

A Campaign Against Avalanches.

BY A. DE BURGH.

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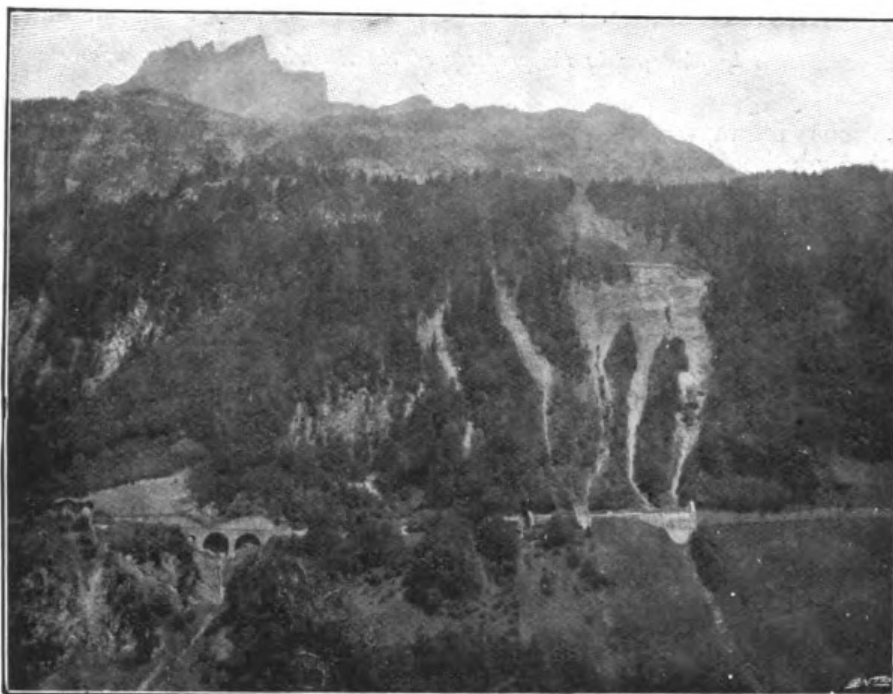


Of the various railways constructed through the Alps none is more interesting, more picturesque, or more important than the Arlberg Railway, which forms a short connection between four countries, namely, Austria, Switzerland, France, and, *viâ* the Lake of Constance, South Germany. Starting from Innsbruck, and passing Landeck, St. Anton, and Bludenz, it reaches Feldkirch, where it divides into two branches—one to Zurich and one to Bregenz. It was opened to the public on September 20th, 1884, the Emperor Francis Joseph of Austria performing the opening ceremony in person. Although it would be interesting to give a full description of this skilfully carried out work of engineering, of the tunnel over 30,000ft. long, of its many high and wide bridges and viaducts, it is not the purpose of the present paper to give a dissertation on railway building, and we will therefore only touch on such points as will assist our readers to grasp the serious difficulties and dangers which have had to be overcome outside the ordinary obstacles encountered in such undertakings as the construction of mountain railways. It will be necessary to show the great elevations attained by the track, and to point out that at such heights the snow-fall is absolutely phenomenal; and although snow-ploughs are constantly employed to keep the track itself clear for traffic, we shall show as we proceed with our paper how obstinate and terrible a foe snow is to encounter in mountain regions. At Innsbruck the elevation of the line above the level of the sea is about 1,750ft.; at Landeck, 2,350ft.; at St. Anton, nearly 4,000ft.; the highest point being reached inside the Arlberg, which is pierced by a long tunnel.

Everybody knows what avalanches are—falling masses of snow and ice which, beginning in insignificant quantities, increase in volume as they move, gathering strength with every foot of ground they pass in their downward path, till they become like wild torrents, tearing up and carrying with them in their destructive career trees, rocks, boulders, even huts and houses—in fact, all that lies in their way. Arrived at last in the valley they spread themselves out over large areas in masses of snow and *débris* 15ft. to 50ft. in

height, containing the ruins of houses, stables, huts, and barns, and not rarely the carcasses of many animals and the corpses of men, women, and children who have been overwhelmed by them as they swept down the mountain-sides.

