department NEWS

Faculty NEWS

Wlodek Bryc attended the Summer School of Probability Theory in St. Flour, France during July 2004, and the Workshop on Wishart and Related Matrices in Mahdia, Tunisia in June 2005. He was recently awarded a three-year grant from the National Science Foundation to study stochastic processes on non-commutative probability spaces.

Roger Chalkley's second monograph on relative invariants for differential equations was accepted by the *Memoirs of the American Mathematical Society.* (See related article in this newsletter.)

Jim Deddens gave lectures this summer at the University of Utrecht in the Netherlands and in Zurich, Switzerland. He continues to be an active consultant with NIOSH, the Veteran's Administration Hospital, and the Wood Hudson Cancer Research Laboratory.

Jintai Ding was awarded a grant from the National Security Agency to fund his project "Analytical Structures of Quantum Affine Algebras." He gave numerous talks in the US and abroad during 2004-2005. This past spring he received the McMicken Dean's award for Distinguished Scholarship. (See related article)

Scott Dumas spent January and February 2005 at the Federal University of Pernambuco in Recife, Brazil, where he taught a mini course on KAM Theory at their Dynamics Summer School.

Don French was awarded a three-year grant in Mathematical Biology from the National Science Foundation. He and co-investigator Steve Kleene of UC's College of Medicine will use mathematical modeling to study ion channel distribution in olfactory cilia.

Chuck Groetsch is a frequent invited speaker. Many of his talks are popular expository lectures (e.g., his keynote address "Smooth or Crunchy?" at the Outstanding Mathematics and Science Teacher Conference in Erlanger, Kentucky last April). He was co-organizer of the Special Session on Integral and Operator Equations at the American Mathematical Society meeting at the University of Delaware in April, 2005.

David Herron organized last January's Special Session "Topics in Geometric Function Theory" at the Joint Mathematics Meetings in Atlanta, Georgia.

Paul Horn leads a group that meets regularly to examine data from the Fernald Medical Monitoring Program. He and his co-authors won the Distinguished Abstract Award given by the National Academy of Clinical Biochemistry. He co-authored *Reference Intervals: A User's Guide* with Amadeo Pesce of the College of Medicine. It was just published by the American Association of Clinical Chemistry.

Xiaodong Lin presented several off-campus lectures, including one at the Applied Stochastic Models and Data Analysis Conference in Brest, France. He received the 2004 Chikio Hayashi Memorial Award from the International Federation of Classification Societies. He spent April 2005 visiting SAMSI (Statistical and Applied Sciences Institute).

Chris McCord, Pat McSwiggen, and **Ken Meyer** co-organized the 2004 Fall Midwest Dynamical Systems Seminar.

David Minda visited the University of Cambridge between November 2004 and April 2005. He gave talks at the University of Cambridge and at York University in England.

Joy Moore and **Mihaela Poplicher** were awarded a grant from the Ohio Department of Education to provide professional development to grade 8-12 mathematics teachers.

Diego Murio was invited principal speaker at the Fifth International Conference on Inverse Problems in Engineering: Theory and Practice in July 2005 at the University of Cambridge in England.

Jim Osterburg co-organized the conference Groups, Rings & Algebras in honor of Donald S. Passman, June, 2005 in Madison, Wisconsin.

Costel Peligrad spent part of his sabbatical last winter at the University of Rome Tor Vergata.

Steve Pelikan organized the 2-day workshop "Designing Assessment Tools to Measure Pedagogical Content Knowledge" in August 2004. Throughout the year, he and **Joy Moore** conducted professional development for college math, science, and education faculty in their continuing role as Ohio Board of Regents Teaching Fellows.

Dan Ralescu spent spring of 2004 in Japan, where he visited the Tokyo Institute of Technology and the University of Kyoto. He was keynote speaker at the International Conference of Soft Methods in Probability and Statistics in Oviedo, Spain in September 2004. Dan was on vacation in Phuket Island, Thailand, in December 2004 when the tsunami struck. His account of this experience can be read on the College of Arts and Sciences website *www.artsci.uc.edu* by following the links to the news and events archive for January 2005.

Nageswari Shanmugalinam spent the spring quarter visiting the University of Jyväskylä, Finland. She was awarded funds from the Charles Phelps Taft Research Center to run a Taft Research Seminar in geometric function theory during this academic year.

