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The Pilatus Railway - Part 1 - The Early Years

By A. J. Pike.

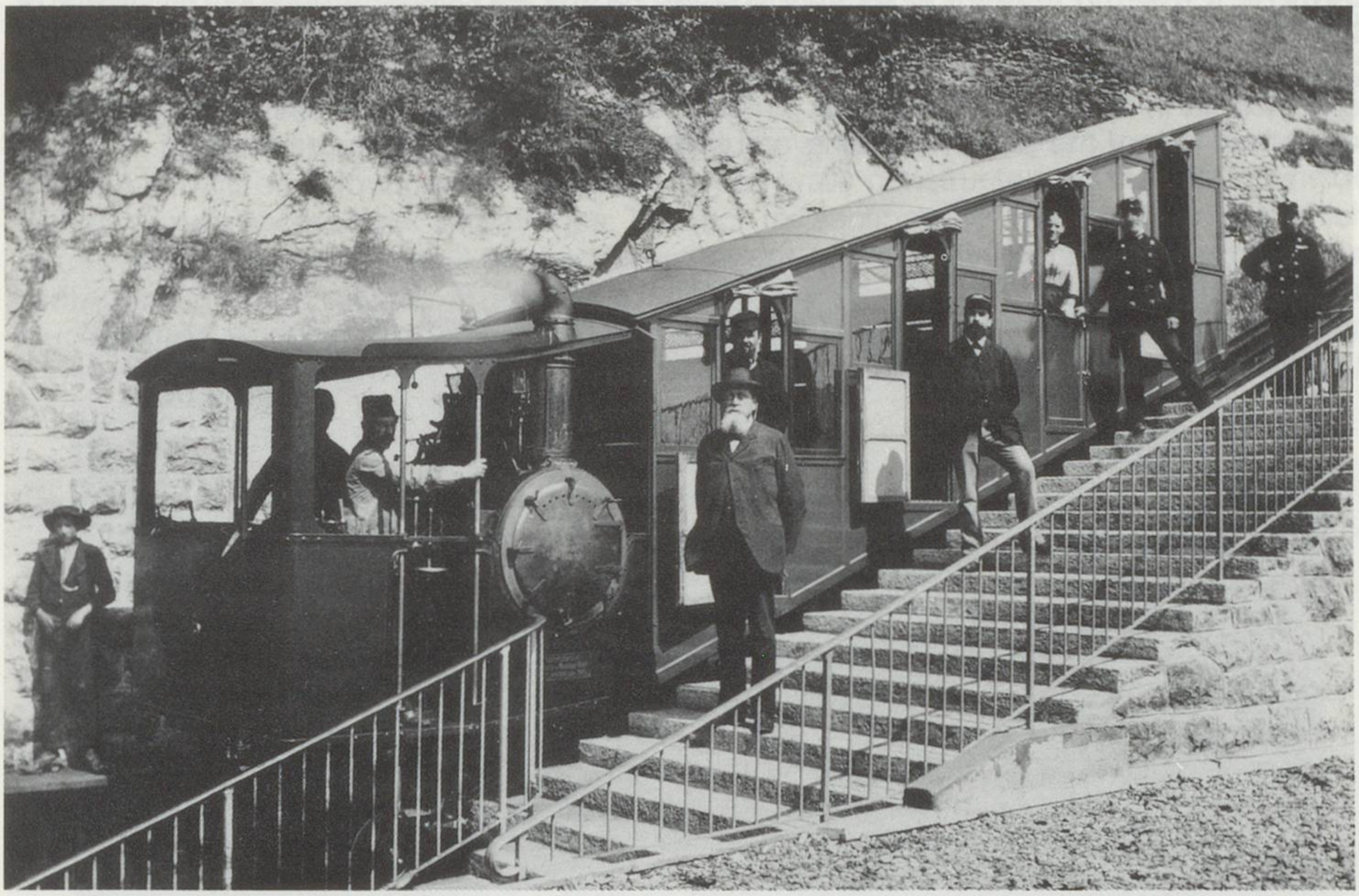
Few people who have been to Luzern in Switzerland can have failed to see the imposing bulk of the Pilatus, a massif of limestone virtually in the suburbs of the city. The massif comprises a number of peaks the highest of which is Tomlishorn reaching a height of 2129 metres, nearly 7,000 feet. In 1762 evidence was found that lynxes, ibex and bears had inhabited the peaks and deer, wolves and wild boars had certainly lived there until around 1700. Today, if one is lucky, the interesting marmot can be found.

