THE AUSTRALIAN JOURNAL
for
HEALTH, PHYSICAL EDUCATION
and
RECREATION

MARCH 1976.
NUMBER 71.

IN THIS ISSUE:
* Articles in the biomechanics field on:
  - Triaxial Photography
  - Basketball Jump-shot
  - Breaststroke

* Special insert
  - Focus on cricket

Published by
THE AUSTRALIAN COUNCIL FOR HEALTH, PHYSICAL EDUCATION AND RECREATION

Registered for posting as a periodical — Category "B"

THE AUSTRALIAN COUNCIL FOR HEALTH,
PHYSICAL EDUCATION AND RECREATION

JOURNAL INSERT MARCH 1976

focus on cricket

* Release velocities of fast bowlers.
* The segmental components of fast bowling.
* A cinematographic analysis of fast bowling.

Batsman:
Stonewall

. . . "If you take a cricket ball, soak it in kerosene, set it alight, and fire it from a cannon you'll get some idea of the Demon's speed . . . When he bowls there's a smell of burnt leather in the air.

His mighty thighs lifted like the pistons of the Melbourne Express, his boots hammered the ground like a mob of wild horses, angry blasts of air whistled through his nostrils . . . the ball left his hand like a red streak. The consensus of opinion afterwards was that it was on the off but no one really saw it . . ."

D. Stivens

"The News", Adelaide.

RELEASE VELOCITIES OF FAST BOWLERS DURING A CRICKET TEST MATCH

Tom Penrose*, Daryl Foster**, Brian Blanksby*

How often is it that the rise to cricketing power by any nation is synonymous with a duo of fast bowlers in the line-up?

The fast bowling exploits of Lillee and Thomson have certainly made a significant contribution to the recent Australian successes. Similarly, the West Indies win in the Perth test was strongly aided by the pace of Andy Roberts and fine support by the youthful Michael Holding.

Tyson (1974) summarized the effect of a fast bowler on the crowd and opposition batsmen when he stated . . . "their fearsome speed makes them legends in their own time. The ball leaves their hands and covers the regulation 22 yards with such velocity that it defies the normal human reflexes. The batsman who is unable to present blade to ball with any degree of surety and consistency, is reduced to an agent of evasion".

Genuine fast bowlers seem to operate in pairs — Gregory and McDonald, Miller and Lindwall, Tyson and Statham, Trueman and Statham, Hall and Griffiths, Adcock and Heine, Proctor and Pollock, Larwood with Voce and Allen, to name some. Lillee and Thomson have earned the right to join the above-mentioned pairs of famous fast bowlers, and Roberts and Holding could well do so in the near future.

Over the years the speed of various fast bowlers has been filmed, measured by sonic beams or equally intriguing devices. Tyson (1974) quotes Wes Hall (West Indies) as being timed at 91 mph in practice; Larwood achieving between 90 and 130 mph by film, while also being officially included in the Guinness Book of Records at 93 mph in 1933; and Statham and Tyson being clocked at 89 mph in Wellington, New Zealand, 1955. Batsmen and cricket lovers everywhere will continue to discuss who was the fastest bowler of all time, and always inaccurately because there is no objective evidence available regarding the speed of any one ball or series of balls by any bowler, a wide variety of methods and testing conditions have been used, and the usual prejudices favouring the era of the proponent will undoubtedly cloud the issue (Tyson, 1974).

It seems that while some people would really like to know the comparative figures of bowling speeds (perhaps cricket commentators who need much fill-in material during the long walk back by fast bowlers), others are disdainful of those who seek to measure them in action. On National television recently Wes. Hall was rather derogatory concerning speed measurements.

With similar disdain from colleagues who opined that some people will do anything for an excuse to spend a couple of days at the cricket, the authors took up a prime position at the West Australian Cricket Association ground for the Perth test.

A high speed Photosonics camera with telephoto lens was lined up at right angles to each of the bowling creases and operated at selected speeds of between 200 and 400 frames per second. The crease lines* were used as a scaling factor to convert film to real life values. Because camera frame rates do vary, timing marks were pulsed electronically on the edge of the film every 0.01s by light emitting diodes. In this way accurate frame rates and therefore the velocity of the ball from one frame of film to the next, can be assessed. Instantaneous velocities were obtained by smoothing the data using finite differences**. Velocities referred to in Table 1 are those achieved by the bowlers during the first 9 frames after ball release (approximately 0.045s) which is when the ball is travelling at its fastest). With a second camera lined up at the batsman end of the pitch it was also possible to pick up the flight of the ball as it reached the batsman. This was done by recording the nine frames of film before the ball reached the batsman's crease. The speeds recorded at the batting end can be seen beside the release speeds of the same ball. It was noted that a rather drastic drop off in velocity occurs. As mentioned above, the "bite" of the ball into the pitch will tend to slow the delivery, especially with a short pitched ball.

