BULLETIN

INTERNACIONAL CENTER FOR MATHEMATICS

December 1998

5

Coming events

University teaching of Mathematics in Portugal and related issues

Debate

CIM, 6-7 February 1999

Organizers:

Luís Trabucho (Univ. Lisboa)
João Filipe Queiró (Univ. Coimbra)

The debate will take place in Caparide, near Lisbon.

Preliminary programme:

The teaching of mathematics for applications

Miguel Beleza, E. Arantes e Oliveira, A. St.Aubyn, J. Pedroso de Lima

The teaching of mathematics for Science and Engineering

J. Teixeira de Freitas, Luís Sanchez, C. Mota Soares, Joana Soares, L. Nunes Vicente

The teaching of mathematics for teacher training

Bártolo Paiva Campos, Armando Machado, E. Marques de Sá, A. Franco de Oliveira, A. Guedes de Oliveira

The use of technology in mathematics teaching at all levels

J. Carvalho e Silva, Vítor Neves, Yolanda Lima, Paulo Lourenço, Susana Nápoles

The organization of the mathematical community in Portugal

F. Dias Agudo, Graciano de Oliveira, J. A. Dias da Silva, Carlos Braumann, José F. Rodrigues

University organization in Portugal

L. Sousa Lobo, Irene Fonseca, Vital Moreira, António Vigário

Theoretical and Computational Fluid Dynamics: Thematic Term

CIM (Coimbra, Observatório Astronómico), May - July 1999

Organizing Committee:

Adélia Sequeira - Instituto Superior Técnico, Lisbon (Portugal)
Hugo Beirão da Veiga - University of Pisa (Italy)
Juha Videman - Instituto Superior Técnico, Lisbon (Portugal)

Main topics:

- Mathematical modeling, analysis and numerical simulation of fluid flows including:
  - Compressible and incompressible viscous flows;
  - Viscoelastic and non-Newtonian fluid flows;
  - Free-surface flows;
  - Turbulent flows.
- Applications to industrial problems.

Scientific Objectives:

The objective of the trimester is to promote research and to establish scientific contacts between foreign and portuguese specialists working in this area. Some of the activities of the Thematic Term are further aimed to encourage young doctoral and post-doctoral students in developing investigation in this challenging field. The main events of the trimester will include:

- Organization of three Summer Schools (each consisting of 20 hours of lectures):
  - Industrial Mathematics, June 5-12.
    (Chairmen: A.M.Anile and A.Fasano.)
    1. Introduction to Hydrodynamical Models of Carrier Transport in Semiconductor Devices (A.M. Anile, Università di Catania, Italy);
    2. Mathematical Foundations of Electrical Network Analysis (P. Rentrop and M. Guenther, Technische Hochschule Darmstadt, Germany);
    3. Mathematical Modeling in Polymer Science (A. Fasano, Università di Firenze, Italy);
    4. Mathematical Modeling of Composite Materials Manufacturing Processes (L. Preziosi, Università di Firenze, Italy).
  - Navier-Stokes Equations: Theory and Numerical Methods, June 28-July 3.
    (Chairman: H. Beirão da Veiga.)
    1. On the Blow Up of the Solution to Navier-Stokes Equations via Self-Similar Solutions (J. Necas, Northern Illinois University, USA and Charles University, Czech Republic);
    2. The Motion of a Rigid Body in a Viscous Liquid: Mathematical Theory and Applications (G.P. Galdi, University of Pittsburgh, USA);
    3. Vortex Methods: Design and Numerical Analysis (G.-H. Cottet, Université de Grenoble I, France);
    4. to be confirmed (D. Kröner, Universität Freiburg, Germany).
  - Computational Fluid Dynamics, July 12-17.
    (Chairman: A. Quarteroni.)
    1. Domain Decomposition Methods in Fluid Dynamics (A. Quarteroni, Politecnico di Milano, Italy and EPFL, Lausanne, Switzerland);
    2. Multilevel Methods in Fluid Dynamics (C. Canuto, Politecnico di Torino, Italy);
    3. An Introduction to Numerical Methods for Fluid Dynamics and Upwind Schemes (B. Perthame, École Normale Supérieure, Paris, France);
    4. Spectral methods for incompressible and compressible flows (Y. Maday, Université Paris VI, France).

