Some Swiss mountain railways

Paul Sharp

Man and railways have much in common—the former might almost have made the latter in his own image as far as their relationships with mountains are concerned. For both, life comes easier on the plains, but travel by rail across North-west Europe or the American prairie is interminable and dull. One sighs for change—for a sight of mountains. How the heart quickens at the first glimpse of the Rockies from the 'Trans Canada', west-bound out of Calgary, or of the Alps, as the south-bound Trans Europ Express approaches the Swiss frontier. These vistas, sky poised, reach across the horizon, barriers later to engulf the train as it weaves its way into the approach valleys, climbs laboriously to the passes, to burrow by the tunnels through to a new world beyond.

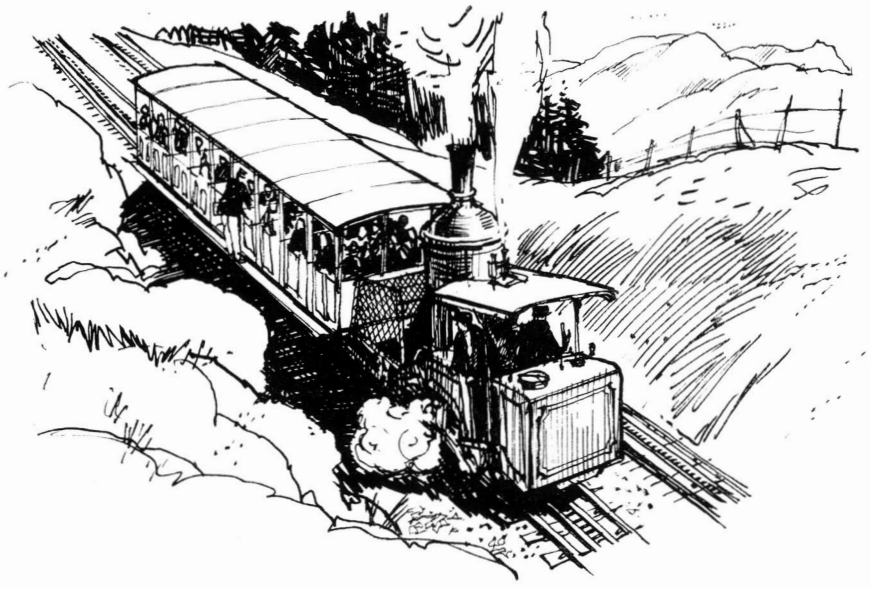
The old folk tales reveal the mountains as regions of fear—the home of demons and trolls, territory where it was man and his works who were alien. At any moment the earth might open and engulf him, as it so often did in the experience of the first engineers who entered this hostile world. Hazardous enough on foot, to build railways there was indeed a challenge. But into the mountains the tracks were eventually driven. It was forty years after Trevithick's engine pulled a train of coal waggons, and twenty years after the opening of the Stockton and Darlington that the first railway came to Switzerland from France. Three years later Switzerland's own first line from Zürich to Baden was opened. Men were already dreaming about north-south routes through the Alps, and of the rich revenues to come from such arterial trade routes, the advantages of which were very clear to the thrifty Swiss. Already England and much of Europe were netted with railways. Soon after the Swiss Federation was established in 1848, George Stephenson was commissioned to draw up plans for a rail system, not only to link the largest towns, but also to have strategic uses. The presence of heavily armed and acquisitive neighbours was not unnoticed. These routes are world famous today and include the Gotthard and Simplon lines linking the whole of Europe. The main routes are entirely adhesion, in spite of formidable gradients; electrification is almost total, for Switzerland is fortunate in her abundant water power for generating electricity. Technical development continues in a way that is amazing in a world of shrinking railways. But these are the main lines, and while they grapple with the mountain barriers, they never scale the heights, avoiding them by burrowing under the mountains. Ingenious as the spiral tunnels are, with their loops and gradients they are earth-bound compared to the routes which actually climb the peaks.

