Introduction: A few words about Mauricio M. Peixoto on his 80^{th} birthday

J. Sotomayor*

April 15, 2001

Mauricio Matos Peixoto, born April 15, 1921, in Fortaleza, Ceará, studied at Escola Nacional de Engenharia, Universidade do Brasil, Rio de Janeiro, graduating as Civil Engineer in 1943. His interest in Mathematics consolidated there, but started at Pedro II School, a traditional High School in Rio de Janeiro, where he received his secondary education.

After his graduation as Engineer, he taught Calculus and Rational Mechanics at Escola Nacional de Engenharia. There he wrote his papers on Convexity and its relation with Second Order Differential Equations and Inequalities[1].

Based at the Department of Rational Mechanics, where he started as Assistant Professor, Mauricio led Seminars on Mathematical Analysis and Differential Equations, starting his research on Structural Stability, which later gave him deserved international recognition and notoriety.

It was during this first period of Mauricio's inspiring mathematical leadership that he, together with Marilia Chaves Peixoto (1921-1961), first a classmate and colleague and later his wife and collaborator, directed the mathematical studies of Djairo G. de Figueiredo (1934-), Mario Henrique Simonsen (1935-1998) and Lindolpho de Carvalho Dias (1930–). All of whom

*Instituto de Matemática e Estatística, Univ. de São Paulo, http://www.ime.usp/~sotp

[1]See http://www.ime.usp/~sotp/peixoto.html for the complete list of his publications and C.V.

became well– known personalities in Brazil and abroad for their outstanding contributions to Mathematics, Economics and Administration.

It should be added that seminars for the purpose of advanced mathematical studies and research were not commonplace in Engineering schools in Brazil at that time. Marilia and Mauricio were among the pioneers in these activities, which consolidated at the Gabinete de Mecânica Racional, founded at Escola Nacional de Engenharia due to their endeavor, after Mauricio became Professor of Rational Mechanics in 1953.

The first contact of Mauricio with a mathematical center of international level occured in 1949, when he visited the University of Chicago and stayed there for one year and six months.

In 1953 together with his former classmate Leopoldo Nachbin (1922-1993) then the best known brazilian mathematician, Mauricio helped to found the Instituto de Matemática Pura e Aplicada (IMPA), to which he has been affiliated thereafter. The support of the Brazilian astronomer and mathematician Lelio Gamma, first Director of IMPA, was essential in this step.

In 1957-58 he visited the University of Princeton. There he met Solomon Lefschetz (1884-1972), with whom he kept close friendship thereafter. It had been through the reading of Lefschetz presentation of Structural Stability that he made his first encounter with this fruitful notion in Brazil. Mauricio also met Stephen Smale (1929-) who visited IMPA for six months in 1960. There Smale completed his famous proof of the Generalized Poincaré Conjecture and began his no less famous work on Dynamical Systems.

In 1962 he organized the Seminar on the Qualitative Theory of Differential Equations at IMPA, with the participation of beginning graduate students. His well known work "Structural Stability on two–dimensional manifolds" and other papers of his and Marilia were presented there by the participants. The activities at Mauricio's Seminar are among the first efforts performed in Brazil towards the systematic training of young researchers in Mathematics. The conclusion, in July 1964, of works prepared under his advice and Smale's above mentioned visit are regarded by Mauricio as "the starting point to establish IMPA as a research institution of international level[2]".

From this time comes the now widespread concept of Kupka–Smale Dynamical Systems and the starting point of the study Generic Bifurcations of Dynamical Systems on manifolds.

[2]page 2 of his Curriculum Vitae

It is true that Mauricio and his students, Ivan Kupka and the author, had "the shoulders of giants" to stand on: there was the Theory of Transversality founded by René Thom (1923–) and applied by Smale to Dynamical Systems. There was also the pioneer work of Pontrjagin, Andronov, Leontovich and the Russian Gorki School on Structural Stability, Oscillation Theory and Bifurcations. It is true also that the Russian bibliography was inaccessible in full form from the West, least to say from Brazil at that time.

