

DEPARTMENT OF MATHEMATICS

Report to the Board - Fall 94

PERSONNEL

Professor Allen Broughton, the new head of Mathematics began work on 22 Aug 94, and officially assumed his chairmanship duties on 26 Aug 94. We thank George Berzsenyi for his six years of faithful service as the previous head and the invaluable help he is providing for a smooth transition.

Professor Robert Lopez continues his special leave, during Fall and Winter quarters, to work as a consultant for Waterloo Maple Software, making presentations at various institutions.

Professor Ralph Grimaldi will be on a full year of sabbatical leave at Clemson University where he will develop his special interests in discrete mathematics.

Professor George Berzsenyi will be on sabbatical leave during Winter and Spring and will work on developing the USA Mathematical Talent search and his other interests in mathematical contests and problem solving.

Professor Steve Carlson has been granted tenure effective the beginning of the 1994-1995 academic year.

GRANTS AND CONTINUING GRANT ACTIVITIES

In July **Professors Bart Goddard, Aaron Klebanoff, Lynn Kiaer and Brian Winkel** worked with six high-school teachers in a project to develop complex, technology based problems in Calculus. The funding for this activity, obtained by Brian Winkel, is a \$100,000 NSF grant combined with \$26,400 from the Arvin Foundation (for the high school teachers). The problems will be class tested this year, and during the final phase next summer, the problems will set up as an electronic educational resource, publicly available on an Internet node at RHIT.

Professor Gary Sherman conducted his sixth **NSF-REU** (Research Experiences for Undergraduates) summer program. The program continues to produce refereed faculty-student publications: 13 published/accepted, 3 submitted, 3 under preparation.

Professors George Berzsenyi, Steve Carlson and Lynn Kiaer ran the **Young Scholars Program** for its fourth year. This summer's three week program had 43 students of exceptional quality. The students were selected from the **USA Mathematical Talent Search** which is now in its sixth year. The support for these programs, from the NSF and the NSA, was obtained by Professors Berzsenyi and Carlson. Carlson and Berzsenyi have also submitted a proposal to the NSF requesting continued funding for the Young Scholars Program into its fifth and sixth years.

Professors Nacer Abrouk and Yosi Shibberu were members of the Sophomore Curriculum design team during the summer. This activity was funded from the Foundation Coalition grant.

Professors Kurt Bryan and Yosi Shibberu developed a course on optimization and optimal design which will be taught this year. The course development was funded by the Lilly Endowment.

PROGRAMS

The **Fast Track Calculus** program attracted 21 students this year. Under the able instruction of **Professors Elton Graves and Robert Lopez** 20 of these students were able to complete a full year of Calculus in five weeks.

The **Jump Start Program** is a new program this year, giving a select group of 24 freshman a head start on their freshman year. The program was run by Mathematics **Professors John Rickert** (director) and **Kurt Bryan** with assistance from **Professor Frank Young**, who gave the students an introduction to the NeXT computer.

STUDENT ACTIVITIES

Jonathan Atkins published an abstract for "The Chimeric Clones Problem" arising from his last summer's research project at the Sandia National Laboratories.