It was left to the smaller individual lines, originally developed by private enterprise, to give access to the most scenic and popular regions, and to build on gradients requiring other means of traction than the ordinary adhesion method. As early as 1863 Niklaus Riggenbach patented a system enabling

a train to climb gradients steeper than anything possible by adhesion. The mountains were becoming known; the Matterhorn was climbed in 1865 and the highest peak of the Meije in 1877, but mountaineering was at that time possible only for a privileged few. There were few roads or huts, certainly no railways or funiculars. Everything had to be carried. Little training was undergone and no specialist equipment had been designed. Yet interest developed into a mania amongst the few, and the many also began to seek the delights and romance of the Alps. The Rigi near Lucerne attracted people from everywhere and by the nineteenth century it was famous throughout Europe. Later these early tourists included Wordsworth, Mendelssohn, Weber and Mark Twain following the footsteps of the young Milords on their Grand Tours, who years before had braved the horrid crags and ravines on their way to the sunny vales of northern Italy.

Tourism was born. Riggenbach's plan was to carry the thousands of the less energetic and adventurous up to the famous view points of his country. He designed a locomotive fitted with vertical toothed driving wheels or pinions which fitted into a rack like a ladder, securely bolted between the running rails. This rack and pinion locked the locomotive to the track; it provided the grip for climbing and prevented running away when descending the steep grades. After his visit to the cog wheel railway built up Mount Washington in the U.S.A., he obtained a concession to build a rack and pinion line up the west side of the Rigi from Vitznau, near Lucerne. A gradient of 1 in 5 takes it to Rigi Kaltbad and then on to Rigi Kulm. The completed line was opened in 1872, after a year's delay, due to the refusal of the Canton of Schwyz to grant a concession until overruled by the Federal Government. During this

51 *A Riggenbach vertical boiler loco climbs the Rigi in the 1870s.* This and next three sketches by Paul Sharp

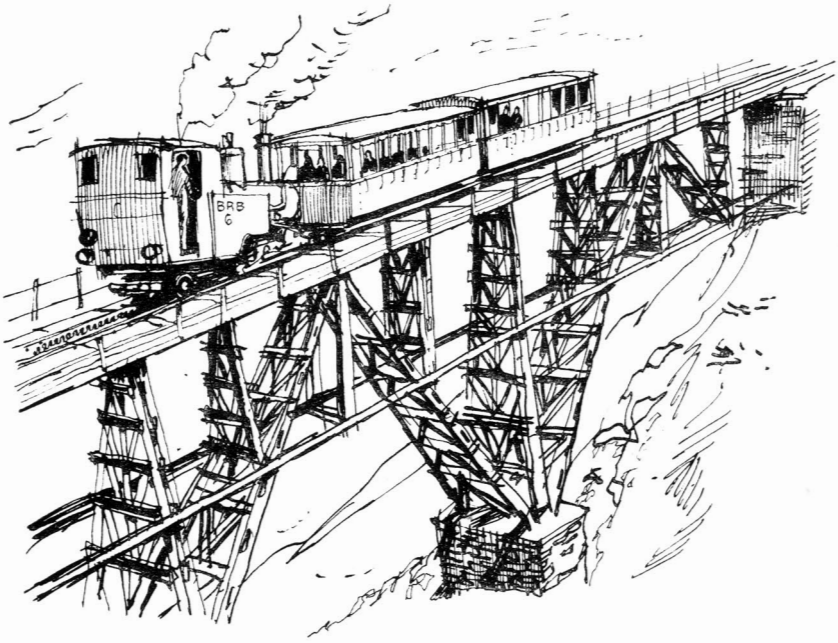


interruption another route from Arth to Rigi Kulm was built, resulting in the last mile of the route being double tracked.

