brought more strongly than ever before us how absolutely unessential to enjoyment in winter high mountaineering is. I shall not for a moment be suspected of undervaluing the benefits both to mind and body of a summer tour; but, personally, I think that a greater amount of mental pleasure and a fuller store of bodily health are to be obtained in winter, with fewer drawbacks, and very much less labour and weariness. That many persons, unless they have tried the experiment, will agree in this opinion, I do not expect. I trust, however, that sceptics will not be content with simple derision of my views, nor believers with passive assent to them; but that both parties will take the earliest opportunity of going and judging for themselves.

The Papaver Alpinum. By Mr. Charles Packe. Read before the Alpine Club by the Secretary.

THE plants which have been selected by the great botanists and first mountain explorers to be associated with their own names are not probably the same as would be chosen by a member of the Alpine Club. The *Linnæa borealis*, *Wulfenia carinthiaca*, *Ramondia pyrenaica*, and *Saussurea alpina*, are all plants more or less rare, of exquisite beauty, and of a very distinct generic character; but, with the exception of the last, they are none of them strictly alpine. I may remark by the way, that Ramond has been thus far more fortunate than De Saussure in his selection; that his plant is exclusively confined to the Pyrenees, while that of the Swiss naturalist is not restricted to the Alps, but is found also in the Central Pyrenees, as well as in Norway, Britain, and high arctic latitudes. Now I feel quite sure that when those ardent mountaineers, M.M. Tuckett and Stephen, shall be driven by infirmity of years and declining powers to have recourse to botanical science, they will unlock their herbarium, and set before our admiring eyes some unknown plant of an order at least as exclusively alpine as the Androsaces, with which they intend to transmit to posterity their names, hitherto only associated with the barren peaks and spitz.

I am not going here to speculate what manner of plant this will be. No two observers, even in the same range of mountains, would probably name the same plant as that which they had met at the greatest elevation.

It would be difficult to find what constitutes an alpine plant. Some—for example, the *Linaria alpina* and *Hutchinsia alpina*

—while occurring on our European mountains at an elevation of 3,000 mètres and upwards, among the very highest of phænogamous plants, descend not unfrequently to comparatively low levels; while others, as the *Saxifraga grænlandica, Artemisia mutellina, Eritrichium nanum,* and *Campanula cenisia,* are only found in company with Lichens and Carices at the last borders of vegetation. Others again, though excessively alpine, and found only on the highest mountain-ranges of temperate regions, do not extend into the arctic circle. The Soldanella, so constant to the brink of the melting snows in the European mountains, and the Swertia, found in the highlands of the Alps, Pyrenees, and also Himalaya, do not extend into the polar regions. Indeed, the entire families of the Gentians and the Primulas, though so abundant, and so evidently alpine in their habits, are all but unrepresented in the extreme north. Of the 760 phænogamous plants that have been found to exist north of the arctic circle, only about 50 are confined to the arctic latitudes; the remainder, as far as their southern dispersion is concerned, may be referred to two classes—one consisting of plants widely diffused over the plains of Northern Europe, Asia, and America, of which there are upwards of 500; and of these the common dandelion (*Taraxacum officinale*), and the ladies' smock (*Cardamine pratensis*), may be taken as types; the other comprises plants more or less confined to the mountain-chains of these countries, and still more southern regions, of which there are only about 200.

Among the last, if there is one more than another calculated to arrest the attention, it is the alpine poppy. Even the non-botanical mountaineer at once recognises in the four broad petals of the flower, the pendulous bud, and the upright capsel, the family of the field-poppies—*Papaver rhœas* and *P. argemone*—and marvels how it has become thus far removed from the cultivation with which he has seen its congeners associated. I think we may assume that all the forms of the alpine poppy have the nearest affinity with the *Papaver argemone* of the plains, as shown in the elongated hairy capsel, with comparatively few stigmatic rays; though in the filaments of the stamens, which are tapering and not dilated, it is more assimilated to the *P. rhœas.*