Wind tunnel tests on cricket balls have indicated that air resistance for a new ball increases steadily up to speeds around 90 mph, but at around 100 mph a critical speed is reached whereby drag decreases drastically and a much lower decrease in velocity would occur as the ball travelled down the pitch (Bowen, 1975)†. Hence the famed Thomson "sandshoe" ball (yorker or full toss) to which Tony Greig can painfully attest, would be still travelling close to 99 mph if released at that speed. For those wishing to pursue this area further an excellent study of physics and fast bowling has been carried out by L. Bowen at the New South Wales Institute of Technology (Bowen, 1975).†

In the Perth test Fredericks was facing Thomson for one delivery timed at 99 mph. The commentator noted the hurried jump into the air demonstrated by Fredericks as he played a defensive prod. The ball took a mere 0.438s from the time it left Thomson's hand until it reached the bat.

According to Williams (1973) it takes approximately 0.30s to perceive the ball, predict its course and decide upon a stroke (reaction time), and a further 0.30s to perform the swing (movement time).

In the present instance the ball only took 0.438s to reach the batsman and therefore his reaction had to be initiated 0.162s before Thomson released the ball.

* Thanks to precise measurement and checking by the curator, Mr. Roy Abbott.

** Computer program devised by A. Pearce, Department of Physical Education and Recreation, University of W.A.

† L. Bowen, Seminar; Department of Physics, University of W.A., 1975.

* *University of W.A.*

** *Secondary Teachers College, W.A.*

Hence an anticipatory phase could be quite useful in cricket so that the bat is poised ready to begin the down swing which would lessen the time required to perform the necessary movement. This prior movement of the bat should enable the batsman more "spare time" to concentrate on the velocity, direction and position of the ball and time the appropriate stroke correctly. Another factor to consider with regard to small amounts of time, is the "no ball" call. On one occasion during the test Thomson bowled a no ball and the umpire had not started to signal or opened his mouth to call "no ball" until 0.301s after the front foot had landed. This coincided with 0.214s after the ball was released. If this was a 99 mph delivery, which takes 0.438s to reach the batsman, then the ball landed on the pitch 1/100th of a second after the call had started and was virtually half way down the pitch. Thus the batsman can rarely take advantage of the umpire's call and alter the stroke.

It should be noted that results presented represent only a limited sample of deliveries from each of Thomson (6), Lillee (9), Roberts (9), Holding (6), Boyce (3) and Gilmour (2) on the first two days of the Perth test match. Roberts was unwell during the opening session of play and was filmed during the first innings, not the second when he appeared to bowl with more venom. Lillee was also not at his top and did not bowl as fast as he had done in matches against the Englishmen the previous summer (Davis, 1975) and when tested at the University. The figures obtained were subject to an experimental error of $\pm$ 2% although every effort was made to bias any discrepancy conservatively.

An interesting sidelight is that when one fast bowler was tested during a game he bowled several quite fast deliveries around 90 mph. After a pre-arranged signal to the cameraman that he was going to "let one fly", the ball was actually the slowest of the over. When attempting a flat-out delivery during the game situation perhaps the player "overdid it" with a resulting inefficient summation of forces. When Denis Lillee was measured at the Department of Physical Education and Recreation, University of Western Australia, he consistently bowled 3 mph faster than during the test match two days later. Practically all speed estimates of famous fast bowlers have been obtained in non-game situations. Perhaps the more relaxed filming session, where a fair number of no-balls occurred (which do not affect the measuring), with no worries concerning foot placement, length and direction, enabled the bowler to concentrate on developing sheer pace.

In the sequence shots of Thomson included in this resume, it can be seen that the 99 mph delivery was also a no-ball.

After examining action shots of Spofforth, Cotter and Gregory, it appears that no marked changes have occurred over the past 80 years. The action of Jeff Thomson is, however, somewhat different in that it resembles a javelin approach. The run-up is controlled, powerful, and well balanced (11.20 mph) but does not reach the same pre-delivery peak of Lillee (20.86 mph), Roberts (17.88 mph) or Holding (17.46 mph). As Thomson approaches delivery he places his right foot behind the left leg in a cross-over type movement to a side-on position from which he can catapult the ball at the batsman. The adoption of this side-on, wind-up position could well provide a more powerful "gathering" for force summation than with a faster more front-on approach. Thomson also places his right foot (rear) down quite close to the back crease at delivery, but instead of this foot being parallel to the crease, it points back towards mid-on (i.e. if a right handed batsman is facing). According to Davis (1975) this characteristic was found in the two fastest bowlers in the groups he studied. Roberts, Holding and Lillee adopted the more usual position of the rear foot being more parallel with the crease.