- Permanent research activities at CIM during the trimester, in particular organization of a weekly seminar and short courses. The following foreign researchers have already confirmed their participation:

  Serguei Nazarov (Institute of Mechanical Engineering Problems, St. Petersburg, Russia);

  Sarka Matusu-Necasova (Czech Academy of Sciences, Czech Republic);

  Konstantin Pileckas (Institute of Mathematics and Informatics, Vilnius, Lithuania);

  Milan Pokorny (Palacky University, Olomouc, Czech Republic);

  Antonin Novotny (Université de Toulon et du Var, France);

  Eduard Feireisl (Czech Academy of Sciences, Czech Republic);

  Anne Robertson (University of Pittsburgh, USA);

  Patrick Penel (Université de Toulon et du Var, France);

  Mark Steinhauer (Universität Bonn, Germany);

  Giovanni P. Galdi (University of Pittsburgh, USA);

  Jindrich Necas (Northern Illinois University, USA and Charles University, Czech Republic);

  Vsevolod Solonnikov (Steklov Institute of Mathematics, St. Petersburg, Russia).

- Offer 20 scholarships to post-graduate students to attend the Summer Schools and to participate in the weekly seminars at CIM.

School on Singularities in Algebraic Geometry and String Theory

The School on "Singularities in Algebraic Geometry and String Theory" is an activity of the International Center of Mathematics, and will be held in Complexo Interdisciplinar da Universidade de Lisboa, Av. Prof. Gama Pinto, 2, Portugal, July 8-17, 1999.

The aim is to have a 10 days long School on the fascinating interface between singularity theory (in complex algebraic geometry) and superstring theory. There will be 6 courses by leading experts on both mathematical and physical aspects of singularity theory.

Planned Courses:

- P. Aspinwall (Duke University):

  "The Role of Singularities in String Theory"

- V. Batyrev (University of Tuebingen):

  "Introduction to Toric Varieties and Mirror Symmetry"

- Ph. Candelas (University of Texas):

  "The Role of Singularities in String Theory"

- Le Dung-Trang (Université de Provence):

  "Introductory Course on Singularities and their Resolution "

- M.S.Narasimhan (International Center for Theoretical Physics):

  "Moduli Spaces of Vector and G-bundles over Riemann Surfaces"

- M. Reid (University of Warwick):

  "Lectures on 3-folds and Classification of Varieties"

Organizing Committee

Carlos Florentino - Lisbon, Instituto Superior Técnico

Margarida Mendes Lopes - Lisbon, Faculdade de Ciências

José Mourão - Lisbon, Instituto Superior Técnico

Orlando Neto - Lisbon, Faculdade de Ciências

João Pimentel Nunes - Lisbon, Instituto Superior Técnico.

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Centro de Matemática e Aplicações Fundamentais da Universidade de Lisboa

Centro Interdisciplinar de Astrofísica, Instituto Superior Técnico

Projecto "Física Matematica"

Project TMR ERCFMRXCT980040 "Singularities of Differential Equations and Foliations".

For more details see internet page of the school in:
http://www.fisica.ist.utl.pt/~jmourao/cim/main.html

Geometric and combinatorial methods in the selfadjoint spectral sum problem

(CMUC-CIM)

Coimbra, July 1999

Organizers:

A. P. Santana, E. Marques de Sá, J. F. Queiró - Universidade de Coimbra

A fundamental open problem in pure mathematics is the following: Given two selfadjoint operators A and B on a Hilbert space, describe the spectrum of $A+B$ in terms of the spectra of A and B. The first nontrivial result on this question is found in a 1912 paper by H. Weyl on partial differential equations. A lot of progress has been made since then, mainly in the finite-dimensional case, that is, involving eigenvalues of Hermitian matrices. In the last few years, interest has intensified on this matter, with contributions from representation theory, harmonic analysis and algebraic geometry. The combinatorics of tableaux plays an essential role in all these approaches. The meeting will gather experts from different fields who have worked on this problem.

