that sanctioned by the Conference—a work eminently practical, that has the support of all astronomers, and that has already been taken up by many of the Governments who were expected to join—a gigantic work such as Dr. Gill proposes, a work beside which that proposed by the Conference sinks into insignificance, would neither be fair to the Conference nor just to those Governments who have joined in the undertaking. The feature of the international scheme that makes it possible to obtain the assent of Government is that the work is proved to be practicable by experiment, and that it can be done at a moderate cost in something like five years, while the results are good for as long as the plates will last. To increase this work by extending it to, at the lowest computation of time, twenty-five and possibly fifty years, and to add enormously to the cost, would be to jeopardize the whole scheme.

Dr. Gill states that the actual state of astronomical science demands a catalogue of stars to the 11th magnitude. He thus raises the question on its merits; and we would here state that it is more than possible that not only is there no need of such a catalogue, but that the use of such catalogues as he proposes has for ever ceased. The minds of some astronomers move in grooves, and it will, no doubt, never be conceded by them that catalogues can be superseded; they will die as they have lived, in the strong belief that the only way to use the stars is to catalogue them.

Till recently the knowledge we had of the stars was only to be gained from a written description of their brightness and position with regard to each other; hence the catalogue was an absolute necessity if we needed to know the number or brightness of certain stars in any part of the sky at any previous time; and we could only find this out if we had a catalogue of that time. Our catalogues of stars are all we have to show what has been observed up to the present time; but when we have a photographic chart of the heavens, we have for our record not a catalogue, but a representation. That catalogues of stars such as are used for fundamental places will be always used goes without saying; the photographic plates themselves, and the four or five stars on each required as the fiducial points and for identification, will of course be catalogued; but, beyond this, to catalogue the stars on each plate, to measure them for the purpose only of getting their places written down, would be the most utter waste of time, labour, and money that it could enter the mind of man to conceive.

The proposition brought forward by Dr. Gill should be settled decisively so far as the proposition concerns the work proposed by the Conference. There can be no question that such a thing was never intended; had such a thing been thought of, we should have had a "Conference for discussing the best way of making a Catalogue of Stars by photography."

As this was not done, it can be done now; and if there is the great need of a catalogue of stars to the 11th magnitude felt by so many astronomers, as stated by Dr. Gill, it is a thing of so much greater importance as far as cost and time are concerned, that it should be considered and dealt with entirely apart from the other work. A new Congress might discuss it; the one which met in 1887 is not in any way committed to such a scheme.