During delivery Thomson has a more exaggerated backward body lean than the other three, and his bowling arm remains cocked down the right side of his body, close to the stumps and behind his back. Roberts, Holding and Lillee place the ball in a similar position near the stumps, but in front of their bodies. Thomson however, maintains this position for almost twice as long as the others before unleashing the ball.

Thomson's action is typical of the javelin thrower who places all the body segments on stretch before maximum unleashing of power from the legs, trunk and finally the arms. Perhaps this is the essence of where the power is gained to finally sling the ball toward the batsman at close to 100 mph.

It is interesting to note that when each of the other three more traditional fast bowlers plant their front foot at delivery, their bowling arm has begun its delivery arc and is at shoulder level. With Thomson, the bowling arm is just leaving his right side, which further delays the action.

Thomson, in common with Holding, pivots over a straight front leg at delivery, whereas Lillee and Roberts collapse somewhat on the front limb. Roberts tends to collapse more than does Lillee and this leads to a relatively low point of delivery which gives the impression of Roberts' deliveries "skidding" off the pitch. Thomson and Holding use every inch of their height during the delivery phase which is conducive to more bounce or lift off the pitch.

Denis Lillee is in the classical fast bowler's mould and depends quite extensively on physical fitness and flexibility to maintain his express pace. His position at delivery does not appear to be as side-on as it was before his back injury. March (1975) considered that Lillee was not bowling as fast now as he was in 1972, but increased subtlety still produces outstanding rewards. While all four are great fast bowlers it is the action of Jeff Thomson that excites most coaches. This method could revolutionize fast bowling actions in the future or perhaps remain particularly suited to Jeff Thomson. Hopefully, a thorough analysis of Thomson's technique can soon be undertaken in an attempt to understand any inherent advantages.

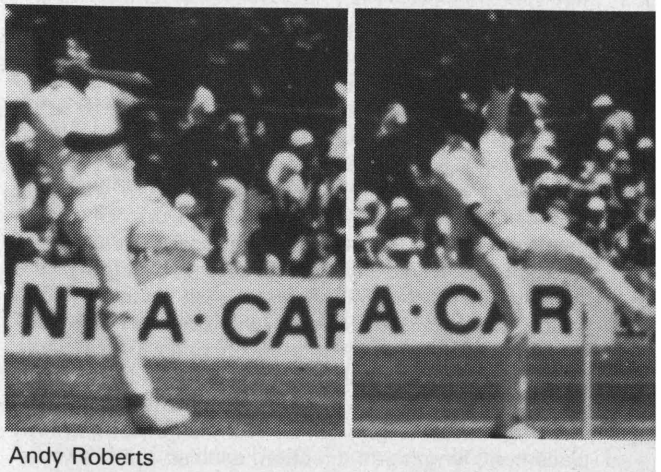
Table 1
Fastest Delivery Filmed of Fast Bowlers
Australia v West Indies, Perth, December, 1975

Bowler	Release Speed	Speed at Batting End
J. Thomson (Aus)	44.3 m/s 99.7 mph	35.88 m/s 80.73 mph*
A. Roberts (W.I.)	41.61 m/s 93.62 mph	35.87 m/s 80.71 mph
M. Holding (W.I.)	41.02 m/s 92.3 mph	33.89 m/s 76.27 mph
D. Lillee (Aus)	38.40 m/s 86.39 mph	32.01 m/s 72.03 mph
K. Boyce (W.I.)	37.89 m/s 85.24 mph	33.61 m/s 75.6 mph
G. Gilmour (Aus)	36.99 m/s 83.25 mph	31.39 m/s 70.639 mph

* This was a short pitched delivery (see p.3, line 18-19). Thomson's second fastest delivery (99.1 mph release speed) came on to the bat at 86 mph.

Jeff Thomson

Michael Holding



Andy Roberts

Dennis Lilee

REFERENCES

Davis, K., "A Cinematographic Analysis of Fast Bowling in Cricket", Unpublished Master's Thesis, Department of Physical Education and Recreation, University of W.A. 1975.

Marsh, R., "Lillee, Thomson — The View from Behind the Stumps", **Cricketer**, Vol 2, No. 4, February, 1975.

Stivens, D., "The Batting Wizard from the City", **Australian Pageant**, ed. P.R. Smith, Angus & Robertson, Melbourne, 1955.

Tyson, F., "A Passion for Speed", **Cricketer**, Vol. 1, No. 8, June, 1974.

Whitington, R.S., **An Illustrated History of Australian Cricket**, Landsowne Press, Melbourne, 1972.

Williams, L.R.T., "Anticipation and Timing in Motor Skill", **N.Z. Journal of Health Physical Education and Recreation**, 6:2, July, 1973.

Acknowledgements

The authors wish to thank Brent Ballon and his Western Australian Cricket Association ground staff for their co-operation; Doug. Cunningham and Bill Plowman of West Australian Newspapers for the use of their news article title and overlay photograph respectively.