Summer School on Differential Geometry

Organizers

Joana M. Nunes da Costa - Univ. de Coimbra

F. J. Craveiro de Carvalho - Univ. de Coimbra

A. M. d'Azevedo Breda - Universidade de Aveiro

Bernd Wegner - Technische Universität Berlin

Date: 3/7 September 1999

Structure

12 hour course on Geometry of Submanifolds by Dirk Ferus - Technische Universität Berlin

12 hour course on Poisson and Symplectic Geometry by I. Vaisman - Haifa

Four 1 hour conferences, one per day, by

David R. J. Chillingworth - Southampton

Sheila Carter - Leeds

Jean Pierre Françoise - Paris

Bernd Wegner - Berlin

Sessions where participants can talk on their own work.

Information available at
http://www.mat.uc.pt/diff_geo.html

Great Moments in XXth century Mathematics

In volume 20, number 2, of Mathematical Intelligencer our attention was drawn to an article by S. Smale where he mentioned, in Hilbert style, a number of mathematical problems that he thinks will be important in the future. Well, we decided to ask a number of mathematicians not for a similar list of problems but for their answer to the following question:

> If you had to mention one or two great moments in XXth century mathematics which one(s) would you pick up?

The choices of Professor José María Montesinos (Universidad Complutense de Madrid, Spain) are given below.

"For me the following are really remarkable moments:

The relationship of 3-manifold topology and the Theory of knots, as Dehn'surgery on links and branched covering spaces of Alexander.

Seifert discovery and classification of Seifert manifolds, central concept in 3-manifold topology and Knot Theory.

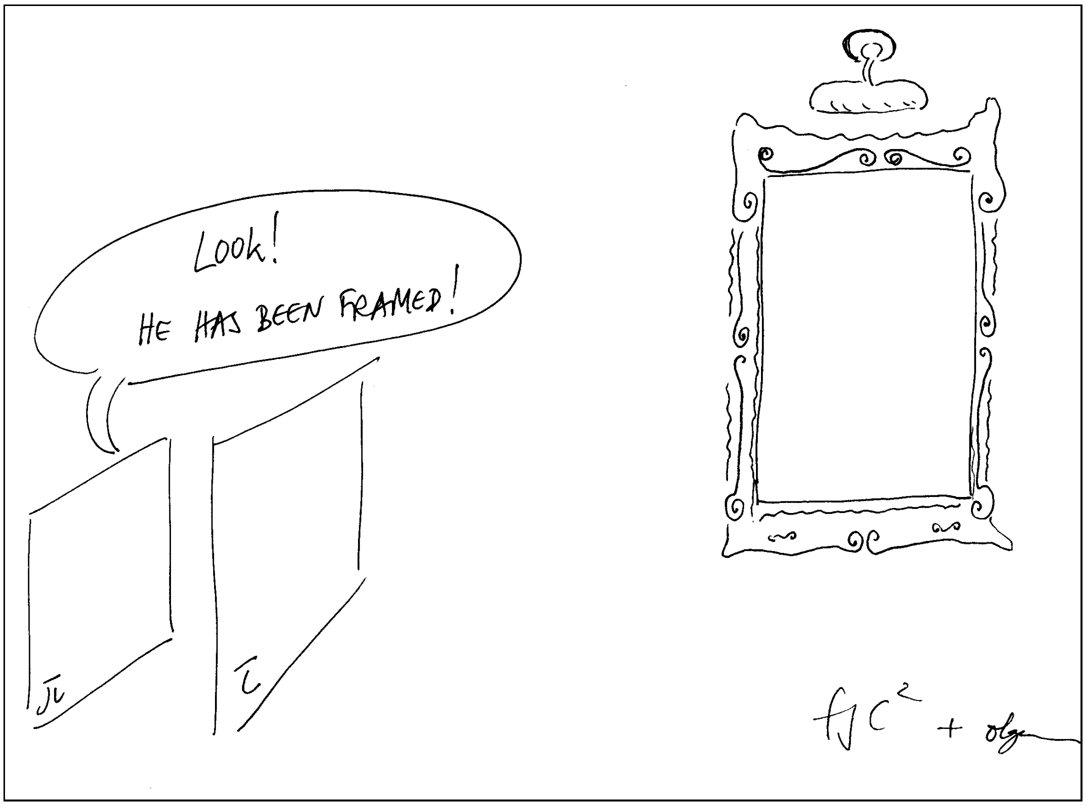
John Milnor's discovery of distinct differentiable structures for S^7, so starting differential topology.

