International Study Group on the Relations Between HISTORY and PEDAGOGY of MATHEMATICS NEWSLETTER

AN AFFILIATE OF THE INTERNATIONAL COMMISSION ON MATHEMATICS INSTRUCTION

No. 28 March 1993

Calendar

1993 March 31 - April 3 Seattle
Annual meeting of the Americas Section of HPM in connection with the annual meeting of the National Council of Teachers of Mathematics. (See inside for more details.)

1993 March 31 - April 3 London
Mathematics in Iberia in the Golden Age. Contact J. V. Field and E. L. Ortiz at Imperial College, London SW7 2BZ. (See inside for more details.)

1993 March 31 - April 3 Paris
Second meeting of the International Society for the History of Arabic and Islamic Science and Philosophy. This meeting will include an international colloquium on Medieval Perspectives (Arabic, Latin and Hebraic) on the Scientific and Philosophical Greek Tradition. Contact A. Hasnaoui, Secretary, International Society for the History of Arabic and Islamic Science and Philosophy, 27 rule Damesme, 75013 Paris, FRANCE.

1993 May 30 - June 1 Ottawa
Annual meeting of the Canadian Society for History and Philosophy of Mathematics. Contact M. A. Malik (address on page 14) for information about the society. (See inside for more details.)

1993 June 7 - 10 Surabaya, Indonesia
SEACME 6, the Sixth South East Asian Conference on Mathematics Education. Contact Susanti Linuwih, Perum Dosen Blok 1 - 15, Kampus Keputih Sukolilo, Surabaya 60111, INDONESIA

1993 July 19 - 23 Montpellier
First European Summer University on the History of Mathematics, organized by Evelyne Barbin, Françoise Lalande, and Yves Nouaze. (See inside for more details.)

1993 August 2 - 6 Munich
Second Gauss Symposium, which includes international conferences on A. Mathematics and Theoretical Physics; B. Statistical Sciences; C. Computing and Information; D. Medical Mathematics and Physics. Within Conference A there are sections on Mathematical Education, chaired by Lisa Hefendehl-Hebeker (Lehrstuhl für Didaktik der Mathematik, Universität Augsburg, Universitätsstraße 10, W-8900 Augsburg, GERMANY), and on History of Mathematics, chaired

by Ivo Schneider (Institut für Geschichte der Naturwissenschaften, Ludwig-Maximilians-Universität, Deutsches Museum, Postfach 26012, W-8000 München 26, GERMANY). A further section on Education is planned within Conference D. For general information on the Symposium, please contact Rudolf Fritsch (Mathematisches Institut, Ludwig-Maximilians-Universität, Thesesienstraße 39, W-8000 München 2, GERMANY) or Gauss Institute (McMaster University, P.O. Box 56, Hamilton, Ontario L8S 1C0, CANADA).

1993 August 13 - 19 Vancouver
Joint Summer Meeting of the American Mathematical Society and the Mathematical Association of America, in conjunction with the Canadian Mathematical Society. (See inside for more details.)

1993 August 22 - 29 Zaragosa
Nineteenth International Congress of History of Science. The Congress will include Symposia, which will address themes of special interest, Scientific Sections devoted to the various branches and periods of the history of science and technology, and Poster Sessions. (See inside for more details.)

1993 August 26 - 27 Tokyo
Second International Conference on Cultural History of Mathematics. Contact Professor Shin Watanabe, Faculty of Marine Science and Technology, Tokai University, 3-20-1 Orito, Shimizu-shi, 424 JAPAN. Tel: 0543-34-0411 or 0543-48-3629; Fax: 0543-34-0862 or 0543-48-3629.

1993 November 11 - 14 Santa Fe
Annual meeting of the History of Science Society. Contact the program chairs, Paul Lawrence Farber, Department of History, Oregon State University, Corvallis, OR 97331-5102, USA; fax: 503-737-2434; e-mail: farberp@ccmail.orst.edu; or Margaret J. Osler, Department of History, University of Calgary, Calgary, Alberta T2N 1N4, CANADA; fax: 403-289-8566; e-mail: mjosler@acs.ucalgary.ca.

1994 January 12 - 15 Cincinnati
Annual meeting of the American Mathematical Society and the Mathematical Association of America. Details will be forthcoming in the next issue of the *Newsletter*.

1994 October Newcastle, Australia
Third Australian History of Mathematics Conference. Details will be forthcoming at a later date.

From the Editor

You may notice a new look to this issue of the *Newsletter*. It has been produced on an IBM PC using Word Perfect rather than on a mainframe using TEX. This will allow a somewhat more flexible format and will also permit graphics to be included. I hope that the readibility continues to be acceptable. As always, I welcome articles and reviews as well as reports on past and future meetings. In general, the authors of articles in the *Newsletter* also welcome responses, either directly or through the editorial office.

Origin and Evolution of Mathematical Theories: Implications for Mathematical Education

Miguel de Guzmán, President, International Commission on Mathematical Instruction

The main problem to which I would like to address myself in this paper is the following: When trying to introduce others to a concrete subject or theory, what is the right attitude one should foster? What is the right way to introduce our young students into mathematical research? What is the style of those who are most successful in the preparation of young people for research?

Of course there are many possible attitudes and some of them could be quite adequate. Some examples:

•Here is one problem. Read nothing. Just dive into it...

•Read these books first, then come to me for a problem...

•Read these recent papers and then try to solve the problems that are left open there...

•Attend my course and you will be exposed to some problems; pick one...

My contention is that the crucial inspirations and insights in the work in a particular field come very often from the familiarity with and deep knowledge of the evolution of the theory from its origin and of the thinking style in that particular area. This is acquired by knowing about its motivations, global (historical, social, personal) circumstances, the right ways of asking questions in the field, and so on.

