Philip Scalisi: On the Trail of Leonhard Euler and the History of Mathematics

One of the longest serving faculty members at BSC, Professor Philip Scalisi has been teaching mathematics here since 1969, but time has hardly slowed his enthusiasm for his subject or his interest in new discovery. Scalisi was the first to introduce courses on the history of mathematics at BSC. His recent study involves **Leonhard Euler** *(1707–83), a grand figure in the history of mathematics and the subject of a recent study tour.* Bridgewater Review *met with Professor Scalisi in March to talk about Euler, the history of mathematics, and the benefits of scholarly study tours.*

BR: How did you first become interested in the history of mathematics?
Years ago, when I was an undergraduate at Northeastern University, I took a course offered by a professor named Holland Filgo. It was just a quarter course, pretty primitive compared to what we do today, but Filgo stirred my interest. It caused me then to think that all majors ought to know something about the history of their own fields. Others have obviously agreed. Now, the National Council of Teachers of Mathematics (NCTM), our math education professional association, has included mathematics history in the recommended standards for courses that prospective math teachers should take. This has been adopted in the Massachusetts State curriculum standards as well. So, mathematics history has come to occupy an important role. I was glad to have introduced a course in the history of math here back in the early 70s and I have taught it ever since. It's refreshing to have our graduates—those now out teaching in the schools—come back and say that they have used the history of math in their teaching.

BR: What topics in the history of mathematics have special appeal for you?
They are all appealing, but I teach the course in different ways. One is from a purely chronological point of view, where we start at the Stone Age and proceed forward. We study the ancient Egyptians, ancient Babylonians, and ancient Mayans. I have actually taught my students how to read mathematically-related Egyptian hieroglyphics. We study math from the Greeks to the Middle Ages into the Renaissance, after that working century by century to the present. Another way is to concentrate on one or two topics, branches of mathematics such calculus, non-Euclidean geometry or number theory, and trace them. At the graduate level, I prefer to teach math history by topics, and at the undergraduate level by chronological order. One challenge in doing all of this involves books; until recently there were only a few good texts in the history of math.

BR: You imply that it is natural to study the history of mathematics chronologically; could you also say that it is natural to study it biographically?
Yes, it is intimately associated with the mathematicians themselves. A good example of this involves the study tour in which I participated last summer. The tour was organized by the Mathematics Association of America (MAA) and focused on just one man, Leonhard Euler. This past year, 2007, was the 300th anniversary of his birth. Any mathematician, math physicist, or astronomer is familiar with Euler; he is generally considered to be one of the top four mathematicians of all time. His work dominated the field throughout the 18th century. He was what we would refer to today as a universalist—one who knew everything in all branches of mathematics, pure and applied. He was a true genius. His total published output is in more than 80 volumes, each one between 300 and 600 pages. Scholars started publishing Euler's *Opera Omnia* in 1911 at the University of Basel, Switzerland and it continues today. The Swiss academicians who are working on it told me that they had completed the editing and publishing of his original books and (as of last summer) they were working on his notebooks and personal correspondence. This project

will make important source materials much more accessible. Euler corresponded with just about every major scientific figure in 18th century Europe such as D. Bernoulli, C.Goldbach, and J. Lagrange. His work provides a storehouse of ideas that we can still examine and test today.

BR: What did Euler's notebooks look like?
Surprisingly, his original manuscripts are well written; not a scribbly mess. He wrote in Latin, French and German, though probably 80 percent of what he published was in Latin. That was typical for all European scientists during the Renaissance. Another 15 percent of what he wrote was in French, the remaining 5 percent in German. Euler was born in Basel, in the German-speaking part of Switzerland. His first major full-time appointment was to the Academy of Sciences in St. Petersburg, Russia, founded there by Peter the Great. He stayed there until 1741, but because of the turmoil that was going on in Russia and the overtures of Frederick the Great of Prussia (who wanted to develop scientific study in his country) Euler was lured to Berlin.

BR: But he left his books behind?
He left some of them, not all of them. He went to Berlin, to the Academy of Sciences created by Frederick the Great, and stayed there for 25 years. While he was there, he still contributed to the publishing house in St. Petersburg. He wrote for all the great scientific journals, including the *Acta Eruditorum* and the *Royal Journal*. When Catherine the Great (Catherine II) became czarina, she lured Euler back to St. Petersburg in 1765 or 66. She had known of Euler's work and reputation, so she offered him a tremendous annual salary and residence. He stayed in St. Petersburg until his death in 1783. His scientific work was carried out largely in those two cities, so that's where the tour spent the most time. Since he began and ended his career in St. Petersburg, most of his original manuscripts are there in St. Petersburg.

What makes his accomplishments even more amazing is that when he was 31 years old he lost sight in his right eye due to an illness. And in the last 12 years before he died he lost sight in the other eye. Still, he continued to produce; in those last years, he produced over 400 publications. Naturally, the notebooks from that time were written in someone else's hand. In fact, I saw some that were done by a transcriber.

BR: And you went to Basel to see where he was born?
Yes, and to the University because that is where his *Opera Omnia* is being published. While we were there, there was at the Natural History Museum a special mathematics exhibit that we went to see. We also conversed and interchanged ideas with the academicians there on math education. We wanted to know what were they doing in teaching mathematics as well as the development of research in mathematics for students.

BR: What are some of the main differences in mathematics education?
It is very interesting the way they foster their math majors to graduate, get a bachelor's degree, and then go on for their doctorate. It's very different from what we do over here. In Berlin, for example, there are three major universities: the Alexander von Humboldt University, the Free University, and the Technical University of Berlin. Then there are two very focused research institutions, one of which is called the *Weierstrass* (named after a 19th century mathematician). A council was formed, formally called the Berlin Mathematical School, sometimes "Matheon." The Matheon program at the German Research center provides funding for students to get from a bachelor's degree to a doctorate degree. The students take courses at each of these institutions. In all, the Matheon program is granted annually by the German Research Foundation (DFG) close to €5 million. It's fairly new; it was initially founded in 2002. In addition, there is the Berlin Mathematical School (BMS) that was established in 2006. It is a two phase graduate program which also uses the above mentioned institutions as well as Matheon.


Leonhard Euler.

BR: What did you take away from the study tour?
It provided me the opportunity to get first-hand information concerning Euler and his works. One of my fields in mathematics is complex variable theory or complex analysis, and Euler did so much in that. One the greatest of all mathematical formulas in terms of complex variables is called Euler's Theorem and I was curious if I could find that in any of the archives, where he used it and what notation he used. And I did, in one of his many notebooks. I was actually allowed to handle them and take pictures. That is a pretty rare privilege. After that, I didn't want to wash my hands!

Study tours like this and others that the MAA has done have a lot to recommend them. They allow you to meet other people in the field, to see who else shares your interests and to become friends. Also, it was useful to actually see the actual institutions where these mathematicians worked, where my European colleagues teach, and what they emphasize in their teaching. The MAA has asked me to organize a math study tour here because of some connections I have to experts in crystallography and mineralogy at Harvard and Yale. Both places have very rich archival and historical scientific instruments collections, which I have used in my own research. Right now, I can't do it; but I might in two or three years. That is the sort of thing that I think members of the MAA would like.

—Professor Scalisi was interviewed by Andrew Holman, Associate Editor of the Bridgewater Review.