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a promising electrical apparatus on condition that the whole drying process were carried out rationally.

From the technical point of view, the task was the following one :— To obtain a sufficient amount of the steam and air mixture, resulting from the electrical heating of the grass and to get this mixture in the best composition into as small a volume as possible, then to transmit as much as was feasible of the heat contained in the mixture to another part of the material being dried this also in as small a space as possible. This problem was solved by means of two drying chests which are strongly ventilated and in a special way, through which the goods being gradually dried are passed successively, being caried on several superimposed endless sieve belts. The latter are so designed that adherence of material to the driving organs does not occur. This used to be feared, as it affected the working and life of the belts. The thermal exchange processes are brought about by new and automatic devices of simple design.

A first trial apparatus was built in the first half of 1940. It was run and tested during several months. The apparatus has an uncovered travelling belt on which it is easy to distribute the fresh grass loosely and evenly, a fan set with air ducts, and the sectioned drying chests from which the dried grass is taken from below. The first tests carried out on the rather primitive apparatus as regards heat insulation and the preparation of the air and steam mixture proved that the saving in heat was greater than in any former apparatus for the same purpose, with a remarkably high quality of the dried grass.

A test carried out in August, 1940, with 333 kg. of grass containing 81.5 per cent. moisture resulted in a final production of 67 kg. of dried grass for an energy consumption of 200 kWh.

In the subsequent period, the experimental apparatus was subjected to more than 30 continuous service tests, in which a variety of working conditions were reproduced, such as might be expected in practice, or as were required to study the working of the apparatus. The mechanical part of the apparatus proved satisfactorily reliable after some alterations. The delicate parts such as the heat exchanger in which the vapour is condensed and the electric air heater could be kept perfectly clean and the cleaning of the drying chamber proved as practicable as in any other drying apparatus.

Further, attendance on the drying machine and adjustment of the drying process itself did not present any more difficulties than were encountered in other drying apparatus, and, as could be expected, the well-known advantages of electricity as regards cleanliness and facility of control showed up here to the full..

THE FURKA-OBERALP RAILWAY.

(" *Modern Transport*," 17*th October*, 1942.)

Switzerland contains a number of noteworthy narrow-gauge railways which can be accurately described as trunk lines, and most remarkable of these is the system formed by the independent Rhætian, Bernina, Furka-Oberalp and Visp-Zermatt Railways, which provides a long east-to-west link between the Cantons of Grisons and Valais. Geographically, the system is most interesting, for it connects the upper reaches of the Rhine, the Rhône, the Inn belonging to the Danubian system, and the Paduan rivers flowing to the Adriatic.

It was not until 1926 that the opening of the recently electrified Furka-Oberalp Railway between Brigue and Disentis closed the last gap between the Rhenish system of the Rhætian Railway and the upper valley of the Rhône. In 1930, the gap between it and the Visp-Zermatt Railway was closed and there was established unbroken communication by metre-gauge railway between the towns of the Rhætian Alps and Zermatt in the shadow of the Matterhorn. The total distance from Landquart on the Rhine to Zermatt viâ this route is just under 133 miles, of which 60¼ miles is contributed by the Furka-Oberalp Railway. Between Chur and Landquart, the route runs parallel to the Swiss Federal Railways, while the short metre-gauge line of the Schöllenen Railway connects the Furka-Oberalp at Andermatt with the Federal St. Gotthard line at Göschenen. The Furka-Oberalp Railway had a chequered early history; work was begun on it in 1910, and it was opened from Brigue to Gletsch in 1915. Operations were then suspended and for years the line remained unfinished. Construction had been started at strategic points and for a while Andermatt had a tragi-comic example of a railway station and yard, complete with a running shed containing one steam locomotive, isolated from all other railways and with its approach tracks petering out into an Alpine wilderness at each end. The marooned engine had been transported to the spot in paris and there erected, for use in pushing forward construction of the line in both directions. The Schöllenen line was not yet built.

