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The Altels' Ice Avalanche.

By CHARLES SLATER.

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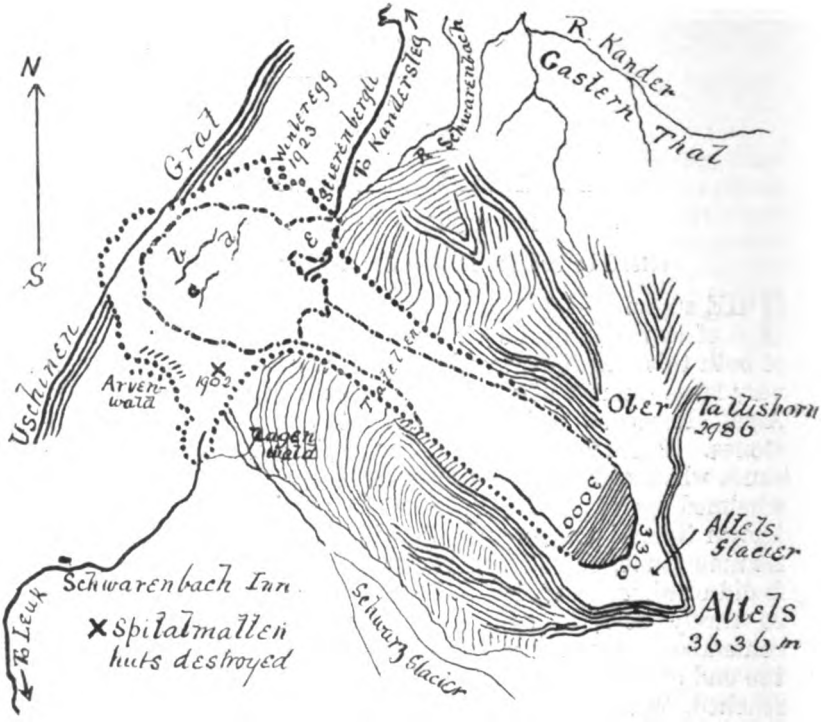
THE summer of 1895, owing probably to the small amount of snow-fall of the winter and the prolonged hot weather of both this and the preceding year, was remarkable for the very large number of rock avalanches which occurred in the Alps. Not a few accidents, some fatal, resulted from falling stones. These various rock-falls sink, however, into insignificance when compared to the gigantic avalanche which overwhelmed one of the fertile pasturages which border the well-known Gemmi route; an avalanche remarkable not only for its magnitude, but still more for its character, consisting as it did of almost pure ice, and reaching, as such an avalanche so rarely does, to cultivated or pasture land. It will be remembered that the path which ascends by steep zigzags at the end of the Kanderthal until a height of some 6,200 ft. is reached, then runs along the edge of the Schwarenbach gorge, giving a magnificent view of the wild Gasternthal, and debouches suddenly at Stierenbergli on to a comparatively wide, flat and fertile valley. This is the first and lowest of a series of basins occupying the bottom of a steadily rising, trough-like valley, which extends from Stierenbergli to the summit of the pass overlooking Leukerbad. In this first basin were situated the cow chalets of Spitalmatten, and the alp or pasturage is known by that name. The alp, though situated in the Canton of Berne, belongs to the commune of Leuk in the Rhone Valley, and on account of its comparative cheapness is chiefly used by the poorer inhabitants of that commune. This was the scene of the disaster. The valley, through which runs the Schwarenbach stream, draining the

Schwarz and other glaciers, is bounded on the E. by steep slopes which rise abruptly and continuously to the glacier-crowned summit of the Altels. On the W. the valley slopes gently to the foot of a steep limestone ridge, known as the Uschinen Grat, whose crest has an average height of 1,500 ft. above the level of the valley bottom. On the S. the basin is



NOTE.—The sketch-map is based on the Ordnance map and a diagram by Professor Heim. The section is drawn from the Swiss Ordnance map.

Description of Sketch-Map.—The darkly shaded patch between the figures 3,000 and 3,300 represents the portion of glacier which fell.