I shall try to substantiate this claim by looking first at what the knowledge of the history of mathematics in general and of the specific subject in particular can offer us in the context we explore here and by briefly examining later on what are the lessons

that can be derived from the knowledge of the evolution of a field in which I personally have been involved some years ago.

WHAT THE KNOWLEDGE OF THE HISTORY OF MATHEMATICS AND OF THE PARTICULAR SUBJECT CAN OFFER US:

•a human vision of science and of mathematics: not just truths, methods, techniques coming from nowhere, not just facts and skills without soul, without history, but the results of the efforts of persons mtoivated by deep interest and passion; not a godlike science, but human and so incomplete and fallible; the human side of the great discoveries and discoverers.

•a frame in which all elements appear in their right place: not facts centuries apart in their origin presented together in the same bag without a single remark, but explorations in their own context and with their own motivation; past fashions in order to be able to understand present fashions; the deep connections along time of the different leitmotivs of the mathematical symphony.

•a dynamical vision of the evolution of mathematics: the motivation and driving forces at the roots of the ideas and methods of the subject; the primordial creativity around each particular subject, its genesis and its progress, with all the light it throws upon its true nature; a flavour of adventure and thrill; a creative immersion into the difficulties of the past in order to better understand our own problems; a possibility of extrapolating towards the future; the realization of the tortuous ways of genuine creativity, in ambiguity, obscurity, twilight, towards the shaping of the first torsos; a guide for a dynamical sense in our educational tasks.

•the intertwining of mathematical thought and culture in human society (mathematics as an important part of human culture); the influence of the history of mankind upon mathematics; the impacts of mathematics upon mankind, its culture, philosophy, technology, arts,...

•a more profound technical comprehension: the initial simplicity of a theory is a strong help to understand it; technical complications coming later make a theory opaque unless one knows their motivations; the lines of development until the present offer good suggestions towards the future and guide us in our research.

•the peculiar life of each mathematical theory: birth at some specific time by the most diverse motivations (curiosity, applications, ludic, expansion, completion,...); growth: each theory in its own style, through expectations, false expectations, false starts,...; strongly influenced in its particular development by its local atmosphere, social and personal.

One can conclude that: the familiarity with the origin and evolution of a mathematical theory can offer profound lessons to the one who tries to introduce himself into the field.

From the talk by Professor Guzmán at ICME-7; the entire talk will appear in the *Proceedings of ICME-7*.

Fourth Midwest History of Mathematics Conference

David E. Kullman

The Fourth Midwest History of Mathematics Conference was held October 2-3, 1992 at Oxford, Ohio. This was also the Twentieth Annual Miami University Mathematics and Statistics Conference, and the Miami University chapter of Pi Mu Epsilon hosted its nineteenth annual student conference.

Calculus was the unifying theme of the five invited addresses. Judith Grabiner of Pitzer College gave the opening and closing keynote lectures. "How to Invent the Calculus" considered the work of Newton and Leibniz in answering the questions of Who first did it? When, why, and how? "How to Apply and Understand the Calculus: Maclaurin and Lagrange" looked at the way each of these two mathematicians used the new calculus to solve important outstanding problems. Maclaurin's geometric approach was contrasted with Lagrange's algebraic view.

Victor Katz, of the University of the District of Columbia, spoke about "Calculus Before Newton." The power rule for integrals is an outcome of the discovery of a simple way of calculating the sum of the n'th powers of the integers. Both ideas had been studied in the Islamic world and in India long before the 17th century.

Fred Rickey, of Bowling Green State University examined "Calculus in the Nineties--the 1690's." The developments that arose from the work of Newton and Leibniz resulted in a decade of "seminal problems, great mathematics, fascinating personalities, and

bitter quarrels."

William Dunham, of Muhlenberg College, looked at "Euler's Extraordinary Sums." In particular, a correct summation of the series of terms $1/k^2$ required "stunning insight and fearless symbol manipulation." Euler's ingenuity also enabled him to sum the series of reciprocals of 4th powers, 6th powers, and others.

The conference program also featured twenty contributed papers, listed here by title and author: "Stopped Random Walks: Areas and Lengths," by David K. Neal of Western Kentucky University; "What do To About Archimedes [as an early progenitor of the calculus]," by Michael H. Millar of the University of Northern Iowa; "The *Synodal 42* -- Analysis and Outline of a Seventeenth Century Russian Geometry Manuscript," by Irving Anellis of Modern Logic Publishing; "Karl Menger's Mathematical Colloquium," by Louise Golland of the University of Chicago; "Victorian Mathematical Periodicals and the Emergence of Disciplines: The Case of Combinatorics," by Thomas Drucker of the University of Wisconsin; "Cartan, Dirac, and van der Waerden -- Their Roles in the Creation of the Theory of Spinors," by John Synowiec of Indiana University - Northwest; "The First Unification Algorithm for Automatic Deductive Systems," by Francine Abeles of Kean College of New Jersey; "Jamshid Kashi (? - 1429) and his *Calculator's Key*," by Mohammad K. Azarian of the University of Evansville; "Newton's Investigation of Cubic Curves," by Jeffrey Nunemacher of Ohio Wesleyan University; "The Ancient Greeks' Impact on Trigonometry," by Richard O'Lander and Ronald Sklar of St. John's University (New York); "Some Excerpts from the *Calculus* of Leonhard Euler (1755)," by Kenneth Cummins of Kent State University; "Supereuclidean Trisections with the Nephroid and Astroid," by Danny Otero of Xavier University; "History of Differential Equations: The First 100 Years," by John E. Sasser of Huntington, West Virginia; "On the Geometrical Construction of Roman Alphabet Letters [from 1460 to 1700]," by James K. Bidwell of Central Michigan University; "Maria Agnesi and her *Analytical Institutions*," by Jerry Lenz of St. John's University (Minnesota); "Mathematics in Ancient China -- From the Han Dynasty to North-and-South Dynasties (206 B.C. - 581 A.D.)," by Xiaoyun Ma of the University of Wisconsin - LaCrosse; "Buffon -- A Pioneer, Not Just a Near Pi," by Barry Brunson of Western Kentucky University; "Did Newton Know Everyting About Kepler Orbits?" by Andrew Lenard of Indiana University; "Complement Arithmetic on 19th Century Hardware [the Comptometer]," by James A. Delaney of Xavier University; "On the Uses of Math History in Today's Mathematics Courses [for elementary teachers]," by Michael Morelli of Indiana University - East.

