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army training site for mounted-transport units on their soil.

Still, over 10,000 hectars of land have been bought by the army since the '50s. The policy is to the use acquired areas as intensively as possible. When the land is not the army's own, then contracts have to be passed with landowners. There are presently about a hundred projected land-acquisition schemes filed in the army's training headquarters. For them it is prepared to devote some 800 million francs to the end of the '80s.

Not only is land lacking, but so are the indispensible instructors. There are 1,232 of them in the recruit schools. This amounts to one instructor for 35 recruits, a proportion which is distinctly too small in the more specialised units.

The general trend of defence policy then seems to aim towards a perfecting of the type of defence on which Switzerland has traiditionally relied. The army remains essentially defensive; the introduction of helicopters does not alter the fact that infantry forms the backbone of our defence. The efforts that have been made in developing civil defence, the plans for coordinating it with military defence and the new organisation of the territorial services point towards a firm (and perhaps static) but more efficient protection of every foot of Swiss soil.

(Compiled from news received by courtesy of Agence Télégraphique Suisse)

THE SWISS RAILWAYS TODAY

By G. Unseld

Switzerland is a small but densely populated country, covering an area of just under 16,000 square miles which is about twice the size of Wales. The extreme distance from west-south-west to east-north east is 226 miles and 137 miles from north to south. Only about half the territory can be lived in throughout the year. The remainder is made up of mountains and lakes. The population of the cultivated areas is 950 per square mile, which is about $1\frac{1}{2}$ times as high as the comparative figure for the U.K. and Northern Ireland.

The mountainous and hilly nature of the landscape presented a tremendous challenge to Swiss railway engineers and their contractors. Twenty-two years after the Stockton-Darlington opening (1825), Switzerland opened its first Railway, Zurich-Baden 19 miles.

During the second half of the last century, Switzerland's Railways consisted of five relatively large and some smaller private concerns. (The Jura Simplon Railway opened an Office in London 1893). The Swiss Federal Railways were established at the beginning of this century by the so-called "Redemption Law" which the Swiss electorate passed by an overwhelming majority. The change from privately owned railways to a State Railway (nationalisation) was carried out under the slogan "The Swiss Railways for the Swiss People".

Today the Swiss Federal Railways own a well equipped electrified network of approximately 1,800 route miles. The gauge is standard, 4 ft. $8\frac{1}{2}$ inches except for 46 miles of the 1 metre Brunig Line Lucerne-Interlaken. A network of similar size is still under private ownership, but apart from the Loetschberg Railway, South Eastern Railway, Bodensee-Toggenburg Railway (all standard gauge) and the Rhaetian Railway (metre gauge), the 300 companies are mainly small concerns including rack-and-pinion railways, funiculars, aerial cableways etc.

As a result of the unpleasant experience gained during the first world war, when no coal or oil could be imported, the electrification of Switzerlands Railways was started early. The Swiss Federal Railways started this tremendous task in 1919 and completed the last stage in 1960. The resp. investment of £150 million although huge for a small country, was well worth while, because without electric traction the Swiss Federal Railways could never have coped with the extraordinary volume of traffic offered during the second world war when all other branches of transport almost completely broke down through lack of oil and petrol. Nor would it have been possible for them to cope with the vastly increased traffic brought about in the last two decades by the economic boom and the Common Market trade. Electrification also contributed considerably towards increased efficiency and rationalisation of operations. These factors all reflected in the satisfactory financial results of almost 20 years during which the Government was not called upon to take over any financial burden, but collected nearly £15 million in the form of interest on capital.

The big Stride

Increased efficiency all round helped by the improved performance of electric traction have achieved remarkable results but especially on the busy Gotthard route, where the tonnage of the goods traffic carried has increased almost threefold between 1950 and 1962. The *daily average* of goods carried between Wassen and Goeschenen for example was 19,400 gross tons in 1950 as compared with 66,600 tons in 1968. Some peak days registered as many as 100,000 tons.