Tara Smith serves on the Southwest Ohio Advisory Board for Excellence in Science and Math Education.

Srdjan Stojanovic made presentations at several meetings organized by the Global Association of Risk Professionals in New York City and London. One of his research articles was published in the *Comptes Rendus de l' Académie des Sciences, Paris.*

Bingyu Zhang gave a series of talks in July 2004 at the Chinese Academy of Sciences in Beijing and a presentation at the 23rd Chinese Control Conference in Wuxi, China in August 2004. He was co-organizer of the Special Session on Nonlinear Waves at the American Mathematical Society meeting at Northwestern University in October 2004.

Ning Zhong was invited speaker at the Sixth International Workshop on Computability and Complexity in Analysis in Wittenberg, Germany in August 2004. She presented a series of five lectures on "Computability in Analysis and Physics" at Kyushu University in Japan last November. She was guest editor of the special issue "Computability and Complexity in Analysis" of the *Mathematical Logic Quarterly* (No. 4/5, Volume 50 (2004)).

Student NEWS

Undergraduate Student News:

The department graduated 14 math majors this year. Undergraduate award winners for 2004-2005 included **Brian Yates** (Jeanne Gulden Scholarship and Harris Hancock Scholarship), **Jessica D'Souza** (Feld Scholarship and Kieval Scholarship), **Donald Brown** (A&S Math Scholarship and Harris Hancock Scholarship), **Samantha Cronier** (Harris Hancock Scholarship), **Mads Almmassalkhi** (Buck Scholarship and Kieval Scholarship), **Jon Slovisky** (Lindner Book Award), **Valerie Caudill, Kristy Lung, Robert Meyer, Allen Miller,** and **Christopher Wagner** (Kieval Scholarship). **Samantha Cronier** won the University's C-Ring Award (see article under "Hypotenews"), and **Jessica D'Souza** was elected to Phi Beta Kappa.

Graduate Student News:

The department graduated 21 master of science students, nine master of teaching students, and five PhDs. **Adama Diene, Anahit Galstyan, Hyeon Oh, Shuhong Zhao,** and **Ron Zhou. Raluca Dimitru** and **Dorj Badamdorj** won Taft Advanced Graduate Fellowship Awards for 2005-2006. **Zeynep Teymuroglu** won the Henry Laws Fellowship Award. **Tamer Oraby** and **Len Ruth** were awarded University Research Council Summer Graduate Fellowships. **David Freeman** received the Outstanding Doctoral Student Award for a First-Year Student; **Yan Jin** received the Outstanding Doctoral Student Award for a Second-Year Student. **Zhuoqiao Wang** was selected the department's Outstanding Masters Student Award. The Outstanding Graduate Assistant Award went to **John Wagner.**

Alumni NEWS

Dennis Berkey (PhD 1974)

Dr. Berkey, the current president of Worcester Polytechnic Institute, received the College Arts and Sciences Distinguished Alumni Award this year. (See last year's *Right Angle* for a profile of Berkey.)

Larry Ungar (BA 1994, MS 1997)

Larry is currently living in Texas, teaching mathematics at two community colleges. Last year, he was mobilized in the Navy Reserves to serve in Operation Iraqi Freedom. He writes, "My reserve unit is responsible for offloading/onloading anything and everything from naval and merchant marine ships. Due to the increase in activity in Iraq, our unit was called up in July 2004. We spent a few weeks training in Virginia and then were sent off to Kuwait, which is where the port is located. We then spent 9 months living in 10-man tents and working 10 - 12 hour shifts. Using cranes, winches, and forklifts, we offloaded track vehicles (tanks, troop transports etc.), ammo, earth moving equipment, food etc. My particular job was that of a hold boss. This meant that I was second in command for my team. I was responsible for directing our 10 man team. This meant giving signals to the crane, reading "stow plans" which allowed me to place equipment in the correct place, assigning my people to load/offload various pieces of cargo. All of this took place 24 hours a day. Since our shifts switched every now and then, we all worked mornings, afternoons and nights. We never saw any gun-play, which is a good thing. However, when we traveled from our camp to the port we were still required to wear our "battle rattle" and M-16s. All and all, it was a very interesting experience; however, I hope that I don't have to do it again."