FACULTY ACTIVITIES

Professor Nacer Abrouk has participated in several curriculum development activities. He was a member of the new Sophomore Curriculum design team, described above. His contribution to the curriculum was the development of a new course in statistics in conjunction with a laboratory component designed to support the statistical concepts involved in the course. He also developed a new course in Biostatistics, MA 490, which is being offered during Fall '94-95. Professor Abrouk also attended the four day workshop, at RHIT, presented by Lynn Bellamy (Arizona State University & Foundation Coalition) on the topics of team based learning and appropriate methods of assessment. Professor Abrouk continues his consulting activities, providing statistical consulting for Chicago Cutlery, a division of General Housewares Corporation, Terre Haute Medical Laboratory Inc. and Market Strategies, a Southfield, Michigan based company. To support these and future consulting activities he initiated the establishment of CIS (Center for Industrial Statistics) at RHIT and is its first director. The "office" is under TASC (Technical Assistance and Services Center, Dr. Brij Khorana) parallel to the existing Center for Applied Optics. A grant proposal to support CIS will be submitted shortly. Some of these consulting activities involve RHIT students. In a joint project between CIS and a local industry (Chicago Cutlery) Mr. Allen Dove was provided an opportunity to interface with some industrial issues using statistical skills. Mr Dove was compensated by Chicago Cutlery, through CIS. Dr. Abrouk also directed Mr. David Jones on a special industrial project involving statistical applications. The project will be completed by the end of Fall '94. Professor Abrouk continues to be active in professional meetings. He has attended the yearly joint colloquium between the University of Michigan and Michigan State University Departments of Statistics, in Ann Arbor, Michigan. He submitted an abstract, subsequently accepted, on a minicourse in Advanced Statistics to be conducted at the 7th Annual International Conference on Technology in Collegiate Mathematics (ICTCM) in Orlando, Florida, on November 17-20, 1994. He will be the program chair, Math/Stats Division, for the ASEE conference in Anaheim, CA, June 25-28, 1995. Finally, he reviewed the book "Statistical Design and Analysis of Experiments with Applications to Engineering and Science".

Professor George Berzsenyi continued his regular columns in Consortium (USAMTS and Problems, Puzzles and Paradoxes), Quantum (Math Investigations), Mathematics and Informatics Quarterly (IMTS), and Math Horizons (Problem Section), as well as the coordination of the USA Mathematical Talent Search (USAMTS) and its associated Young Scholars Program (YSP), which were described above. In July he also attended the Second Congress of the World Federation of National Mathematics Competitions (WFNMC) in Provets, Bulgaria, where he was in charge of Topic Area 10: International Mathematics Competitions. At the Congress he also presented a paper on the International Mathematics Talent Search (IMTS), which is conducted through the column in the Mathematics and Informatics Quarterly.

Professor Allen Broughton continued his collaboration with a group of mathematicians at the Universidad

Nacional de Educacion a Distancia and Universidad Complutense in Madrid, Spain, working in the area of symmetries of Riemann surfaces. After leaving Cleveland State University, he was able to spend a couple of weeks as a visitor at RHIT in July-August before officially starting at the end of August. During this time he was able to learn about RHIT as well as giving a guest lecture in the Young Scholars Program.

Professor Kurt Bryan spent most of June working on a grant that he and Yosi Shibberu obtained from the Lilly Endowment, to develop an undergraduate course in optimization and optimal design. He then spent several weeks in July at the Institute for Computer Applications in Science and Engineering (ICASE) at NASA Langley Research Center, working on mathematical methods for corrosion detection using thermal imaging. This was followed by a week in San Diego at the annual meeting of the Society for Industrial and Applied Mathematics, where he gave a talk on thermal imaging. He is continuing work on the mathematics of thermal imaging with both Bill Winfree at NASA Langley Research Center and Lester Caudill at the University of Kentucky. Professor Bryan also spent a week in early August working with Michael Vogelius at Rutgers University, on mathematical models and homogenization techniques for electrical conductors which have many small cracks or defects. Finally, he spent the last few weeks in August working with John Rickert on developing and teaching the "Jump Start" program for a select group of incoming freshman.

Professor Steve Carlson was granted tenure as of the beginning of the 1994-1995 academic year. In collaboration with Professors Berzsenyi and Kiaer, he developed and conducted the 1994 USAMTS/Rose-Hulman Young Scholars Summer Program, and he continues as a member of the USAMTS staff for the 1994-1995 academic year (as described in the grants section above). As Secretary-Treasurer of the Indiana Section of the Mathematical Association of America, he has worked on planning committees for the Section's Fall 1994 Meeting and Spring 1995 Meeting. He continues to coordinate the ISU-RHIT-SMWC Mathematics Colloquium series and also continues to contribute reviews and abstracts to the "Media Highlights" column of the *College Mathematics Journal* and *Zentralblatt fur Mathematics*. This fall, Carlson will serve on the RHIT Compensation Committee, and he also will begin his second year of service on the RHIT Faculty Affairs Committee which he will chair during the 1994-1995 year. At the beginning of the current year, Carlson directed several of the NeXT Computer Orientation sessions, offered to freshmen.

