



CAN YOU Believe it?

WITH ASSOCIATE PROFESSOR DEREK LEINWEBER

Behind the seams

SOME tormented cricket batsmen are sure that a ball that starts swinging early will stop mid-flight. Others are certain that a straight ball will suddenly swing late in flight. Yet others have reported swing to one side to be mysteriously reversed.

Of course, it all happens so fast that one might wonder if it's all in the minds of the batsmen.

In fact, it's all possible if you know the tricks up the bowler's sleeve.

Through years of experimentation, trial and error and passing down of folk-lore secrets from one generation to the next, today's top bowlers like England's Andrew Flintoff can reduce even the most seasoned batsmen to French cutters.

To appreciate how the ball can swing from one side to the other as it travels through the air at speeds of 110km/h, one needs to know a few basic facts about how air moves around the ball.

On the surface of the ball is a coating of air that is carried along with it. Further out is air that is undisturbed by the ball's motion.

In between these extremes is a layer of air known as the boundary layer.

At the very high speeds obtained by today's best bowlers, this air layer is compressed to only a few millimetres thick. This thinness makes the protruding hand-stitched seam of the cricket ball a big deal in the ball's aerodynamics.

Air flowing around the ball in the boundary layer has a longer distance to travel as it follows the contour of the ball. It therefore must travel faster than air outside the boundary layer. The air must stretch out as it speeds up - much like cars moving off from a stoplight - resulting in low air pressure in the boundary layer.

Manipulating this boundary layer can be used to suck the ball in different directions.

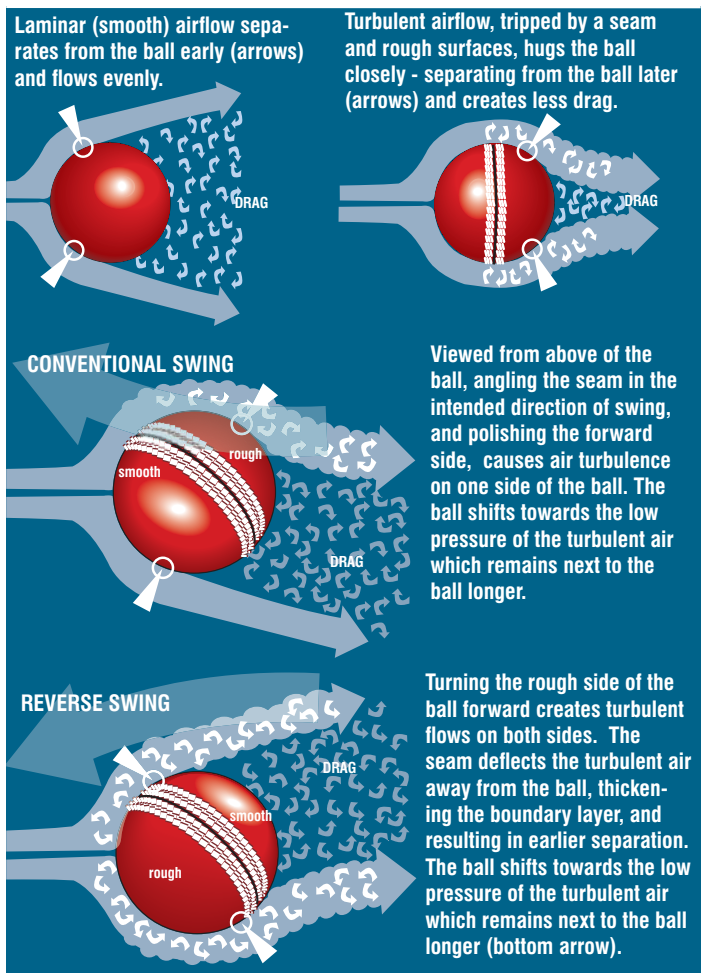
Smooth laminar flows, where the air flows regularly and evenly in layers nearly parallel to the surface of the ball, tend to separate early from its surface and therefore do not affect its motion in a big way.

On the other hand, turbulent air flows have additional rapid, random fluctuations in the motion of the air particles that keep the flow hugging the surface of the ball.

So how does a bowler bowl a swinging ball?

Conventional swing bowlers polish one side of the ball to produce laminar flows while letting the other side of the ball roughen up during play. By bowling the ball with the seam angled to the side and the polished surface forward, the bumpy stitching of the seam (and any roughness on the ball's surface) will trip the air flow into turbulence on the seam side. Because the turbulent flow hugs the contour of the ball and the laminar flow doesn't, a pressure imbalance is set up. The ball is sucked to the seam side, inducing side swing.

Wind tunnel experiments indicate that at a bowling speed of 110km/h, maximum swing is



obtained with a seam angle of 20 degrees from the front and a spin rate of 11 revolutions a second. This is comfortably within the abilities of the best bowlers.

Spin the ball too fast and you'll upset the smooth air flow on the polished side.

Now try bowling the ball with the rough scuffed-up side forward. This time, the flow is turbulent on both sides, but the seam deflects the turbulent flow away from the surface of the ball and leaves low-pressure flow next to the ball on the opposite side. The ball swings in reverse.

Bowl the ball fast enough and the flow will become turbulent on both sides - even with the polished side forward. Only after the ball slows will the smooth side become laminar and produce conventional swing late in flight. In fact, it's possible that reverse swing could be followed by conventional swing.

It's not all in the batsmen's minds after all.

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