Smoky Mountain

UNDERGRADUATE CONFERENCE ON THE HISTORY OF MATHEMATICS

SMURCHOM VI 17 MARCH 2012

SCHEDULE OF EVENTS

8:30-9:30 Registration and breakfast .... NCCAT Library

9:30-9:45 Welcoming Remarks .... NCCAT 130-132
Sloan Despeaux, Western Carolina University

9:45-10:45 Keynote Address .... NCCAT 130-132
Quadratic Equations: Can We Really Apply Them?,
Victor Katz, Professor Emeritus, University of the District of Columbia

11:00-12:00 Poster Session .... NCCAT Library
Look for clues for the QR Code Scavenger Hunt during the Poster Session!

12:00-1:45 Midday Activites
Picnic Lunch .... NCCAT Dining Room
QR-Code Scavenger Hunt .... WCU Campus
Climbing Wall .... WCU Campus Recreation Center
Show your SMURCHOM ID to get into the Rec. Center

2:00-3:00 Contributed Paper Sessions*
Parallel Session I: History of Mathematics .... NCCAT 130-132
2:00-2:20, *A Look into the History of Land Surveying,*
Graylon Haynie, Georgia College and State University
2:20-2:40, *Journey to Thomas Harriot's Algebraic Contribution*
Dalton Tedder, Western Carolina University
2:40-3:00, *The History of International Mathematical Olympiads*
Cristina Korb, Western Carolina University

Parallel Session II: Mathematics Inspired by History .... NCCAT Amphitheater
2:00-2:20, *Data Encryption Standard-the History and New Directions,*
Andrew Kimball, Western Carolina University
2:20-2:40, *On Cartesian Product of Graphs and the Roman Domination Function*
Tony Yaacoub, Clayton State University

3:00-3:30 Afternoon Refreshments .... NCCAT Library

3:30-4:10 Contributed Paper Sessions*
Parallel Session III: History of Mathematics .... NCCAT 130-132
3:30-3:50, *The Euclid's* Elements *Controversy and the* AIGT
Sarah Martin, Western Carolina University
3:50-4:10, *Euler's Contributions to Graph Theory*
Travis Weiland, Western Carolina University

Parallel Session IV: Mathematics Inspired by History .... NCCAT Amphitheater
3:30-3:50, *On Some Relations Between Chemical Indices on Trees*
Marcus Bartlett, Clayton State University
3:50-4:10, *On New Bounds for the Monophonic Number of Cartesian Products of Graphs*
Michael Ngo, Clayton State University

4:15-4:30 Closing Remarks and Prizes .... NCCAT 130-132

** During Parallel Sessions, feel free to switch between rooms.*

Keynote Speaker

Quadratic Equations: Can We Really Apply Them?

Victor Katz

In a first course in school algebra, one of the culminating ideas is the quadratic formula for the solution of quadratic equations. But why is this so important? Are there quadratic equations out there in the real world that we need to solve? Mohammad al-Khwarizmi, back in the ninth century, thought that quadratic equations were important, so important that their solutions, using what we might consider versions of the quadratic formula, were at the center of his own algebra text, the first true textbook in algebra. Later Islamic authors extended al-Khwarizmi's work, and it was this Islamic work that was transmitted to Europe in the late Middle Ages and became the core of Europe's own work in algebra. Did Islamic mathematicians or medieval and Renaissance European mathematicians find important problems to solve that required the knowledge of the quadratic formula? We will take a quick tour of algebra textbooks in various countries, from the ninth century through the seventeenth century, to see why mathematicians continued to stress the importance of solving quadratic equations. We will then look at the implications of this importance in the teaching of algebra today.

