Proceedings of the Third International DERIVE/TI-92 Conference
Introduction

Carl Leinbach
Gettysburg College
Gettysburg, PA

The use of Computer Algebra Systems for the teaching of mathematics precedes the announcement of DERIVE by the Soft Warehouse. Computer algebra had moved out of the research laboratory and into the classroom in the early 1980's. However, the use of computer algebra as a pedagogical tool required large scale computing devices. The systems themselves were primarily for symbolic manipulation and had a rather arcane user interface. These systems were expensive and only those schools blessed with a generous budget as well as a powerful central computer could afford to use them.

The advent of DERIVE provided instructors and students with computer algebra capabilities that had a natural interface and could be run on a personal computer with a RAM of 256K. Furthermore, it was a Computer Algebra System. It included symbolic computation, numeric approximation, and computer graphics all in one package. It had a friendly interface that was easily learned. Most importantly, it was priced in the hundred dollar range, not thousands of dollars. Even more unusual was the fact that there was a truly responsive support group that was eager to listen to user suggestions and improve the system on the spot. Many times an update was sent seemingly by return mail.

The availability of an easy to use, affordable computer algebra system that could fit on a minimal personal computer caught the attention of mathematics teachers in several countries. As a result symbolic computation joined numerical-graphical computation in mathematics classrooms for which it had been only dream. The use of symbolic computation extended beyond college classrooms to secondary and middle schools. Notable among the pedagogical uses of Computer Algebra Systems (CAS) is the work done in Austria is the work begun in 1992 by the Austrian Center for Didactics of Computer Algebra under the direction of Helmut Heugl. This project has proven that computer algebra can successfully be introduced at the secondary school level to the benefit of both the student and the teacher. The Austrian Ministry of Education has just initiated a similar project using the TI-92 and this conference includes a preliminary report on the first year of this project. But this gets us slightly ahead of our story.

Other notable efforts in the use of DERIVE were initiated in the UK at the University of Plymouth and John Moores University in Liverpool, and also in the Netherlands, Germany, France, and Sweden. In Japan an active users group soon developed. Of course, there was a great deal of activity in the United States.

The easy availability of DERIVE as well as other Computer Algebra Systems forced those who wanted to use this tool to think deeply about the question of what it is that we are doing in the classroom. The old methods of conveying mathematical knowledge simply will not work in the presence of this new, exciting computational tool. It was time to seriously address the question "What do we want the students to learn?" This question

leads to many deep issues in mathematical pedagogy: “What role do manipulations play in the learning of mathematics?” “Must students do the manipulations or can they direct a computer to do them?” “What is the role of applications in the learning of mathematics?” “How can we organize material in order to teach important concepts?” “What new opportunities are opened for our students as a result of this system?” Teachers of mathematics needed a way to share and exchange ideas on using DERIVE in the classroom.

In response to this need, Josef Böhm of Würmla, Austria founded the DERIVE Users’ Group and published the International DERIVE Newsletter. Several articles by teachers in many countries have been published in this newsletter. Ideas are shared and distributed on a regular basis in the form of articles in the Newsletter with a disk containing supporting DERIVE utility files around the world from the home of Josef with the loving help of his wife, Noor.

However, there needed to be a more immediate and interactive forum. It became mandatory that teachers of mathematics get together to discuss their pedagogy and the impact of CAS such as DERIVE. Thus, after a few important preliminary symposia which were held at Krems, Austria, the first of the International DERIVE Conferences was held in Plymouth, England in 1994 under the direction of John Berry of the University of Plymouth. The success of this conference was reflected in the spawning of a new journal, **The International DERIVE Journal**, which was edited by Berry and a decision that an international conference be held every two years with different countries serving as the host.

Parallel to the developments within the computer algebra arena were developments in the hand held calculator market. Powerful hand held graphing calculators were developed with many hundreds of special functions for exploring mathematical ideas both numerically and graphically. These calculators were also extendable in the respect that users could write custom programs to meet their specific needs. Students and teachers had at their disposal an unprecedented power for visualizing and exploring mathematical ideas. Furthermore, the cost of such a calculator was below $100. These facts produced a shock wave comparable to an earthquake with an intensity of 7+ on the Richter scale throughout the secondary school mathematics community. Teachers using this new technology were also finding that how and what they teach has to change. They, too, needed an outlet for their ideas and a way to discuss pedagogical issues with each other.

