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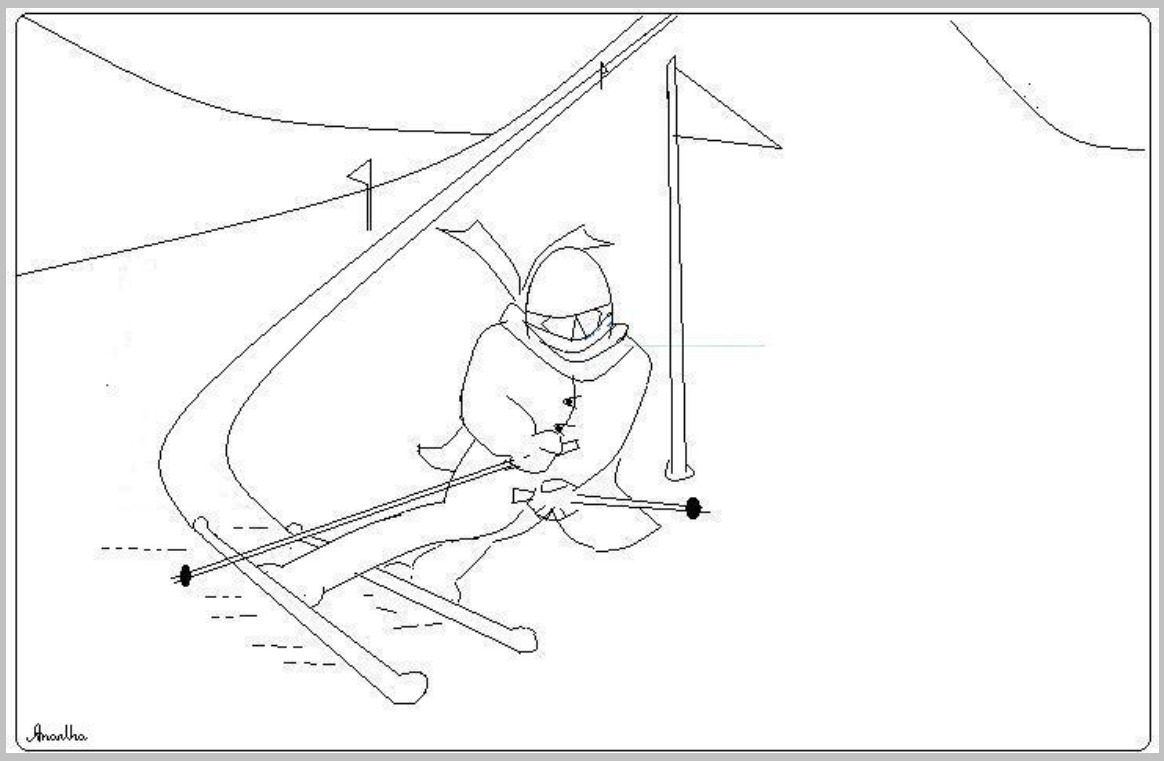


Science and swifter skiing

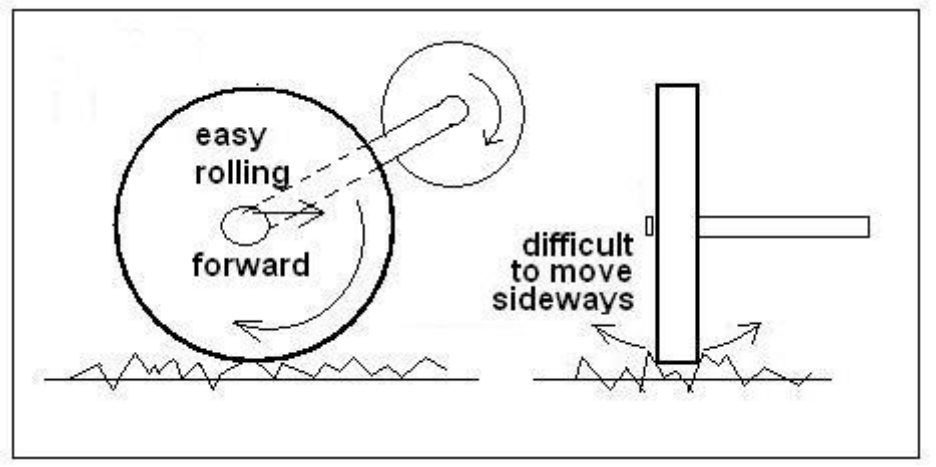
Science has helped sports define new standards of performance, says S.Ananthanaryanan.

From better running shoes, fiberglass pole vault poles, high power racing cars, astro-turf, lightweight tennis racquets – technology has kept raising the bar for the athlete or sportsperson. The latest is the University of Sheffield's innovation that will make a difference in winter sports. The University has formed a company called ***Widlfire Snowsports*** to commercialize a way to cut friction and improve performance of skis in speed trials

First came the wheel

Wheels were the first devices to increase speed. The wheel typically reduces friction by rolling over irregularities rather than 'scraping' through them. Development of the wheel changed civilization by enabling quick transport – to maximize trade and amplify the reach of kings and armies. And then, with the economic effects of speed, came the sporting effort to make the best speed – the chariot races of Rome and similar events in other parts of the world.