Victor J. Katz *received his Ph.D. in mathematics from Brandeis University in 1968 and was for many years Professor of Mathematics at the University of the District of Columbia. He has long been interested in the history of mathematics and, in particular, in its use in teaching.*

The third edition of his well-regarded textbook, A History of Mathematics: An Introduction *appeared in 2008. A brief version of this text was published in 2003. Katz is also the editor of* The Mathematics of Egypt, Mesopotamia, China, India and Islam: A Sourcebook*, published in 2007. Professor Katz has written many articles on the history of mathematics and its use in teaching and has spoken widely on the subject. He presented an invited lecture, "Stages in the History of Algebra with Implications for Teaching," at ICME-10 in Copenhagen in 2004*

He has edited or co-edited three books dealing with this subject, Learn from the Masters *(1994) and* Using History to Teach Mathematics *(2000), and* Recent Developments on Introducing a Historical Dimension in Mathematics Education *(2011). He also co-edited two collections of historical articles taken from journals of the Mathematical Association of America in the past 90 years,* Sherlock Holmes in Babylon and other Tales of Mathematical History *(2004) and* Who Gave You the Epsilon and Other Tales of Mathematical History *(2009).*

He has directed two NSF-sponsored projects that helped college teachers learn the history of mathematics and how to use it in teaching and also involved secondary school teachers in writing materials using history in the teaching of various topics in the high school curriculum. These materials, Historical Modules for the Teaching and Learning of Mathematics, were published on a CD by the MAA in 2005. Professor Katz was the founding editor of Loci: Convergence*, the MAA's online magazine in the history of mathematics and its use in teaching, serving from 2004 until 2009. Professor Katz is married to Dr. Phyllis Katz, a science educator, and has three grown children and six grandchildren.*

Abstracts of Talks

A Look into the History of Land Surveying,
Graylon Haynie, Georgia College and State University

Land surveying is a trade that has, in modern times, been somewhat under-appreciated. This presentation provides a brief history of land surveying techniques and tools from ancient Egypt through today. We show how surveying has changed relatively little and survey those changes.

Journey to Thomas Harriot's Algebraic Contribution
Dalton Tedder, Western Carolina University

While the name Thomas Harriot is not widely recognized, he contributed much to the advancement of mathematics, especially in algebra. The question then becomes, "Why do we not know more about this man?" This presentation is designed to help us journey through the many aspects of Thomas Harriot's life. We will also dive into the reasons many of his algebraic contributions were not published during his life, and why many people were still left flustered by his mathematics after his death.

The History of International Mathematical Olympiads
Cristina Korb, Western Carolina University

The International Mathematical Olympiad (IMO) is an international competition that was founded in Romania in 1959. Within only fifty years, over 100 countries have participated in the IMO. This presentation gives a brief history of the preliminaries that led to the IMO and explains the structure and regulations of the contest. It also aims to show the impact that the IMO has had on the education in mathematics and other sciences worldwide.

Data Encryption Standard-the History and New Directions,
Andrew Kimball, Western Carolina University

The Data Encryption Standard (DES) is a symmetric key encryption system that was published in 1975 by the National Bureau of Standards. Symmetric key encryption algorithms transform blocks of plaintext into blocks of ciphertext of the same length and require a user-provided secret key. Decryption is performed by reversing the transformation using the same key. DES and its variants have been used in electronic financial transactions, secure data communications, and the protection of passwords or PIN's against unauthorized access. In this presentation, we will talk about the history of this cryptosystem and the impact that DES has had on the development of the cryptology. Even though DES has been replaced with a new system, variations of DES are still in use, often in a combination with other cryptosystems. All commercial versions of DES have been implemented over $\mathbf{Z}_2$, and studying properties of DES-like cryptosystems over other finite groups is both a worthy and valuable undertaking. We will also talk about recent results obtained studying DES-like cryptosystems.

On Cartesian Product of Graphs and the Roman Domination Function

Tony Yaacoub, Clayton State University

For any graph G, the Roman domination function of G is a function f that maps the vertices of G to the set {0,1,2} such that every vertex with 0 has a neighbor with 2. The Roman dominating number of G, RDF(G), is the minimum sum of all labels over all Roman dominating functions of G. We apply the method of S.Suen and J.Tarr from their work on Vizing's conjecture, as well as that of Y. Wu, to show an inequality for the Roman dominating number of the Cartesian product of two graphs in terms of the Roman dominating numbers and dominating numbers of the two graphs.

The Euclid's Elements *Controversy and the* AIGT
Sarah Martin, Western Carolina University

This presentation will discuss the controversy about Euclid's *Elements* as the main source for teaching geometry in 19th-century England. It will also highlight two main adversaries in this controversy: James Wilson and Charles Dodgson. Moreover, it will consider the formation of the Association for the Improvement of Geometrical Teaching (AIGT) and the results of its efforts.