J. H. C. Whitehead's discovery of a new open, contractible 3-manifold, so starting the train of ideas ending in the proof of the topological Poincaré conjecture in dimension 4.

Papakyriakopoulos's proof of Dehn's Lemma and other basic 3-dimensional geometric theorems, so starting modern 3-dimensional topology.

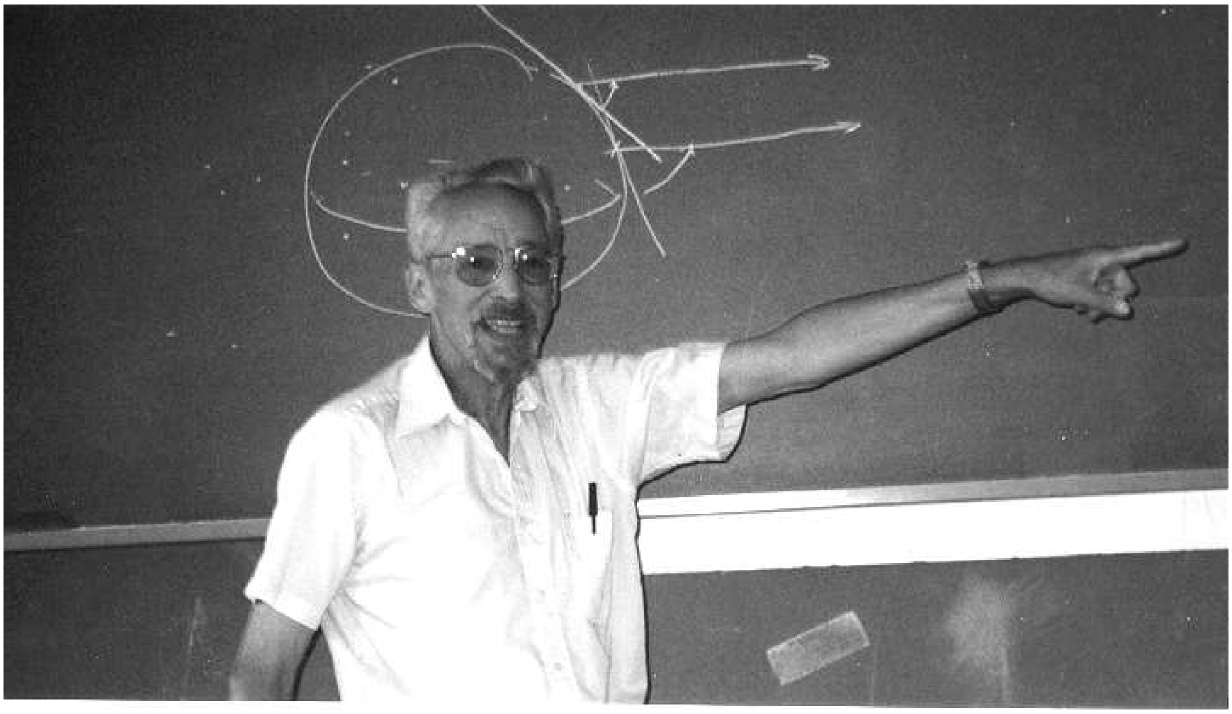
William Thurston's observation that the completion of certain incomplete hyperbolic structures in the complement of the figure 8 knot gives rise to Dehn surgery, leading him to conjecture that hyperbolic manifolds are in the center of 3-manifold topology.

It is likely that 20th Century mathematics will have as one of the most important developments, Knot Theory."



Robert Osserman wrote his PhD thesis under 1936 Fields Medalist Lars V. Ahlfors on Riemann surfaces at Harvard University. Although is name is immediately associated to minimal surfaces he has contributed to a variety of other mathematical areas: Differential Geometry, Isoperimetric Inequalities, Partial Differential Equations and Ergodic Theory. He joined Stanford University in 1955 where he spent most of his career. In 1990 he became Deputy Director at MSRI and is currently Special Projects Director.