It was against these awful and appalling enemies that the railway company had to fight. So frequent were avalanches on this line that, although snow-sheds of a very substantial nature were erected all along the line where it appeared necessary, winter often saw the trains unable to proceed, and large parts of the permanent way either destroyed or entirely covered with snow and *débris*, and made impassable for many days. Various engineers were instructed to make observations on the spot, and they spent whole winters and springs in the mountain regions for the purpose, braving great dangers and undergoing severe privations. It was their object to study the matter fully, to learn where the avalanches originated, and to find, if possible, means of preventing their disastrous descent. After various winters so spent these outposts and pickets of the army of science became so familiar with the nature and peculiarities of avalanches that they could foretell almost to the hour when one was likely to descend. From the state of the snow on the mountain-sides and the existing temperature they could at last calculate exactly the time when the enemy might be expected. Had the railway servants always listened to the warnings of the engineers much less life would have been lost during the four or five years before the campaign against the terrible foe terminated. We heard of one case where, from the nearest station, an engine and truck were especially sent to one of the signal-houses occupied by a signalman, his wife, and three little children, to communicate the approaching danger. He was ordered to place all his belongings on the truck and return with his family to the station, as an avalanche was almost certain to descend upon his abode within a few hours. He laughed at the warning, and refused to leave his cosy home. He did not believe in these prognostications of the scientists. The engine returned for peremptory orders, but when arriving again at the site of the signal-house the latter was found to have been carried away with all its inhabitants. The five



1.—SCENE NEAR HINTERGASSE, SHOWING THE BARE TRACKS CUT BY AVALANCHES THROUGH THE WOODS.

bodies were discovered some days afterwards. There have been unfortunately some other fatal disasters among the railway servants owing to avalanches, but it speaks well for the care and precaution which were always taken by the administration that, during the sixteen years of the railway's existence, only one passenger was injured by them. This happened in 1885.

Under the leadership of the head of the Arlberg section of the Austrian State Railways, the Imperial Court Councillor, Wilhelm Von Drathschmidt - Bruckheim, and with the assistance of engineers and experts of high renown whom the Director had called around him, war was declared against the elements, which always seem hostile to the works of mankind. It was in 1890 that it was decided to spend the necessary sum of money in order to

dissipate once and for ever this formidable danger, should it be possible to do so through human agency. In order that we may be able to show our readers the battlefield where defeats and victories followed each other for some time we give a series of photographs, the originals of which are the sole property of the Austrian State Railways, and have been kindly placed at the disposal of the writer of this paper.

The section of the railway depicted in illustration No. 1 is that near the station of Hintergasse. This district was particularly exposed to the danger of avalanches, and the tracks of such may be plainly seen about the centre of the photograph, a perfect clearing having been effected. Illustration No. 2 shows an avalanche which came down at the station of Flirsch, just passing the signal-house, which, however, had been abandoned,



2.—A FALLEN AVALANCHE NEAR THE STATION OF FLIRSCH.



3.—CLEARING AN AVALANCHE FROM THE LINE NEAR PIRKER MÄHDLE.

the fall of the avalanche having been fully anticipated. This happened in 1896, and it was one of the last which damaged the permanent way. This whole district is now absolutely free from danger, science, after long battling, having won a complete victory.

No. 3 again shows an avalanche, the snow and rubbish being just cleared off the track. The scene is near Pirker Mähdle; time, March, 1896. Illustration No. 4 shows an avalanche which also occurred in 1896. It fortunately passed under the iron bridge, but destroyed the track for some hundreds of feet at the side of the ironwork. The next illustration (No. 5) was taken a few minutes after the Glong-Tobel avalanche had descended into the valley with terrible effect. The iron bridge, over 50ft. long, was carried along nearly half a mile, and was deposited amongst the snow and rocks on the farther side of the valley. No. 6 depicts the effects

of an avalanche near Flirsch Station. The permanent way was entirely destroyed for some distance, and we see in the photograph the operation of constructing a temporary track. At the time this photograph was taken the snow had melted to a considerable extent, leaving behind it the rocks and boulders which the avalanche had carried down. In our next reproductions we have photographs of the village of Stuben, which was visited and partially covered by an avalanche. The photographs were taken



4.—BRIDGE AND LINE DESTROYED BY AN AVALANCHE.