Professor Bart Goddard worked with Brian Winkel et al, to create a "Development Site for Complex, Technology-Based Problems in Calculus" described in the grants section above. The first phase, a workshop this Summer involving 6 high school teachers who use computer algebra systems in their classrooms, was highly successful. He continues to referee papers for the Fibonacci Quarterly, and problems for the MAA Monthly. He continued research in the area of Analytic Number Theory and joint research efforts with Professor Dale Mesner of the University of Nebraska concerning integer triangles and the associated Diophantine systems. He has included two student mathematics/computer science majors in his research on these systems. He is a Freshman advisor, faculty sponsor of the new Rose Volleyball Club, and serves on the Committee to Select Laptop Computers for the Institute.

Professor Ralph Grimaldi attended the NSF Conference on Difference and Differential Equations with Applications in Biology - held at the University of Wyoming. During the second week of this three week conference he gave a series of four lectures on various topics in Discrete Mathematics in another NSF sponsored program - this one for high school mathematics teachers in the NSF Model Master's Degree Program. He also attended the MAA meetings in Minnesota. While there, he attended five of the nine major (one hour) presentations, attended the minicourse on "Combinatorics through Functional Equations " (given by Robert Snow), he presented the minicourse on "Unifying Themes in Discrete Mathematics". Professor Grimaldi has worked with Professors John Rickert and Herbert Bailey on preparing the High School Mathematics Competition, which will be given on the second Saturday in November. Professor Grimaldi continues to review and referee, having reviewed eight chapters of an analysis textbook for the Addison-Wesley Publishing Company, two chapters of John Kinney's text on probability and statistics and three articles for the *Mathematics Magazine*.

Professor Elton Graves was the Program Chair (94-95) for the Mathematics Division of ASEE this past year. He was responsible for setting up the mathematics portion of the National ASEE meeting which was held in Edmonton, Alberta, Canada, this past June. At the end of the National ASEE meeting, Professor Graves was elected to the position of Division Chair of the Mathematics Division of ASEE for the 1994-95 school year. He was the campus coordinator for the Castle Chess Camp which brought over 50 students (age 7 through 16) to the campus for a week a chess instruction. He was a member of the thesis committee for a masters degree student who finished his degree this past summer. Professor Graves also taught our Fast-Track Calculus course during the last five weeks of the summer.

Professor Lynn Kiaer attended the four day workshop, at RHIT, presented by Lynn Bellamy (Arizona State University & Foundation Coalition) on the topics of team based learning and appropriate methods of assessment. She then participated in a week-long conference on Integrated First-Year Curricula later that month. In July she spent two weeks working with Professors Winkel, Goddard and Klebanoff, and six high school mathematics teachers from Indiana and Illinois, developing complex, applied calculus problems. This is the first phase of a project to create a library of such problems to be used as a resource for calculus teachers. These problems are being made available to our faculty this year. In late July, 43 highly talented high school mathematics students arrived on campus for a three-week Young Scholars program, run by Professor Berzsenyi, in which Professor Kiaer participated, along with Professor Carlson. For four days in early August, Professor Kiaer took time out from the Young Scholars to join an interdisciplinary team (Professors Stienstra and Cornwell from Mechanical Engineering and Professor Kirtley from Physics) to lead the solar car project in the inaugural Fast Forward program for 7th and 8th grade girls. Professor Kiaer is currently engaged in getting ready to teach in the Integrated First-Year Curriculum in Science, Engineering, and Mathematics (IFYCSEM). In addition to these activities, Professor Kiaer is working on the solution manual for an introductory textbook in discrete mathematics that she is co-authoring, and revising a paper on mathematical induction that has been accepted for publication in *PRIMUS*.