Professor Osserman is also the successful author of "Poetry of the Universe – A Mathematical Exploration of the Cosmos", a book meant for the general public.



We know that you are a distinguished mathematician but apart from that we must confess that we know very little about you.

Shall we start with your mathematical upbringing? Where did you go to school? Which universities did you attend?

'I was very lucky with schools. I grew up in New York City which had some wonderful public high schools, and just at the time I was ready to think about where to go they started two new ones – the first specialty high schools. One was the High School of Music and Art, the other was the Bronx High School of Science. Both of them were free public high schools, but they required an examination to get in and admission was on a competitive basis. I was a member of the first full graduating class of the Bronx High School of Science and I had some wonderful teachers, as well as terrific fellow students. One of my classmates (who happened coincidentally to live in the same apartment house in Manhattan that I did) was Richard Kadison, who became a well-known mathematician and was just elected to the National Academy of Sciences this year (1997). Others became famous in physics and the other sciences.

For college I went to New York University and for graduate school to Harvard. I also spent two years abroad during my graduate studies – one at Zurich and one in Paris.'

You wrote your Ph D thesis, on Riemann surfaces, under Lars V. Ahlfors.

What was it like to be a research student of a Fields Medal winner?

'The fact that Ahlfors was a Fields Medalist was certainly known to the graduate students, but it was not a big issue. Partly, I guess, because there were other brilliant mathematicians on the faculty, such as Zariski and Gleason – neither of whom ever won a Fields Medal – and partly, perhaps, because Ahlfors' field – one complex variable theory – was much less fashionable than some others, like Banach algebras, which Mackey worked on.'

When a friend of ours heard that you were to give a talk in Coimbra he asked *"Does he not work on minimal surfaces?"* It is probably not fair to associate your name just with minimal surfaces.

What other geometrical topics attracted your attention during your career?

'It is true that my best-known results have been on minimal surfaces, and also my book, *"A Survey of Minimal Surfaces"*, has associated me with the subject in many people's minds. Another area I have worked in is that of isoperimetric inequalities; a number of my results are given in the book of Burago and Zalgaller and a survey article I wrote for the Bulletin of the American Mathematical Society became a standard reference for certain parts of the subject; also an article on Bonnesen-style isoperimetric inequalities for the American Mathematical Monthly which received a Lester Ford award. My thesis work with Ahlfors was on geometric function theory and Riemann surfaces, which is a topic I have returned to over the years, especially in relation to differential geometry, as in the recent work I have done on the Schwarz-Pick-Ahlfors Lemma that I will be talking about at the meeting in Braga later this week. Finally, after spending a sabbatical year at MSRI in 1983-84 during a special year on ergodic theory I became interested in that subject; I proved a couple of theorems and had two Ph D students work on related questions. It also led me to a conjecture in Riemannian geometry which has received increasing attention.'

A few years back, 1995 to be precise, a translation of your book *"Poetry of the Universe – A mathematical exploration of the cosmos"* was published in Portugal.

Have you written other books on the popularisation of mathematics? Do you see it as a duty of the working mathematician to make his work accessible to the general public?

'I have written a number of survey articles, one of which became my book on minimal surfaces; they were directed at a broad range of mathematicians, but there were no other books on the popularization of mathematics. I do not see it as the duty of working mathematicians to write such books, and in fact it would be a big mistake for some of them to do it, because they can be making important contributions to mathematics and they may have neither the gift nor the interest in exposition. In each generation there have been mathematicians with the urge to do it, and some quite successfully. For example, in the nineteenth century, there was Clifford, who was the first to popularize Riemann's notion of curved space, and early in this century two books which influenced me greatly when I was a young teenager: *"Mathematics and the Imagination"* by Kasner and Newman and *"What is Mathematics?"* by Courant and Robbins. I do think it is important that somebody do it, but it is very difficult to do well and I do not recommend that anyone try who is not strongly motivated to do it.'