Riggenbach's first engines were unorthodox and primitive. One is preserved at Vitznau. It has a vertical boiler mounted on a raked chassis frame so that, even when on 1 in 5 gradients, it remains upright. These engines were later replaced by horizontal boilered locomotives, but the tilted chassis was still retained. Passengers travelled in open cars of light-weight design—every gram saved counted, and still does today. Both Rigi railways are unusual for rack and pinion, as they are of standard gauge, 4 ft $8\frac{1}{2}$ in. Today, after leaving the terminus near the steamer pier, the bright red electric motor coaches from Vitznau climb 1311 m in $4\frac{1}{2}$ miles. The maximum gradient is 1 in 4. Stops are made at Freibergen and Rigi Kaltbad where there are a number of hotels. The summit is further up, past Staffelhöhe, 1750 m above sea level. The Arth-Rigi line caters for passengers from the Zürich side and after leaving the main line station climbs across meadows and then up the east slope to Kräbel. After the ascent of the Kräbelwand rock wall it meets the Vitznau line and accompanies it to the summit. The views are glorious. At one time a branch line ran 4 miles along the Rigi ridge, but after the sanatoria closed it too was dismantled. The track has been made into a pleasant path and still retains a viaduct and tunnel.

Locher, another engineer, developed Riggenbach's techniques when he tackled the more difficult ascent of Pilatus at the opposite side of Lake Lucerne, and a thousand feet higher than the Rigi. His route is from Alpnachstad to just below the peak; 1629 m are climbed in $2\frac{1}{2}$ miles at an average gradient of 1 in $2\frac{1}{2}$ with a maximum of 1 in 2. It is the steepest rack and pinion line in the world. Riggenbach's rack would have not been safe on such inclines so Locher designed a system of his own. Flat bars of steel with teeth on either side were laid between the tracks and the locomotives were fitted with horizontal pinions which gripped the track on both sides. In 1889 the old steam trains took eighty-five minutes for the ascent. Today's electric coaches, still using the same rack system, take thirty minutes. The running wheels need no flanges and the coach compartments are stepped; even the platforms are flights of steps. As ordinary switches on such gradients would not be safe, electric transporters are used to move coaches from one track to the other. The most spectacular part of the line is above Aemsigen Alp where the cars move diagonally across the precipice of the Esel, using a series of tunnels. At the summit, 2070 m above sea level, is a wide choice of walks, giving views of the Bernese Oberland.

All these peak-climbing railways have been electrified except one, the Brienzer Rothorn. Opening in 1892 it remained closed for many years as a result of the First World War and the depression. Some years after when it reopened in the 30s there was a proposal to replace it with a cable way. But interest in preserving steam was already growing and such was the local outcry at the prospect of losing their only steam line that it was agreed to keep things as they were; and so the tough little engines still push their loads of passengers up the $4\frac{3}{4}$ miles of track with grades of 1 in 4. From Brienz the train climbs through woods to high above the lake. At Planalp the engine takes on water, and there is a loop for passing. Nearby is a bridge so made that it can be dismantled in winter when the



52 *A 'kneeling cow' loco on the Brienzer-Rothorn*

line is closed, and rebuilt each spring after the avalanche danger is over. The line climbs steadily through barren alpine country to reach the upper terminal at 2252 m. The final summit is 90 m higher and the walk there gives superb views.

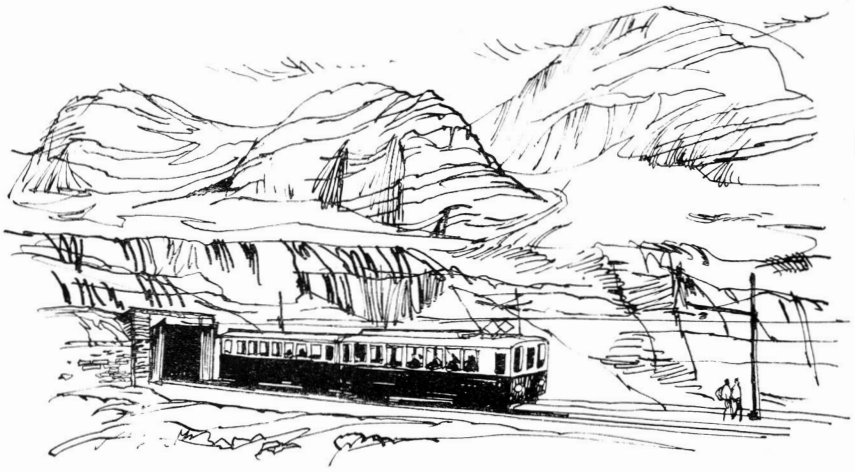
In the 1890s a series of private railways were opened to take tourists into the remoter and more spectacular parts of the Bernese Oberland. Mostly metre gauge, they centred on Interlaken, extending to Grindelwald and Lauterbrunnen. In 1893 the Wengernalp line was built over the Kleine Scheidegg, below the North face of the Eiger. Entirely rack operated it had a gauge of 2 ft $7\frac{1}{2}$ in, instead of 1 m, like the rest. Shortly after, a rack and pinion line joined Wilderswil and Schynige Platte, while the nearby sports resorts were made more accessible by cable cars and funiculars. The crowning project of these lines, the Jungfrau railway, was conceived by Adolf Guyer-Zeller. Begun in 1896 it was scheduled for completion in seven years. Work began at Kleine Scheidegg and the route was planned to scale the ridge to the Eiger glacier. From here a $4\frac{1}{2}$ mile tunnel zig-zagging through solid rock would take the line to the summit terminus. But the line was not completed until sixteen years of unexpected difficulties had passed. Guyer-Zeller died three years after the work was started but his engineers and work teams continued the struggle with the unexpectedly hard rock and the hazards of high altitude working. In all it cost $12\frac{1}{2}$m francs instead of the budgeted 7m, and only began to pay in 1949.