Area of outer zone of avalanche enclosed by dotted line ◆◆◆◆◆◆◆◆◆◆; area covered by direct fall of glacier enclosed by interrupted line ▬ ▪ ▬ ▪ ▬

bounded by a low ridge, behind which lies the little Schwarenbach Inn. It is near the foot of this ridge that the Spitalmatten chalets were situated, and the low hills which stretch from behind these chalets to the foot of the Uschinen Grat are covered with a considerable forest of pines known as the Arvenwald. Smaller patches of forest are found near the Winteregg chalets, and on the eastern side at the Zagenwald. The Altels, whose slopes run directly into the valley, as will

be seen on the sketch-map, is, or was, glacier-crowned from a height of about 3,000 m. to the summit, 3,636 m. (*i.e.* from about 9,800 ft. to 11,900 ft.). This glacier, hanging imminent over the Gemmi route, has been one of the striking features of the scenery. The rock stratification—it is a limestone district—has the same general direction as the hill slope, so that the glacier lies on a smooth limestone bed sloping from the summit of the Altels to the eastern edge of the valley. The general slope is only broken by a plateau, known as the Tatelen, a few hundred metres above the valley, and from this the rocks drop quickly to the Schwarenbach.

During August two crevasses are said to have started from each side of the glacier, and, advancing gradually, to have met and cut off by a huge semicircular crack the lower part of the Altels glacier. This appearance may have been due to the small amount of snow of the winter and the consequent clearing of the glacier. The ordinary crevasses, especially the Bergschrund, which in this case lies almost parallel to the edge of the fracture, would thus be rendered unusually visible.

On the evening of September 10, the Vice-President of the commune of Leuk arrived at the Spitalmatten chalets to regulate the summer accounts for the pasturage. For some days preparations had been made for leaving the chalets, and fortunately some of the calves and other animals had been driven down to the valley by the women. On the following day the rest of the cattle were to be driven down to their homes, the dairy product distributed, and the chalets closed until the succeeding summer. For some days the temperature had been high and the Föhn wind blowing, while the summit of the Altels was cloud-enwrapped. On the morning of the 11th, about 5 A.M., the scanty inhabitants of the district and the dwellers in the Schwarenbach Inn were startled by a roar as of an earthquake, accompanied by a violent blast of wind. The servant of the inn, frightened by the noise, rushed out and saw, in the dim light of breaking day, what appeared to be a white mist streaming down the Altels slope. The huge mass of ice forming the lower end of the glacier had broken away, rushed down the mountain side, leapt from the Tatelen plateau into the valley, and, like an immense wave, had swept over the alp, up the Uschinen Grat as if up a 1,500 ft. sea-wall, and even sent its ice foam over this into the distant Uschinen Thal. Notwithstanding the noise which must have accompanied this immense fall, it does not seem that anyone realised what had happened, but

thought, some that an earthquake had occurred, others that a little larger avalanche than usual had fallen.

The first to report the disaster were four woodmen who had been employed in the Arvenwald, and who usually slept at the Spitalmatten chalets. On this night, however, they had been at the Schwarenbach, and thus escaped the fate which otherwise would have befallen them; an escape due, alas! not to any excess of virtue, but to the desire, as they put it, to have 'a good drink once in a way.' The news was sent on to the summit of the Gemmi, and thus reached the telegraph, while a messenger struggled over the avalanche to Kandersteg. From both places parties were organised for the work of rescue and repair.

One of the most striking features about this great disaster is the entire absence of eye-witnesses, with the solitary exception of the Schwarenbach servant, and even observations are lacking until several hours after the event. The avalanche occurred just as dawn began to break; a shoulder of hill cuts off the view from the nearest inhabitants at the Schwarenbach Inn, and all who were engaged in cattle-tending on the alp itself were killed.

A traveller walking up the Kanderthal from Frutigen, about 5 A.M., had, indeed, a distant view of the accident. He saw in the Gemmi direction a fearful whirlwind with dust and snow-clouds, and experienced later a cold rain falling from a clear sky, the rain being probably due to the melting of the ice-cloud. He concluded that an earthquake had occurred.

The scene presented on the morning of the 11th to one rounding the shoulder close to the Schwarenbach Inn must have been most startling. Winter had apparently come in the midst of summer. The Spitalmatten basin and the Uschinen Grat to its crest were whitened as though by snow, while numerous masses of still white ice lay scattered over the area and rested far up on the steep sides of the Grat. Mist and cloud hung over the peak of the Altels, so that the origin of the disaster was shrouded in gloom and mystery. Several days elapsed before a clear view of the Altels glacier was obtained, and there was considerable anxiety lest a further fall should occur.