Throughout the whole extent of the boreal regions circumjacent to the North Pole, comprised between the arctic circle and the 78th degree of latitude—that is, in Lapland, Spitzbergen, East and West Siberia; in arctic North America, where it is found as far north as Melville Island, in latitude 77°; and again in Greenland, and on the northern coast of

Iceland, we find growing a small dwarf poppy, of a very hairy habit, with bright sulphur-coloured flowers—the *Papaver nudicaule.*

On the Alps of Europe, the Dovre-feld of Scandinavia, the Carpathians, the Pyrenees, and Sierra Nevada; on the high mountain-chains of Western and Eastern Asia, the Caucasus, Altaï, and Himalaya, as well as on the Rocky Mountains and ranges of North America, under some form or variety, a dwarf poppy recurs very similar in general habit. This poppy is always found growing at a considerable elevation in the Alps and Pyrenees, at from 2,400 to 2,900 mètres, a zone corresponding pretty nearly in mean temperature to that of the lowlands within the arctic circle up to latitude 75°. All these varieties of alpine poppies have been classed under the general name 'Papaver alpinum;' and the question naturally arises whether all these varieties are to be ranked each as a distinct species, or whether they may all be considered as mere modified descendants from one common ancestor, the 'Papaver nudicaule' of the arctic regions.

My attention has been drawn to a paper by Professor Kerner, in Vol. iv. of the 'Jahrbuch' of the Austrian Alpine Club (pp. 296–308), in which he does me the honour to allude to a note which I wrote on this subject in the 'Alpine Journal' for 1865. Since then I have had many opportunities of studying the alpine poppy of Central Europe, not only in various parts of the Pyrenees, but also on the Sierra Nevada, and on the Alps; and as, in a great measure, though not entirely, I agree with Professor Kerner's distribution of the different species, perhaps I may be allowed first to state Kerner's arrangement, and then my own personal observations, and the conclusions that appears to me most in accordance with them.

After balancing the respective merits of what he calls the lumping and the splitting schools of botanists, Professor Kerner at last settles down to three distinct species of alpine poppy in the mountains of Central Europe. He distinguishes them as follows:—

1. The fine-leaved poppy (*Feinblättriger Mohn*), *Papaver alpinum* of Linnæus, *Papaver Burseri* of Crantz.—The fine-leaved poppy he describes as rather a stately plant, with the leaves bi-tripinnate, divided into narrow lineal segments, resembling those of the fumitory and scandix. The flower is large, with the petals overlapping when in full bloom, and somewhat broader than long, their length being 20 to 30 millimètres. The filaments of the stamens are longer than the capsel, and the stigmatic rays decidedly project. The flower-

ing peduncle attains to a height of 10 to 25 centimètres, but is rather decumbent (*geschweift*) at the base. The leaves are furnished with a few scattered hairs, and those of the flower-stalk are upright and applied.

This poppy, according to Kerner, is wanting in the Pyrenees and Apennines, and is restricted to the Alps and Eastern Carpathians. Its most western situation is Mont Trelod, in Savoy; and the most eastern the Kuhorn and the Butsets, in Transylvania. Towards the borders of this widespread district the plant is rare, and in Savoy, Switzerland, and Transylvania only found in patches here and there. On the contrary, in the centre of this region—that is, in the Eastern limestone Alps—it appears in great quantities in the ravines and on the shady slopes; and in Styria and Upper Austria descends into the valleys, carried down along the torrent-beds. In the north-western portion of this region—that is, Savoy, Switzerland, Styria, and Austria—it is only found with white flowers; in the south-eastern portion—that is, Carinthia, Carniola, and Transylvania—principally with a yellow flower. It grows both on the schist and limestone soil: on the first more seldom, and always yellow; but on the limestone principally, if not exclusively, white.