At a meeting of the Modern Logic Board of Directors, held during the conference, Nathan Houser of Indiana University / Purdue University - Indianapolis, spoke on "The Peirce Edition Project as a Resource for Historians of Mathematics and Logic."

A collection of papers from the Fourth Midwest History of Mathematics Conference is being planned for publication later in 1993. For more information, contact Professor David E. Kullman, Department of Mathematics and Statistics, Miami University, Oxford, OH 45056.

Mathematics in Iberia in the Golden Age

A conference on mathematics in the Iberic world in the 16th and 17th century will take place in London from March 31 to April 3, 1993. In the first part, mathematics and society in the Golden Age will be discussed, with special reference to Spain, Portugal, and their American possessions. The second part concerns the Jesuit order and its influence in the transmission of mathematics to the Iberic world. Finally, the work of specific 16th and 17th century mathematicians and logicians from that cultural area will be discussed. There will also be special sessions on bibliography, archives, and documentation.

Among the speakers will be Ugo Baldini (Rome), Giovanna Cifoletti (Milan), Jean Dhombres (CNRS, Paris). Alberto Dou (Royal Academy of Science, Madrid), J. V. Field (Imperial College, London), Santiago Garma (Madrid), David Goodman (Open University), Philip Holgate (Birkbeck College, London), José Maria Lopez-Piñero (Valencia), Victor Navarro (Valencia), E. L. Ortiz (Imperial College, London), W. G. L. Randles (CNRS, Bordeaux), and Roshdi Rashed (CNRS, Paris).

For more information, contact J. V. Field or E. L. Ortiz, Imperial College, London SW7 2BZ, ENGLAND; fax: 071-225-8361.

First European Summer University: History and Epistemology in Mathematics Education

The first European Summer University organized by the IREM (Institutes of Research into Mathematics Education) is taking place in Montpellier (in the south of France) from July 19 - 23, 1993. This Summer University is intended for teachers of mathematics from schools, colleges and universities, and those engaged in research into the history or didactics of mathematics, as well as teachers of philosophy, history and physical sciences.

The Summer University is intended both for those who have no experience in using historical approaches in the teaching of mathematics and for those who already have some experience in this field. If this approach is new for you, you will receive guidance and share in the experiences of other teachers who have explored the use of history in their teaching. If you are already involved in using history, you will find many other colleagues in the field with whom to exchange ideas and experiences. The mixture of workshops and general lectures by eminent scholars will provide a rich environment to give everyone a solid grounding in the historical approach to teaching. A Certificate of successful course completion will be provided.

The official languages of the Summer University will be French and English.

The program involves five plenary lectures: *On Mediterranean Mathematics*, by Christian Houzel; *On the History of Algebra*, by Jens Høyrup; *On the History of Geometry*, by Jean-Claude Pont; *On Comparisons between Mathematical Teaching in France and in Great Britain from a Historical and Cultural Point of View*, by Bruno Belhoste and Leo Rogers; and *On Ethnomathematics*, by Ubiratan D'Ambrosio.

The program (not definitive) also involves:

•Workshops on the historical construction of mathematical knowledge through the reading of original texts. These workshops will be presented by Evelyne Barbin, Otto Bekken, Joëlle Delattre, Michel Guillemot, Gilles Itard, IREM du Mans, J. Pierre Legoff, Michel Levard, M:ATH, Henri Plane, Luis Radford, Karin Reich, Steve Russ, and Klaus Volkert.

•Workshops on reports of experiences in introducing a historical perspective into the teaching of mathematics. Presenters include Neil Bibby, Anne Boye and J. Luc Le Chevalier, J. Pierre Friedelmeyer, Jean-Paul Guichard, Costel Harnasz, IREM de Toulouse, IREM de Poitiers, Marjolein Kool, M:ATH, Peter Ransom, Roland Rosenfeld, Jacky Sip, Constantinos Tzanakis, and Greisy Winicki.

•Workshops on reports of courses in the history of mathematics for initial and inservice teacher training. Speakers include Gertrudes Amaro, Michel Ballieu, Jacques Borowczyk, Eliane Cousquer, J. Michel Delire, IREM de Caen, IREM de Nantes, and Danièle Scheier.

•A panel on the place of the history of mathematics in mathematical teaching and the curriculum of many European countries, including France, Germany, Greece, Great Britain, Italy, the Netherlands, and Portugal.

•A panel on the place of the history of mathematics in initial and in-service teacher training in many European countries, including Denmark, Belgium, France, Germany, Great Britain, Italy, and the Netherlands.

•Talks on the relationship between mathematics education and the culture in which it occurs (including the history of mathematics education) by Ali Assem, Annie Bartez, Jaroslav Folta, Jean Dhombres, Marie-Josée Durand-Richard, Athanassios Gagatsis, Helène Gispert, Marta Menghini, Mariano Hormigon, Albert Krayer, Luigi Pepe, Siegbert Schmit, and Harm Jan Smid.

•Talks on the relationship between epistemology and didactic and pedagogical questions by Faïza Assem-Medjber, Benaouada and Mohamed Bennaceur, Didier Bessot, Rudolf Bkouche, Pier Luigi Ferrari, Athanassios Gagatsis and Yoannis Thomaidis, Shin Huyn Sung, Nikos Kastanis and Stéphanie Zionpoulou, Manfred Kronfellner, Marisa Krysnika-Grand'-Henry, Rachid Bebbouchi, and Anna Sfard.