5.—IRON BRIDGE SWEEPED HALF A MILE BY AN AVALANCHE.

the day after it had descended. No human life was lost on this occasion, but many cattle were buried alive and some uninhabited huts destroyed. These pictures will give our readers a very true idea of the quantity of snow which an avalanche deposits when it finds rest. Illustrations Nos. 7 and 8 show single houses of Stuben, some of them com-

pletely covered. The people inside had to build tunnels through the snow in order to leave their houses, which were in very great danger of being crushed in by its weight. In illustration No. 9 we see an avalanche which entirely closed up the entrance to the long tunnel and caused an interruption to traffic lasting some days. Our next photograph (No. 10) shows an

avalanche in motion — actually the picture of an avalanche descending! This was taken by a railway engineer from a good point of vantage, who “snap-shotted” it as it passed on its way. We are informed, and can well believe, that this photograph is unique, and the only one existing of an avalanche in actual motion.



6.—THE LINE AT FLIRSCH WIPED OUT BY AN AVALANCHE. A TEMPORARY TRACK BEING CONSTRUCTED.

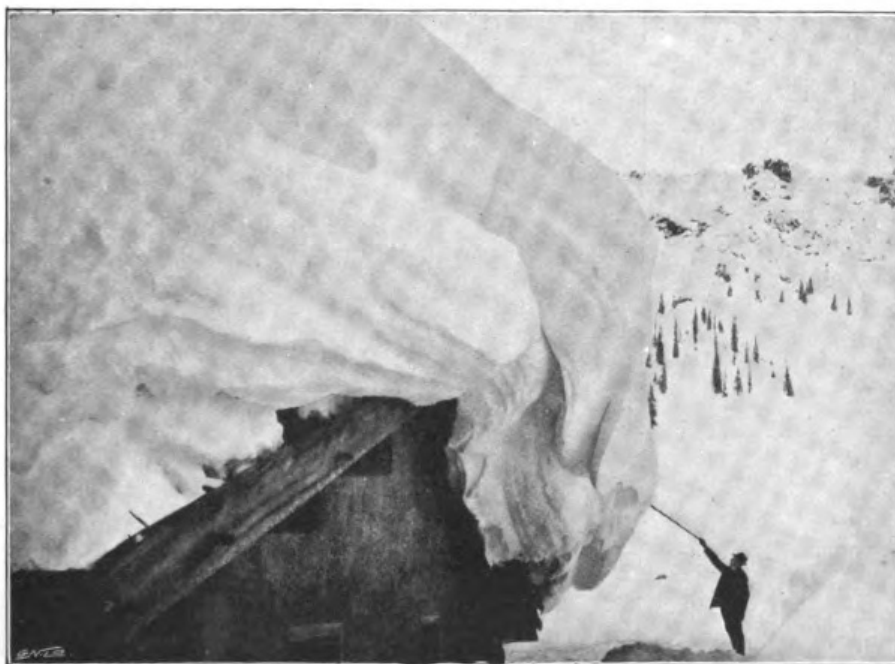


7.—HOUSES AFTER AN AVALANCHE AT STUBEN.