It is metre gauge with grades of 1 in 4 to the Eismeer station. From there to the Jungfraujoch the grade is 1 in 16. Originally of mixed rack and adhesion, rack

was installed over the whole length in 1951. The system can carry 2500 passengers a day and operates throughout the year. It is the highest railway in Europe, carrying passengers to a region otherwise accessible only to skilled and well-equipped climbers. At the Eiger glacier station passengers can see the overhanging ice curtains and grottoes. The two-coach train then enters the tunnel which is heated and lit. $1\frac{1}{4}$ miles from the entrance is the Eigerwand station, inside the Eiger wall. High glass windows have been cut in the rock face, 1800 m above Grindelwald village, giving bird's eye views of the valley. The next stop is Eismeer station; here again glass windows give exciting panoramas of the Wetterhorn and Schreckhorn. It is another fifteen minutes to the terminus, Europe's highest station, and the Berghaus, 3454 m above sea level. Here a gallery leads to the famous 'ice palace' cut from solid ice 60 ft below the surface of the glacier. There is a skating rink and various novelties, including a garage and cars, a cocktail bar and music room with instruments all modelled in ice. The more adventurous can hire dog sleds to the Aletsch glacier, while for the more romantic there is the sunset—all made possible by Guyer-Zeller's cogwheel trains which have lifted them 2887 m in $2\frac{1}{2}$ hours.

While the Jungfrau lines are the most famous the Rhône valley has a number of quite formidable rack and pinion routes. These run from the valley floor to give access to villages and winter sports centres. Below Visp there are the Leuk-Leukerbad, the Martigny-Châtelard, and the Bex-Villars. Finally at Aigle three railways meet; two are rack, one to Champéry, the other to Leysin. The main rival of the Jungfrau Railway, however, is the line from Zermatt to the Gornergrat, opened in 1898. Unlike the tunnelled Jungfrau line this one is nearly all in the open. The $5\frac{3}{4}$ miles of the route give views of the Matterhorn while from the summit is the famous glacial panorama of the Gorner glacier surrounded by the peaks of Monte Rosa, the Lyskamm and Breithorn. To make possible all-year working there is over a mile of snow shed at Riffelalp. More rack lines run from the shore of Lake Geneva, while on Lake Lugano is a unique line using diesel motive power. Here from Capolago a $5\frac{1}{2}$-mile journey climbs over

53 *A train enters the $4\frac{1}{2}$ mile tunnel to the Jungfrau terminus*



1200 m to the summit of Monte Generoso, to give views south to the Lombardy Plains.