•Talks on the history of Mediterranean mathematics by Didier Bessot and J. Pierre Legoff, Sabine Koelblen, and J. Luc Verley, talks on ethnomathematics by André Cauty, Isabel Soto, and Gelso Knijnik, and talks about the historical construction of mathematical knowledge by Rachid Bebbouchi, Luis Morello Armella, Guillermina Waldegg, and Michel Serfati.

During your stay, you can visit the beautiful and old town of Montpellier and the beaches of the Côte du Languedoc and attend the celebrated Music Festival.

The registration fees are 500 FF (including some lunches). Accommodations are available in a Campus residence. The price for a single room is 300 FF for five nights. Breakfast costs 12 FF and dinner costs 30 FF. To register, please write before April 30 to IREM de Montpellier, Université d'été, Université de Montpellier II, Place Eugène Bataillon, 34095 Montpellier Cedex, FRANCE. Tel: (33) 67 14 33 83; Fax: (33) 67 14 39 09.

XIXth International Congress of History of Science

The 19th International Congress of the History of Science will take place in Zaragoza, Spain from August 22 - 29, 1993. Much of the program will be of interest to historians of mathematics. Symposia dealing with mathematics, which will have several invited speakers each, include "Some aspects of mathematics in the 20th century," organized by Pierre Dugac (France), Jean Mawhin (Belgium), and Jean-Paul Pier (Luxemburg); "Arts and mathematical sciences," organized by Eberhard Knobloch (Germany) and Kirsti Andersen (Denmark); "Logic and the foundations of mathematics (1885-1905)," organized by Ivor Grattan-Guinness (Great Britain) and F. Rodriguez-Consuegra (Spain); "The impact of the computer on the sciences," organized by Javier Echeverria (Spain) and William Aspray (U.S.A.); "History of model theory," organized by H. Sinaceur (France), Gabriel Sabbagh (France), and H. Jerome Keisler (U.S.A.); "Mathematization of the biological, economic and social sciences," organized by Giorgio Israel (Italy) and Claude Menard (France); "Algebra and curves: 16th-17th centuries," organized by E. Giusti (Italy) and Henk Bos (The Netherlands); "The theory of parallels up to the end of the 19th century," organized by Alberto Dou (Spain), Boris A. Rosenfeld (U.S.A.), and Jean-Claude Pont (Switzerland); "Mathematical and philosophical aspects of probability theory between 1800 and 1950," organized by Ivo Schneider (Germany) and Marisol de Mora (Spain); "The historical role of algebraic and discrete methods in infinitesimal calculus," organized by Craig Fraser (Canada) and Niels Jahnke (Germany); "Formation of mathematical schools in the 19th and 20th centuries," organized by Sergei Demidov (Russia) and Mariano Hormigon (Spain); "Pre-columbian mathematics, astronomy and modes of thought," organized by Leonel Aldana Morales (Guatemala) and Michael Closs (Canada); "Ethnomathematics and ethnoscience and the recovery of the history of science," organized by Ubiratan D'Ambrosio (Brazil) and Paulus Gerdes (Mozambique); "Analysis and synthesis in mathematics: philosophy, history and historiography, a methodological discussion," organized by Michael Otte (Germany) and Marco Panza (Switzerland); and "Historiography of history of mathematics," organized by Joseph Dauben (U.S.A.) and Christoph J. Scriba (Germany).

There will also be scientific sections of short papers. The ones in mathematics include "Mathematics in antiquity," "Medieval mathematics," "Mathematics in early modern Europe," "Probability and statistics," "Mathematics and applications," "Mathematics in the 19th century," and "Mathematical trends in the 20th century." As of this writing, the plenary lectures by invited speakers have not been announced, but there will certainly be several dealing with the history of mathematics.

For more information, contact Comité Organizador del XIX Congreso International de Historia de la Ciencia, Facultad de Ciencias (Matemáticas), Ciudad Universitaria, 50009 Zaragoza, SPAIN; tel: (76) 357180; fax: (76) 565852; e-mail: ichs@cc.unizar.es.

AMS-MAA Summer Meeting in Vancouver

The annual joint summer meeting of the American Mathematical Society and the Mathematical Association of America, to take place August 13-19 in Vancouver, will contain two special events of interest to readers of the *Newsletter*. First of all, there will be an AMS Short Course entitled "Calculus: The Source of Applications," organized by Fred Rickey. The course will deal with the history of calculus and applications arising out of that history, especially during the 19th century. The speakers will be D. T. Whiteside, Craig Fraser, Roger Cooke, Tom Archibald, Uta Merzbach, and Fred Rickey. There will also be an MAA contributed paper session dealing with the history of mathematics, organized by Fred Rickey and Jim Tattersall. Watch for further details in the AMS *Notices* and the MAA *Focus*.

HPM in Seattle

The Americas Section of HPM will meet as usual in connection with the annual meeting of the

National Council of Teachers of Mathematics in Seattle from March 31 to April 3, 1993. The first HPM session will be on Friday, April 2 from 5:00 to 7:30 pm in the Aspen Room of the Sheraton Hotel. Speakers will include Karen Dee Michalowicz, "All you ever wanted to know about the abacus: history and applications," Barnabas Hughes, "The book of more and less," and Kevin Lees, "Logarithms in analysing data and designing curves." HPM will also hold a joint session with the International Study Group on Ethnomathematics on Saturday, April 3 from 1:00 to 5:00 in room 428 of the Sheraton. If you are interested in speaking, it is still not too late. You may contact Erica Voolich, 244 Summer St., Somerville, MA 02142 (e-mail: evoolich@ecn.mass.edu) or Fred Rickey, Department of Mathematics and Statistics, Bowling Green State University, Bowling Green, OH 43403 (tel: 419-372-7452 or 419-352-4194; fax: 419-372-6092; e-mail: rickey@andy.bgsu.edu).

