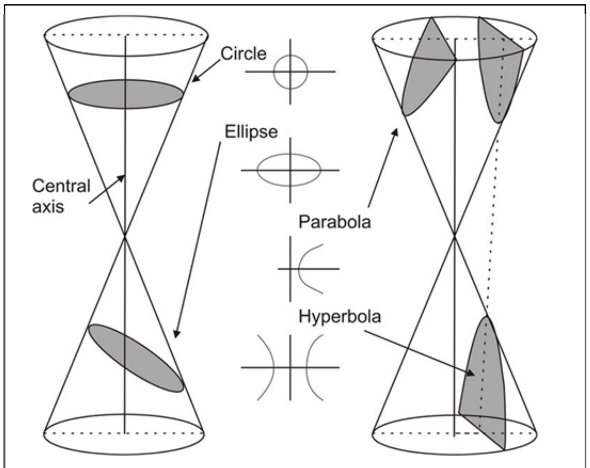
What about "Pure" Mathematics?

By James D. Nickel

In the mathematical world, pure mathematics is concerned with interrelationships and connections within mathematics, either within a specific branch (e.g., number theory) or cross-branch (e.g., number theory and probability). In pure mathematics, there is little concern for applications to the physical world; it is primarily a study of the inner beauty and logic of mathematics (NB. a majority of professional mathematicians are of this "pure" variety). But, wonder upon wonder, this inner beauty often explodes into amazing connections to the real world. Two examples illustrate this:

1. Ancient Greek mathematicians studied the conic sections (parabola, circle, ellipse, hyperbola) and developed a corpus of mathematical knowledge revealing a host of mathematical connections. The logical undergirding these studies could be called pure mathematics but, as science historian Otto Neugebauer (1899-1990) has noted, the shadows of a sundial revealed by the daily motion of the sun across the sky formed the heuristic basis for the study of the conics. In the 17th century, scientists like Newton and Kepler used these ancient Greek principles to develop classical mechanics. The mathematicians of ancient Greece would have never dreamed that their work in pure mathematics would bear fruit in this manner.



The Conic Sections

2. In the 17th and 18th centuries, the French lawyer/mathematician Pierre de Fermat (1601-1665) and the Swiss mathematician Leonhard Euler (1707-1783) refined many wonderful theorems about number theory. This was pure mathematics par excellence. In the early 1970s, I studied these theorems in university and said to myself, "What use is this?" The logic of these theorems is resoundingly beautiful but applications were "missing in action." I did not realize then that in the 1960s the ARPANET (Advanced Research Projects Agency Network) was in the development stage. The INTERNET is a direct consequence of the ARPANET and it introduced the world to a maze-like informational network in the 1990s. The big need generated by the INTERNET was security. In 1978, a RSA algorithm was published by Ron Rivest, Adi Shamir, and Leonard Adleman at MIT (the letters RSA are the initials of their surnames, listed in the same order as on the paper). This algorithm has turned out to be one of the first great advances in public key cryptography and it is used to secure information packets sent across cyberspace. And ... what is the mathematical basis of this algorithm? The theorems of number theory proved by Fermat and Euler! These two

> men would have never dreamed that their work in pure mathematics would bear fruit in this manner.

Elsewhere, in my writings, I give a warning to the "pure" mathematics crowd to not forget applications. I am not alone in this caution for many well-known mathematicians, men like the Hungarian John von Neumann (1903-1957), a pioneer in computer theory, have noted that the study of the physical world "is the matrix of mathematical thoughts."

For elementary school mathematics (K-8), the focus on heuristic arguments and a real world matrix for grasping mathematical principles is a proven and sound pedagogy. However, for grades 9-12, I believe that some elements of pure mathematics can be introduced (in fact, I have taught the RSA security algorithm to senior high school students).

As Biblical Christians, we should not downgrade pure mathematics because its rational beauty is in an infinitesimal way reflective of the rationality of the universe (what goes on both outside the mind and inside the mind) which is founded upon the logos of God in Christ (John 1:1-3).

Hence, as Biblical Christians, we should make sure that pure mathematicians understand the true basis for the beauty they are beholding