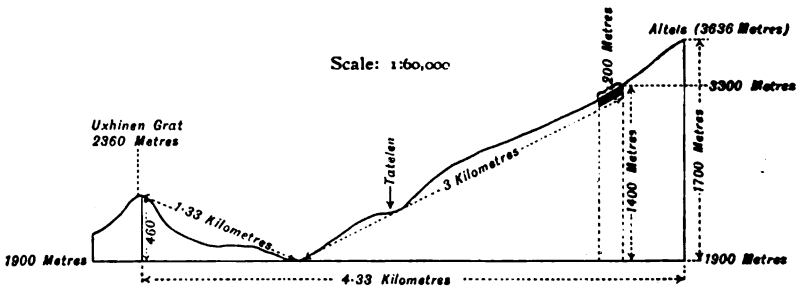
The rescue parties soon recognised that their duties would consist of burial and salvage. The cow-chalets and huts of Spitalmatten had disappeared, smashed into splinters and blown over the alp, while all the inhabitants had been killed instantaneously and their corpses buried, some thinly and some deeply, by the *débris*; two bodies have only recently

been found. The body of the Vice-President was found lying 180 yards away from the hut. Another body had been flung into the branches of an uprooted tree, while a third was found still holding a stocking in one hand, having been killed in the act of dressing. The clothes had been partly stripped from those who were dressed, and the legs and arms were in several cases broken. The two bodies so long missing were those of the herdsmen who had already gone out to collect the cattle and were buried by the main body of the avalanche, which, it must be remembered, did not reach nearly to the chalets. It was evident that the men had just risen and were about to go out on their duties when overwhelmed, practically without warning, and wholly without chance of escape. The time from the breaking away of the ice mass till the avalanche struck the huts was little more than 60 secs. The herds were almost entirely destroyed, 158 cows being killed either by the direct fall or, as happened in the great majority of the cases, by the wind and ice-hail of the avalanche. They seem to have been blown like leaves before a storm to enormous distances, and thrown high up on the Uschinen Grat. There is evidence that many were carried for 500 m. to 1,000 m., and left 250 m. to 350 m. above the place from which they had been blown. Baulks of timber 10 ft. to 12 ft. long and 9 in. or 10 in. thick were found on the Uschinen Grat at a height of 2,180 m.—more than 120 m. above the hut of which they had formed part. This hut was one situated midway between the Arvenwald and Winteregg, about *b* on the plan. It stood much higher than the Spitalmatten chalets and much nearer the Grat. A year after the disaster the timbers could be seen lying on a mass of scree-like material on the slopes of the Uschinen Grat. This apparent scree was really solid ice, and was part of the main fall. It is not a perfectly obvious problem how these timbers came to lie on the *surface* of the avalanche which carried them away. Close to this spot the body of a cow was just beginning to appear through the melting ice after a year's entombment. The contents of the huts, the dairy produce of the summer, were scattered and destroyed; all, save 150 cheeses which resisted a convulsion of Nature of even these dimensions—striking evidence of the solidity of Swiss cheese.

Travellers over the pass the day after the disaster met a sad and solemn procession wending slowly down the steep zigzags overlooking the valley of Leuk, carrying to their native villages the bodies of those who, in the discharge of

their duties to the commune, had been so suddenly and terribly destroyed.

To return to the consideration of the avalanche itself: the whitening of the ground produced by a thin coating of the fine ice-powder scattered by the wind of the avalanche was very temporary, a few hours of sun serving to dissipate it, and rapidly convert even the more thickly covered portions from white to black. Indeed, after the first 12 hrs. had passed there seemed to have been but little gross change in the avalanche *débris* until I saw it myself on September 21, ten days later. Coming over the Gemmi from the Rhone Valley it was not until we arrived almost at the Schwarenbach Inn that the Altels and the first sign of the catastrophe appeared. Behind the shoulder which cuts off all view of the



Description of Section.—The section passes through summit of Altels to a point in Uschinen Grat in the central line of fall. The thick line represents the portion of glacier which fell.