Abstracts of Talks, continued

Euler's Contributions to Graph Theory
Travis Weiland, Western Carolina University

Euler is commonly credited as the father of graph theory. He was the first mathematician to write formally on the subject; however, it was not known as graph theory at the time but as *Geometriam Situs,* geometry of position. Euler wrote two papers that contributed to the field of graph theory. The first and most famous was "Solutio Problematis ad Geometriam Situs Pertinentis," in which Euler solved the Königsberg Bridge Problem and proved several propositions that are still used in graph theory today. The second, lesser-known paper was "Solution d'une question curieuse qui ne paroit soumise à aucune analyse" in which Euler discussed formally how to find solutions to the Knight's Tour Problem. Euler contributed greatly to the field of graph theory; however, over time, the lines between what Euler did and what we do now in Euler's name have become blurred. In this case it is important to look at Euler's actual words to see how he worded his solutions and the specific methods he used in solving both the Königsberg Bridge Problem and the Knight's Tour Problem. When Euler's work is translated into modern terminology we lose some of what Euler actually did. Euler did provide a new way of thinking about and solving problems that most people considered to belong of the realm of logic and not that of mathematics. What Euler never did was to actually make a graph or anything resembling one in spite of being the father of graph theory.

On Some Relations Between Chemical Indices on Trees
Marcus Bartlett, Clayton State University

The Wiener index of a graph *G* is defined to be the sum of distances between every pair of vertices of *G*. When *G* is a *k*-ary tree, Hua Wang found a surprising relation between this index and the sum of distances between every pair of leaf vertices of *G* (called the gamma index) and showed a counterexample for another conjectured functional relationship. In this presentation, we define two new natural indices (the spinal index and the Bartlett index), which when summed with the gamma index above, yield the Wiener index. We then show analogous relations to that of Wang, produce a counterexample to a functional relation for the spinal index, and state a conjecture about the Bartlett index.

On New Bounds for the Monophonic Number of Cartesian Products of Graphs
Michael Ngo, Clayton State University

Given two vertices *u,v* in a graph *G*, a chordless path from *u* to *v* is also known as a monophonic path. Let *JG*[*u,v*] be the monophonic closed interval consisting of all vertices on all monophonic paths from u to v. For any subset of *S* of vertices of *G*, let *JG*[*S*] be the set of all monophonic intervals for every pair of vertices from *S*. A set *S* is called a monophonic set of *G* if *JG*[*S*] is the set of all vertices in *G*. The minimum cardinality of *S*, for all *S* subsets of vertices of *G*, so that *JG*[*S*] is a monophonic set, is called the monophonic number of *G* and is denoted *mn*(*G*). In this talk, we further describe these concepts, beginning with an introduction of basic graph theoretic terminology. We then discuss some new bounds discovered by A.P. Santhakumaran and S.V. Ullas Chandran on the monophonic number of graphs *C* which are Cartesian products of two graphs *G* and *H*. Finally, we mention some open problems in the subject. This talk will be self-contained and aimed at a general audience.

Poster Abstracts

Newton's Method and Fractals

Michael Bennington, Clayton State University

This poster will explain how Newton's Method can be used to generate a fractal.

Maria Gaetana Agnesi (1718 - 1799)

Carol Baldwin, Western Carolina University

Maria Agnesi was an Italian mathematician and author of the mathematics textbook, *Analytical Institutions*. Agnesi overcame obstacles throughout her lifetime and devoted herself to the service of the church and the sick.

Map Projections through History

Ben Blake, Western Carolina University

The world is flat! Humans have known for over two-thousand years that the earth is a sphere, but the challenge for cartographers has been how best to represent the sphere on a flat map. Ptolemy was one of first mathematicians to formally address the subject, and his notions held as the authority on the subject for 1500 years. With the surge in nautical exploration in the 16th century, Mercator used his projection to aid sailors with their navigation. In the 18th century, Lambert addressed the subject of map-making, publishing a paper on the subject introducing seven new map projections and their associated functions.