Rich Franklin (BA 1997)

The former high school math teacher is now a mixed martial arts fighter in the UFC (Ultimate Fighting Championship) and middleweight champion. His personal website is *www.richfranklin.com.*

Greg Hull (BA 2004)

Greg is coach for the Cincinnati Junior Rowing Club. He took a group of rowers from the CJRC and St. Xavier High School crew team to England in June to train and compete in the Henley Royal Regatta on the River Thames. The group also competed in the Reading Regatta and the Marlow Regatta.

Please use the included form to include your latest news in the next issue of *The Right Angle* and other McMicken College publications.

the department welcomes SEONGHO SONG

Seongho Song arrived on campus on August 26 with a fresh PhD in statistics from the University of Connecticut. Formerly a student and then part-time lecturer at Pusan National University in Korea, Song works in Bayesian statistics, especially Bayesian hierarchical analysis and Bayesian computing with Markov Chain Monte Carlo methods. His research has focused on the analysis of genetic diversity with hierarchically structured data. (Here "hierarchical" refers to the multi-level nature of the data.) In the article below, he presents an elementary overview of his research.

Throughout the history of population genetics, mathematical models have played an important role in elucidating the forces affecting genetic diversity of organisms. Fisher, Haldane and Wright initially developed population genetics theory in the 1920's and 1930's, and current theory still bears the imprint of their work. Indeed, so fundamental are their contributions that researchers have found it difficult to move beyond the paradigms that they introduced. However, such a move forward is necessitated by the need to use population genetics theory to analyze data from the human and other genome projects. During the last decade, many statistical models have been proposed. Population geneticists have increasingly employed Bayesian methods for the analysis of complex hierarchical genetic data.

Mendel's rule tells us how the genes present in the parents are redistributed among the offspring.

parents	$A_1A_2 \times A_1A_2$		
	↓		
offspring	$^1/_4A_1A_1$	$^1/_2A_1A_2$	$^1/_4A_2A_2$

Population genetics describes how the genes present in a population of parents are redistributed among a population of offspring. Assuming random mating with all matings producing the same average number of offspring, the frequency of an allele among newly born offspring will be equal to the allele frequency in the gametes (a specialized sex cell). We call this phenomenon the "First Law of Population Genetics." However, in real populations, several factors may change the allele frequencies in successive generations. In population genetics, we are interested in studying the forces that cause allele frequencies to change and in learning how to use statistical inferences to infer the actions and properties of those forces from observed genetic variations.

Population geneticists are also interested in how population structure affects the interpretation of the observed pattern of genetic diversity. In natural populations, members rarely mate at random in a global sense. For instance, geographical boundaries may play a role in mate selection, and differentiated subpopulations may develop. In statistical terms, population structure introduces some correlation or covariance between alleles taken from different subdivision levels (nested subpopulations organized in a hierarchical manner). Using the F-statistic introduced by Wright (1951), statisticians quantify the effect of population structure on the amount of inbreeding at a given level of the population subdivisions.

Computational advances due to the development of Gibbs sampling and Markov chain Monte Carlo (MCMC) in recent years have led to the increased use of Bayesian inference in many fields, especially population genetics, bioinformatics, survival analysis, and so on. These algorithms make it easy to build and analyze the complicated statistical models that arise in population genetics of hierarchically structured populations.

In addition to hierarchical Bayesian modeling, my other areas of research interest are longitudinal data analysis with a Markov regression model that uses the reversible jump MCMC method and compositional data analysis that employs the multivariate truncated normal distribution and multivariate logistic transformation.

the HYPOTENEWS

mathematics professor, alumnus, & senior WIN TOP HONORS

Three members of our departmental family were recognized this year for their outstanding accomplishments: faculty member ***Jintai Ding*** *won the 2005 McMicken Dean's Award for Distinguished Scholarship, recent graduate* ***Carl McTague*** *added an NSF Graduate Fellowship and a Student Fulbright Award to his list of achievements, and 2005 graduating senior* ***Samantha Cronier*** *won the 2005 University of Cincinnati C-Ring Women's Leadership Award for the outstanding graduating senior woman.*

Jintai Ding is an extremely talented young mathematician who began his career working in quantum group theory. In the span of a few years, he has moved from a novice in the area of cryptography to become one of the world's most inventive and original experts in cryptology. He was honored this spring at the annual College Awards Dinner with the 2005 McMicken Dean's Award for Distinguished Scholarship.

