Miguel de Guzmán Ozámiz
January 12, 1936 – April 14, 2004

by

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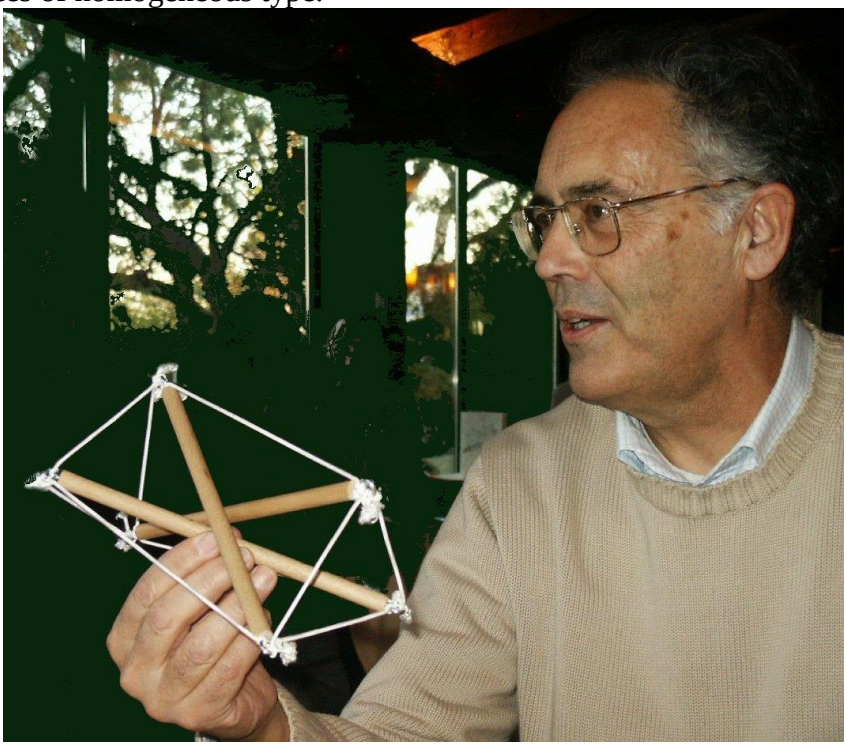
Miguel de Guzmán has been a central figure in the development of harmonic analysis in Spain and has captivated the enthusiasm of several generations of mathematicians. He was an extraordinary teacher and communicator and his ideas in mathematical education have had a profound influence on the teaching of mathematics in Spain and in the world. His books, translated into several languages, have made accessible to a large audience that extraordinary activity of the human spirit known as Mathematics. His loss will leave a void in the international mathematical community.

Miguel de Guzmán Ozámiz was born in Cartagena (Murcia) on January 12, 1936. He studied Engineering from 1952 to 1954 in Bilbao (Vizcaya) and Humanities and Classical Arts from 1954 to 1958 in Orduña (Vizcaya). He finished his studies in Philosophy in Munich, Germany, in 1961. Miguel completed studies both in Mathematics and Philosophy at the Universidad de Madrid in 1965. In 1968 he obtained a Ph.D. in mathematics at the University of Chicago under the supervision of Professor Calderón and was an Assistant Professor at De Paul University in Chicago (1967-68) and Washington University in St. Louis (1968-69). Miguel had been a Professor of Mathematical Analysis at the Universidad Complutense de Madrid since 1969, a period interrupted when he held a position at the Universidad Autónoma de Madrid for the 1982-83 and 1983-84 academic years. He has been a visiting professor at several universities, among them Princeton University, Washington University in St. Louis and the Pontifica Universidade Catolica in Rio de Janeiro. He was named a member of the Spanish Royal Academy of Mathematical, Physical and Natural Sciences in 1982 and served as President of The International Commission for Mathematical Instruction (ICMI) from 1991 to 1998.