Bernoulli Epidemic Modeling

Doug Cutshall, University of North Carolina at Asheville

Daniel Bernoulli published a paper in 1766 about death rates with respect to diseases, immunizations, and immunity. In our poster we will be discussing epidemic modeling as a direct result of his works. We will also be mentioning the applications of his formulaic models as well as the reasons behind their development.

Georg Cantor and the Infinite

Candace Dillin, Western Carolina University

George Cantor was a German mathematician who is commonly known as the inventor of set theory – an important contribution to mathematics. His well-known accomplishments in mathematics include establishing the importance of one-to-one correspondence between members of different sets and the definition of infinite and well-ordered sets. He also made a great impact when he proved that the real numbers are “more numerous,” or larger in quantity, than the natural numbers. By proving this, Cantor proved that there exists an “infinity of infinities.” While his ideas were seen even as a “grave disease," this awful criticism was eradicated as his theories and findings became crucial to mathematics.

Pell's Equation Through Time

Lauren Dubuke and Austin Mack, University of North Carolina at Asheville

Diophantine equations have been investigated for thousands of years. Shadowed by the famous Pythagorean Theorem, Pell’s equation is a one of the most popular Diophantine equations, x^2-Dy^2=1 where D is a non-square integer. The study of Pell’s equation dates back to as early as 400 BC in ancient Greece and India. Pell’s equation has been considered by prominent members of the mathematical community such as Brahmagupta, Fermat, and Euler among others. We investigate the motivation for these mathematicians to study this equation. We will also look at the application of Pell’s equation over the ages. Along with the motivation and individuals that studied Pell’s equation we will investigate the various methods used to achieve the first non-trivial solution through time.

Metric System

Christian Gosnell, Western Carolina University

During the late 1700's and early 1800's, the people of France realized the need for one standard unit of measure. Finding this measure would not be an easy task and would take the government of France decades to tackle alone, without the help of other world powers such as Great Britain and the US.

Sir Francis Galton and Popularization of Statistics in 19th-century Great Britain

Travis Hartley, Western Carolina University

This poster focuses on the scientist and statistician Francis Galton. Francis Galton’s inherited wealth and family connections, as well as his fascination with the inheritance of traits, contributed significantly to the popularization of data analysis in the mid to late 19th-century in the United Kingdom. The talk will cover a variety of factors in Galton’s life that contributed to the growing interest and application of statistics.

Poster Abstracts, continued

The Mathematics of Medieval Cathedral Building

Kriston Haynes, Western Carolina University

This poster will discuss the role of the mason in the construction of medieval cathedrals and the mathematics that he used in his task.

The Universe of Archimedes

Michelle McDuffie , Western Carolina University

This poster is about the goal of Archimedes' *Sand Reckoner.* Archimedes decided to show his ability with large numbers through calculating how many grains of sand it would take to fill the universe. Archimedes used the distance of the stars and the diameter of the Earth's orbit to start off his theory and, after calculating the size of the universe, he proceeded to calculate the sand. The number system used by the Greeks could not express his findings, and thus Archimedes invented a new counting system involving powers of 100 million.

The Mathematics of Ancient Babylonian Scribal Education

Haley McFadden, Western Carolina University

The education of a scribe in ancient Babylon has been a mystery for many of years. Today we know as much as the curriculum, when students were taught, and a day in the life of a student. All of this has been uncovered through the tablets left behind from this fascinating civilization.

Pythagorean Brotherhood

Ellen Phillips, Western Carolina University

This poster discusses how the Pythagoreans made mathematical discoveries through their mystic beliefs and almost cult-like nature, and how they contributed to the overall significance of Greek mathematics.

Interpretations of Plimpton 322

Alex Rector and Sarah Weatherman, University of North Carolina at Asheville

In this poster, we will discuss one of mathematics' most famous artifacts, Plimpton 322. We will focus on the idea that historical documents can only be understood in their historical context. A four-column, fifteen-row cuneiform tablet, Plimpton 322 is a mathematical document surviving from Mesopotamia. The meaning behind this tablet has been depicted as quite the mystery. Part of the tablet has broken away, but it is known that the numbers on this table are written in a base 60 place value system. There have been three major interpretations of the tablet's function. The first thought included trigonometry. The second includes Pythagorean triples, and we will be discussing its controversy. The third theory uses cut and paste geometry, dealing with reciprocals. We will explore these three interpretations and establish our own theory based on our findings.