In *"Poetry of the Universe"* you quote David Hilbert, on hearing that a student had given up mathematics, as saying *"Well, he did not have enough imagination to be a mathematician."*

What do you think it takes to make a mathematician?

'I think that many people – including many mathematicians – have much too narrow and monolithic a notion of what constitutes mathematical ability. Some mathematicians, like Riemann and Thurston, have amazing geometrical vision and imagination. Their most important contributions may be new ways of looking at things and new directions to pursue. Others, such as Yau and Wiles, have enormous technical skills, and are able to solve problems and conjectures that nobody else can. Some are particularly good at computations, others at inventing ingenious arguments, some have encyclopedic knowledge of their areas, others read very little of earlier work but strike out in their own directions. The one quality I have never seen absent in a successful mathematician is the willingness to work hard.'

You are now at **MSRI**.

Could you give us some idea of the importance of that institution for American mathematics these days?

'MSRI serves many different functions. One of the most important is the large number of postdoctoral fellows who come each year. There are always at least six associated with each program and they have the opportunity at an early point in their career to meet many of the leading people in their subject, to learn of the newest results and the ideas that are being pursued. Conversely, the more established people in the field get to know some of the best newcomers, and they get time to work on problems, both old and new. Often new collaborations develop.

There are also workshops associated with each of the programs where much larger numbers of mathematicians can come for shorter periods and have intensive exposure and interaction around some particular aspect of the subject.

Besides the regular programs there are a number of visitors each year who have the opportunity to do research in whatever direction. I am not sure how typical my own experience was, where I became involved in a program that I initially had no connection with and continued working in that area for a while.

Under Thurston's leadership, MSRI has also moved in other directions, toward contact with high school teachers, and public events, such as the very successful "Fermat Fest" after Wiles' proof was announced, and the subsequent videotape that sold several thousand copies (and is still selling). We are currently involved in experimental efforts to make MSRI much more widely available using the latest advances in computer technology, including the "MBone" and other even newer methods. We have been encouraging lecturers to give us their notes and transparencies to put up on our web pages, and that has become one of the most frequently visited parts of our website, available to everyone. Also, our electronic distribution of preprints has reached large numbers of people.'

Professor José Vicente Gonçalves

José Martins Vicente Gonçalves was born on 26th August 1896 in the city of Funchal. The insularity of his environment had already moulded his character, when, in 1913, he moved to Coimbra, attracted by the beauty and rigour of Mathematics and the tradition and fame of the University of the Mondego. Four years later, he graduated in Mathematical Sciences with brilliant marks, and was immediately contracted as 2nd Assistant for a group working in Mechanics and Astronomy.

The scientific career of Vicente Gonçalves, which was the name by which he became known in the academic world, began to take shape in 1919, when he was transferred to the group of Analysis and Geometry. In 1921, he did his Doctorate, presenting a thesis entitled *Sobre Quatro Proposições Fundamentais da Teoria das Funções Inteiras* (Coimbra, Imprensa da Universidade, 1921). Although he was only 25 at the time, his dissertation contained not only original results, but also new demonstrations of familiar propositions.

His progression throughout the academic career was swift, due to his uncontested merit: in 1922, he was promoted to 1st Assistant, and five years later had achieved the grade of Full Professor, presenting a dissertation entitled *Teoria Geral da Integração Riemanniana* (Coimbra, Imprensa da Universidade, 1926). He continued to teach at the Faculty of Science, University of Coimbra, until 1942, and during all this time, his lessons were noted for their brilliance, rigour and elegance.

Then, in 1942, he moved to the capital, and the Faculty of Science, University of Lisbon, was privileged to have him on their staff. His competence was well-known, and consequently, the Instituto Superior de Ciências Económicas e Financeiras of the Lisbon Technical University sought his collaboration in 1947. He lectured there for thirteen years.

The level and style of his lectures and course material were not always easy for students to absorb, since they were naturally required to study the material meticulously and in depth. Gonçalves was as demanding with his students as he was with himself, and consequently, was affectionately dubbed 'the wild animal' in the university world. Nevertheless, he was greatly respected by everyone.