In his essay "Uma lista de problemas de E.D.O[3]" ("A list of O.D.E. problems"), the author has written about this period of Mauricio's activity as a teacher. There he has attempted to record the effect that Mauricio's lecture "Open Problems on O.D.E.", delivered in October 1962, had on the direction of the future mathematical work of the participants of the Seminar.

The essay also includes a discussion of the mathematical ideas involved in the evolution from the work of the Russian pioneers to that of Peixoto's Brazilian School of Differential Equations and Dynamical Systems.

During his long career, Mauricio has been appointed Professor of Mathematics at Brown University, Providence, RI, USA, (1964–1968), and at the Mathematics Department, University of São Paulo, (1973–1978).

For his contribution to Dynamical Systems he has been awarded following distinctions: Moinho Santista Prize for Mathematics, São Paulo 1969, and the Third World Academy of Science Prize for Mathematics, Beijing 1987.

He has been President of the following Societies and Institutions: Brazilian Mathematical Society (1975–1977), Brazilian Research Council–CNPq (1979–1980) and the Brazilian Academy of Sciences (1981–1991). In 1996 he was nominated for the National Council of Science and Technology of Brazil.

On April 1991, he retired from IMPA, where he continued his mathematical work as Emeritus Researcher.

Since the beginning of his career, Mauricio has kept a keen interest on boundary value problems of second order differential equations, his first published paper is in this direction. In 1982 Mauricio introduced in this context the concept of "focal decomposition" (initially called sigma–decomposition). In 1986-1987 he and René Thom published three notes on the "Comptes Rendues" about this subject.

Focal decomposition is nowadays his main domain of research where he has found deep unexpected connections with Differential Geometry, the

[3]Revista de Matemática e Estatística da UNESP, São Paulo , **18**, 2000, posted in the above home page

Arithmetic of quadratic forms, the semi-classical quantization via the Feynman path integral, the Brillouin zones of Solid State Physics.

Of his paper "Sigma décomposition et arithméthique de quelques formes quadratiques définies positives", René Thom writes:

"Mauricio M. Peixoto has thrown into relief the long experience that he has drawn from his research on differential systems (and their structural stability) in order to concern himself with a very specific object. He proposes a synthesis of great depth concerning an Euclidian structure that is capable of receiving a physical interpretation (the "Brillouin zones") and an origin drawn from the analysis of Differential Systems - the concept of sigma decomposition, which he produced. It is by a systematic use of Diophantine analysis bearing on quadratic equations that he has succeeded in achieving this synthesis, the richness and depth of which can only be admired."

In Mauricio's C.V. one also finds spontaneous comments on his work on Dynamical Systems by several authors including S. Lefschetz, S. Smale, R. Thom.

One could inquire how from the modest and rough formal mathematical training of engineers offered in Brazil at his time, Mauricio developed the geometric vision, penetration, sophistication and esthetic touch that is the mark of his mathematical work. The fact is that he belongs to the generation of self–taught Brazilian scientists –the leaders–, a class of talented special spirits, living ahead of their time, who themselves defined their training, opening their own paths and pointing to new directions.

May the Lord grant Mauricio many more years producing beautiful mathematics, for the inspiration of the generations to come.

Photo 1: Graduation, Pedro II High School, 1936

Photo 2: Marilia(left bottom corner) and Mauricio (center, bottom row) with some participants of the First Brazilian Mathematics Colloquium, 1957 Photo rescued from an original with borders damaged by time

Photo 3: P. Seibert, A.P. Stokes and Mauricio with Lefschetz, Baltimore, 1959

Photo 4: Lindolpho Dias, Mauricio, J. Sotomayor, Leopoldo Nachbin and Alcilea Augusto (all facing camera, upper row) with research fellows, students and staff members at the entrance of IMPA, 1962

Photo 5: with Thom, Berkeley, 1990

Photo 6: with J. Sotomayor, M. Teixeira and C. Gutierrez at a meeting in Campinas, 2000.