A turning point in his career came in 1965, when Professor Alberto Calderón visited Madrid, discovered Miguel's natural talent for mathematics and encouraged him to apply to the graduate program at the University of Chicago. The Department of Mathematics of the University of Chicago was home of one of the most famous schools of harmonic analysis, created by Professors Zygmund and Calderón. In this conducive atmosphere, Miguel wrote his doctoral dissertation on singular integrals with generalized homogeneity. This was a

natural extension of the so-called Calderón-Zygmund theory, associated with the problem of existence and uniqueness of certain linear partial differential equations. During his stay at Washington University in St. Louis as an Assistant Professor (1968-69), Miguel worked with Ronald Coifman on an extension of his result. This work was the starting point of a more general theory developed by Ronald Coifman and Guido Weiss in harmonic analysis on spaces of homogeneous type.



Although Miguel developed his research mostly in analysis, geometry was one of his favorite subjects. He reconciled his own work with that of geometry by working in an area where the appropriate combination of the two is essential: the theory of differentiation of integrals. This is a field where one replaces the simple geometry of one-dimensional intervals in the acclaimed theorem of Lebesgue by the extremely difficult one in higher dimensions. The starting point here can be found in the work of Hardy and Littlewood and even before that in the work of the Italian mathematician Vitali, from whom the notion of the so-called (geometrical) covering lemmas originates. After returning to the Universidad Complutense de Madrid, Miguel concentrated his work on this subject and for years organized a weekly seminar where he discussed with visitors and his students the old and new results in differentiation of integrals. As a result of this seemingly endless work of more than six years, Miguel published an extraordinary monograph on this topic entitled "Differentiation of Integrals in R^n" (Lecture Notes in Math, Vol. 481, Springer-Verlag, Berlin, 1975.) The "yellow book" represented not only an excellent survey of the "old stuff." It also provided a quick introduction to the newest results, including his own, some obtained in collaboration with Grant Welland. The book was a complete success and is still widely used by specialists in the area.

After finishing with the book on Differentiation of Integrals, Miguel undertook a more complex project as he collected in a single volume the techniques most commonly

used at that time in harmonic analysis. Again, the work began in his seminar and finished with the write-up of a monograph entitled "Real Variable Methods in Fourier Analysis" (North-Holland Mathematics Studies, Vol. 46, Amsterdam, 1981). The book describes not only the classical techniques, but also shows in subsequent chapters how one can apply them to several topics. A chapter on differentiation of integrals along curves (a new topic not covered in his previous book) and the disproof by Charles Fefferman of the disk multiplier conjecture are two examples of this.

Many mathematicians have benefited from these two books throughout the years. But it is mainly a large number of Spanish mathematicians who are the most indebted, for they discovered through these writings how to conduct proper research at high standards, all back in a time of complete isolation for Spanish scientists.

Writing these two books on "modern" harmonic analysis was not the end of his project. Ever since Miguel had returned to work in Madrid, he had decided to bring Spanish mathematics to international recognition. Miguel knew that isolation was not a good thing for the development of science in general, and in particular for mathematics. During the period in which the books were written he sent many students abroad, mainly to universities in the U.S.A. like the University of Chicago and Washington University in St. Louis. The idea was to speed up the process of exposing young people to the real world of research, specifically in the area of harmonic analysis, as another way to attain the goal he had in mind when he returned to Spain. In addition to this, several students also obtained their Ph.D. under his supervision during this period, among them Baldomero Rubio, Ireneo Peral, Magdalena Walias, Antonio Casas, Maria Teresa Carrillo, Agustín de la Villa and Camilo Aparicio.

This decade of exciting work was embellished by two events that show the extraordinary capacity of Miguel to organize successful meetings. In collaboration with mathematicians from the Universidad de Extremadura, a summer school in Jarandilla de la Vera (Cáceres) was conceived to give graduate students an opportunity to learn the recent developments in all areas of mathematics. Unfortunately, the experience only lasted for four years, but it had a profound influence on many graduate students.