The views which we are able to present to our readers will sufficiently show how hostile, subtle, and powerful a foe had to be grappled with by the engineers. It would almost seem as if the elements hate the handiwork of man; but science is a power which seizes directly upon the weaknesses of its opponents, and with unerring calculation turns physical forces against each other, by this means achieving ends which it were otherwise impossible to attain, and we shall now see with what patience and perseverance her disciples carried on the campaign until they remained victorious in the field. There was a time when it was seriously thought that the Arlberg Railway would have to stop all traffic during the winter months. But the avalanches, beside endangering passing trains and doing great damage to the permanent way, were also most destructive to forests and woods, and the State Department which has charge

of these willingly united with the railway authorities in the endeavour to find ways and means to prevent them from descending. Elaborate woodwork was constructed during the summer months which should stop the masses of snow on their way, and with grave anxiety the engineers awaited the result of their protective measures. In the following February an avalanche descended on the spot where

the wood barriers were erected, and, alas, the snow masses passed unhindered on their career, even increasing their volume by adding to it the *débris* of the beams, rafters, and planks. It was soon found that it would be almost impossible to construct barriers strong enough to withstand the onslaught of such a charge as that of a descending avalanche. Observations led to the conclusion that the only way to overcome this tremendous power would be to prevent the accumulation of snow and formation of



8.—A CORNER OF A HOUSE AT STUBEN.



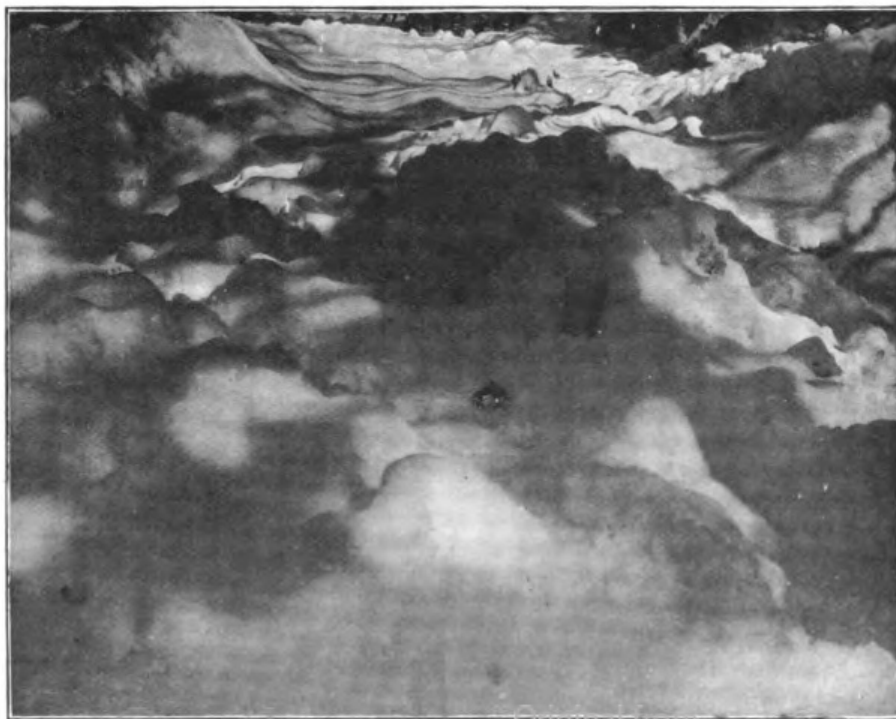
9.—THE MOUTH OF A TUNNEL CLOSED BY AN AVALANCHE.

avalanches. It has ever been the endeavour of the strategist to divide, as much as possible, the forces of the opposing foe, and such was the policy now followed in this campaign. As we show in our illustration, No. 11, both stone and wooden walls were erected, starting quite at the tops of the mountains. Besides these obstacles, heavy posts were driven into the earth in clusters and rows, at various distances down the mountain-side. This scheme had the desired effect. Whenever masses of snow began to accumulate the obstructions were strong enough to divide them and break their power. Our next illustration (No. 12) shows two of the many walls which were erected, and there are also clearly visible the tracks of avalanches where in former years they used regularly to descend. Such