Spitalmatten basin, and under which lies the Schwarenbach Inn, rose the pyramidal peak of the Altels, showing, on its western face, the glacier cut away sharply by a vertical ice-cliff, and presenting a parabolic concavity facing downwards. The glacier looked as though a huge bite had been taken out of it. On the right or south side of this western face was seen a long finger-like projection of the glacier, which always protruded from the main mass, and which remained undisturbed, though there is evidence that part of the avalanche passed over it. On the sketch map this tongue is shown at the left of the Altels glacier below the fall. On rounding the shoulder the whole scene of the disaster came into view. To anyone who has a preconceived idea of a plain covered with glittering ice-blocks and fallen seracs the reality was disappointing. The basin was covered with a black mass, resembling a mud- rather than an ice-avalanche, and it was difficult even, as so often occurs in the Alps, to realise the

magnitude of the fall in this bird's-eye view. It was evident from this point that the avalanche presented an outer comparatively thin zone and a central area where the fallen material was thicker and more irregular. Just below us lay the little forest of the Arvenwald, divided sharply into two portions, one intact, and the other having all its trees laid flat in parallel rows like swathes of corn. The trees of the Zagenwald, nearer to the fall, but on the E. of the valley, were, on the contrary, perfectly unharmed. Scattered over the black mass of *débris* were white, glittering blocks of ice or mixed snow and ice, indicating the origin of the fall. High up on the banded walls of the Uschinen Grat were dark stains produced by the melting of the masses of ice thrown up on the slopes. Below this ridge, at the line marked *b* on the map, was a thickened heap of material produced by a back stream from the Grat, the sides of which were too steep to allow of the material coming to rest. Similarly at *c* and *d* were two bare places produced by a slipping backwards of the *débris* on the steep sides of some small elevations in the valley.

Descending from our point of observation we found, on reaching the outer avalanche zone, that the whole valley bottom, which at this point is almost filled by the stony bed of the Schwarenbach, looked as though it had been covered with a thin layer of mud and small stones, and then combed with a gigantic rake in radial lines, which start from the foot of the rocks below the Tatelen. It was evident, too, that these radial lines did indicate the line of action of the destructive force, for while the lee-side of hummocks and rocks was perfectly protected, the exposed sides were plastered with mud, stones, and ice, and the uprooted trees of the Arvenwald all lay in the course of these same radial lines. The Arvenwald covers a series of small hillocks, and in one of the small hollows between these—but still in the zone of uprooted trees —lay a little chalet, absolutely intact, not a roof-shingle disturbed. Between the streaks of *débris* lay bands of untouched soil, on which the grass, plants, and small bushes grew unharmed. It was, in fact, a striking feature of the avalanche, as has been carefully pointed out by Professor Heim, of Zurich, that there was absolutely no evidence of any plough-like action on the soil. The material of the fall appears to have spread over the ground like water, shaving off the grass, and carrying away superficially-rooted plants, but leaving the earth almost intact. The feature is well seen in the bare patches which exist in the midst of the direct

track of the avalanche (*c* and *d*), where the *débris* has fallen back and uncovered the ground.

Reaching the central zone of the covered area the thin layer of black *débris* gave place to large irregular masses of mud-like material, forming a coating 15 ft. or 20 ft. in thickness. This mass, black as a cinder-heap, really consisted of a kind of ice-conglomerate, covered by a very thin layer of mud and fine black gravel, which hid in a remarkable way all ice-like appearance. Walking over this was like walking over a thinly-covered moraine, where one was constantly—and sometimes disagreeably—reminded of its true character and the proximity of the ice. A path had been cut over this region, but owing to the constant melting of the ice it was not very sound, and some care was necessary to avoid stepping into various unexpected cracks. Where no road had been made these cracks became veritable crevasses, which afforded a correspondent of the 'Patrie Suisse' an opportunity of showing his courage and resource. A lady—English, of course—exploring the avalanche, fell into one of these crevasses, and was unable to extricate herself. Our correspondent, however, with courage, and the aid of a pine-branch, succeeded in extricating her *sans jupes mais avec sa vie*. The skirtless lady showed her gratitude to her rescuer by drinking a bottle of Bouvier with him at the Gemmi Inn, and thus proved that he had not had to do *avec une ingrate*.

The avalanche area stopped abruptly at the Kandersteg side, and it was remarkable to step off the fall on to the well-kept and intact path, and in a few strides to lose all sight of the disaster. At this point there was a noticeable feature in the shape of a piece of uncovered ground between two portions of the main avalanche. This is not due to any leaping of the mass, but to the fact that the tongue *e* is really due to a back flow of the original material.