Professor John Kinney was on sabbatical leave during the winter and spring quarters. He prepared a textbook on probability theory titled "Probability: An Introduction With Statistical Applications" and submitted it to some major textbook publishers. A contract for publication has been offered and will be completed early in the fall quarter. He is a member of the "Core 40" curriculum development committee for the Indiana State Department of Education and hosted a meeting of the mathematics writing group on campus in June; the committee will produce a new mathematics curriculum for all students attending state-supported higher education institutions in Indiana. He is a member of the subgroup writing course descriptions in probability and statistics. In August he coordinated and hosted a week-long program, the Indiana Quantitative Literacy Project - 1994, for 18 Indiana secondary mathematics teachers. Also in August he participated in our Fast Forward program and attended the Joint Statistical Meetings in Toronto. He also continues to serve as a referee for *The American Statistician*, a publication of the American Statistical Association.

Professor Aaron Klebanoff worked with Brian Winkel et al. during the month of July to develop complex, applied calculus problems (project described in the grants section above). Professor Klebanoff's paper "Chaos in three species food chains" (co-authored with his thesis advisor, Alan Hastings) has been well received and he continues to get requests for reprints from all over the world. The complete citation for this article is: Klebanoff, Aaron and Hastings, Alan, "Chaos in three species food chains", *Journal of Mathematical Biology*, 32:427-451, 1994. Hastings and Klebanoff have also recently co-authored a paper, "Chaos in One-Predator, Two-Prey Models: General Results from Bifurcation Theory", which will soon be published in *Mathematical Biosciences*. Professor Klebanoff also attended the four day workshop, at RHIT, presented by Lynn Bellamy (Arizona State University & Foundation Coalition) on the topics of team based learning and appropriate methods of assessment.

Professor Roger Lautzenheiser was employed for the second summer by Sandia National Laboratories in Albuquerque, New Mexico, in their University Summer Faculty program. He continued his work with other mathematicians and physicists on a semi-conductor device modelling project.

Robert Lopez has continued to be on Special Leave, working for Waterloo Maple Software. In that capacity he has given workshops, seminars, and presentations at the University of Wisconsin-Madison, West Virginia University, Ohio State University, the University of Toledo, the University of Michigan, Essex Community College, the University of Maryland Baltimore County, at the SIAM annual meeting in San Diego, and at the Maple Summer Workshop and Symposium (MSWS) at Rensselaer Poly. Moreover, he has edited the Proceedings from the MSWS '95, conference and published the text "Maple via Calculus: A Tutorial Approach." This special leave continues through the fall and winter quarters.

Professor John Rickert spent the summer as part of the teaching staff at the Research Science Institute on the campus of the Massachusetts Institute of Technology. He was the director of the Jump Start program for twenty-four incoming freshman. He administered the freshman Mathematics Diagnostic Exam, given to all freshmen during registration week. He is working with Elton Graves to remedy the deficiencies of students who performed poorly on the diagnostic exam and is analyzing the results of this and past diagnostic exams. He served as a coach to the team representing the state of Indiana that placed 22nd in the B division at the American Regions Math League meet. He continued to serve as a member of the USAMTS staff and organize the 29th annual Rose-Hulman High-School Mathematics Competition. He will be serving as a freshman advisor to seventeen RHIT freshmen, in addition service on the RHIT Honors and Awards Committee

Professor Al Schmidt continues as Chairman (4th year) of the Education Committee of the Indiana Business Management & Technology Corporation (formerly CST) and as organist at the Central Presbyterian Church (23rd year) He spent the summer gaining some familiarity with Maple in preparation for use in this fall's classes. He also delivered the "History and Traditions" lecture in this year's Student Orientation.