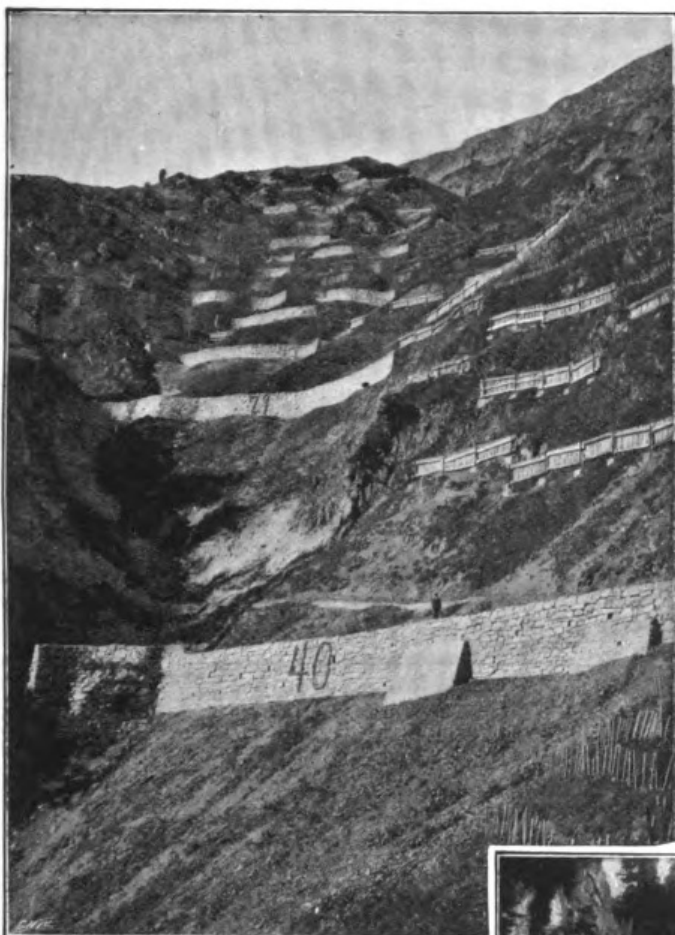
tracks are now planted with young trees, and when these are grown up they will be no small assistance towards the permanent prevention of avalanches. These works of obstruction, for such they really were, formed at first a cause of great anxiety, for many were the misgivings as to their efficiency, so often had previous methods failed to be of use. Only those who had taken observations for several years on the spot, and

had mastered the whole question to their satisfaction, felt secure and entertained no doubt as to the issue.

The winter of 1897 was a particularly severe one, and there were great snow-falls. Avalanches were reported from various parts; but on the so-called Benedict-Tobel, which was, so to say, the very head-quarters of the enemy, and the mountain first experimented



10.—THE ONLY PHOTOGRAPH EVER TAKEN OF AN AVALANCHE ACTUALLY DESCENDING.



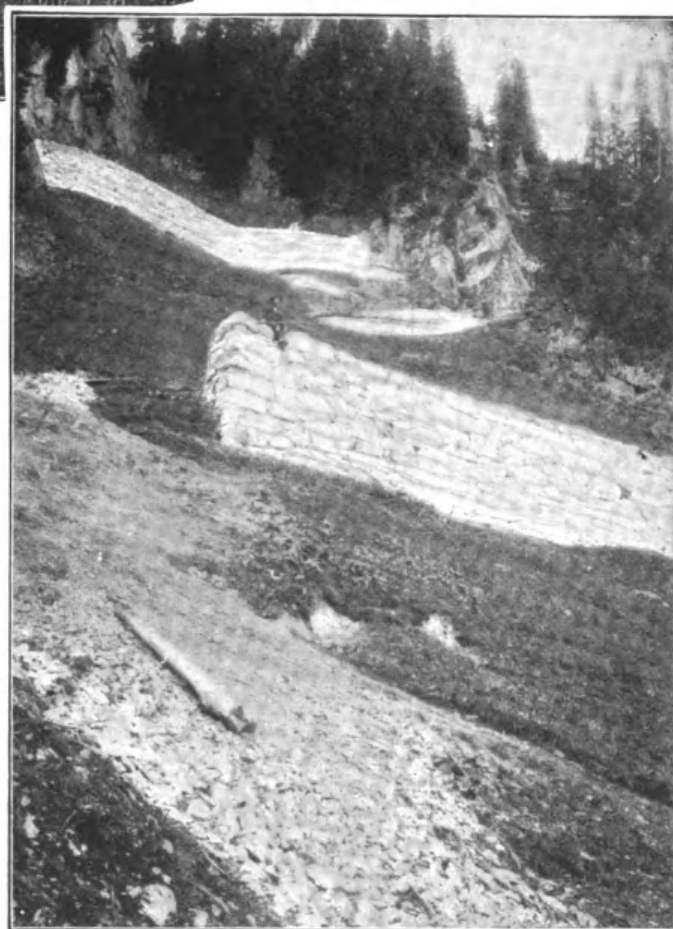
11.—THE WALLS AND FENCES BUILT UP THE MOUNTAIN-SIDES TO BREAK UP THE AVALANCHES.