The mountain range had such an attraction that even before the railway was built a number of famous people made the ascent, no mean feat. These included, no less, Queen Victoria in 1868, and the interests of tourism gave rise to the construction, near the peak, of two hotels which opened in 1860.

Alpnachstad Station. Early 1900's. *Photo: Courtesy of Pilatus Bahn.*

But this account is of the railway itself which celebrates its centenary this year. It has a number of features which set it apart from most other mountain railways thereby making it a "must" for those who have an interest in rail traction. Like so many other mountain systems, the spur to its construction was based on tourism and, following the success of the Vitznau Rigi, the first rack and pinion railway in Europe opened in 1871, thoughts turned to the Pilatus. It is something of a surprise to learn that a petition was made to the Federal Council in 1873 for the grant of a licence to build a railway using the Rigi system from Alpnachstad to Mount Pilatus. The petition was made by the Luzern Credit

Bank and signed by the Chairman of the Board of Directors of the Vitznau Rigi Company. This implied a standard gauge track with the gradient restricted to 25% (1 in 4). The route was to follow a path used by the porters and, indeed, horses but it was so circuitous that it was realised that the enormous construction costs would be unlikely to lead to profit both because of the length of line and the use of standard gauge.



Bhm No.5. Awaiting departure from Alpnachstad. *Photo: Courtesy of Pilatus Bahn.*

If the peak were to be conquered by rail, a shorter and much steeper route had to be found. An obvious one was almost straight up the mountain from the lake at Alpnachstad but this would require gradients of about 50% (1 in 2). It is necessary to go back into history to see how this was overcome. In the early days, it was thought that a metal wheel on a metal rail would not provide adhesion and that the wheels would merely spin when the power was applied. Blenkinsop among others designed the system whereby a cogged wheel engaged in cogs on the track. We all know that this was found to be unnecessary but here was the germ of the idea which led to the conquest of mountain peaks.

For once, the first success was not in Europe but in the United States. In 1847 a rack and pinion line had been laid between Indianapolis and Madison as an experiment which was not a success then. An American, Sylvester Marsh, designed a ladder rack with circular rungs secured between the running rails into which a vertical pinion wheel engaged. This enabled a railway to run to the summit of Mount Washington in New Hampshire, a height of 1936 metres - 6,293 feet - above sea level and gave rise to the term "Cog Wheel Railway".

In Switzerland, Nicklaus Riggenbach the locomotive engineer of the Central Railway of Switzerland (SCB), took out a patent on 12 August 1863 for a system of railway operation using rack and pinion. However, he was unaware of the work being done by

Marsh in the United States and when he heard of it in 1869 on the opening of the Mount Washington Railway, he visited it. He then constructed a short experimental line in a quarry near Bern to try out his own ideas. These were successful. A suitable candidate for the practical application was soon available in the form of the Vitznau Rigi Railway and, as this system proved itself, the fame of Riggenbach spread with the construction of further lines. However it was not thought to be safe enough for the very steep gradients necessary to produce an economical line up Pilatus. The Mount Washington line had a maximum gradient of just over 33% (1 in 3), but the Swiss Federal Authorities had limited gradients to 25% (1 in 4) for those with vertical pinions meshing in racks as it was feared that there was a real risk of the pinion climbing out of the rack on very steep gradients.