Unlike the situation at recent NCTM meetings, there are very few presentations in Seattle dealing with history. Among the presentations that may be of interest, however, are Lawrence Shirley, "Multicultural Ideas from Africa for Classroom Use" (Friday, 12:00-1:00), and Nyles G. Stauss, "Establishing a Geography-History-Mathematics Connection" (Friday, 3:00-3:30). There will also be a meeting of the International Study Group on Ethnomathematics on Thursday from 4:30-6:00. Locations of these sessions will be available in the final program to be distributed at the meeting.

Canadian Society for History and Philosophy of Mathematics

The annual meeting of the CSHPM will be held from May 30 to June 1, 1993 at Carleton University, Ottawa, Ontario, Canada. There will be a special session on the philosophy of mathematics organized by Robert S. D. Thomas of the University of Manitoba. Speakers include John L. Bell (Western Ontario) and Stuart Shanker (York). Tom Archibald is organizing a panel discussion on the teaching of the history of mathematics. He can be contacted at Acadia University, Wolfville, Nova Scotia B0P 1X0, CANADA (tel: 902-542-2201; e-mail: archi@ace.acadiau.ca). The remainder of the program is being organized by G. R. Van Brummmelen, The King's College, 10766 9th St., Edmonton, Alberta T5H 2M1, CANADA (tel: 403-428-0727).

An Historical Calculus Course for Liberal Arts Students

Daniel Otero, Xavier University

The following is a description of a curricular experiment in yet another version of calculus reform that began during the Fall 1992 semester when I offered for the first time a new, one semester, freshman calculus course. What sets this course apart from most of the other course proposals popular in the current decade-long reform movement in the teaching of calculus are (1) its fundamental reliance on the historical development of the calculus as a guiding principle for motivating those ideas central to the subject; (2) its use of original sources in the classroom; and (3) its emphasis on making connections between the discovery (or invention, if you prefer) of mathematical ideas in and around calculus and contemporaneous developments in philosophy, science, commerce, etc. What I will relate in the next few paragraphs is something of why I felt this new course was necessary, why I chose the principles enumerated here to guide the design of the course, what classroom materials came to be chosen, reflections on how the first incarnation of the course turned out, and what sort of modifications I expect to make the next time around. I hope that sharing this experience might inspire others to adventure into similar projects.

Although an historical approach to the teaching of mathematics is far from revolutionary, especially to readers of this *Newsletter*, it seems that except for a few texts designed for students of the history of mathematics (the large majority of whom are studying to become mathematical professionals), there are very few classroom materials available that take seriously the historical approach to teaching the more ordinary college courses in mathematics. It seems that the most we as instructors seem capable of doing is enriching the standard calculus curriculum with historical asides or, somewhat more substantively, using vignettes from the history of calculus to motivate key ideas here and there during the course of the term. What I propose here, however, is that the three principles enumerated above can be used to design an entire first year calculus course.

To set the stage: I am on the faculty at Xavier University, Cincinnati, Ohio, a medium-sized (enrollment just under 6000 with about two-thirds of these undergraduates) Catholic liberal arts college, one of the 29 Jesuit-run institutions in the United States.

Xavier has three Colleges: Arts and Sciences, Social Sciences, and Business, and no graduate program in mathematics. As a component of a rather sizable core course requirement, all undergraduates in each of the three colleges must complete at least two semester courses in mathematics, and for many of these students, calculus will be chosen to fill one or more of these requirements. Xavier offers two flavors of calculus for undergraduates: the math/science flavor is the typical 12-hour, three course sequence; the business/social science flavor is a 6-hour, two course sequence, although the second course of the sequence (essentially multivariable calculus) is not required for most students and has only about 15% of the enrollment of the first semester course.

Into this mix comes the University Scholars program. Open to students throughout the university, it provides an academically challenging program of courses in various disciplines, generally by offering sections of university core courses which are reserved only for students within the program. In particular, there is a special requirement that all Scholars students must take a Scholars section of calculus as one of the two core requirements they must take in mathematics. And until this past fall, the mathematics department has offered special Scholars sections of the business calculus course for these students to fill their requirement.

Having taught sections of this special course twice before, I found that this arrangement has been less than ideal. Because the students in the Scholars program come from a wide range of major programs, they tend to have very different mathematical backgrounds. Half have taken calculus in high school, and half have not. Indeed, a number of them are English or history or music majors and are taking calculus only because the Scholars program requires them to and not because their own major does.

As might be expected, many of the students have voiced dissatisfaction with this traditional business calculus course, for a number of reasons. The students with poorer backgrounds become deeply frustrated because they feel the course is paced too high and too fast, while the others resent the fact that they "have had this all before in high school" (whether or not they really understand it), and are not challenged by a rehash of the same material.

In addition, both constituencies voice the familiar complaint that they are learning little of value to them by calculating the extrema of a half dozen cubic polynomials or finding the dimensions of a box of maximum volume made from a cross-shaped sheet of cardboard. They realize that the traditional business calculus course is unsuitable for the many students with majors in the humanities who join the University Scholars program, and they perceive that the course does little to uphold the principles of a liberal arts education by emphasizing computational skill, applications they do not value, and an unwillingness to even respect questions like, "Why is this important?", "Where did this all come from?", and "What does it have to do with anything else I am learning about?", much less offer any answers. It dispassionately ignores the fact that mathematics -- calculus in particular -- is a human enterprise, that it was developed over the course of centuries, blooming in ancient Greece alongside the work of the early metaphysical philosophers and reaching fruition simultaneously with the birth of the quantitative sciences in and around 17th century Europe. These are precisely the features of a study of calculus about which humanities students should not be ignorant.