In 1923 the company went bankrupt. The completed section was put up for auction, and bought for S.fr.1,250,000 by a syndicate headed by Mr. A. Marguerat, director of the Visp-Zermatt Railway. Work on the unfinished line was then prosecuted with great energy, and, as we have remarked, was completed between Brigue and Disentis three years later. It included a tunnel on the Furka Pass, 1.21 miles long, at an altitude of 7,100 ft. above ordnance datum. A bridge over the Steffenbach gorge was twice wrecked by avalanches, after which a movable bridge was installed at this point, the structure being dismantled in winter when there was no through service over the mountain section between Oberwald and Sedrun, near Disentis, except on the short stretch between Andermatt and Nätschen on the Oberalp Pass, kept running for winter sports traffic. Eleven sections were equipped with Abt rack rails, the total rack-equipped route mileage being 19¾ miles. There is a ruling gradient of 1 in 9, and other interesting physical features include the remarkable spiral ascent near Griengiols. Gletsch station takes its name from the adjacent Rhône glacier, and east of this the line crosses the Furka and Oberalp Passes into the valley of the Vorder Rhein.

Steam traction was adopted, with 34-ton 2-6-0 tank locomotives of characteristic Swiss type, built for both rack and adhesion working. These took over the through trains from the electrically operated Rhætian Railway at Disentis. Coaches were of the central gangway type from the first, the usual load for one locomotive being three bogie carriages and a four-wheel van. Petrol railcars, two in number, were of later introduction, and were used in the operation of light winter services. In 1930, when physical connection was made between the Furka-Oberalp and the Visp-Zermatt Railway, the celebrated Glacier Express was inaugurated between St. Moritz and Zermatt, a distance of 167½ miles viâ the Albula line, Thusis and Reichenau. On this service, vehicles of the Rhætian Railway worked right through to Zermatt in turn with vehicles of the other two companies controlling the route, and Schöllenen Railway coaches likewise ran through from Göschenen to Zermatt.

The Rhætian Railway system was electrified during 1913-22 on the 11,000 volts, 16⅔ cycles single-phase system; indeed, its 30-mile section between Bevers and Schuls has always been electric. Somewhat later, in 1929, the Visp-Zermatt Railway was likewise converted. The Furka-Oberalp Railway, however, continued for a relatively long time to be worked by steam traction, so that the through trains, while beginning and ending their journeys behind electric locomotives, made the central part of the cross-country journey under steam power. War conditions have made the position of the steam line in Switzerland one of increasing difficulty, and the electrification of the Furka-Oberalp, foreshadowed for some time, has now become a reality. It is, of course, equipped on the same system as its neighbour lines, to which the connecting Schöllenen Railway, originally equipped on another system, has been converted. Electric traction between Brigue and Disentis began on July 1st of this year.

At the same time, opportunity has been taken to render the Oberalp section usable at all times of the year, and extensive galleries and avalanche tunnels have been built to this end. In the Furka Pass the line will be closed, as before, during the winter, and here the supports of the contact line have been made demountable, to be removed on the cessation of the seasonal train service. Oblique catenary suspension of the contact line has been employed on the curves, an existing and entirely successful practice of the Visp-Zermatt Railway having been followed in this respect.

For through passenger and goods trains, four-motor, four-axle electric locomotives have been built, having an hourly output of 1,400 h.p. Additionally, there are electric motor coaches with two motors on each bogie, giving a total output of 1,300 h.p. With these new motive power units, the journey time between Brigue and Disentis has been reduced from 4 hr. 45 min. to 3 hr. 15 min. Locomotives and motor coaches are designed to attain a maximum speed of 37 m.p.h. on adhesion lines and 18.6 m.p.h. on the rack sections. New motive power has also had a very favourable effect on the timing of the Schöllenen Railway, the short journey of 2½ miles up the gorge from Göschenen now occupying 11 instead of 22 min. For operating the through cars over the Schöllenen line, new four-wheeled locomotives with a total output of 650 h.p. have been introduced. Electric motor coaches operate the ordinary passenger service between Göschenen and Andermatt.

SCHWEIZERISCHE SCHIEFERKOHLE.