To turn now to a few details as to the mass and force of the fall, for which I am in part indebted to a description by Professor Heim. The portion of the glacier which broke away lay at an altitude between 3,000 m. and 3,300 m., and the line of rupture, which is almost parabolic, is a new fracture lying some 50 m. to 80 m. below the true Bergschrund. The walls of the ice-cliff measure about 40 m. in height as a maximum, and average from 25 m. to 30 m., except at the sides, when they sink rapidly. The area of the rock exposed by the fall measures some 180,000 square metres, and this space and its bounding wall of ice, 120 ft. high, can be seen from long distances, as much as 140 kilometres; its appearance from

Frutigen, some 20 miles as the crow flies, is shown in the sketch.

Taking the average thickness of the ice at 25 m., this gives for the mass of the avalanche four and a half million cubic metres of ice—an estimate certainly below the truth. This gigantic mass fell through a vertical height of 4,700 ft., in a horizontal distance of less than three kilometres, $1\frac{3}{4}$ miles.

A glance at the section, which is on the same scale both in horizontal and vertical measurements, shows the track of the avalanche. The upper 1,000 m. has an angle of 30° to 36°. This angle at the Tatelen plateau sinks to 10°, and the final slopes above the valley again rose to an angle of 25°. The mass of ice appears to have begun to move *en bloc*, the breadth of its track being 600 m., but as the pace increased the ice became broken up, the centre moving faster than the sides, until the fall poured like an ice-river down a track diminishing in breadth to 250 m. Reaching the outer edge of the Tatelen, the whole mass appears to have sprung through the air, clearing the rock-slopes and pitching directly into the valley bottom. It was at this period of its course that the maximum wind-effects were produced. The compression of the layer of air between the slopes of the Tatelen and the backward dropping mass caused a blast which, acting on the crushed and disintegrated mass, drove out the clouds of ice-dust, stones and mud, which form the outer zone, and caused the destruction of the trees of the Arvenwald.

That this was the way in which the wind acted, tearing off the sides and lower surface of the avalanche, is indicated by the fact that the radial lines of distribution, mentioned above, start not from the central line of the fall, but from the edge of the mass, and spread out like a fan. The great majority of the trees, which are mown down, but not carried away by the wind, lie in lines corresponding to these radii; but it appeared to me that others, especially those nearest to the Uschinen Grat, were lying at a greater angle to the central line, as though the blast had been compressed by the bounding walls of the valley, and forced to travel in the direction in which the valley was most open.

The wind-blast seems to have preceded, probably momentarily only, the hail of ice and stones, for the sides of the trees which are stripped by the blast are those which are unprotected in the *fallen* position. The way in which the avalanche spread over the valley, up the Uschinen Grat, and over its crest, 1,500 ft. above the lowest point of the fall, has

been already described. The rate at which the ice would be moving at the end of the fall is about 118 m. per second, and its average velocity between 50 m. and 60 m. per second, or over two miles a minute.

The main mass of the avalanche covered about one square kilometre to the average depth of 5 m., so that the 4½ million cubic metres of ice had become increased by stones, mud, &c., to about 5 million cubic metres. Adding to this the area of the outer zone, the total ground covered by the *débris* was, in round numbers, two square kilometres, and the total mass 5½ million cubic metres.

It is difficult to realise these vast figures, even when expressed in familiar English terms, and a few comparisons have been suggested which may help to give some idea of the forces which were called into play. The material which fell would have sufficed to bury the City of London to the depth of six feet, and Hyde Park and Kensington Gardens would have disappeared beneath a layer six and a half feet deep. The enormous energy of the moving mass may be dimly pictured when we think that a weight of ice and stones ten times greater than the tonnage of the whole of England's battle-ships plunged on to the alp at a speed of nearly 300 miles an hour.

Owing to the fact that the Altels is ice-covered to its top, there is practically no moraine, lateral or terminal, and although there was in all probability *débris* in the hollow on the Tatelen, yet the avalanche is very free from stones, the proportion not being more than one to two per cent.

One of the great elements of destruction by avalanche—the damming of the rivers, and subsequent inundation—was in this case happily not active; although the avalanche crossed the track of the Schwarenbach, and in part blocked it, no stopping of the river or formation of a lake occurred.