2. The broad-leaved poppy (*Breitlappiger Mohn*), *Papaver pyrenaicum* of Linnæus, *P. aurantiacum* (Loisel).—Of this the leaves are simply pinnate, with the indentations not deeply penetrating, but the segments broad and lanceolate, or terminating in 2 or 3 broad lance-like lobes. Like the last, the petals are somewhat broader than long, and overlapping. The *P. pyrenaicum* (*Breitlappiger Mohn*) is of a more depressed growth than the *P. alpinum* (*Feinblättriger Mohn*). Its leaves are less finely divided, and much more hairy, and the peduncle is shorter, more upright (*weniger geschweift*), and much more abundantly clothed with hairs, which are erect and not applied.

This poppy is wanting in the Carpathians, but widely extended over the high mountains of the Pyrenees, Alps, and Apennines. Its most western stations are the Sierra Nevada, Pic du Midi, and Mont Perdu. The most eastern stations are in the Northern Alps, the Solstein chain, near the source of the Iser; in the Central Alps, the Katschthal and the Malthathal, in Carinthia; in the Southern Alps, Raibel and the Wochein Alps; and in the Apennines, Monte Cornu, Monte Costone, Monte Amaro, and Monte Velino. In the Northern limestone Alps the flowers are only found white; in the Central Alps and Pyrenees, both on the limestone and mica schist, the flowers are only yellow; in the Southern Alps and

Apennines, both on the limestone and schist, the flowers are generally yellow, but sometimes also white.

3. The small-flowered poppy (*Kleinblutiger Mohn*), *Papaver suaveolens* of Lapegrouse, *P. pyrenaicum* (Willd).—Flowers small; the petals at the time of full bloom not overlapping, but somewhat narrower than long, their length being 10 to 16 millimetrès. Stamens not so long as the capsel; the stigmatic rays not projecting beyond the capsel. In fine, says M. Kerner, the *Papaver suaveolens* (*Kleinblutiger Mohn*) is a small plant, whose leaves resemble in their cutting those of the *P. pyrenaicum* (*Breitlappiger Mohn*), but are generally furnished with much coarser hairs; and the peduncle is shorter by half, roughly hairy, with erect bristles.

This plant is wanting in the Carpathians, Alps, and Apennines, and is confined to the high parts of the Pyrenees and the Sierra Nevada. In the Pyrenees it is found with golden as well as with brick-red flowers (*ziegelrothen*); on the Sierra Nevada only with brick-red flowers.

In considering whether the different alpine poppies of Central Europe are to be referred to one of these three forms (I purposely avoid the debateable word, species), into which they have been distributed by Professor Kerner, I will describe the varieties which I have myself met with, and specimens of which I have carefully examined. De Candolle and others have shown that plants which have very wide ranges generally present varieties; and this might have been expected, as they become exposed to diverse physical conditions, and as they come into competition (a still more important circumstance) with different sets of organic beings. If we are to accept as a distinct race any collection of individuals which continue to produce their like so long as they are under the same physical conditions, I think we may admit as many as six, or perhaps seven, distinct forms of alpine poppy on the mountains of Europe. In my herbarium I have at least that number, that I could at once pick out, however they were intermingled, and assign to each its locality. This question, however, cannot be fully decided till experiments have been made in raising plants from seed under cultivation, when the various races may be produced under the same external conditions of soil and climate. I have more than once tried to do so, but it is no easy matter; and I have hitherto not succeeded. I have also trusted to nature, and sown seed upon the mountains in situations apparently the most favourable, but could find no trace of them the ensuing season. I may here remark that, unlike the poppy of the plains, which is an annual, the *Papaver alpi-*

num in all its varieties, as well as the *P. nudicaule*, is perennial, or at least biennial—an essential condition of their existence in so rigorous a climate; for, with an annual plant, if one single season it fails to ripen its seed, it must necessarily disappear from that locality.

I do not think that the distinction founded by Kerner, on the cutting of the leaves into fine or broad lobes, is sufficiently constant, though undoubtedly, as a rule, his No. 1 *P. alpinum* has the leaves most finely cut. He is quite right in excluding this form from the Pyrenees and Sierra Nevada. I have only seen it growing below the peak of the Esel, on the north side of Mont Pilâtre, at about 2,400 mètres, where I found it in full flower on the limestone débris in the middle of August.

