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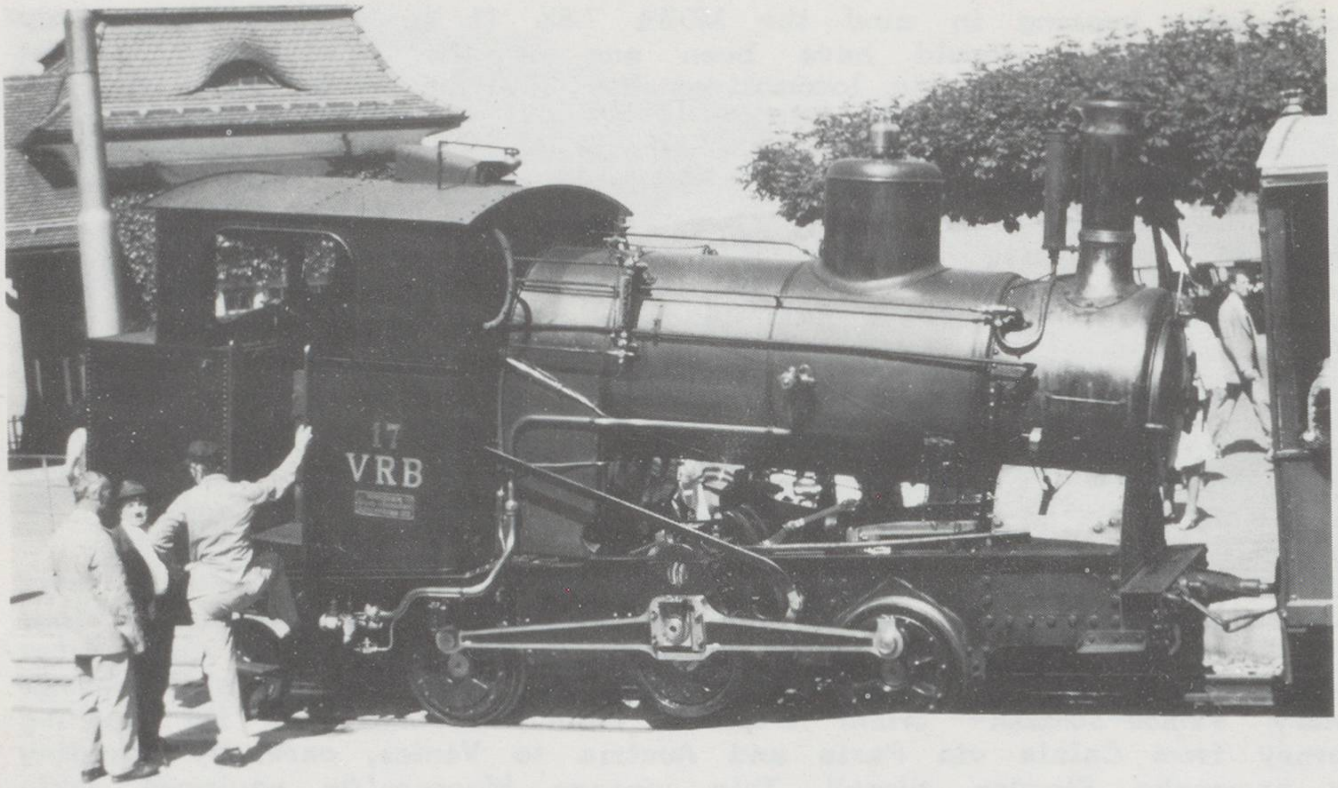


Vitznau-Rigi Bahn 0-4-2T, class H2/3 at Vitznau, 26 July 1975. SLM No 3043, built 1925. *Photo P.Russberger*