This keen sense of curricular dishonesty that I heard my students relate challenged me to attempt to rethink the Scholars calculus course and lay down principles (1) and (3) which I stated above. The question then was, how can this drive the creation of a calculus course? I recall being inspired by reading the wonderful article that Victor Katz wrote for the *Humanistic Mathematics Newsletter* (#6, May, 1991), advocating an historial approach to the teaching of precalculus and calculus and outlining what such a curriculum might look like. I believed that this might solve my problem. But how to flesh out an entire course from this two-page sketch? I recollected having seen Otto Toeplitz's *The Calculus: A Genetic Approach* (U. of Chicago Press reprint, 1963) and Morris Kline's *Mathematics for Liberal Arts* (Addison Wesley, 1967) back in graduate school and saw that what I was hoping to do wasn't totally pioneer work. But neither of these books is suitable for a one semester freshman calculus course. More recently, William Priestley's *Calculus: An Historical Approach* (Springer-Verlag, 1979) attempts to expose the content of a calculus course with special attention to historical development, but I think Priestley doesn't go far enough.

Then, last summer, I heard David Pengelley speak at the ICME-7 satellite conference in Toronto on how he was using original sources as classroom

texts to teach real mathematical content ... and he reported that it can actually work! His success emboldened me to try something similar for my calculus course, and I consequently formulated principle (2) above.

Armed with these guidelines, I build the course around a number of selections (rarely more than two pages of text each) from important original works in the history of the calculus. These selections (in English translation) would serve the students both as text, exposing the content of the course and acting as the starting point for a more thorough and pedagogically coherent treatment of the material in the classroom, and as context, focusing attention on the issues that connect the mathematics with related and contemporaneous developments in philosophy and science and with the corresponding historical and cultural settings in which they all reside. These readings, along with a "Brief Calculus" textbook that acted as a reference and source of exercises, formed the basic course materials. Of course, it is a tall order to expect a college freshman to make sense of these readings on his own, so a good amount of class time must be devoted to parsing these texts for the students. Besides, the scope of the course requires that we deal with many of the mathematical issues that these readings bring up in only the most cursory ways, so quite a number of difficult spots are simply glossed over. But this is an introductory course, so I do not view this as a problem.

In retrospect, I am surprised at how smoothly the course went. The students appreciated doing mathematics within a more human context, commented most positively on the discussions we had that developed the connections between mathematics and philosophy, and mathematics and science, and they found rewarding the assignment of having to write a term paper which explored in more detail some topic of the course. The problem with some students' poor preparation was mitigated substantially by the fact that much of the course material was new to everyone. Some criticized the course for being a history of math course and not a calculus course, but this was levelled by students who were comparing it to their traditional high school calculus courses. In future incarnations of the course, I will be able to devote more time to chosing homework exercises for the students that fit the curriculum more closely, a feature I feel was neglected the first time around. But in any case, I am still excited by the course; I am satisfied that this approach works, and I am eager to try it again.

Readers who are interested in more information about this course may contact me at the following address: Daniel E. Otero, Xavier University, Cincinnati, OH 45207-4441; e-mail: (bitnet) otero@xavier; (internet) otero@xavier.xu.edu.

Great Theorems: The Art of Mathematics; A Course Based on Original Sources

Reinhard C. Laubenbacher and David J. Pengelley

In an upper level university honors course, we adopt the view of mathematics as art, and examine a collection of mathematical masterpieces from antiquity to the present. Our philosophy is that this is best accomplished by having students read original texts, without any modern writer or instructor as intermediary or interpreter, as is common in the humanities. As with any unmediated experience, a special excitement comes from reading a first-hand account of a new discovery. Original texts are also a perfect vehicle for understanding the roles played by both cultural and mathematical surroundings in the invention of new mathematics. Moreover, through appropriate selection and ordering of the sources, students can appreciate longterm progress in the clarity and sophistication of concepts, techniques, and notation, seeing progress impeded by certain ways of thinking until some quantum leap ushers in a new era. Finally, no other method shows so clearly the evolution of mathematical rigor and abstraction.

Although we are mathematicians rather than historians, we have succeeded in selecting mathematical masterpieces meeting the following criteria. First and foremost, the sources should be original in the sense that new mathematics is captured in the original words and notation of the inventor. Thus, we aim for original works or direct English translations. When acceptable English translations are not available, we and our students do read some works in their original French, German, or Latin. In the case of truly ancient sources, for which original writings do not exist, our goal must also be compromised somewhat. The texts also encompass a breadth of mathematical subjects stretching from antiquity to the twentieth century, and include the work of both men and women, and work of Western and non-Western mathematicians. Finally, our selection provides an overall view of mathematics building on our students' background, and aims in some cases to reveal the development over time of strands of mathematical

thought.

At present, the masterpieces studied are selected from the following:

• Archimedes on the area inside a spiral, illustrating the Greek method of exhaustion along with number theoretic knowledge on sums of consecutive squares.

• Omar Khayyam's geometric solution of certain cubics, followed by an algebraic solution from Cardano's *Ars Magna*.

• Torricelli on the finite volume of an infinite solid using indivisible shells, prior to the work of Newton and Leibniz.

• Pascal's development of formulae for sums of powers in arithmetic progressions, with connections to the development of integration. This is followed by Jacques Bernoulli's explicit general formula introducing the Bernoulli numbers for the first time. These numbers can then be used to express the results of a later text of Euler's on infinite sums of reciprocal powers.

• Lobachevsky's exposition of non-Euclidean geometry in *Geometrical Researches on the Theory of Parallels*.

• Germain's proof of a general theorem implying Case I of Fermat's Last Theorem for all exponents less than 100.

• Eisenstein's illuminating geometric adaptation of Gauss' third proof of the Quadratic Reciprocity Theorem.

• Hamilton's exposition of his discovery of the quaternions, and Cayley's first papers on abstract groups and their classification, illustrating the beginnings of modern algebra.

• Dedekind's theory of cuts defining the real numbers, and Cantor's development of the transfinite ordinals, both subsumed in Conway's recent definition of surreal numbers in *On Numbers and Games*.