The Swiss Ae 6/6 locomotives of 6,000 h.p. have virtually revolutionised traffic operations between Erstfeld and Chiasso where they haul 15 four axles passenger coaches or goods trains of 26 wagons of 25 tons at 47 miles an hour on gradients up to 1 in 40. This corresponds to a weight of 650 tons being lifted approximately 21 in. a second. Overtaking of slow goods trains on this route by express passenger trains is a thing of the past, as they run at the same speed. The introduction of a whole number of special measures coupled with the amazing progress made in locomotive design made this outstanding performance possible. Centralised train operating supervision introduced in 1956, operating and locomotive control, up to date signalling equipment (illuminated panels representing the track layout of the controlled area), shorter and automatic block sections, (81%) were some of these measures.

Another important contributory factor is the modern rolling stock especially the EUROP freight wagon pool, to which each member administration contributes a certain number of freight wagons, and which cuts out the empty run back to the home country. More than $\frac{1}{4}$ of a million such wagons are freely available to the member administrations. The modern freight wagon is naturally equipped with air brakes which make it possible for whole trains to be moved by a single manned electric locomotive and only one guard.

Three Titans

The phasing out of the first electric locomotives which have given over 40 years of service, is well under way. Their output was 2,000 h.p. which now looks very small compared with the latest locomotives. In their time however, they represented a considerable improvement on the last steam locomotives of 1,580 h.p. used on Swiss main lines.

Today the building programme is limited to three types of main line locomotives.

1. *The Ae 6/6* class which has two three-axle bogies (all axles power driven), a normal rating of 6,000 h.p. (which can be developed to as much as 9,000 h.p.). Of the original order of 120, all were in use by last year. Weight 120 tons. Maximum speed 77 miles per hour. Working heavy trains on steep gradients.

2. *The Re 4/4 II* class with four power driven axles (2 bogies) and an

output of 6,500 h.p. working heavy trains on level stretches (fast inter-city services). Weight 80 tons. Maximum speed 87 miles per hour. Of a final total of 174, a first batch was ordered in 1964; about 70 were in use in Summer 1969. Of the older Re 4/4 I 50 units are in use.

3. *RBe 4/4* railcar class with four power driven axles (2 bogies), output 2,720 h.p. light and medium express trains and stopping passenger trains. Weight 68 tons. Maximum speed 77 miles per hour.

In 1959 push-and-pull trains were introduced where fixed train formations could be used. These trains can be driven from either end, locomotive or a driving cab, thus avoiding locomotive movements at the train terminals.

Last year saw the introduction of yet another new improved train type, the electric three-unit suburban train with centre couplings, between Zurich and Rapperswil. Greatly improved acceleration is achieved by applying power to all axles. This is obviously of great importance on lines where station distances are short. Special carriages are reserved for season ticket holders in order to save manpower (travelling ticket collectors). These trains run at half-hourly intervals between 5 a.m. and midnight. The journey for this 22-mile run takes 51 minutes including 16 stops. This represents a saving of 10 minutes on the best previous time.

All for your comfort

Parallel with the programme for the introduction of the vastly more efficient traction vehicles, goes the effort aimed at increasing the standard of comfort for the travellers. Progress in track engineering such as continuously welded rails (800-1,000 yds) and shock-absorbing spring points achieve much smoother running of the rolling stock. In the last 10 years, 1,000 route miles were modernised in this way. (Total 1,800 miles). Light alloy coaches with small diameter wheels (2 ft. 7 ins.) reclining seats, comfortably cushioned and individually adjustable, acoustic and thermic insulation, double glazing, fluorescent lighting, tastefully chosen colour schemes for panelling and roofs create an atmosphere of truly gracious living and have therefore great passenger appeal. The last word in modern rail travel is no doubt the sleek and fast, TEE train, linking the principal European cities, and bringing Paris 5 hours 50 minutes away from Zurich, and Milan 3 hours and 47 minutes.

The Swiss Federal Railways participate in the Trans European Express network with five electric train sets which can operate on all electrified European lines and which run regularly in Switzerland, Italy and France under four different current supply systems, and with two Diesel trains for the lines Zurich-Brussels-Amsterdam and Zurich-Munich. The counter part of the TEE in the goods sector is the TEEM (Trans-Europ-Express Merchandise) conveying goods from the production areas (fruit and vegetables in the south) to the large consumer centres in the north. Some TEEM trains cover the distance Chiasso-Basel in 5 hours which is the time taken by fast passenger trains.