THE NEED FOR THE KNEELING COW

by Paul Russberger

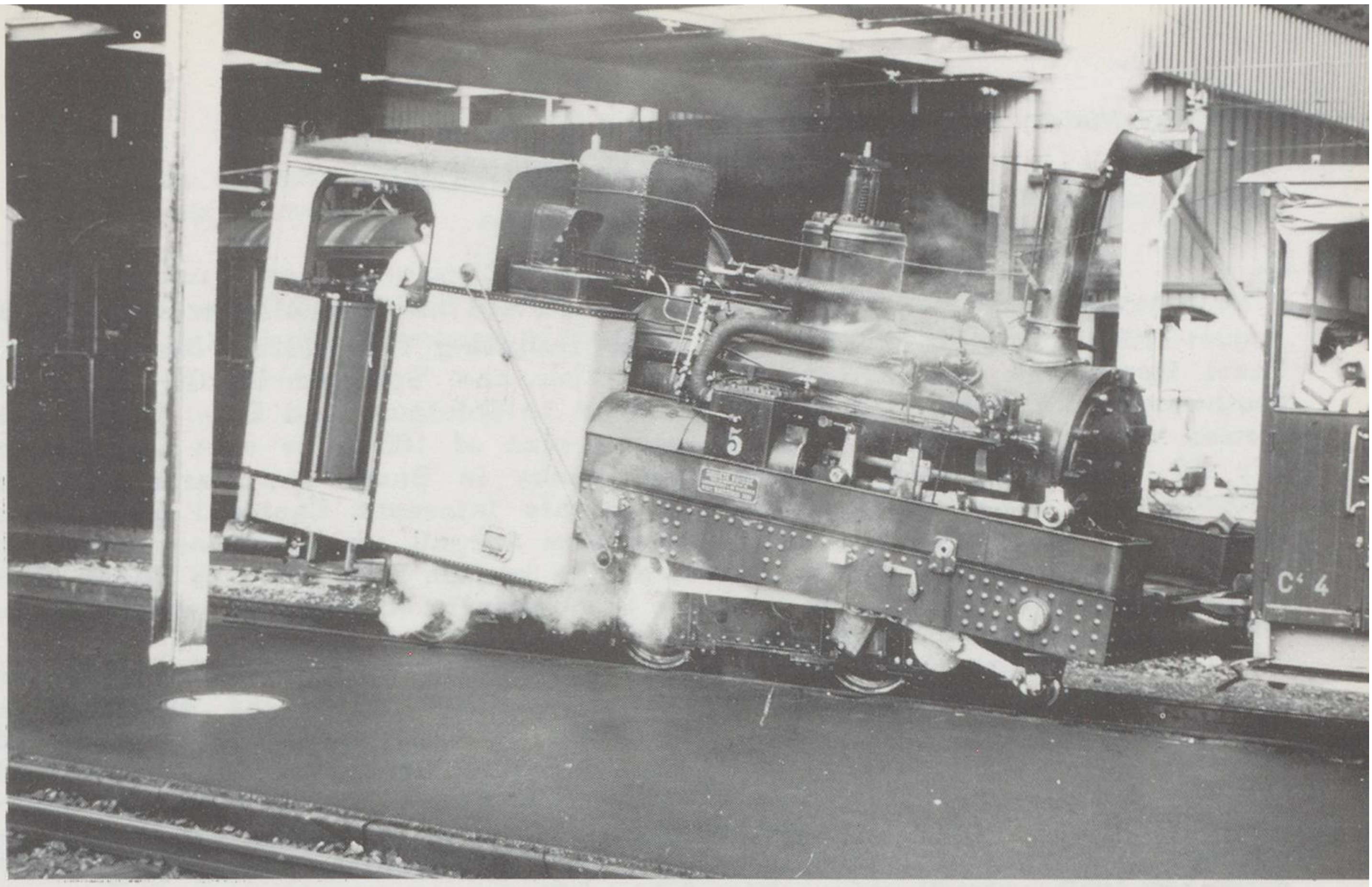
No, nothing to do with milk or, still less, chocolate

K*neeling cow* is the nickname given to pure rack steam locomotives with inclined boilers because, when standing on level track, their profile has just that aura. But bearing in mind that other steam locomotives work effectively with the axis of their boilers parallel to the track, why do these machines have their boilers so pitched as to give them such a curious (if not quaint) appearance. The answer lies in the word "effectively".

It is worth recalling the internal arrangement of a steam locomotive boiler (Fig.1) At one end is the firebox where the fuel is burnt. The hot gases which result from the combustion pass through tubes to the smokebox at the other end. The firebox and tubes are surrounded by water which is being heated to produce steam. This collects in the steam space at the op of the boiler from where it is passed via the regulator to the cylinders.

In designing a boiler it is necessary to make sure that the opening leading to the regulator is far enough above the surface of the water to prevent water being carried over into the cylinders - a situation known as priming - and that there is sufficient free water surface to enable the steam to pass easily from the water to the steam space. If the last condition is not met, steam discharge will be localised and violent. (It is the same effect of the small surface area of wine in the neck of a champagne bottle which helps to produce the spectacular effect when it is opened!)

Now suppose the boiler of a rack locomotive remain parallel to the track when it moves onto a gradient. The water would run towards the firebox, well and truly covering the crown and probably filling it to the outer wrapper



Schynige Platte Bahn H2/3 No.5 at Wilderswil in August 1988. SLM No.881 of 1894. *Photo Paul Russberger*

plate as well! It would also be necessary for the fireman to fill the boiler still further to ensure that the tubes are adequately covered at the smokebox end. This would reduce the volume of the steam space, the distance between the steam collector and the water level as well as the surface area of the water. Fig.2 illustrates the situation. Indeed there might be no free water surface above the firebox - the hottest part of the boiler, where the rate of evaporation is greatest and there is most need for free water surface. This would actually occur in a *Britannia* class boiler on a gradient as shallow (by rack railway standards) as 1 in 10.

The fireman would be faced by another difficulty. Since the water level would have disappeared out of the top of the gauge glass, he would have no idea of where it stood or whether the front of the boiler tubes were covered.

These problems are neatly solved by inclining the boiler so that it is more or less horizontal when on the rack sections.

There is one disadvantage. On *level track* a higher boiler water level must be carried to prevent the firebox crown being uncovered, thus reducing the steam space and the free water surface area. This is a small price to pay, as the locomotive is not then working hard so the demand for steam is much less than when it is mountain climbing ■

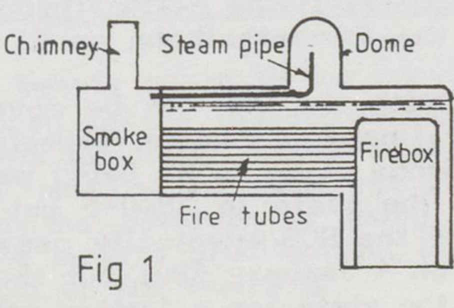


Fig 1

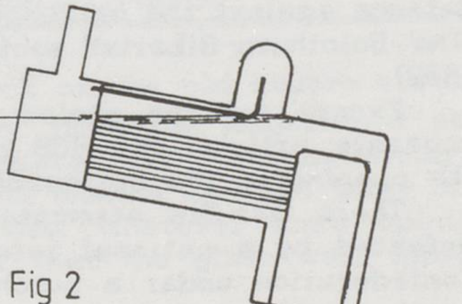


Fig 2