The other event was the celebration of the "Seminar on Fourier Analysis" held in El Escorial (Madrid) on June 17-23, 1979. Miguel first had to overcome the extraordinary difficulty of getting support from public institutions, an almost impossible task at the time in Spain, to gather some of the best researchers in this area of mathematics, among them Alberto Calderón, Ronald Coifman, Antonio Córdoba, Yves Meyer, Elias Stein, and Stephen Wainger. The Seminar was a success, as is recognized in a letter sent by Antoni Zygmund, Alberto Calderón, Elias Stein, Stephen Wainger, Ronald Coifman, and Yves Meyer and published in the introduction to the Proceedings of the Seminar (Miguel de Guzmán and Ireneo Peral, Editors, Asociación Matemática Española, 1979).

This conference has been continued through the years and has become a classic meeting in Fourier Analysis. With one exception, the conference has taken place every four years, and the next one, the 7th International Conference on Harmonic Analysis and Partial Differential Equations, will be held on June 21-25, 2004, at the same place as the first one

organized by Miguel 25 years ago. The fifth of this series was dedicated to Miguel de Guzmán on the occasion of his sixtieth birthday and "to show appreciation and gratitude for the person who has contributed the most to the flourishing of modern Harmonic Analysis in Spain" (Introduction, Proceedings of the Conference dedicated to Miguel de Guzmán, J. of Fourier Analysis and App., Special Issue, CRC Press, 1997).

All this work should be enough to fill the mathematical lives of several people for a decade. But it was not enough for Miguel. He was not a person to let teaching languish while his research was flourishing. His extraordinary ability to communicate enchanted several generations of students at Universidad Complutense de Madrid. From this period, in the 1970's, some of his classroom lectures grew into a book entitled "Ecuaciones diferenciales ordinarias: teoría de estabilidad y control" – Ordinary Differential Equations: stability and control theory, (Alhambra, Madrid, 1975). From this period also is his translation of "Mathematics in the Modern World" ("Matemáticas en el mundo moderno" Blume, Madrid, 1974), a collection of articles published by Scientific American to make mathematics accessible to readers, which highlights his continuous interest in the history of mathematics.

His desire to write appropriate textbooks in mathematics for undergraduate students has been a permanent goal throughout his teaching career at the University. The three volumes "Problemas, conceptos y métodos del análisis matemático" – "Problems, concepts and methods of mathematical analysis" (Pirámide, Madrid, 1990-1993), written in collaboration with Baldomero Rubio, is a good example of this interest in clear exposition and teaching of mathematics and shows also his vitality to do it.

It was in the mid 1980's when he realized that his goal of bringing Spanish mathematics to the international forefront had been a success and he decided to move forward to yet another project. As several of his Ph.D. students and his "students abroad" had started to publish papers on their own in international journals, Miguel felt that he had another important task to accomplish, that of modernizing the teaching of mathematics not only at the university level but at other levels of the educational system in Spain. In collaboration with José Colera and Adela Salvador, Miguel wrote several textbooks for middle and high school students. These books represent a landmark in the way mathematics is taught today at this level. The original motivations of the each of the subjects, the approach to deducing results from a variety of examples, and the final notes of each chapter showing the many applications that mathematics provide have been imitated by many high school textbooks to follow.

This idea of Miguel of bringing mathematics education to high standards was not confined, as said before, to a particular level. We have already mentioned his interest in undergraduate teaching. Furthermore, he co-directed a Ph.D. dissertation in mathematical education and played a decisive role in bringing this area, where mathematics and education meet, to university recognition. Miguel was a driving force in designing the Expert Degree Program in Mathematical Education that has been successfully running at the Universidad Complutense de Madrid since the 1994-95 academic year.

For many years during the decade of the 1990's, Miguel participated either as a director, organizer or speaker, in many Conferences on mathematical education in Spain and abroad. His work was recognized by The International Commission on Mathematical Instruction (ICMI), which in 1991 named him as its President when his candidacy was presented by J. P. Kahane. Miguel held this post until 1998. Among the many activities that he supported during this period, it is important to mention his active role in the organization of the 8th International Congress on Mathematical Education in Sevilla, Spain, on 14-26 July 1996.