Professor Gary Sherman was an invited speaker at the Rutgers Conference on Symbolic Computation and its Applications to Research and Education. The paper he delivered, "Trying to do mathematics with undergraduates and computers: some examples" will appear in the Journal of Scientific Computation. He also directed our sixth NSF-REU program as noted in the grant activities section. Three technical reports are being written, in addition to the two papers submitted from last years REU. Professor Sherman continues to write a text "Indiscrete Discrete Mathematics" and a monograph "Experiments in Finite Group Theory".

Professor Yosi Shibberu presented a paper at the 14th World Congress on Computational and Applied Mathematics held at Georgia Institute of Technology. He also presented a research lecture on numerical methods for Hamiltonian systems at the University of Illinois. Professor Shibberu was accepted as a participant in an NSF workshop titled Interactive Mathematics Text Project Workshop on MathKit held at the University of Michigan at Dearborn. He was also accepted as a participant in another NSF workshop at Rensselaer Polytechnic on teaching differential equations with computers. As noted in the grants section he was a member of the Sophomore Curriculum design team.

Professor Brian Winkel directed and hosted the National Workshop on Integrated First-Year Curricula in Science, Engineering, and Mathematics, Estes Park CO, 17-22 June 1994 Approximately 80 faculty from some 35 colleges and universities around the country attended. Workshop was sponsored by the National Science Foundation and the GE Foundations. Another such workshop for next summer is in the planning stages. In another project he directed six high school teachers (four from Indiana and 2 from Illinois) and three RHIT faculty - Bart Goddard, Lynn Kiaer, and Aaron Klebanoff, in a National Science Foundation and Arvin Foundation project to develop complex, technology-based problems in calculus from science and engineering. Some 30 developed problems and solutions are now on-line at Rose-Hulman for local use and evaluation. He also participated in a number of conferences and workshops including:

attending the "Teaming and Curriculum Development Workshops" put on by Foundation Coalition at RHIT,

attending the ASEE meeting in Edmonton Alberta and presenting an invited panel with, Jim Mitchell, a colleague from Drexel University, comparing and contrasting Rose-Hulman's IFYCSEM with Drexel's E4 program as two of the nation's leading science, engineering, and mathematics curriculum reform efforts,

serving as member of visiting team of consultants for University of Colorado's (Boulder) Integrated Teaching Laboratory in their College of Engineering,

visiting the Colorado School of Mines' mathematics, physics, and engineering colleagues to discuss their sophomore and first-year integrated curriculum efforts,

giving a class for Fast Forward students - RHIT program for 7-8th grade girls.

In preparation for the fall quarter he worked with 1994-95 IFYCSEM faculty team to develop the course for this year and presented several sessions of the NeXT Orientation program before school started to first year students. Finally, throughout the summer he continued to read, send out for referee readings, and solicit manuscripts for PRIMUS and Cryptologia, published a June issue (Volume IV, Number 2) of PRIMUS, a July issue (Volume XVIII, Number 3) of Cryptologia and is preparing the September issue of PRIMUS and the October issue of Cryptologia.

PAPERS, PUBLICATIONS AND TECHNICAL REPORTS

Justin Gallager, Robot Space Coordinate Representation of Objects in Euclidean Space, *MSTR 94-04*.

Aaron Klebanoff and Alan Hastings, Chaos in three species food chains, *Journal of Mathematical Biology*, 32:427-451, 1994.

Aaron Klebanoff and Alan Hastings, Chaos in One-Predator, Two-Prey Models: General Results from bifurcation Theory, to appear in three species food chains, *Journal of Mathematical Biology*, 32:427-451, 1994.

Robert Lopez, *Maple via Calculus: A Tutorial Approach*, Birkhauser (1994)

Robert Lopez (editor), *Maple V: Mathematics and its Applications*, Proceedings of MSWS '94, Birkhauser (1994)

Gary Sherman, Trying to do mathematics with undergraduates and computers: some examples, to appear in *Journal of Scientific Computation*.