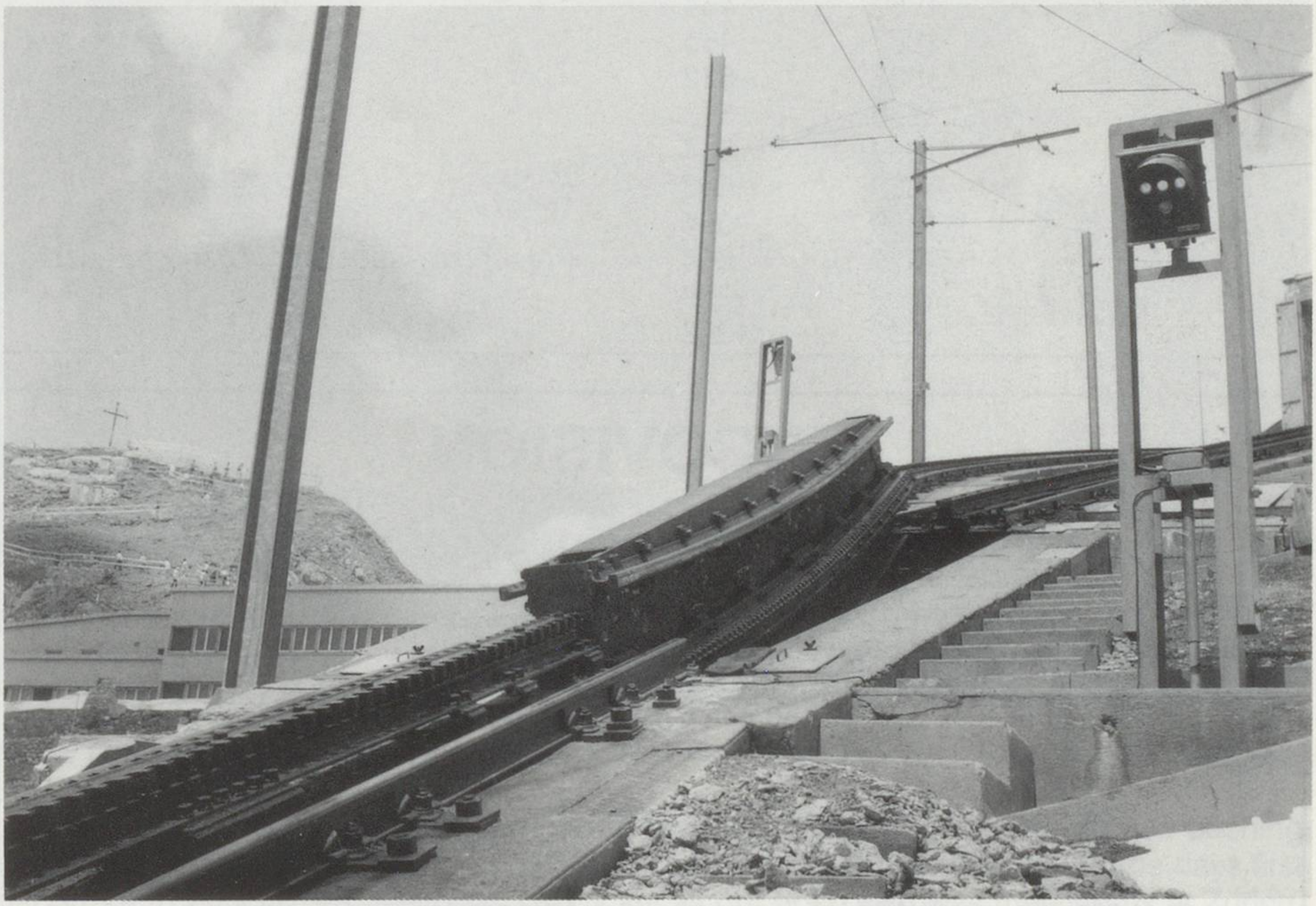
Aemsigen Waterstation and Crossing point. *Photo: Courtesy of Pilatus Bahn.*

It was Riggenbach again who probably produced the germ of the idea which led to the final solution. The Territet - Glion Funicular had a gradient of 57% (1 in 1.75) and for safety reasons, the rack was so constructed that hooks under the car gripped under the rack. At the opening of the line Riggenbach, to demonstrate confidence in his engineering, unhooked the wire cable to the car and took it down merely using the brakes.