Jintai was attracted to the area of cryptography at a time when newly discovered flaws in the widely used RSA encryption system had experts searching for new techniques. One such system, known as the "Tame Transformation Method," was claimed to be more secure and efficient than previous systems, and its inventor T. T. Moh had challenged mathematicians to try to break different versions of his codes. In a series of papers, Ding took the TTM system apart and demonstrated that it could be broken by a fairly straightforward algebraic trick called "dimension reduction." This was an impressive accomplishment for someone new to the subject.

The defeat of the Tame Transformation Method underlined the need for a totally new and far more secure encryption system. One idea being discussed by experts at the time involved replacing single variable polynomials (such as $x + 2$) with multivariable polynomials (such as $xy + yz + 3x - 5$). However, the most obvious methods had subtle flaws. Jintai used his experience in quantum groups and the associated ideas of continuous deformation of an algebraic system to come up with the concept of *internal perturbation* in a multivariate public key cryptosystem. The added feature of internal perturbation enabled him to construct new multivariate public key cryptosystems that are far more efficient and secure than existing systems. They are among the most original and promising encryption systems proposed in recent years, and they open a whole new direction in research into multivariate public key cryptosystems. Perhaps the most significant aspect of this work is its resistance to the threat posed by ultra-fast but as yet hypothetical quantum computers.

Carl McTague (BA 2004) blazed through his undergraduate studies in mathematics, quickly working up to graduate level courses and launching himself into research projects in dynamical systems with Jim Crutchfield of the Santa Fe Institute and in topology with former UC professor Markus Banagl, who is currently at Universität Heidelberg. His work in algorithmic music composition gained wide recognition when he was invited to address the 5th International Mathematica Symposium in London during the summer of 2003. That trip also inspired his interest in Cambridge University's Center for Mathematical Sciences, where he was admitted to graduate study last autumn. He spent all of 2004-2005 attending lectures and preparing for the Certificate of Advanced Study in Mathematics, which is also known as Part III of the Mathematical Tripos. It is described as "the culminating part of the oldest and most famous mathematics examination in the world." Examinations are given over a week's time in June, and each candidate receives both a numerical score and a quality mark from α+ to γ-. An aspirant must pass these exams "with distinction" in order to be accepted as a PhD candidate, and over one hundred students compete to reach this level each year. During a dramatic ceremony last June at the University Senate House at Cambridge University, McTague learned that he had succeeded.

This success came on the heels of other spectacular news. In April he was notified that he had won a prestigious three-year National Science Foundation Graduate Research Fellowship to fund his PhD studies at Cambridge. His was one of only 31 awarded nationwide in the mathematical sciences in 2005. In May he received news of a 2005-2006 U.S. Student Fulbright Award to support a year-long visit to Heidelberg, where he will resume his research on the topology of singular spaces with Markus Banagl.

Carl is currently in Heidelberg. When he returns to Cambridge next year, he will work under Professor B. J. Totaro.

2005 graduate **Samantha Cronier** came to UC to study biomedical engineering but was drawn to mathematics during the course of her studies and subsequently completed both majors this spring. An Honors Scholar, she made the dean's list every quarter while carrying a heavy course load. She won many scholarships and awards, including a Cincinnatus Scholarship and a grant from the Association of International Education in Japan to study under the Nagoya University Program for Academic Excellence. Samantha participated in biotechnology research both at UC and at Toyobo, a Japanese biotechnology laboratory specializing in fibers, films, and textiles for industrial and medical applications. This spring she received the 2005 University of Cincinnati C-Ring Award, which honors the outstanding graduating senior woman for achievements not just in academics, but also in service and leadership. In her case, these latter attributes were exemplified by her presidency of the Biomedical Engineering Society, the Japanese and American Student Society, and UC Skeptics; by her leadership of her senior capstone design team, her participation in a UC program aimed at recruiting middle school girls into science, engineering, and math; and by her work with a local girl scout troop and at a battered women's shelter. This exceptional young woman aspires to travel and study Arabic or Hindi. She is already fluent in Japanese and French. This fall Samantha is off to the University of California at Berkeley to continue her PhD studies program in bioengineering.