In the Pyrenees form, No. 2 *P. aurantiacum* (Loisel), with bright yellow flowers, is found on the Pic du Midi, on the slaty schist, on the north side, at a height of 2,870 mètres. It is also found on the Alps of Dauphiné, and is very abundant on Mont Ventoux. The buds of this last are much more round than those of the alpine poppy, which are rather oblong; and the stigmatic rays and parietal divisions of the capsel in this and the following varieties are 5 to 6 in number, while in the alpine poppy they are only 4 to 5. In the seeds of the different kinds, even with the microscope, I have been unable to assign any difference. Some are slightly more rugose than others, but that seems to depend upon the age at which they are gathered. On the Pic de Salette, above the Port de Cambiel, in the Pyrenees, and also above the Port Vieux d'Estaubé, in both localities, only on the north side of the mountain, there is another variety of this poppy, with the flowers white and rather less hairy. It grows on the schist débris, at an elevation of about 2,700 mètres. The plants much resemble stunted specimens of the alpine poppy; but, as this is excluded from the Pyrenees, perhaps Kerner would refer them to his second variety, though their flowers are not much like the bright yellow blossoms of the plant from the Pic du Midi. Under some of the sheltered rocks at the Port d'Estaubé I have found a dwarf variety almost entirely glabrous; the flowers white; and the leaves very glaucous, cut into small, almost circular, entire segments. I have not been able to meet with a plant resembling this in any other spot, or in any other collection.

But perhaps the most characteristic of the Pyrenean forms is Kerner's No. 3, the *Papaver suaveolens* of Lapeyrouse. Of this poppy there appear to be two quite distinct varieties, though in neither of them can I perceive any odour to justify the epithet 'suaveolens.'

a. A plant with a small flower, but of which the petals are at least as broad as long, so as to overlap when in full bloom. Their colour when fresh is of a vivid crimson, but when dried this changes to a deep brick-red. The leaves are for the most part simply pinnate, with the terminal segment more or less incised. The stamens are shorter than the capsel. The whole plant is very hirsute, and the peduncles and little globulose buds are completely covered with erect and not adpressed hairs. These hairs, when examined by the microscope, appear rough, as though formed of a series of ducts of unequal length, placed side by side. The plants growing in the most exposed situations and at the greatest elevation are almost always the most hairy. The use of these hairs may be twofold—partly to protect the plant against a vigorous climate, but partly also to regulate evaporation, absorb moisture, and enable the plant to resist extended periods of drought. Be this as it may, the plants growing under the shelter of a rock, or in a moist position, are always the least hairy.

β. A plant with a flower of about the same size, but with the petals decidedly longer than broad, so as to give to the open blossom the shape of a Maltese cross. The colour is of a lighter red, more approaching scarlet, on the schist rocks; on the limestone it is generally of a vivid orange. The leaves are rather more finely cut. The buds are not quite so globular, but rather oblong. The plant is hairy, but the hairs on the peduncle are applied and not erect.

Var. *a.* was first discovered by Lapeyrouse, who describes it as growing on the rocks of the Port de Plan, where I have since gathered it. On all the high mountains in Spain, immediately south of the Maladetta, this poppy is almost sure to be found on the red ferruginous schist, at a height of 2,700 to 2,900 mètres. On the summits above Castanéza and Malibierne it is quite abundant. In all this region the soil is strongly charged with iron, and as, where this is the case, I have never been able to find a poppy of any other colour, may we not suppose that the iron had something to do with the colouring of the plant? The alpine poppy is absent from all the mountains of Central Spain which are not sufficiently high to favour its growth; but this same form, *P. suaveolens*, reappears on the Sierra Nevada, but only in one locality, on the Pic de Mulhahaçen, quite close to the summit, on its north-west slope, facing the Veleta, at a height of 3,500 mètres.