In ICMI, Bulletin No. 50, June 2001, Miguel de Guzmán wrote: *In my opinion, the main problem with which ICMI should be concerned, as an organism responsible for the health of mathematics education at a global level, as well as IMU, as an organism which has to attend to the good state of the mathematical activity, is the huge gap in many places around the world between those members of the mathematical community whose main activities are related to education, and those whose main occupation is the furtherance of mathematical research, be it oriented towards its more theoretical or its more applied aspects.*

The "huge gap in many places around the world" mentioned in the above paragraph did not show in Miguel's work. During his long period of work on differentiation of integrals and harmonic analysis, his research permeated all his teaching. When he became active in mathematical education, he never abandoned his research. This time he found another area were the interplay between analysis and geometry was essential: the theory of fractals. He had three Ph.D. students who wrote their dissertations in this area: Miguel Ángel Reyes, Manuel Morán, and Miguel Ángel Martin. At the same time, to show that the gap between education and research should be narrowed, a book on fractals entitled "Estructuras fractales y sus aplicaciones" - "Fractal structures and applications" (Labor, Barcelona, 1993) was written with some of his collaborators, aimed at presenting the theory of fractals in an accessible way to undergraduate students and high school professors.

His early training in geometry accompanied him all his life. The publication in 1999 of "*An extension of the Wallace-Simson theorem: Projecting in arbitrary directions,"* (American Mathematical Monthly, Number 6, June-July 1999, pp 574-580) is an indication of this activity. Other results, which he called "miniatures in the geometry of the triangle," can be found on his web page http://ochoa.mat.ucm.es/~guzman/. Newly developed mathematics software gave Miguel the opportunity of experimenting in geometry. He was a champion in the use of computer programs like Derive and SketchPad to show properties of figures and to give live presentations of results.

His last project in geometry was about tensegrity, a system in which structures stabilize themselves by balancing the forces of compression and tension, used to create designs that apparently float in the air like the "Needle Tower" by the outdoor sculptor K. Snelson (Hirshhorn Gallery of the Smithsonian Museum in Washington, D.C.) and in the construction of many domes and towers. As one of us accompanied Miguel to Barcelona in February 2003, he talk enthusiastically about the results he had proved in tensegrity and the beautiful models he had constructed with wood, straws, rubber bands, wires and clips. He was aware that by working in a new field he might encounter a wealth of seemingly new

discoveries, only to find out later that they had already been discovered by others. His project of determining whether his results were worthy of publication ended suddenly with his death on April 14, 2004.

Miguel always offered his generosity and imagination to undertake difficult projects. As the knowledge of mathematics among high school students decreased across Spain in the 1990's, partly due to the massive number of students in the classrooms, universities encountered a large number of failures among first-year math students. Miguel designed and organized at the Universidad Complutense de Madrid a "Mathematics Lab," also known as "Course Zero," designed to bring the knowledge of high school students to the level needed to overcome their first year of undergraduate studies. The Lab starts one month before regular classes, lasts for two months, and is taught with a problem-solving approach, letting the students work the problems at the same time that they discover mathematical relations and proofs.

Miguel was an extraordinary communicator, both in speaking and in writing. He applied his talent and efforts to make mathematics accessible to many readers. In his particular task of communicating *"the indescriptable beauty of mathematics,"* as he used to say, and making it attractive to many readers, Miguel writes in a profound style that is at once entertaining. These are some of the books he wrote: "Mirar y ver: nueve ensayos de geometría intuitiva" –"*Look and see: nine essays in intuitive geometry*" (Alhambra, Madrid, 1976), dedicated to high school students; "Cuentos con cuentas" (Labor, Barcelona, 1984) (Translated into English as *The Countingbury Tales*) dedicated to his son and daughter, Miguel and Maite; "Aventuras matemáticas" – "*Mathematical adventures*" (Labor, Barcelona, 1986) written while in the hospital, and translated before the second printing into Finnish, French and Chinese; "El rincón de la pizarra" – "*The blackboard corner*" (Pirámide, Madrid, 1996), dedicated to his wife, Maite, and written for university students. His last book, "La experiencia de descubrir en geometría" – "*The experience of discovering in geometry*" (Nivola, Madrid, 2002), contains several of his results in one of his favorite subjects.