THE RIGHT ANGLE is produced by the Department of Mathematical Sciences McMicken College of Arts and Sciences University of Cincinnati PO Box 210025 Cincinnati, OH 45221-0025

THE RIGHT ANGLE

Editor: Joanna Mitro

For more information, call (513) 556-4050 or email us at RightAngle@math.uc.edu Comments and suggestions are welcome.

Layout and design by McMicken College of Arts and Sciences Office of Marketing and Communications

Please affix postage here

THE RIGHT ANGLE
Department of Mathematical Sciences
McMicken College of Arts and Sciences
University of Cincinnati
PO BOX 210025
Cincinnati, OH 45221-0025

F O L D H E R E

from the EDITOR

Thanks to all of the people who contributed inspiration, ideas, information, articles, and news items for this issue of the *Right Angle.* I encourage all readers to become contributors! Please send in your comments, suggestions, and items for the Alumni News section; use this form or email me at RightAngle@math.uc.edu.

Joanna Mitro

Name _____

Address _____

_____

Year of graduation _____

Degree _____

Current occupation _____

Professional or personal news (comments/suggestions):

_____

_____

_____

_____

_____

_____

tom king SETS SAIL

by CHUCK GROETSCH

Tom King recently retired after 35 years of service to the University of Cincinnati and the Department of Mathematical Sciences. But his connection with UC goes back even further. He is a native Cincinnatian whose early years were spent in Mt. Adams in the days before it became trendy. He attended Elder High School and was a student in UC's College of Engineering. He received his BSEE degree in 1966. While a student at UC, he co-oped at AVCO Electronics and Allis-Chalmers Corporation. But his interests took a theoretical turn, and with his student days behind him, Tom climbed into his MG roadster and headed to Ithaca and a fellowship at Cornell University's Center for Applied Mathematics .

In the 1960s Cornell's applied mathematics program was innovative and cutting-edge. It was not departmentally-based, had no required courses, and immediately immersed new doctoral students in the culture of research. Tom thrived in this environment and was a junior member of one of the leading research groups in the theoretical analysis of finite element methods for partial differential equations. It was led by James Bramble.

Tom returned to UC as an ABD assistant professor in 1970 and was granted his Cornell PhD in 1971. He soon made his mark in the finite element research community. His early research involved the careful mathematical analysis of the vexing problem of "rough" or "irregular" boundary effects in partial differential equations. The straightforward approach of constraining finite element approximations to satisfy these inconvenient boundary requirements leads to huge analytical difficulties. Another approach involves unconstrained optimization techniques that "penalize" deviations from the required boundary conditions (I'm told that Sheriff Simon Lies thought very highly of Tom's work on penalization methods). Unfortunately, this approach led to sub-optimal convergence rates, and the complexities of finite element techniques requires good convergence rates for effective numerical solutions. By a very clever and precise analysis he was able to show that an extrapolation technique could restore optimal convergence rates to the penalty method.

His work received wide recognition in 1974, when it was featured in a "Research News" article in the journal *Science*, one of the most widely circulated science periodicals in the world. Over the next thirty years, he continued to produce significant research results in a number of branches of numerical analysis, including finite element methods, iterative methods for ill-posed linear problems, multi-grid methods, and domain decomposition methods, as well as some nice applications of the finite element method to optimal control problems that he produced with Don French, who is also a product of the Cornell Center for Applied Mathematics.

A busy research career never prevented Tom from spending enormous amounts of time and effort on his teaching. He has always been known for his meticulously prepared lectures and for the high standard to which he held his students. Some of his experience in the classroom has been made available to a wider public in two books. His work *Introduction to Numerical Computation*, published by McGraw-Hill in 1984, is still, I think, the most correct and careful presentation of the subject at its level. Some years later Tom slipped a bit when he teamed up with a shady co-author of questionable repute to produce *Matrix Methods and Applications*, published in 1988 by Prentice-Hall. Legend has it that legions of engineering students remember Chapter 4 of this book (and not very fondly) as a trial by fire, a bad toothache, or Chinese water torture. Tom assures everyone that, whatever the perceived defects of this most theoretical chapter of the book, they are entirely attributable to the sloth and incompetence of his colleague and co-author.

Tom King's presence in the Mathematics Department will certainly be missed, but we hope to see him often - at least whenever his sailboat is in dry dock or when he and his wife Leanne give in to irresistible cravings for Skyline chili or Graeter's double chocolate chip ice cream.

