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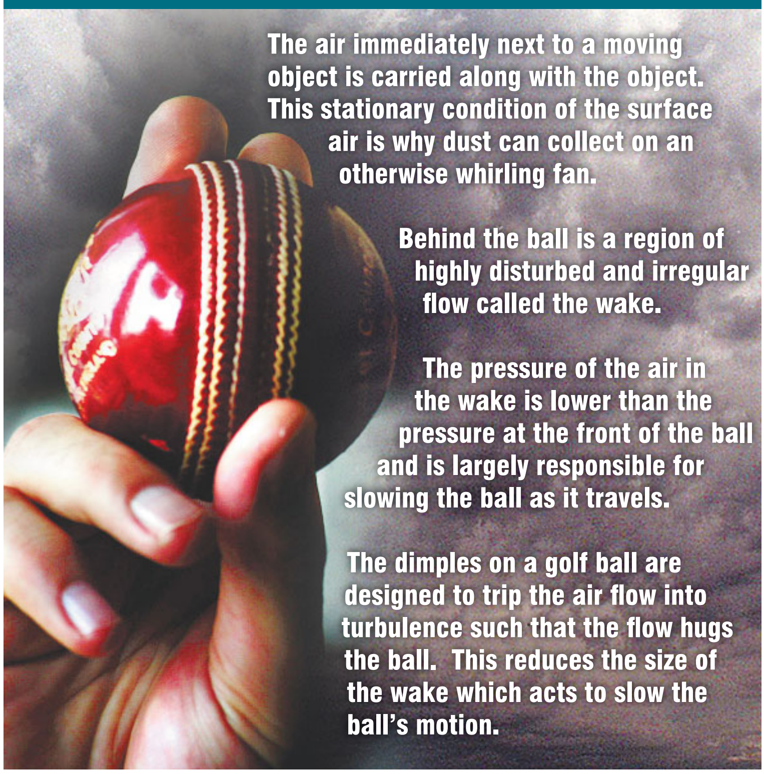
Believe it?

WITH ASSOCIATE PROFESSOR DEREK LEINWEBER

Swinger's delight

Probing the mystery of the swinging cricket ball.

Air forces



SWINGING cricket balls have been making life miserable for both batting line-ups in this summer's Test series. And it's no wonder that swing bowling is a mystery to batsmen – the science behind it is quite involved.

For instance, while it is widely reported that swing is enhanced by humid conditions, the physics behind this observation is not obvious.

The key to the swing of a cricket ball is releasing the ball in a manner that allows the air to flow differently on each side of the ball.

Air flowing along the contour of the ball has a longer distance to travel and therefore speeds up to cover the longer distance in the same time.

As it speeds up, it stretches, resulting in low air pressure that can swing the ball, just as low pressure air over the wing of a plane provides lift. This air, pushed aside by the ball's motion, forms a thin boundary layer that can be less than 1mm thick, making the ball's hand-stitched seam a big deal in its aerodynamics. 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, so do not affect its motion in a big way. But turbulent airflows have rapid, random fluctuations in the motion of the air particles, keeping the flow hugging the ball surface.

Swing bowlers polish one side of the ball to produce laminar flows while letting the other side roughen. By bowling the ball with the seam angled to the side and the polished surface forward, the stitching of the seam (and 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 laminar flow doesn't, a pressure imbalance is set up and the ball is suctioned to the seam side.

So can high humidity and temperature maintain laminar flows and yet enhance turbulence?

The density of the air is a key factor in determining the nature of the air flow around the cricket ball. While humid air feels "heavy", it is actually less dense, which makes it easier to maintain a laminar flow over the polished side of the ball, essential to swing. But these are subtle effects of just a few per cent in the ball's aerodynamics and are unlikely to be responsible for the extra swing on humid days.

Another possibility is that the seam swells in humid conditions, making it easier to get the essential turbulence on the seam side. However, a little extra humidity seems unimportant compared to standard tactics of applying saliva and sweat in polishing the ball. But a factor physicists discovered during the development of supersonic aircraft might affect the swing of a cricket ball – condensation shock. The key here is that the amount of water vapour in the air depends on the temperature. Imagine a hot and sticky day, late in the afternoon as a cloud passes over the sun. The drop in temperature could bring the air humidity close to 100 per cent. Now, as the humid air stretches out around the ball as it flows in the boundary layer, the pressure and the temperature drops. If the temperature drops substantially, as it might on the seam-side of the ball where the lowest pressure is reached, the water will condense out of the air, releasing heat. This condensation shock could enhance the turbulence of the air essential to swing.

With hot humid air, it's easier to maintain the smooth laminar flow on one side of the ball, while condensation shock could act to enhance the low-pressure turbulent flow on the seam side, swinging the ball wildly to the seam side.

But there's no real evidence for this. The matter remains a mystery – one that has caught the attention of researchers at the University of Adelaide and the South Australian Partnership for Advanced Computing. They plan to use supercomputers to numerically simulate the aerodynamics of cricket ball swing in high humidity and finally resolve this sticky problem.

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