It is our experience that students find the study of original sources fascinating. The benefit for instructors and students alike are a deepened appreciation for the origins and nature of modern mathematics, as well as the lively and stimulating class discussions engendered by the interpretation of original sources.

More information can be obtained from the authors by contacting them at the Department of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003 or via e-mail: davidp@nmsu.edu and rlaubenb@nmsu.edu.

New Videos Available

Frank Swetz

"One picture is worth a thousand words." I certainly believe this is true when discussing the history of mathematics to a class of students. Following are some comments on two recent videos produced for this purpose:

Luca Pacioli, Unsung Hero of the Renaissance, South-Western Publishing Co. and the Pacioli Society, 1990 (ISBN 0-538-81336-9), app. 30 minutes.

This video traces and discusses the life, career, and times of Luca Pacioli (ca 1445-1509), monk, teacher, author, and mathematician. While its main focus is on Pacioli's contribution to modern accounting, that is, the method of double entry bookkeeping, it also tells the story of a Renaissance mathematician, his activities, professional associations, and mathematical concerns. In this respect, I find this video a valuable resource for use in my history of mathematics classes.

The video relates how Luca Pacioli's life began in the village of Sansepolcro just north of Perugia in northern Italy. As a young man, Pacioli learned the merchant's mathematics of his region. He broadened his mathematics background further by studying theories of geometrical proportion and perspective with the artist and mathematician, Piero della Francesca. Upon moving to Venice, Pacioli entered into the service of the merchant family Rompianse as tutor for their children. He also made the acquaintance of the architect Leone Battista Alberti and became the student of the mathematician Domenico Bragadino. Now developing into an accomplished and recognized mathematician, Luca Pacioli wrote his first book. It was on algebra. In 1477, Pacioli became the first mathematics lecturer at the University of Perugia.

Following the death of his friend Alberti, Pacioli took religious vows and became a monk; however, he continued his activities as a teacher and

author. At the height of his career, he produced his opus magnus, *Summa de arithmetica, geometria, proportioni et proportionalita* (1498). The video discusses the impact and influence of the *Summa* on the mathematical climate of the times. It then goes on to discuss Pacioli's association with the Duke of Urbino and his eventual collaboration with Leonardo da Vinci, which resulted in the appearance of *De divina proportione* in 1509. After having distinguished himself as a teacher of mathematics in Perugia, Venice, and Florence and being an associate of some of the most illustrative figures of the Italian Renaissance, Luca Pacioli returns to Sansepolcro where he finishes his life.

This video presents the Renaissance as a period of intellectual, artistic, and creative ferment. Dramatization is effectively used to develop the story. Period works of art and architecture are employed to visually enrich the presentation. A viewer obtains a sense of the increased mathematical tempo taking place in Italy during the 15th century and, perhaps more importantly, the influences for this activity. I highly recommend the use of the video, *Luca Pacioli, Unsung Hero of the Renaissance*, in teaching the history of mathematics.

Journey Through Genius: The Video (Episode 1: Math) Carbondale, IL: Universal Video, 1992 (Distributed by the Mathematical Association of America), 28:15 minutes

Can all best-sellers be turned into video mini-series? Of course they can, but the results can be disappointing. Bill Dunham's book *Journey Through Genius* shares the author's vision of the excitement and beauty of mathematics as revealed through the development of some of its great theorems. The book was well planned and superbly crafted. Enter, a video producer with an idea – turn the book into a video. Obviously, the producer did not confer too closely with Bill Dunham on this matter. What has resulted in Episode 1 of *Journey Through Genius: The Video* is an interview with Bill Dunham on the general aspect of the importance of mathematics and its expressions throughout the ages. Dunham's interviewer, a Gary Wolf, is knowledgeable and articulate; however, at times his questions made me wince as when he opened the interview with, "Why does math seem boring?" Dunham fields the questions in a pleasant informative manner and, in doing so, discusses such topics as "the right triangle and pyramid building," Hippocrates of Chios' quadrature of the lune, Abraham Lincoln's fondness for Euclid's *Elements*, and Archimedes as a one-man "military-industrial complex." In his discussions, Bill Dunham poses some rhetorical questions of merit, such as "Where does mathematics come from?" and "Should ancient theorems excite today's students?"; however, these themes are not pursued and their heuristic effect readily dissipates. The concept of a video series based on the book *Journey Through Genius* holds great promise, which, however, is unfulfilled by this effort. Dunham and Wolf's conversation, while interesting at times, goes nowhere. If this is a trailer for the series of theorems to come, there is no indication of it. No sense of anticipation emerges. Graphic effects are sparse and appear to be an afterthought. The video shows us "two talking heads" engaged in a discussion about mathematics. Certainly, Bill Dunham and *Journey Through Genius* both deserve more.

Philosophia Mathematica

The Canadian Society for History and Philosophy of Mathematics announces the publication, beginning in 1993, of its new philosophical journal, Series Three of *Philosophia Mathematica: Philosophy of Mathematics, Its Learning, and Its Application*, edited by Robert Thomas of the University of Manitoba. This newly revived journal is the only journal devoted specifically to philosophy of mathematics. The aim of the journal is scholarly interchange. To that end it will publish new work in philosophy of mathematics, including what can be learned from the study of mathematics, whether under instruction or by research, and including the application of mathematics, including computation. Several papers by members of the editorial board will appear in 1993. In addition to main articles, sometimes grouped on a single theme, there will be shorter discussion notes, letters, book reviews, and advertisements. Occasional issues will be filled by invitation and devoted to a single topic. It is intended that each issue of the journal have contents of interest to both mathematicians and philosophers and also to those concerned with the teaching of mathematics at every level. Submissions and books for review are solicited from authors and publishers. Frequency of publication will initially be semi-annual, with increase to three and four times a year as soon as possible, because increased frequency facilitates scholarly interchange. A special effort has been made to ensure that the journal is affordable for individuals.