THE RIGHT ANGLE
Department of Mathematical Sciences
McMicken College of Arts and Sciences
University of Cincinnati
PO Box 210025
Cincinnati, OH 45221-0025

RETURN ADDRESS REQUESTED

Non-profit
Organization
U.S. Postage
PAID
Permit No. 133
Cincinnati, OH

THE RIGHT ANGLE

Vol. 13 MATHEMATICS ALUMNI NEWSLETTER Autumn 2005

McMICKEN COLLEGE OF ARTS AND SCIENCES
Department of Mathematical Sciences
RightAngle@math.uc.edu

UNIVERSITY OF Cincinnati

from the HEAD

Dear Alumni and Friends,

This year saw a number of prestigious awards come the way of the Department of Mathematical Sciences. Dennis Berkey (PhD 1974), currently President of WPI, won the college Distinguished Alumni award; Associate Professor Jintai Ding won the McMicken Dean's Award for Distinguished Research; and undergraduate Samantha Cronier won the C-Ring award for the outstanding graduating senior woman. Alumnus Carl MacTague received an NSF graduate fellowship and a Fulbright award to continue his graduate studies in Europe.

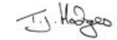
This year was also a successful one for external support with new grants by the NSF awarded to Wlodek Bryc and Don French and by the National Security Agency to Jintai Ding.

Professor Tom King retired in June after 35 years of service to the department. We wish him well for the future. He will be greatly missed. At the same time we welcome Seongho Song, our new Assistant Professor of Statistics.

In January a new Mathematics Learning Center opened on the sixth floor of Old Chemistry. Staffed by a variety of helpers ranging from advanced undergraduates to senior faculty, the MLC provides much needed drop-in help to students in introductory mathematics and statistics classes. Co-directors Paul Sontag and Mary Schuster report that student response has been very positive and usage is strong. This year we will be experimenting with expanding evening hours and including weekend hours.

For more details on all this and more, read on…

My best wishes to you all for a happy and productive year,



Tim Hodges

chalkley COMPLETES A CAREER-LONG QUEST

Almost 50 years ago Roger Chalkley was introduced to the subject that has fascinated him over his entire career. In 1957, he was a doctoral student at the University of Cincinnati when his advisor, Professor Arno Jaeger, suggested he investigate some nonlinear differential equations that had been studied by French mathematician Paul Appell in the 1889 paper "Sur les invariants de quelques équations différentielles." Several challenging unanswered questions therein intrigued Chalkley. They provided his thesis topic and have influenced his subsequent research.

Chalkley's years of work in this area recently culminated with the preparation and publication of a pair of monographs in which he gives a complete solution to general problems in the theory of relative invariants for certain classes of differential equations. *Basic Global Relative Invariants for Homogeneous Linear Differential Equations* was published in the series *Memoirs of the American Mathematical Society* (2002), and *Basic Global Relative Invariants for Nonlinear Differential Equations* will appear in the same series. Chalkley explains that he had to first develop his results for the linear case in order to reach his goal of describing relative invariants for the types of nonlinear equations that Appell had begun to study.

The history of these problems goes back before Appell's work to an 1879 paper in which Edmond Laguerre discovered the basic relative invariant for the class of homogeneous linear differential equations of order 3 with meromorphic coefficients. [Note to the reader: a meromorphic function can be thought of as the ratio $\phi(z)/\psi(z)$ of two analytic functions, where $\psi(z)$ is not identically zero.] Such equations may be represented as $y'''(z) + c_1(z)y''(z) + c_2(z)y'(z) + c_3(z)y(z) = 0$ where c_1, c_2, c_3 are meromorphic functions on some region Ω of the complex plane. Laguerre considered changes of the variables in such equations and examined the effect on the coefficients c_1, c_2, c_3. The change of dependent variable $y(z) \to v(z)$ given by $y(z) = \rho(z)v(z)$, where ρ is an arbitrary (not identically zero) meromorphic function on Ω, transforms the original equation into $v'''(z) + c_1^*(z)v''(z) + c_2^*(z)v'(z) + c_3^*(z)v(z) = 0$, another equation of the same class on Ω. The new coefficients c_1^*, c_2^*, c_3^* are uniquely determined by the original coefficients and ρ. The change of variable $z \to \zeta$ by means of $z = f(\zeta)$ and $u(\zeta) = (y \circ f)(\zeta)$, where f is the inverse of an arbitrary univalent analytic function g on Ω, transforms the original equation into $u'''(\zeta) + c_1^{**}(\zeta)u''(\zeta) + c_2^{**}(\zeta)u'(\zeta) + c_3^{**}(\zeta)u(\zeta) = 0$ on $g(\Omega)$. When Laguerre expressed the coefficient functions c_1^*, c_2^*, c_3^* and c_1^{**}, c_2^{**}, c_3^{**} in terms of the original coefficients and the functions ρ and f and their derivatives, he discovered some remarkable identities that reflect a relative invariant for this class of equation.

