

# DIFFERENTIAL GEOMETRY

## A Geometric Introduction

Self Study Third Edition  
revised July 2013

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The first edition of this book was previously published by Pearson Prentice Hall, 1996.

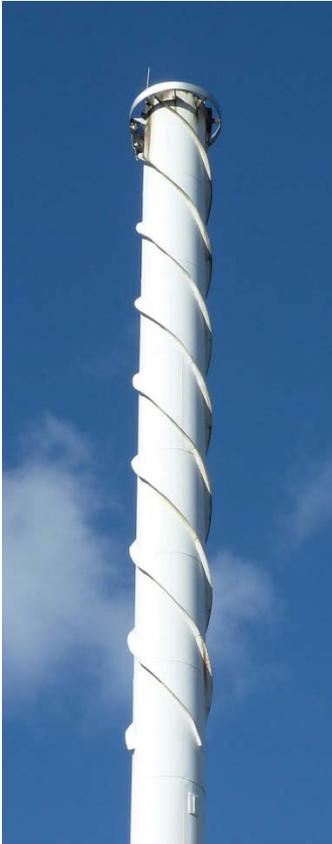


To Daina, Ætna, and the angels

## Geometry

Logic can only go so far —  
after that I must see-perceive-imagine.  
This geometry can help.  
I may reason logically thru theorem  
and propositions galore,  
but only what I perceive is real.  
If after studying I am not changed —  
if after studying I still see the same —  
then all has gone for naught.  
Geometry is to open up my mind  
so I may see what has always been behind  
the illusions that time  
and space construct.  
Space isn't made of point and line  
the points and lines are in the mind.  
The physicists see space as curved  
with particles that are quite blurred.  
And, when I draw, everything is fat  
there are no points and that is that.  
The artists and the dreamer knows  
that space is where an image grows.  
For me it's a sea in which I swim  
a formless sea of hope and whim.  
Thru my fear of Infinity and One  
I structure space to confine  
my imagination away from the idea  
that all is One.  
But, I can from this trap escape —  
I can see the geometry in which I wander  
as but a structure I made to ponder.  
I can dare to let go the structures and my fears  
and look beyond  
to see what is always there to see.  
But, to let go, I must first grab on.  
Geometry is both the grabbing on  
and the letting go.  
It is a logical structure  
and a perceived meaning —  
Q.E.D.'s and "Oh! I see!"'s.  
It is formal abstractions  
and beautiful contraptions.  
It is talking precisely about that  
which we know only fuzzily.  
But, in the end, and, most of all,  
it is seeing-perceiving  
the meaning that  
I AM.

— David Henderson, 1978



Triple Strake



Helicoid parking ramp



Auger



Crocheted Helicoid

Photos for **Problems 1.6, 2.5, 6.6ae, 7.2bc**

Photos by David Henderson and Daina Taimina



Constructing Annular Hyperbolic Plane

Pseudosphere

Photos for **Problems 1.8, 3.1f, 5.7d, 7.5, 8.2d, 8.7d**

Photos by Daina Taimina



Catenoid Soap Bubble (minimal surface) – Problem 6.6cde



Catenoid locally isometric to Helicoid – Problem 6.6e

### Problem 6.6

Photos by Daina Taimina