on, there was not a sign of any snow movement. In the illustration No. 13 we have a view after a heavy snow-fall. The summer of the same year saw these experimental constructions carried out on all those mountains adjacent to the railway track, and the method was proved perfect in 1898. Our final illustration (No. 14) gives a more detailed view of the obstructions as they appear after a heavy snow-fall. A railway engineer is depicted on his tour of inspection. The year 1899 passed without a day's interruption of the traffic. There were no avalanches reported, and the victory was proved to be complete, the foe entirely routed.

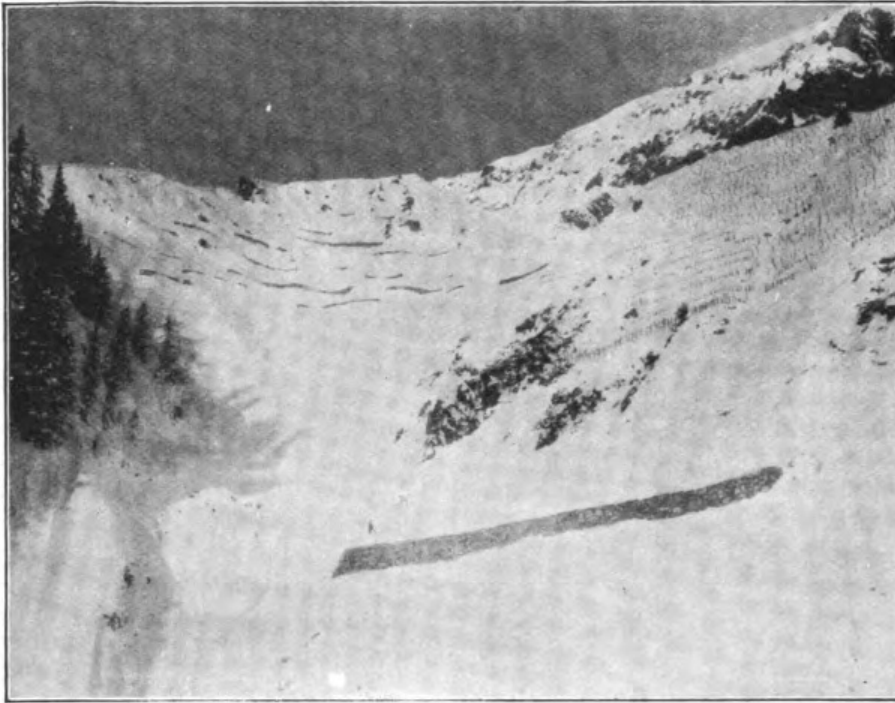
The dissipation of avalanches enables the Department of Woods and Forests to replant districts which heretofore were so frequently scoured by the enemy that any attempt to replant them had failed. Great results are expected from this work, for landslips which increase in

frequency as the mountain-sides are denuded of trees will all soon become occurrences of the past.