History of Linkages

Brad Rogers, Andrew Zorn, and Jefferson Dunn, University of North Carolina at Asheville

Our poster will be about mechanical linkages. A mechanical linkage moves about a joint in order to manipulate force, and many may be combined for more complex tasks. Our poster will cover from the early history of linkages (such as the discoveries of Archimedes) through simple explanations of more intimidating geometric designs.

The Influence of Mathematics on Modern Musical Theory

Nikki Sanford, High Point University

The study of the connection between music and mathematics dates back over a thousands years. The Ancient Greeks, Pythagoreans, and individuals were able to express the beauty of music in terms of mathematical relationships. Harmonics, note frequencies, and scales, which compose the basis of music theory today, were constructed and ultimately improved by these studies. From the Golden Ratio to the Fibonacci sequence, these relationships have had a great influence in both shaping our modern musical foundation, and on past and present composers.

Poster Abstracts, continued

The Archimedes Palimpsest

Adam Schrum, Western Carolina University

Archimedes was a Greek mathematician and geometer who lived and practiced in 3rd century B.C.E. Syracuse. His works survived until the early 20th century only because of two books, written in ancient Greek, known as Codex A and Codex B. A third book, a 6th-century palimpsest known as the Archimedes Palimpsest, was discovered by Johann Ludvig Heiberg in late 1800s and was lost again to history. The Archimedes Palimpsest has been rediscovered and, with the help of modern imaging, the works of the great Archimedes are being restored to mankind at last.

The Brachistochrone, Tautochrone, Isochrone, and Catenary Problems

Brielle Spencer, High Point University

The 16th and 17th centuries were a time period of great mathematicians and mechanics that caused great development of advanced mathematics. The 16th and 17th centuries also saw a rise in applied mathematics and its practical uses. Four such problems emerged near the end of the 17th century that would attract the minds of some of the most prominent mathematicians of the period, although Galileo had actually considered parts of all four of these problems earlier. These four problems were the Brachistochrone, Tautochrone, Isochrone, and Catenary problems. These problems were solved using the newly developed methods of calculus and solidified the power and usefulness of this new tool for solving real physical situations. More modern terminology, such as integral, was used in presentation of solutions and these problems helped to lay the foundation for further work in calculus and the development of calculus of variation.

Planetary Orbits

Laura Tinney, University of North Carolina at Asheville

Theories about the movement of the planets have been around for thousands of years and are part of ancient religions, myths and man's earliest foray into science. Our research will focus on the changing views of planetary orbits and the people who shaped these ideas.

Construction of Platonic Solids using Golden Rectangles

Sarah Vintin, Rachel Cook, and Heather Sain, University of North Carolina at Asheville

Our poster will be about Platonic Solids and Constructions using golden rectangles. We are going to look further into Luca Pacioli's Construction of the icosahedron, using three copies of the golden rectangle. Also, we plan to create various models of constructions to further the understanding of participants at the conference. Overall, we plan to look deeper into different types of Platonic Solids while understanding the applications of each.

Blaise Pascal

Zac Wallace, Western Carolina University

This poster will demonstrate the many areas of culture affiliated with Blaise Pascal. It will go in depth on his mathematical theories and provide insight in his religious views. It will also demonstrate how to use the Pascal Triangle.