Now in the movement of the chariot, while the action is to reduce friction in moving forward, there has to be solid sideways friction to keep the chariot in its track and also to enable turns left or right. The first is achieved by rolling forward, and the second by the sharp profile of the chariot wheel.



Sliding and the ski

But the wheel needs a rigid surface to roll over and is not effective in moving in snow. Fortunately even the irregularities in snow are not rigid and hence sliding over snow is possible. The sledge and the ski then became the 'wheels' of the winter. Apart from using sliding motion, the runners of sleds and skis spread weight over a larger area, to reduce penetration of the snow. But this is where some kind of optimization becomes important.

The irregularities in a snow surface do not only collapse under the sled but they also melt, and provide a thin layer of water. The melt is because of both the heat of friction and also because the melting temperature of ice gets lowered when the pressure increases. Now the combination results in a layer of water, which reduces friction, but the layer of water also tends to make the sliding object 'stick' to the snow surface – and this would increase the drag. It is over centuries of use that the correct dimensions for the runners of sledges and skis have got developed, to be suitable for different uses - for carrying loads or for moving fast. And like in the case of the wheel, a class of sled and skis is meant entirely for speed, and even these are made differently for different slopes and varieties of snow.

Controlling friction

Like the wheel, the ski also needs friction to help stay on course and to make turns. In the case of the ski, this is of vital importance because the speeds are high and the sportsperson is unprotected. This friction is again in the sideways direction and it is achieved by the sharp edges of the ski runners. But for forward speed, the friction needs to be kept low. Here, it is tiny imperfections in the surface of the ski that limit the best speed the skier can make.

In sporting events, hence, the ski is carefully waxed before the start of the race. But the trouble is that the wax does not last the whole race and the speeds fall towards the final laps. Dr Alex Routh of Cambridge University and Prof Peter Styring, at Sheffield University have developed a method to continuously lubricate skis during the progress of the race.

According to the rules of the Féderation International du Ski (FIS), no eternal device or energy input is permitted. Hence ski design cannot use batteries or even compressed air, to pump wax

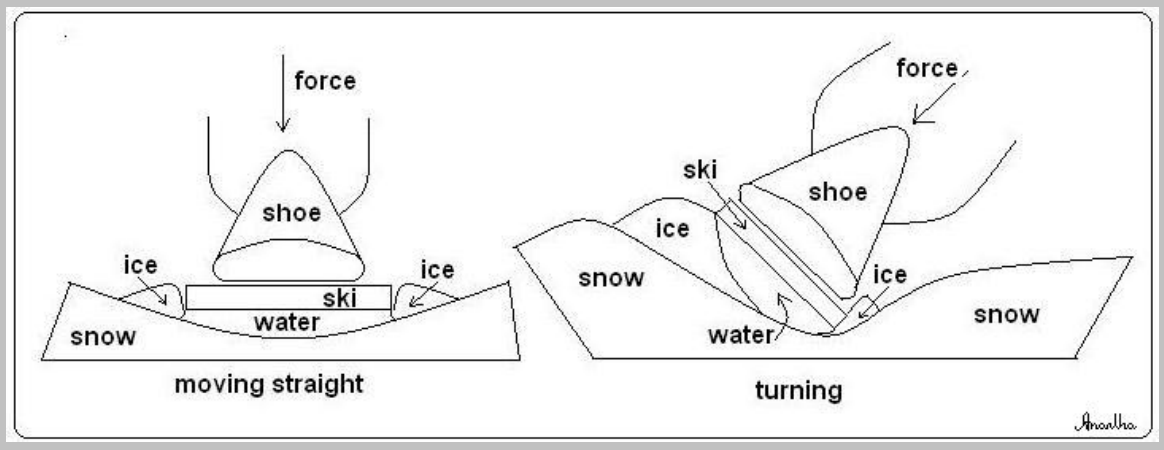
onto the ski surface. Over the last 3 years, Routh and Styring developed the right kind of wax and also a way of slowly pumping the wax on to the skis. The wax is stored in a reservoir just below the skier's foot and there is a system of tubes and valves to carry wax to the surface of the ski. The wax is propelled by the force of the skier's weight – and hence there is no external source of energy!

The system has been extensively laboratory-tested and trials on Austrian ski slopes showed a speed improvement of 2%, which is awesome in Olympic speed events. The wax is inert and biodegradable and comes in different grades to suit snow varieties and temperatures.

Warming the skis

One method or reducing friction was to promote melting by warming the skis. The trouble with this method was that the skis became too slippery and were difficult to control

In the usual skis, the pressure of the ski melts snow and creates a thin layer of ice underfoot. The extra water is squeezed out and this water freezes as soon as it emerges. This 'bulge' of ice helps the ski hold on and make turns.



But when the skis are heated, the water does not freeze and the skier cannot turn – the skis keep going straight even when the skier uses the edge, to the skier's peril!