Var. *β.* is pretty abundant on the high summits of the Eastern Pyrenees, where I have gathered it on the Pics Carlitte and Cambredase at the end of July. It is found a

little lower than the poppy of the Central Pyrenees, at an elevation of from 2,500 to 2,700 mètres; and in the bed of the stream, at the head of the Valley d'Eyne, it grows lower still; but there it seems rather to assimilate itself, except in its colour, which is red, to the *P. alpinum*.

In company with this red-flowered poppy we invariably find two other plants growing on the same schist, though often descending rather lower—the *Viola cenisia* and *Galium cometerrhizon*. On the Sierra Nevada we again find plants of the same orders—*Viola nevadensis* and *Galium pyrenaicum* —associated with the same poppy. It is worth noting that neither of these orders are strictly arctic, and to this I shall presently allude.

It is quite evident that the existence of the alpine poppy, or indeed of all other alpine plants, on isolated mountain-ranges, has to be accounted for in one of three ways. Either each variety of the plant has been specially created in the situation it now actually inhabits—in which case there must be a special centre of creation for each separate locality; or it is merely a modified form of the allied species in the surrounding plains, which have been forced up the mountain-side in the struggle for existence with other species; or it has been left, as it were, in a citadel by a receding arctic flora. Under both these last-mentioned conditions the plant would have to adapt itself to a new climate, soil, and nourishment, as well as to contend with new and hostile species; and all this would in time produce considerable change and modification.

The theory of separate centres of creation for each isolated plant or group of plants on a mountain, may, I think, at once be dismissed as untenable, and we shall then have only to decide between the two last hypotheses—are they the outcasts of an arctic flora, or have they been dispersed upwards from their congeners on the plains?

Without adopting extreme views, it may be considered as proved that there was a period, at the close of the Pliocene, when the mean climate of the countries adjacent to the 45th parallel was much colder than at present; when glaciers of giant dimensions poured down the mountains, eroding and polishing the rocks, and carrying boulders and drift, and with them probably seeds, and even living plants, to considerable distances from their native habitats; when an arctic flora and fauna occupied Europe, Central Asia, and the northern half of America; and when at length returning warmth drove the ice backward, here and there little patches of northern vegetation, detached from their families, took refuge among the mountains,

gradually ascending their sides; where they still remain on the Alps, Apennines, and Pyrenees, on the Alleghanies and Himalaya, like beleaguered towns cut off from their friends, and hemmed in by a host of more favoured races.

But this is not all that we have to take into account. There is evidence sufficiently strong, if not quite so conclusive as that for the Glacial epoch, that at an earlier period, at the close of the Miocene, a period subsequent to the upheaval of the mountain-ranges, the temperature of Central Europe was considerably warmer than at the present day.* Professor Heer's researches in the arctic Miocene flora pretty clearly establish that, at that period, the beech, chestnut and oak grew as far north as the 70th degree of north latitude; that the magnolia, walnut, and even two species of vine, grew in Greenland, and a large-leaved lime and an alder in Spitzbergen.

When the climate of the arctic regions was sufficiently raised to admit of such a vegetation, it requires no great stretch of imagination to conceive what must have been the state of things in the temperate zone, where there must have been a corresponding advance of temperature, though not perhaps to the same extent.

At that period a luxuriant, perhaps tropical, vegetation must have overspread the lowlands, and many of the plants now confined to the plains had been able to ascend the mountain summits, then strangers to snow and ice.