When he reached the age limit in 1966, Vicente Gonçalves retired from the Faculty of Science at Lisbon after a career spanning almost half a century. He left a vast and varied corpus of scientific work: ten or so books, and almost a hundred articles. Having developed an interest in secondary education early on (perceiving it as the basis of future knowledge), he also wrote five coursebooks for use at that level, published by Livraria Cruz in Braga: -*Compêndio de Álgebra*, Part 1, for the 3rd Class, 1935; -*Aritmética Prática e Álgebra*, 1st, 2nd and 3rd Years (1st cycle), 1937; -*Compêndio de Álgebra e Geometria*, 4th, 5th and 6th Years (2nd cycle), 1937; -*Compêndio de Álgebra*, 7th Year (3rd cycle), 1937; -*Compêndio de Aritmética*, 7th Year (3rd cycle), 1939.

Within the area of university teaching, the textbooks written by him were noted for their rigour and organisation. His *Lições de Cálculo e Geometria* (Vol.1)

(Coimbra, Imprensa da Universidade, 1930) were written with great care, as was the *Curso de Álgebra Superior* (Coimbra, Atlântida Editora, 1933), which was re-published on a number of occasions, each time with updates and additions.

His *Curso de Álgebra Superior* was an exceptional work, an authentic treaty of algebra and analysis, compared to similar published works in Portugal and abroad. He therefore moulded generations of students, inculcating them with contemporary mathematical rigour. His writing style was precise and elegant, and he appreciated economy of language, a feature that was difficult to encounter in the textbooks available in Portugal at the time.

His research activities are well documented in the articles he published in scientific journals and selected works, and in conference proceedings. Much of his work is to be found in the section *Historiae ac Pedagogiae de Minutis* of the *Revista da Faculdade de Ciências de Lisboa* (2$^{\text{nd}}$ Series), which he founded in 1950 and edited until his retirement. These focus principally upon themes three areas of Mathematics: Analysis, Algebra and History. His scientific output in the areas of Analysis and Algebra was very creative, and he introduced simplifications of demonstrations of familiar propositions, improving results or achieving original results. Also, within the area of History of Mathematics, he displayed an exceptional talent for astute analysis, and contributed towards a better understanding of the work of some of the great Portuguese mathematicians. His first published work, 'Análise do Livro VIII dos Principios Mathematicos de José Anastácio da Cunha' (Congresso do Mundo Português, 1940, Vol.I) is noteworthy. In this essay, which is perhaps the best-known of his historical works, Vicente Gonçalves proved that, in 1790, Anastácio da Cunha correctly defined the convergence of a numerical sequence, something that was only presented much later by the renowned Cauchy (born 1789) in his *Cours d'Analyse de l'École Polytechnique* (1821).

He wrote many other works of a historical nature, even after retirement. Most is published in the *Boletim* and *Memórias* of the Academia das Ciências de Lisboa, for which he was elected *sócio correspondente* in 1941 and *sócio efectivo* in 1945.

Vicente Gonçalves clearly was both a brilliant teacher and a prolific and determined researcher. He introduced the results of his research into his lessons, and his research was always regulated by his obvious desire to improve the quality of teaching, making it more profound and more stimulating.

His death on 2$^{\text{nd}}$ August 1985 did not extinguish his reputation. He left behind an important legacy of scientific and pedagogical work, and the image of a competent and honest teacher will remain in the memory of those who had the privilege to be taught by him, or to have made his acquaintance.

The centenary of his birth was commemorated on 4$^{\text{th}}$ December 1996 by former students, assistants and colleagues. The ceremony took place in the Department of Mathematics, University of Coimbra, in the room that bears the name of José Anastácio da Cunha, the Portuguese mathematician whom Vicente Gonçalves helped to raise to prominence. All contributions were of excellent standard, and displayed respect and admiration for the man and his work.

I myself had the honour of being a disciple and assistant of Vicente Gonçalves during his period at the Instituto Superior de Ciências Económicas e Financeiras. Thus I can personally vouch that José Vicente Gonçalves had a profound impact upon the scientific community, both as a mathematician and as a man, and left his mark not only upon generations of students, but also upon his closest collaborators.

Fernando de Jesus
Professor catedrático aposentado, Instituto Superior de Economia

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