The personal subscription rate is $29 (U.S.)

or $29 (Cdn) to addresses inside Canada. Members of the Canadian Society for History and Philosophy of Mathematics enjoy a $5 discount. To subscribe, send your check to Journals Division, University of Toronto Press, 5201 Dufferin Street, Downsview, Ontario M3H 5T8, CANADA. To subscribe as a member of the CSHPM, send your check to the Society. For more information, contact the editor at the Department of Applied Mathematics, University of Manitoba, Winnipeg, Manitoba R3T 2N2, CANADA; e-mail: Robert_Thomas@UManitoba.ca; tel: 204-474-8126; fax: 204-275-1498.

Acta Didactica Universitatis Comenianae

A new journal of mathematics education, the *Acta Didactica Universitatis Comenianae*, has just appeared under the auspices of Comenius University Bratislava, edited by Peter Bero. The journal is open to articles concerning the whole field of mathematics education. In particular, articles written at a rather informal level are as welcome as articles which meet the usual professional criteria. Apart from reports of completed research projects, the journal has space to publish preliminary reports of ongoing research. Articles challenging well-established opinions, as well as controversial or dissenting papers, are welcome. The language of the journal is English. For more information, contact the editor at KZMaDM, MFF, Univerzita Komenskeho, 842 15 Mlynska dolina, CS-842 15 Bratislava, SLOVAKIA.

Asociación para la Historia, Filosofía y Pedagogía de las Ciencias Matemáticas

Dentro del marco del III Coloquio Internacional de Filosofía e Historia de las Matemáticas, celebrado del 22 al 26 de Junio de 1992 en al Universidad Nacional Autónoma de México, se fundó las Asociación para la Historia, Filosofía y Pedagogía de las Ciencias Matemáticas.

Esta Asociación, de carácter internacional, pretende, entre una de sus múltiples metas, fungir como medio de comunicación entre los investigadores hispanoparlantes interesados en estas disciplinas, entendidas dentro del marco conceptual más amplio posible. La Asociación fomenta la investigación, la enseñanza y la divulgación de la historia, filosofía y pedagogía de las ciencias matemáticas, así como sus interrelaciones sociales y culturales; también promueve su uso en todos los niveles de las enseáanza. Resumiendo, la Asociación es una institución educacional en el medio académico que fomenta la investigación y la docencia y transmite y divulga conocimiento. La Asociación cuenta entre sus miembros: científicos en general -- incluyendo astrónomos, físicos, químicos, biólogos, etc. --, historiadores, filósofos, matemáticos, psicólogos y pedagogos profesionales; estudiantes de estas disciplinas; periodistas académicos; archivistas; museólogos; ingenieros; antropólogos; bibliotecarios; políticos científicos; economistas y sociólogos, entre otros.

Correspondencia: AHFPCM, Apartado Postal # 19-365, 03901 México, D.F., MÉXICO.

A History of Mathematics: An Introduction

HarperCollins has recently published *A History of Mathematics: An Introduction* by Victor J. Katz. This new text in the history of mathematics is designed for mathematics majors, in particular, for those intending to teach mathematics at some level. As is evident, it is the author's belief that a knowledge of the history of mathematics is essential in the teaching of mathematics and that history has much to offer in enabling students to understand mathematics. To order a copy of the book, contact a HarperCollins representative -- there are representatives in many countries around the world -- or your local bookstore.

Have You Read?

Ronald Calinger, ed.

This column welcomes references from across the history or pedagogy of mathematics, as well as other works with sections that have potential for encouraging and motivating students to learn mathematics better or that enrich courses. Please send citations with complete bibliographic information to the section editor c/o Department of History, Catholic University of America, Washington, DC 20064, U.S.A.

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Distributors:

U.S.: Editorial Office

Canada: M. A. Malik (Concordia University, Montreal, Qué H4B 1R6)

Mexico: Alejandro Garciadiego (UNAM - contact at José M. Velasco 71, Del. Benito Juárez, 03900 Mexico, D.F.)

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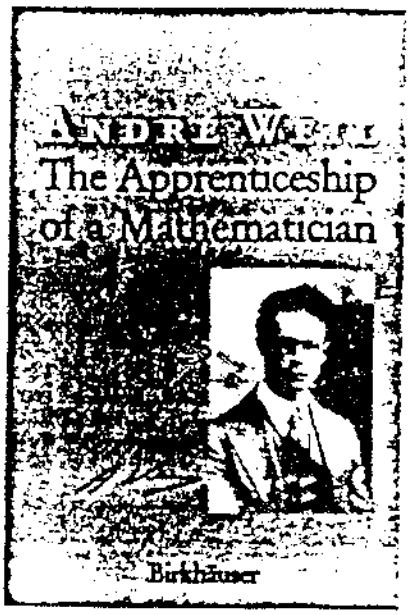
André Weil

The Apprenticeship of a Mathematician

The author, a mathematician whose horizons have never been limited to mathematics, recalls a career that led him to numerous continents: to Italy and Germany first of all; then to India where he lived and taught at a critical time in the history of that country, and where he met with Gandhi and Jawaharlal Nehru; to Russia when Stalinism seemed to be waning only to then rise up again with increased ferocity; to Princeton, the modern "clearing house" of mathematical ideas, called at times a mathematician's paradise; to a prison in Finland where, taken for Soviet spy, he narrowly escaped execution; to France, where he was convicted for dodging his military obligations (the draft) and where, in the prison of Rouen, he had time to write one of his best mathematical works; to England, where he lived through the Battle of London before returning to France and then moving on to the United States; and finally to Brasil, scene of the last of his vicissitudes, before returning permanently to the United States. Through these often picturesque episodes, the destiny of a mathematician is unfolded, of which perhaps the most salient event was his participation in the foundation of the Bourbaki Group, an *auteur collectif* of a treatise that has long since become a classic.



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