The whole character of the Arlberg Railway, its geographical position and the climate, and also the peculiar nature of the mountains through which it passed, caused it to be specially liable to landslips and avalanches. As a matter of fact some of the valleys through which the railway wends its way have always been known to be frequently visited by them. The village of Stuben, which we already mentioned, and which is situated above the station of Langen, has been on various occasions almost entirely destroyed by falling snow masses, and terrible loss of life has from time to time taken place, until in 1849 the Government came to the rescue and caused buildings to be erected above the village in the shape of earthworks resembling redoubts, which were intended to at least partially break the force of the descending snow. Our illustrations



12.—A NEARER VIEW OF TWO OF THE WALLS.



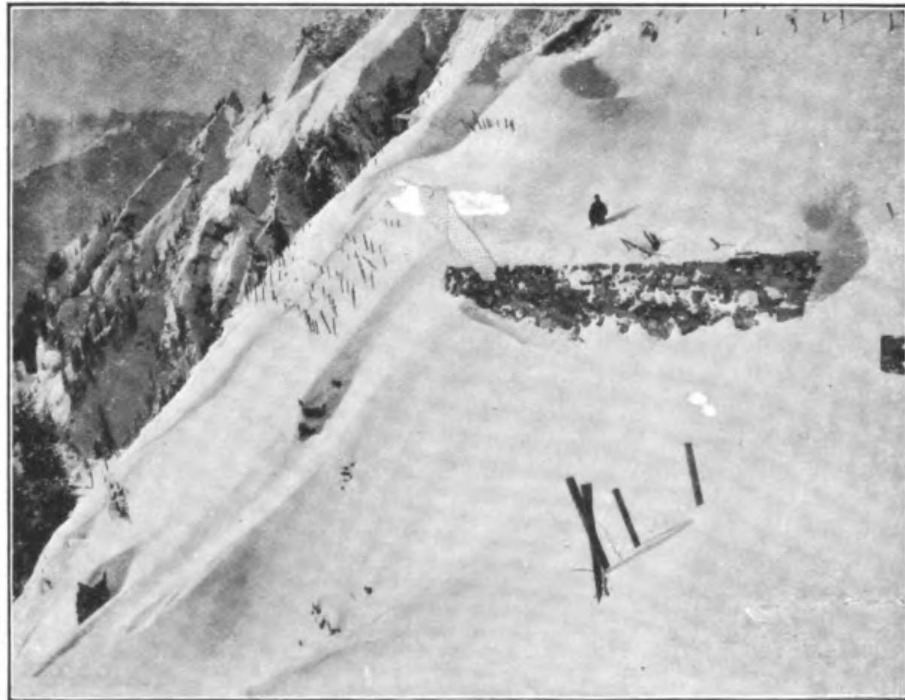
13.—VIEW SHOWING AN AVALANCHE STOPPED AND BROKEN UP BY THE WALLS.

show of how little avail, however, were these obstructions. The work erected by the railway will doubtless prevent a repetition of the disastrous occurrences formerly so frequently reported. Stuben affords a special proof of the love of the Tyrolesè for the spot on which they were born, for in spite of the annual danger and of the many visitations, in spite even of the repeated destruction of their homesteads, they could not be prevailed upon to move from their beloved mountain-sides.

During our inquiries in the valleys through which the Arlberg Railway passes, namely, the Upper Valley of the Inn, the Stanz Valley and the Kloster Valley, we heard some sad and terrible stories of the disasters caused by avalanches, which made us the more rejoice that this danger is at least partly averted for the future. To

mention only a few instances, it is on record that on one occasion a whole wedding procession, bride, groom, and sixteen other persons, were killed; at another time some children were carried to the church to be christened when a terrible avalanche came suddenly down the mountain, and ere the fathers, with the godfathers, friends, and children, could find a refuge they were overtaken by the terrific torrent of snow. The bodies were found

long afterwards more than two miles distant. There are also on record some marvellous escapes, and one particular instance which came to our notice was that of a man and woman who were buried under the snow of an avalanche and who dugged themselves out of it and rejoined their friends the day after. They found them bewailing the death of the arrivals.



14.—NEAR VIEW OF ONE OF THE WALLS AFTER AN AVALANCHE.