He has also written essays and tales. While he corrected the galley proofs of his book "Real Variable Methods in Fourier Analysis," he wrote "Los espingorcios," a collection of stories based on personal experiences with his family and on other events, designed to keep his son and daughter occupied while he was working on the completion of the book. His early training in philosophy shows in "Para pensar mejor" – "*To think better*" (Labor, Barcelona, 1991), where Miguel draws from works by Descartes, Bacon, Balmes and Polya and from his own experience.

Around 1995, Miguel started to talk about the possibility of having a program directed at talented young students, similar to the ones held at Johns Hopkins and Hamburg and to the "Mathematical Circles" of the former Soviet Union. The idea crystallized in 1998 in the Madrid region as part of a program of the Spanish Royal Academy of Mathematical, Physical and Natural Sciences, an Institution of which Miguel de Guzmán was a member since 1982. The main financial support for this program came from the Vodafone Company. Known as ESTALMAT (for Stimulation of Mathematical Talent), 25 students, aged 12 to 14, are selected every year with a test designed to show talent and

imagination rather than knowledge. The selected students meet every Saturday, for 3 hours, during two consecutive academic years. The activities are monitored by both high school and university professors, carefully selected by Miguel. As the sixth year of ESTALMAT comes to a close, the program has been extended to Catalonia and Burgos. The day before his death he was still making plans, from his bed in the hospital, to have the test ready for the next selection process in June 2004.

We have joined efforts to show our personal recollection of the work of Miguel in mathematics. It will take more people to have a complete account of his achievements. An indication of his enthusiasm and vitality to create original ideas in connection with mathematics and mathematical teaching can be seen in the vast amount of material he put into his website at the Universidad Complutense de Madrid, accessible at http://ochoa.mat.ucm.es/~guzman

The Spanish scientific community has lost an excellent mathematician. For both of us, who had the unique opportunity to meet him as undergraduate students and who belong to that group of "students abroad" that he sent to do graduate work, his death has robbed us of a friend and a teacher.

On Miguel's project ESTALMAT

by

Marcos Castrilón and María Gaspar
(members of the ESTALMAT project)

One of the dearest projects of Miguel de Guzmán in the last few years is ESTALMAT (Math Talent Search and Treatment Project) for young students aged 12 and 13. Such a project would have been impossible to imagine in Spain some years ago. But Miguel was firmly convinced that, despite the criticism of many people involved in mathematical education about the possible elitism of the nature of the project, the creation of a free system open to any gifted student, regardless the social and cultural status, was the most efficient way to provide a social tool and a chance to improve their talent to all of them.

It was in the last 80's when he started to look for institutional support to develop his ideas. In 1996, the Spanish Royal Academy of Sciences assumed the project and provided it with the necessary funds from its own budget. Since then, every year a group of 25 children is selected in Madrid among, more or less, three hundred applicants. These groups follow a program run every Saturday morning along two years in the Faculty of

Mathematics at the Universidad Complutense. The main goal is to foster the mathematical abilities of the students without interfering with the mathematical curricula at their schools. In this way, the students need not to be enrolled in a special school but they receive an adapted program to enrich their capabilities.

Although Miguel was strongly inspired by other similar enrichment projects he endowed the ESTALMAT project with his personal touch. He gave expression to his own ideas on the *mathematical task*, a topic about which he liked so much to speak.

From the very beginning, the project was very successful and, in the present year, it has started in other Spanish cities (Barcelona, Burgos). It represents the first step to extend Miguel's ideas to the rest of the important cities of the country. Precisely, two days after he passed away, a meeting took place facing these goals.

Miguel was 68, and although he looked much younger, the true source of his youth was his tireless capability of filling his friends and collaborators with enthusiasm. All the members of the project will deeply miss Miguel and his valuable advice, his warm conversation and his generosity. The best tribute to his memory will be the continuation of his work in the way he would have liked.