Bert Waits and Frank Demanna of Ohio State University perceived this need very early and began organizing workshops and conferences for mathematics teachers. They founded the T^3 (Teachers Teaching with Technology) organization. T^3 provides workshops, teaching materials, and an annual conference to which teachers from the elementary school through college level flock annually. Demanna and Waits also founded the ICTCM (International Conference on Technology in Collegiate Mathematics) that is held annually and attended by thousands of college teachers. The tireless efforts of Waits and Demanna have made the use of technology in the teaching of

mathematics the norm and standard expectation for all mathematics classrooms throughout the United States.

In addition to the conferences and workshops, there is support for teachers using technology via the internet. Texas Instruments corporation (TI), a major producer of graphing calculators, has supported chat groups and program archives where teachers can ask immediate questions and download to enhance their calculators with special programs and packages free of charge. Furthermore, TI supports users of its products with newsletters, a user help line, workshop loan programs, and regular new product announcements. All of these may be accessed via the web at http://www.ti.com/calc

It was natural and inevitable that these two threads of the use of technology in mathematics education would intertwine to form a strong rope. The idea of a hand held CAS which could be married to a graphing calculator was an idea whose time had come by the mid 1990's. It was perfectly natural that TI considered using a system based on the algorithms developed by David Stoutmeyer, one of the two developers of DERIVE. Thus, the TI-92 was born, beta tested, classroom tested, and released to the public. Students and teachers had an incomparable tool to investigate mathematics from a numerical, graphical, and symbolic point of view! In addition to being able to visualize students can conceptualize and hypothesize. They can move smoothly from the particular to the general and even develop proofs of hypotheses based on their observations.

Thus, by 1996 when the second conference was held in Bonn, Germany under the direction of Bärbel Barzel the name of the conference was expanded to the International DERIVE/TI-92 Conference. Most of the presentations at this conference were still based in DERIVE, but the presence of hand held CAS was definitely there. Two of the keynote speakers, John Berry and Bert Waits, gave talks that involved the use of the TI-92. There were a few workshops and presentations illustrating the use of the TI-92 in teaching and learning mathematics. After this conference a special issue of the International DERIVE Journal, now named the International Journal of Computer Algebra in Mathematics Education, was devoted to the TI-92. The International DERIVE Newsletter is now the International DERIVE/TI-92 Newsletter and regularly features articles on the TI-92 as well as those about DERIVE.

Now we are presenting the Proceedings of the Third International DERIVE/TI-92 Conference. There is a full scientific program of over 40 talks and 35 workshops. The keynote lectures for the conference do not appear in these proceedings. Three of the keynote addresses were given by experts in the use of Computer Algebra Systems in the teaching and learning of mathematics:

1. Joseph Böhm; Würmula, Austia: *A Plea for Pure Mathemtics*
2. Wade Ellis; West Valley College; Saratoga, CA: *Out of the Frying Pan into the Fire: Mainstreaming CAS into the Curriculum*
3. Adrian Oldknow; Chichester Institute of Higher Education, England: *Why CAS must mean more than Symbolic Algebra by Computer (or Calculator)*

There was also a keynote address from David Stoutmeyer of the Soft Warehouse, Hawaii who provided the delegates with a "*Brief History of Portable Computer Algebra*."

While keynotes set the tone and guide many of the conversations at the conference, the meat of the conference can be found in the workshops and presentations made by the delegates. These *Proceedings* contain the essence of this meat. It tells how teachers are using DERIVE and the TI-92 in their classrooms or are implementing programs for their schools and school systems to take advantage of their efforts. Others contain evaluations of the use of these tools. All center on what must be our most important bottom line – how can these tools help students learn mathematics and understand ways in which they can use mathematics in their lives?

The workshops are designed to give delegates "hands-on" experience in the use of DERIVE, the TI-92, or the data collection devices that can be attached to their calculator or computer within the context of a specific courses. There are workshops that cover the spectrum of mathematics education, Middle School through College. Titles range from "What Beginning Algebra Students CAN DO with a TI-92" through "Factoring and RSA Codes with DERIVE." Certainly the conference was packed with information for teachers of mathematics at all levels.

Finally the conference was used to showcase new advances in technology. Al Rich, a co-author of DERIVE, displayed the current status of the development of DERIVE FOR WINDOWS version 5. Texas Instruments displayed its just released TI-92 *plus* module and the soon to be released vertical CAS, the TI-89. Jerry Glynn of Mathware displayed and presented a paper on *Cyclone*, an implicit 3-D plotter that he has developed.

In short, the conference provided delegates with an opportunity to discuss mathematics and the teaching of mathematics with technology with their colleagues from several countries, try out new ideas, and glimpse into the future of technology for the classroom. Our hope in presenting these Proceedings is that you can share in some of the excitement and expertise that appeared during one week in July at Gettysburg College in Gettysburg, Pennsylvania.