Let us follow the changes as this period passed, and the glacial climate slowly came on; in its turn also gradually to pass away, and be succeeded by the climate of the present day. I must be allowed to quote from the effective description of Mr. Darwin:—'As the cold came on, and as each more southern zone became fitted for arctic beings, and ill-fitted for their former inhabitants, the latter would be supplanted, and arctic productions would in a great measure take their place. Many of the original inhabitants of the temperate regions would travel southwards, unless stopped by barriers, in which case they would perish; but a large proportion, especially of the hardier forms, would long linger in their native haunts, and maintain a fierce struggle with the arctic invaders, over which they could not but exercise a modifying influence. The

* In a paper recently addressed to the French Academy of Sciences, M. Alphonse Milne Edwards describes certain researches of his in the tertiary formations of the Bourbonnais. From the fossil remains of parrots, and other tropical birds of the species, he concludes that there must at one time have been an African climate in that part of France.

mountains would become covered with snow and ice, and the former alpine inhabitants would descend to the plains. By the time that the cold had reached its maximum, we should have a uniform arctic fauna and flora covering the central parts of Europe as far south as the Alps and Pyrenees, and even striking into Spain.'

The now temperate regions of the United States would likewise be covered by arctic plants and animals, and these would be nearly the same with those of Europe; for the present circumpolar inhabitants, which we suppose to have everywhere travelled southward, are remarkably uniform round the world, though at the same time, as remarked by De Candolle, they are eminently liable to variation.

As the cold passed away, the arctic forms in a body would retreat northward, closely followed up in their retreat by the productions of the more temperate regions; but as the snow melted from the base of the mountains, the arctic forms would seize on the thawed ground, gradually ascending higher and higher as their brethren pursued their northern journey. Hence, when the warmth had fully returned, the same arctic species, which had lately lived in a body together on the lowlands of the Old and New Worlds, would be left isolated on mountain summits (having been exterminated on all lesser heights) and in the arctic regions of both hemispheres.

'The arctic forms during their long southern migration and re-migration northward will have been exposed to nearly the same climate, and having kept together in a body, will have had their mutual relations little disturbed, and will not have been liable to much modification. But with their alpine brethren left isolated from the moment of returning warmth, first at the bases, and ultimately on the summits, of the mountains, the case will have been somewhat different; for it is not likely that all the same arctic species will have been left on mountain-ranges distant from each other, and have survived there ever since; they will also, in all probability, have become mingled with ancient alpine species, which must have existed on the mountains before the commencement of the Glacial epoch, and which, during its coldest period, will have been driven temporarily down to the plains; they will also have been exposed to somewhat different climatal influences. Their mutual relations will thus have been in some degree disturbed; consequently they will have been liable to modification.'

In this supposition of an arctic invasion, modified on its first appearance by the temperate forms of vegetation which

receded before it, and yet further modified when its scanty garrisons were besieged on the mountains by those same forms on their return, I think we have the true cause to explain alpine vegetation.

On the distant ranges many of the species are identical, some present varieties; some are ranked as doubtful forms, some as distinct, yet closely allied species.

To take the example of our alpine poppy on two occasions, once in its advance, and again in its retreat, the *Papaver nudicaule* must have come into close contact with cognate forms of a more temperate climate. The struggle must have been severe, and would leave its impress on the prevailing race; and when, in their turn, the arctic forms were forced to recede, many of the hardier plants from the plains would have followed them up the mountain-sides, and exercised a further influence before they became extinct. That the temperate forms did so ascend, we have further evidence in the plants with which the alpine poppies are now found associated in their mountain homes. Many of them, such as the Violas, Galiums, and Artemisias are not arctic species or genera, but are merely modified forms of families that grow on the surrounding plains. With these the struggle was less severe, for they had no more favoured cognate species to contend against, and so they have succeeded in making good their footing on the mountain outposts of the arctic flora.

But with the poppies the case was different. The more temperate forms from the plains must have gradually succumbed to the more favoured northern race; and, once conquered, they went lower and lower, till at last they settled down in the fields where they now exist.

A wide zone of elevation, though partly bridged over by the kindred form of the Meconopsis, now separates the field-poppies, *P. rhœas* and *P. argemone*, from their alpine kindred; but, in spite of this, I think we can see that they once must have exercised considerable influence on each other, and that there is good reason for believing that the various races of the alpine poppy, on distant mountain-ranges, are but modified descendants of the *Papaver nudicaule* of the arctic regions.