Schon während des letzten Weltkrieges wurden neben den *Anthraziten* des Wallis und unseren Molassekohlen auch unsere *Schieferkohlenlager* abgebaut. Diese Schieferkohlen sind, geologisch gesprochen, ein junges Produkt. Ihre Bezeichnung leitet sich von ihrer Eigenschaft ab, in trockenem Zustand schieferartig aufzublättern.

Die wichtigsten Vorkommen liegen in der Gegend des oberen Zürichsees und der Linthebene, wo sie am Berghange nördlich der Bahnlinie *Uznach-Gauen-Kaltbrunn* auf 4 Km. Länge und 1,2 Km. Breite erschürft wurden. Ihr Abbau geht bis auf das Jahr 1763 zurück. Eigentlicher Bergbau setzte jedoch erst seit 1822 ein, war aber wenig rationell, weil allzuviele Unternehmer sich gegenseitig konkurrenzierten. Ihre Streitigkeiten führten schliesslich zur Intervention der St. Gallischen Regierung, welche 1829 die Produktion kontingentierte, damit aber wenig erfolgreich war, sodass dieses Gesetz wieder aufgehoben werden musste. Eine Blütezeit erlebten diese Gruben von 1850 — 1860. 1850 wurden beispielsweise 150,000 Meterzentner ausgebeutet im Werte von 240,000 Fr. und in den folgenden Jahren hob sich der Jahresgewinn auf 850,000 Fr., woran 20 Betriebe beteiligt waren. 1912 erlosch der dortige Bergbau. Total wurden bis dahin vielleicht 500,000 Tonnen gefördert, wovon ein Viertel im Produktionsgebiet und der Rest in den Kantonen Glarus und Zürich abgesetzt wurde. Im Ganzen sind über 125 Ausbeutungsstellen und bis zu 5 verschiedene Flöze mit z.B. bis zu 3m. Mächtigkeit bekannt. — Von weiteren Vorkommen dieser Gegend seien noch diejenigen von *Wangen* genannt am Südufer des oberen Zürichsees, am Südhang des Buchberges, sodann solche bei *Eschenbach*, 5 Km. westlich von Uznach, und weiterhin diejenigen von *Dürnten* und *Wetzikon*, nördlich von Rapperswil. Alle diese Vorkommen wurden früher gleichfalls ausgebeutet. Die Betriebe gingen jedoch ein. Einige dieser Lagerstätten sind heute erschöpft oder sind nicht mehr abbauwürdig. — Schieferkohlen finden sich auch bei *Mörschwil* zwischen St. Gallen und Rorschach, welche schon seit 1827 ausgebeutet wurden, wahrscheinlich aber schon viel früher bekannt waren. Eine erste Blütezeit erlebte der dortige Bergbau in den 50er Jahren des vorigen Jahrhunderts als die Industrialisierung der Ostschweiz rasche Fortschritte machte, was eine vermehrte Nachfrage nach Brennstoffen zur Folge hatte, welcher jedoch zufolge der damaligen Verkehrsverhältnisse nicht in genügender Weise entsprochen werden konnte. Auch in den folgenden Jahren stand der Bergbau in Mörschwil niemals still bis endlich im Jahre 1895 der letzte Betrieb einging. Ein anderes Vorkommen von Schieferkohle ist dasjenige von *Gondiswil-Zell* an der bernisch-luzernischen Kantonsgrenze, welches im Gegensatze zu den bisher genannten erst im Jahre 1893 entdeckt wurde. Von allen Schieferkohlenlagerstätten ist diese mit bis zu 5 verschiedenen Flözen, von denen einige bis zu 4½ m. Mächtigkeit erreichen, die weitaus produktiveste. — Ausser den bisher angeführten sind noch eine ganze Anzahl anderer Schieferkohlevorkommen bekannt, welche hier jedoch wegen ihrer praktischen Bedeutungslosigkeit nicht erwähnt werden sollen.

Zur Zeit der Kohlennot während des letzten Krieges wurden die meisten unserer Schieferkohlenlagerstätten genau untersucht, und Manche derselben lieferten in der Folge einen nicht unbeträchtlichen