Switzerland has a number of mountain lines using rack and pinion only on their steeper sections and some with considerable gradients up to 1 in 14 worked entirely by adhesion. The engineering is inspired. Such is the Rhaetian railway in Eastern Switzerland. This is a sparsely populated country, but good roads attracted trade until the opening of the Gotthard line in 1882. The Canton decided to develop a railway system of its own and a narrow gauge line was built from Davos to Landquart, with extensions to Chur and up the Albula valley to St Moritz. Eventually 244 miles of superb railway were engineered mostly single track, through narrow gorges, along cliff tops, through the spiral tunnels between Bergün and Preda, and over the elegant viaducts of the Landwasser. One of its branches, the Bernina, can, in spite of grades of 1 in 14 and 20 ft of snow at altitudes of over 2000 m, boast of all year round working by adhesion only. Most of the Rhaetian system is worked by articulated electric locomotives named after the towns of the Canton and capable of hauling a dozen coaches round the bends and twisting curves. Another branch, in the Vorder-Rhein valley, meets the Furka-Oberalp system at Disentis where through coaches are transferred. It is a halt for the 'Glacier Express', introduced in 1928 as a tourist attraction, connecting the Grisons and Valais regions. Originating in St Moritz it runs on the Rhaetian, Furka-Oberalp and Brigue Visp-Zermatt railways. Occasionally steam specials are run for rail fans and the F.O. Class HG 2-6-0 rack tanks can be seen here together with the old Rhaetian 2-8-0 tender locomotives.

Like the Rhaetian the Furka-Oberalp Railway is narrow gauge but makes extensive use of rack on the steeper grades. Covering 60 miles from Brigue to Disentis it was the last Swiss line to be built. It connects the Rhône and Rhine valleys which are separated by the Furka and Oberalp Passes, with the Urseren valley in between. Extremely difficult terrain, an immense switchback through remote country, the area suffers appalling winter conditions. No trains run on the Furka section in winter, but round Andermatt winter sports justify snow clearing for winter running. Begun in the 1900s it was not completed until 1926, being financed by the Federal Government because of its strategic importance. From Brigue the Rhône valley is followed, the higher levels being reached by rack and spiral tunnel. More rack sections take the trains on to Fiesch, a climb of 442 m in $8\frac{1}{2}$ miles. The rack used is the Abt type which has two parallel rows of teeth staggered in pitch. At Oberwald the mountains close in and the rack becomes continuous. Another spiral tunnel opens on to Gletsch and views of the Grimsel Pass. Ahead is the Furka Pass and the Rhône glacier. After the $1\frac{1}{4}$ mile Furka tunnel the train is at 2134 m, the second highest through line in Switzerland. Here, even in May, 50 ft of snow is common. In the Steffenbach gorge the bridge is dismantled every winter to prevent its destruction by avalanches. After Realp and Hospental, Andermatt is reached; the train is now directly over the Gotthard tunnel 335 m below the village. The line now climbs a 1 in 9 grade by a series of loops through nearly a mile of avalanche sheds to a summit at Oberalppasshöhe. Finally the descent to Disentis completes the 60 miles of switchback-starting at 650 m, attaining

2160 in the Furka tunnel, dropping to 1436 at Andermatt, up again to 2033 and then down to 1130 at Disentis. Even so the trains average 18 m.p.h. The 2-6-0 rack tanks of pre-war years have been replaced with forty-six ton BoBo electric locomotives. The steamers were until recently used for snow clearing and pole and cable reinstatement every spring. Some of my own most vivid memories are of two journeys on this railway, over thirty years ago; somewhere, mislaid but not lost, are box-camera snaps from those Y.H.A. days, many taken hanging from the steps of the curious little platforms at the ends of the coaches as the trains ground up the rack and round the curves under clouds of smoke and steam. And not only were the trains memorable, but also the views, the walks and climbs and the catering!—all made possible by these wonderful mountain railways.

Switzerland has an almost infinite variety. They are so much part of the landscape, attaining summits, scaling heights, tunnelling and cutting through great alpine barriers. The engineers must never have heard the word 'impossible' as they drove their tracks through, up and over the summits. Their imagination and ingenuity and their essential practicability have made a whole new world available for everyone to experience and enjoy. No longer are the mountains to be feared, no longer are they unapproachable; buy a ticket—they are all yours.

54 *A 'steam special' on the Furka-Oberalp headed by No 4*