The cause of the avalanche seems undoubtedly to have been the excessive heat of the summer of 1895, and of the two or three previous years. The Altels glacier lies in the zone where the earth temperature is, on the average, a little below 0° C.; and, as a rule, the temperature of the rocks below the glacier ranges between minus 1·5° C. and 0° C. The bed of the glacier is so steep and smooth that the ice must fall but for the fact of its being frozen to the bed. The rocks of the mountain may this year be assumed to have been nearly 5° C. warmer than usual, so that the temperature of the glacier-bed, as the result of a summation of the effect of the three preceding summers, probably ranged from 0° C. to 1° C.,

and the fall took place owing to the loosening of the cohesion between the ice and rock.

History repeats itself. One hundred and thirteen years earlier, in August of 1782, an almost similar fall of the same glacier occurred, and the remembrance of it still lingers in the villages around Leuk. It was accompanied by almost exactly the same precedent conditions, and the results were curiously similar. The 1895 disaster resulted in the death of six men, 158 cows, and some nine or ten other domestic animals, a fertile alp was destroyed, and the whole damage was estimated at about 135,000 francs.

Could this accident have been foreseen and avoided? It is easy to be wise after the event, and many are found who state that widening of the crevasses and other signs were present which should have given warning. These statements appear, however, to be products of the imagination, stimulated by the disaster: and, in fact, all active remembrance of the 1782 fall having disappeared, there was nothing to suggest the occurrence of an avalanche this year. Had the disaster been foreseen, nothing could have been done to avert it, but the lives of the men and their herds might have been preserved.

The very practical question arose as to whether any further fall was likely to occur during the days immediately following the first fall. This uncertainty had its commercial aspect in the keen eyes of one of our American cousins, according to the anecdote related to me by two travellers who had crossed the pass one or two days after the fall. They found a gentleman who had ridden up to look at, but not to cross, the fallen mass, who, after fairly warning them of the danger of the passage and the risk from overhanging ice, and finding them still persistent, offered to insure them in his company at a dollar per thousand. The offer apparently was not accepted, and the dollars were saved.

Though warning was wanting this time, the recurrence of meteorological conditions similar to those of the past years will cause insecurely perched, hanging glaciers to be looked on with suspicion, and precautions to be taken to avoid disaster.

What will be the permanent result of this avalanche? In 1895 Professor Heim prophesied that in a couple of years the ice would have melted from the pasture, leaving it covered with rock, dust, and stones. Though, doubtless, this will happen in time, last year's progress would seem to indicate that this estimate of the period required is unduly optimistic.

There is an enormous mass of ice to be melted, yet sooner or later the old grass will reappear and spread over the thin coating of bare soil, and though for some time after this the pasture will be poor, yet with a little labour, and the lapse of a few more years, the alp will once more serve as a summer grazing-ground for the Valais cattle, and the memory of the catastrophe be only a legend deepening the hold of the 'Mountain Gloom' on the inheritors of the 'Mountain Glory.'

The Aiguille de Tronchey.

By the EDITOR.

(Read before the Alpine Club, May 4, 1897.)

WHEN the mysteries of battels were explained to a Freshman at Oxford, in my day, I remember that one piece of information usually vouchsafed was that fagots included cream. Let me hasten to inform my readers that the title 'The Aiguille de Tronchey' includes all the climbs that the weather allowed me to accomplish in 1896. 'All,' you will say to me; 'I know not what ye call all.' 'Is it ten, or twelve, or twenty?' Alas! no; 'tis three!

My first impulse, on sitting down to write this paper, was to make a sort of anthology of abuse, a catalogue, in fact, of expletives, suitable for firing off at intervals, and copy one or two chosen morsels in the middle of each page, with the certainty that they would come in naturally and meet—if sufficiently strong—with the approval of all mountaineers whose fortune led them to the Alps in 1896. But I gave it up, through sheer inability to find words adequate to express my feelings on the subject. Never before have I noticed such poverty in our native tongue; but I feel that in this failure I shall have the sympathy of you all.

We were attended by a bad omen at the very outset, for the bigger of our two horses lay down just as we were starting, smashed the shaft, and generally delighted himself; but when, after an hour's interval, as the driver was burrowing for wine in a wayside inn, he meditated a second edition my patience reached its limits. Just as he was tucking himself in with a languorous enjoyment I bestowed the stick upon him with such effect as to drive out of him the passion for acting as though he were a buffalo at large. Then the wind rose, the rain asserted its right to bully us, and we were