

# OFF LEVEL

PI AND ITS FUNCTIONS

BY PETER MANSFIELD

**P** I IS THE ratio of a circle's circumference to its diameter. The  $\pi$  symbol probably evolved from the first letter of the Greek word "Periphēria" meaning periphery. Surveyors use pi on a day-to-day basis, either directly or indirectly, for it lies at the heart of curve geometry. But does it have any other functions?

Perhaps its most fascinating characteristic is its utter irrationality. Irrational numbers were discovered after an all-night party in ancient Greece much to the chagrin of the Pythagoreans of Crotona who believed that all geometries could be defined by an arithmetic of rational numbers. One outspoken advocate of irrationality

was Zeno of Elea who was finally ostracized for his subversive behaviour which included standing in Crotona's main square and shouting irrational numbers at old ladies. Even more bizarre was his brother Zero of Elea who could not only conceptualize irrational numbers such as pi, but enjoyed rolling them up and smoking them as well, and for this became known as the pi'd piper.

Ultimately, the Pythagoreans may have been right. Irrational numbers are irrational. Consider the square roots of 2 and 4. It is fully accepted that there exists a number that when squared equals 4. This number is 2 (or -2). Is it unreasonable to expect, therefore, that somewhere in the human ideosphere there exists a number that when squared equals 2.

It is. No such number has ever been found. No matter how many decimal places we take our 1.41421356... to, the resultant square is never 2. Pi is the same. No true value of pi has ever been found — only infinitely long approximations. Yet circles exist, as do diameters. How can this be?

Perhaps it is the numbering system that is at fault. A linear numbering system is inadequate in describing a world full of curves, just as Euclidean geometry and Newtonian physics have proved inadequate in describing a curved universe. We need a curved numbering system; one in which long bouts of counting do not take us into the far reaches of infinity but eventually bring us back to zero.

Mathematicians have been searching for the "true" value of pi for more than 2 millenia. By the 16th century it had still only been calculated to 30 decimal places. The search for the Holy Grail of geometry was intense. Ruling monarchs hunted high and low for mathematicians capable of extending pi, for such an accomplishment brought honour and glory to the homeland.

In 1780, William Snout of Hockwold-Cum-Wilton was appointed Royal Calculator. For 32 years (and at the King's expense) he laboured at the royal task of calculating pi to 200 decimal places. Unfortunately, in 1811, with Snout's work nearing completion, a mistake in the 14th decimal place was discovered by a village idiot from Kent. The King greeted this news with a royal "C'orr Blimey", and ordered Snout hung from the royal maypole by his cube root.

The introduction of the electronic computer revolutionized pi calculations. By 1962 it had been calculated to 100,000 decimal places, and by 1973, to a million.

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decimal places, and by 1973, to a million.

Scientific America recently reported that two Japanese computer specialists have used a high-speed Hitac m-280 H computer, and an algorithm devised at Stanford University, to compute pi to 8,388,608 ( $2^{23}$ ) decimal places. This took a mere 6.8 hours of expensive computer time.

Surveyors will agree that 8 million plus decimal places is accurate enough for most curve lay-outs, but aren't there other considerations? For example, how many Canadian jobs will be lost by importing a made-in Japan pi? And what real purpose does such precision serve?

The answer lies with the bladder — or more specifically the bashful bladder. This medical phenomenon is one that arises wherever men meet in large numbers. Football stadiums, for example. At scheduled breaks in the action, called intermissions, as many as 47,000 men may descend upon the one 12' x 20' washroom with it's 2 functioning urinals. If you are among the lucky few to ever reach a stall, the pressure of having half the city of Hamilton breathing down your neck may prove too much. You may freeze up. You may find that your ability to go, has gone. And this is not helped by the 500 thugs directly behind you, indicating with salacious comments and obscene gestures that they're not too concerned whether they do it in the urinal or on your Argyle socks.

This inability to perform is the result of bashful bladder. But what is the cure?

Concentration, of course, but on something else. Some all-absorbing diversion. What better centring device than a full recitation of the true value of pi. Whenever you sense your bladder is becoming bashful, simply begin reciting pi starting with 3.1415 and proceeding as far

# BOOK REVIEW

*From Compass to Satellite: William D. Stretton, C.L.S., O.L.S. Published by the Canadian Institute of Surveying, Box 5378, Station F. Ottawa, K2C 3J1. \$25.00.*

Bill Stretton, whose career has combined the two compulsions of writing and surveying, and whose articles have for many years been features of THE CANADIAN SURVEYOR and THE ONTARIO LAND SURVEYOR, is the very man to have written this, the story of Canadian surveyors since Confederation. Its appeal is both general and specific; for the general reader, a history of an exciting period in Canada's development, and, for the sur-

as you can (clearly some memorization is involved). With pi now calculated to 8,388,608 decimal places there is no need to worry that you will run out of numbers. Long before you've reached even the millionth decimal place, the frantic mob behind you will have rolled you up into a tiny ball and flushed you down the pissoir.

The functions of pi, therefore, reach far behind curve geometry and the needs of the lowly surveyor. Pi can serve all men, in times of need.

For those who require immediate help, here are the first 200 decimal places.

3.141592653538979323846264338  
327950288419716939937510582077494  
459230781640628620899862803482534  
211706798214808651328230664769384  
460955058223172535940812848111745  
028410270193852110555964462294895  
4930381964.

NOW, LET'S GO!●

veying community, a profusely pictured chronicle, to the present day, of surveying after Canada came of age.

For this task he has had access to virtually all records, and it is a credit to his skill that he has been able to condense such an abundance of detail into such a readable form. With a sense of humour as well as a sense of drama, he has filled the book with vignettes of the surveyors who march through the pages, solving their problems as we try to solve ours.

Even today, difficulties between surveyors and those who occupy the land are not unknown, but they pale beside what was faced by, for instance, the magnificently whiskery Lt. Col. J. S. Dennis when he undertook to subdivide the West before it was part of Canada. The suspicious Metis, under Riel, didn't like it a bit, and "prevented them from continuing their work by riding on their chains".

That emergency burgeoned into the first Riel Rebellion, which was quickly settled, but Col. Dennis, a compulsive warrior, was back for the second one, fifteen years later, as captain of - are you ready? - The Dominion Land Surveyors Intelligence Corps, which served with distinction as scouts (not spies).

It is a comprehensive story, and even, at the end, looks into the future, to predict that, by 2030, surveyors will be prominent in federal and provincial politics, and "The Ontario Land Surveyor's circulation will grow to ten millions"!

On such an upbeat note this entertaining and informative book ends. It should be in our libraries.

A.G.

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