Cayley's Group Theory

Colby White, Western Carolina University

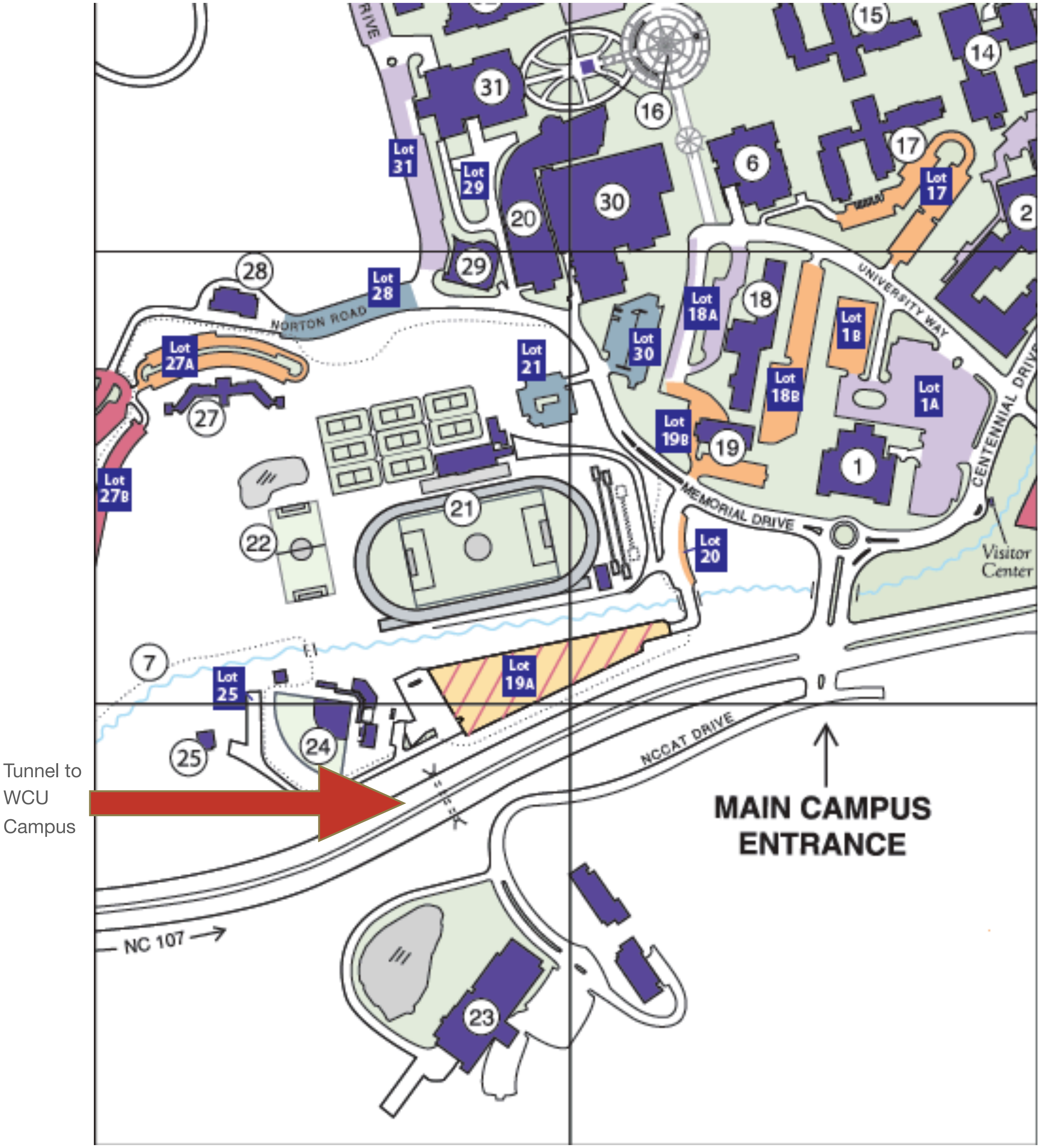
Arthur Cayley was a brilliant mathematician that has shaped the mathematical world that we know today with his work in group theory and other fields. In particular, Cayley developed the first abstract definition of a group as well as the first example of a non-abelian group. However, Cayley's ideas on group theory were somewhat rejected in the 1850's and then accepted later in the 1870's. Why would the mathematical community not accept the work of such a proven mathematician at one point in time, and then accept it merely two decades later?

Edwin Abbott and Flatland

Cody Williams, Western Carolina University

This poster looks at the life of Edwin Abbott and his accomplishments. It also investigates his most famous novel *Flatland*, which looks at fictional worlds of different dimensions and what happens when they meet.

Campus Map: #23 is NCCAT; #20 is the WCU Campus Rec. Center.



Institutions Represented at SMURCHOM VI:

Clayton State University
Columbus State University
Georgia College and State University
Haywood Community College
High Point University
Robbinsville High School
Southwestern Community College
University of North Carolina--Asheville
Warren Wilson College
Western Carolina University
Young Harris College

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