Colonel Eduard Locher of Zürich, who became Engineer to the Pilatus Railway, presumably developed the idea to provide the solution for this remarkable line. The system is not easy to describe in words but, if members would like to see a drawing, I shall try to obtain permission to publish one. On the steam locomotives, two cylinders drove a shaft connected to two bevel gears on which were mounted vertical shafts terminating in pinions which engaged on the parallel rack teeth on either side of the rack rail. Beneath the teeth on the pinions a disc overlapped the teeth to fit under the rack. This prevented both vertical and lateral movement thereby rendering conventional flanged wheel superfluous.

Having solved this problem, Messrs Locher and Company along with Eduard Guyer-Freuler applied for a concession to build a rack railway up Pilatus. This was approved remarkably quickly by the Federal Assembly and the Pilatus Railway Company was formed in Luzern on 29 March 1886. Building began in the Spring and as early as the 5th October trials were made of the steam coach system which was to be adopted. The story of the construction of the line would fill many pages but the few following leading statistics I consider impressive. The difference in level from Alpnachstad to the summit station is 1623 metres [5274 feet] achieved in a distance of 4.618km [15,008 feet] requiring an average gradient of just over 40% [1 in 2.5] with a maximum gradient of 48% [1 in 2.08].

Ballasted track at such an angle would have been impracticable so the whole of the line is built on a foundation secured between walls constructed on the mountainside with extremely secure track anchorages. The rack rail sections are only 3 metres long which readily allows for considerable temperature changes and can also cope with the maximum radius curve of 50 metres. The track gauge for the carrying wheels is 800 millimetres. Curves make up over one third of the track length, totalling 1538 metres [5000 feet]; seven tunnels total in length some 307 metres [1000 feet]; and there are no less than 23 small bridges and viaducts and 3 avalanche shelters.



Track Traverser near the Summit station. *Photo: Courtesy of Pilatus Bahn.*

The turnouts are quite remarkable. In 6 cases, heavily constructed traversers are moved to align the track either for sidings or at the Aemsigen Alp passing point. But in two locations, the most visible of which is near the summit station, the whole of the track is rolled over to create the necessary realignment.

Now for a brief word about the early rolling stock. As ever, Locher was an innovator. The locomotive and carriage sections were placed on a common box frame which also became the tank for the water supply. The locomotive boiler was mounted across the frame thereby dispensing with the problems of changing water levels which risk the exposure of the firebox crown, where boiler and firebox are 'fore and aft' as in conventional locomotives and other mountain railway steam locomotives.

Two, two wheel axles carried locomotive and coach, the drive from the two steam cylinders being transmitted to the rack rail as described earlier. Four compartments seating 32 people were steeply inclined up the frame so that passengers could sit comfortably during the ascent and descent. The overall length of the coach was 11 metres and the speed of travel 3.6 km/h. Ten of the initial type were built between 1886 and 1900 and an eleventh in 1909 of slightly different dimensions. All were built by the Swiss Locomotive and Machine Works in Winterthur.

A description of the journey as it is today and details of the more modern rolling stock from electrification will be given in the second part of the article.

Steam powered wagon. Type Bhm. Later classified as Xhd 1/2.

Number.	Built.	Works No.	Remarks.
1	1886	451	
2	1887	464	
3	1887	465	
4	1888	512	
5	1888	513	
6	1888	514	
7	1889	563	
8	1889	564	
9	1889	565	Preserved Transport Museum. Luzern.
10	1900	1309	
11	1909	1982	