> Define $P = c_3 - {}^1/_3\, c_1c_2 + {}^2/_{27}\,(c_1)^3 - {}^1/_2\, c_2^{(1)} + {}^1/_3\, c_1c_1^{(1)} + {}^1/_6\, c_1^{(2)}$ on Ω, and let P^* and P^{**} be the corresponding expressions when c_j is replaced by c_j^* or c_j^{**}. Then $P^*(z) = P(z)$ for all $z \in \Omega$ and $P^{**}(\zeta) = (f'(\zeta))^3 P(f(\zeta))$ for all $\zeta \in g(\Omega)$. In this case the relative invariant is the basic polynomial $w_3 - {}^1/_3\, w_1w_2 + {}^2/_{27}\,(w_1)^3 - {}^1/_2\, w_2^{(1)} + {}^1/_3\, w_1w_1^{(1)} + {}^1/_6\, w_1^{(2)}$.

In the early 1880s, Georges-Henri Halphen was able to deduce the two basic relative invariants for the class of homogeneous linear differential equations of order 4 with meromorphic coefficients, but his method of direct pencil-and-paper computations is too tedious to employ for higher order equations.

In 1888, Andrew Forsyth used infinitesimal transformations to deduce formulas for the $m - 2$ basic relative invariants for homogeneous linear equations of order m when $5 \le m \le 7$. Ironically, this success actually impeded further progress in the area during the years 1889-1986, as numerous papers were published claiming that the desired identities for any $m \ge 3$ should be obtained as consequences of yet-to-be-developed arguments involving infinitesimal transformations. Other approaches during these years were, for various reasons, also unsatisfactory. In Chalkley's words, "the subject languished." Chalkley returned to these equations in 1987 and by using constructive methods, was able to find simple explicit formulas for the $m - 2$ basic relative invariants for homogeneous linear equations of order m for each $m \ge 3$. (There are no relative invariants for $m = 1$ or 2.) His invariants, like those of Laguerre and Halphen, are global, i.e., the functions in the identities they specify have the same domains as the coefficients of the corresponding differential equations.

The non-linear extension of this work concerns differential equations of the form $H_{m,n} = 0$, where $H_{m,n}$ is expressible as an nth-degree homogeneous polynomial combination of the function y and its derivatives $y', \ldots, y^{(m)}$ that has coefficient of $(y^{(m)})^n$ is 1. Chalkley has shown that the number of basic relative invariants for these equations is $\binom{m+n}{n} - 3$ when $m \ge 2$ (and equals $n - 1$ when $m = 1$), and as in the linear case he is able to give simple explicit formulas for the basic relative invariants. In the 1889 paper that inspired this work, Appell had found one of the three basic relative invariants for the equations $H_{2,2} = 0$; the other two were unknown until Chalkey's study revealed them.

In addition to presenting these definitive new results, Chalkley's mongraphs encompass work on these problems that has spanned about 120 years. He provides rigorous proofs for some basic assertions from the early days of the theory that until now were based on incomplete arguments. He has also gone further to include the basic relative invariants for numerous classes of nonhomogeneous algebraic differential equations.

Congratulations to Roger Chalkley for this outstanding achievement.

nancy diemler COMES ON BOARD

The department was especially fortunate this year to hire **Nancy Diemler** as Financial Analyst to take charge of business and personnel matters, including grant administration for the department. With almost 10 years of experience in accounting and administration in other units of the university, Nancy brings a wealth of experience and expertise to the position created after the retirement of Sue Curtis, and her familiarity with arcane university systems has helped the department attain high levels of function and efficiency. We admire her attention to detail, can-do attitude, and creative solutions to problems. Next time you visit the department, stop in and meet Nancy.