Of considerable interest is the way the Swiss Federal Railways have organised the transportation of cars through the Alpine Tunnels. They run special car conveying trains of the push-and-pull type. The wagons are linked with stout steel flaps over the buffers. This allows whole columns of cars to be driven (by their drivers) the full length of the train. Loading and unloading is possible in a matter of minutes, especially since there is no need for the occupants to leave the cars. The cars close up to within inches of each other, regardless of whether they come to rest with both axles on the same wagon. The frequency of these trains is flexible according to demand and no pre-booking is necessary. The simplicity and speed of this system is such that many motorists use the service even during the summer months when the Alpine passes are open. Easter and Whitsun bring peak frequencies, when approximately 6,000 cars are conveyed on a single day.

The Channel Tunnel Study Group have some time ago studied the possibility of its application for their future operations.

A new service is now available to European Road Hauliers working the north-south route. They can transport their heavy articulated trailers on low wagons through Switzerland and the Gotthard Tunnel during the night without personnel.

The container revolution

Great strides have been made during the last 15 years in the mechanisation of Goods Handling. The equipment adopted by Swiss Federal Railways includes pallets and accessories for every commodity, fork lift trucks, containers cranes and road transporters.

The standard pallet (approximately $2\frac{1}{2} \times 4$ ft.), a double sided portable wooden platform was introduced in 1952 and has proved to be one of the most successful ways of saving labour and accelerating goods handling. So far about 6,000 Swiss firms have joined the pallet pool of the Swiss Federal Railways. All partners contribute to this pool by supplying a certain number of pallets.

When the rail users hand in loaded pallets at the goods station, they receive the same number of empty pallets for future use. The owner of the pallets is the partner who happens to be in possession of them. This system avoids subsequent checking and accounting. At the present time there are about 1,000,000 of these standard pallets in circulation, or available in goods sheds, warehouses, stores etc. As Switzerland has a population of 6,000,000 this means a pallet for every six members of the population.

The Swiss standard flat pallet can be used in traffic with 18 European countries (except Great Britain, Spain, Portugal, Rumania, Greece and Turkey) in the same way as in the Swiss domestic traffic.

As the weight increases, containers (high walled or tanks) with wheels replace the pallets.

Fully laden railway wagons can be taken to their destination by low level road transporters, owned by the railway or by forwarding agents.

For bulk and special goods all types of special purpose wagons are available i.e. tank wagons for oil and petrol, silo wagons for grain, hopper wagons for coal or coke, elevator tipping wagons for tipping loads into lorries, folding roof and sliding roof wagons.

Among well wagons, a new type can carry loads of up to 270 tons. Such loads present a weight distribution problem (the maximum permissible load on a wheel being 10 tons) which was solved by a ingenious application of balancing frames resting on three, three-axle bogies on either side of the load, which is suspended (very low over the rails) between the two-bogie combinations. This 36 wheel wagon is especially suitable for transformers. All the efforts aimed at higher speeds and rationalisation could of course not ignore the safety factor. It is in this field that the Swiss Federal Railways have also achieved remarkable results. They started experiments with their own automatic train control system 35 years ago. This is based on the magnetic principle. One magnet pair is positioned on the track. Its counterpart on the locomotive passes over this without making physical contact. There is in fact a gap of approximately 4 inches through which the magnetic field operates. Today 94, 7% of the total network is equipped with this system.

Technology for safety

There are three major locomotive safety devices: the foot pedal which cuts out the current and applies the brakes after 100 yds. if it is not kept depressed, the brakes will also automatically be applied if the driver has not operated the train controller, the control handle or the brake valve control over a distance of 1 mile. In both cases a warning signal will precede the setting in motion of the braking sequence, so that the driver can stop their unintentional application. Thirdly, if the train is allowed to pass a distant signal showing danger or if the driver passes a home signal set against him, a horn will sound in the cab. If this signal is ignored by not cutting out the automatic train control, the emergency brakes will be applied immediately.

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