By the book

A marathon is an obscure definition of distance that course measurers strive to pin down to the tarmac. The re-publication of the IAAF handbook **The Measurement of Road Race Courses*** aims to help.

How do you know when you have just run a marathon?

Chances are, because the race organisers have told you so. But who told them? That's the job of the course measurer, a rare species of official seen mainly in the dead of night, mounted on a bicycle. On a bike, because that's the easiest way for them to cover the ground; at night, because it's a lot easier to do so when fewer cars are around to flatten them.

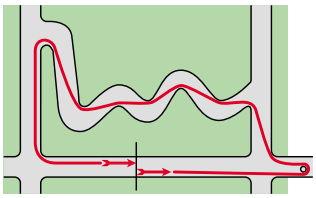
Back in 1924 it was accepted that a marathon is 26 miles 385 yards, later 42,195m. It made sense to fix it as some known distance, rather than allow it to remain an unspecified long distance of about 40km, but which had already been anything between 36km and 48km. But how to fix that distance on the Earth's surface?

In 240BC distance in Egypt was customarily measured as a number of days' journey. To convert to linear distance it was assumed that each day the caravan would travel 100 stadia (about 18.5km). The same principle has been applied in most measurement since.

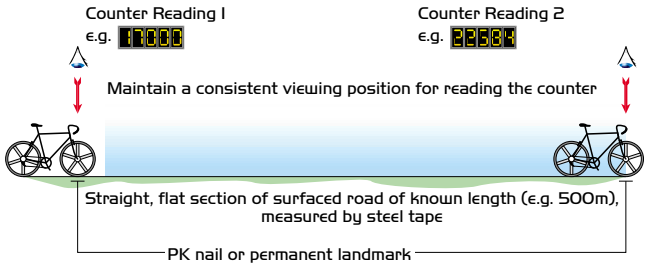
A proxy measure is made, and then converted to distance on the ground by applying a known factor representing the relation between the two. Many people pace off distance by assuming the relation of one stride to one metre. The reliability of the assumption is crucially important.

If our stride length was consistent, we could very accurately tape-measure a piece of road between two fixed points and then count how many strides it took us to cover that same distance. We would then have an average measurement of one stride length. If we multiply this constant by the number of strides we take to cover any chosen route, the result will be the distance of that route.

This method was actually used by the 19th Century Indian 'pundits' in clandestine surveying of forbidden Himalayan lands, despite the difficulties of maintaining a standard stride in such mountainous terrain. There was also the difficulty of keeping count of the strides taken.



Winding roads – use of full width of road



Provided we are on roads and not in the Himalaya, a bicycle can be used to more accurately and easily achieve the same result. If we count the number of revolutions of the wheel from one end of our accurately measured 'baseline' to the other, we can convert revolutions of the wheel into linear distance.

This was the method used by the Road Time Trials Council of the British Federation of Cyclists to determine standard length courses over which they held time trials, and it was later adopted for official road race measurement.

A mechanical counter inserted between the front fork and wheel records numbers which, depending on the internal gearing of the counter, may amount to 20 or 23.6363 'counts' per revolution.

All that a has to be done is to ride the known, accurately-measured length of road to 'calibrate' the bike's wheel with counter readings, and then ride the road race course from start to finish. As the 'calibration' gives a number of counts per metre, the total counts for the road race course can easily be converted into metres to determine its length.

Using a bike has two other distinct advantages. Provided we sit steady in the saddle, we have a constant weight on the front (see illustration from book, right) wheel which maintains good road contact. It is almost impossible to do this with a surveyor's wheel. Secondly, a bike can be ridden along the "shortest possible route" that a runner can take along the course. Runners are free to cut tangents across the road to avoid running further than necessary; they can hug the kerbs at corners.

A bike can reproduce this ideal running line [see picture, above, and illustration from book, bottom of page 30] so that it is impossible for any runner to have run a shorter course than that measured. Even the 'blue line' used for many marathons is only an indication of this shortest possible route – the equipment used to paint it on the road can't take the corners as close as a runner might, or a bike-borne measurer certainly will.

Using a mechanical counter also has two great advantages. As the normal wheel circumference is about 2.2m each 'count' registers about 9cm to 11 cm of road length. Electronic counters are 100 times less sensitive, registering only every 10m. Secondly, mechanical counters retract when the bike is wheeled backwards while electronic counters do not distinguish between forwards and backwards movement.

Despite the existence of this highly accurate and convenient 'calibrated bicycle' method of measurement, other inferior methods long continued in use. Derek Clayton's world marathon record in 1969 was set on a course officially measured using a car odometer, and subject to dispute ever since.

But if you ask the question point-blank: "How long was that course I just ran?", no one can give you an exact answer. There is no such thing as a perfect measurement. All measurement is subject to some error.

If we know what the error is, we can say that the distance measured is within a definite range: not less than x metres and not more than y metres. The error of the calibrated bicycle method is 1 in 1000, or 1m for every kilometre.

It is the x value that is of interest to us as runners. We don't want anyone to be able to suggest that our time could be unduly flattering because we didn't actually run quite as far as advertised. So 42,195m should be the minimum we could have run. Yet if our error is on the side of under-estimation of what is measured, we could have only run 42,153m - 0.1% less than 42,195m. To avoid this we factor in the error, effectively measuring out each kilometre as 1001m.

This way, by the time you get to the finish line, you know that you have just run at least a marathon.

Tracking you down from space

Adventure events have become increasingly popular, but until recently they were impossible to measure with any great accuracy.

Technological advances in GPS ('global positioning by satellite') equipment now allow constantly updated distance and pace measurement in cumulative and lap/split formats.

The GPS system makes use of two lightweight modules, one to talk to the satellites and one, a wristwatch, to store and display the information recorded.

Up to 10km, distance readings are given to 1m. Compared against short but accurately steel tape-measured distances, readings are reliably within 1-2m.

This system was used to measure each daily stage in the Augrabies Extreme marathon in South Africa (see Results section, p.7). Due to the rugged terrain over which this event is held [see picture] it had previously only been possible to estimate distances from large-scale maps. There seems real potential to use this equipment in measuring off-road events.

Moreover, it can be used while running, cycling or driving over a potential road race route to determine a preliminary layout.

Although only shower proof the system is also ideal for the measurement of triathlon and open water swim events, kayak, surf, ski and raft courses. It could become the standard for multi-disciplinary sports, as it offers a single credible method of measurement.

Norrie Williamson

*** The Measurement of Road Race Courses is an instructional manual. If you are interested in becoming a course measurer, please contact the Editor.**