Preface

My entire scientific life, from 1958 on (when I was 30 years old), has been devoted to modeling the fluid flow problem governed by Navier–Stokes–Fourier (NSF) equations (see Chap. 4). Every beginner in fluid dynamics will become aware of such models such as the inviscid flow over an airflow or a laminar boundary layer. The advanced researcher will be familiar with a large number of such models, derived heuristically from NSF equations.

A very large number of works have been published on constructing and using various models, and I have devoted all my scientific activity from 1970 to 2012 in a search towards unifying all of these contributions in a scientific discipline of itself. This rational asymptotic modeling (RAM) underlines "rational" (as opposed to ad hoc) and "asymptotics" for emphasizing the two main concepts in this approach. Let me specify that turbulence—a large class of motions with complex, irregular, and rather unpredictable features—is beyond the scope of this RAM approach. However, in the 1980s, with Guiraud, two short *notes* on asymptotic rational modeling of turbulent flow were published (Zeytounian and Guiraud [1] and Guiraud and Zeytounian [2]); see also the paper by Deriat and Guiraud [3] in a different context.

The RAM approach actually resulted from a quite long struggle both with specific fluid dynamics problems as well as with my personal life, especially from age 19 to 38, first in Soviet Armenia and then in Moscow. My Armenian period of almost 10 years led me to acquire in Yerevan the basic university education as a pure "mathematician." The second period, again almost 10 years, spent in Moscow up to 2 September 1966, as a "Soviet research worker," made me familiar with the mathematical physics of partial differential equations and gave me a good background on fluid dynamics meteorology while I was working for a Russian Ph.D. under the supervision of Ilia Afanasevich Kibel, one of the leading Soviet scientists in the field of theoretical hydrodynamics of his time, who is mainly famous as the founder of a hydrodynamic method of weather forecasting and for implementing mathematical methods in meteorology (see, also, our paper of 2004 [4], at the occasion of the 100th birthday of I. A. Kibel).

Before engaging in the subject of the present scientific autobiography, let me provide you with a short biosketch: Paris from birth to age 19—suddenly, in early September of 1947, under very special circumstances, I find myself in Soviet Armenia, to spend the next 19 years there and in Moscow. Before that time my education was very basic, only having obtained the first elementary certificate in 1941, followed by 2 years as a student at a lycée. Having returned to Paris in September of 1966, I eventually managed to be granted a French *Doctorat d' État ès Sciences Physiques* from the University of Paris, at the age 41, in 1969.

With this scientific autobiography, I intend to guide the reader through a rather untraditional career, pointing out along the way how I first encountered fluid mechanics to then devote further 55 years to intensely working to reach a deeper understanding of that scientific matter.

I intend to convince the reader that there is an amazing way to get an overall view of the very large variety of fluid flow models. More than that, I want to show that gathering these models in a particular way for specific flow situations is a first step in organizing a numerical simulation, then applying the RAM approach as a necessary implement before moving on to a numerical simulation by means of high-speed computers.

My quite deep and particular interest for theoretical fluid dynamics has guided all of my scientific activities. In Chaps. 1–3, I elaborate on my long journey to reach a better understanding of the way particularly to solve stiff fluid flow problems and my discovery of the RAM approach.

Chapter 1, "Ten Years in Armenia," is a narration of how I learned the basic mathematical physics tools for my later research. A special argument that I am making is in my disagreement with the commonly held notion that early teaching is decisive for future life as a researcher. In this chapter I also tell about the special influence of my supervisor at Yerevan State University, Serguei Mergelyan, who directed my university mini-thesis.

Chapter 2, "The Moscow Period with I. A. Kibel," is a narration of my own growing involvement with fluid mechanics research in the context of dynamical meteorology and my Kandidat thesis (1961, Russian Ph.D.) on local unsteady atmospheric circulations and also my approach to lee waves above and downstream of a mountain from 1960 to 1966. It is strongly inspired by my deep gratitude and respect for my mentor and research supervisor, Ilia Afanasevich Kibel, who I consider to have been the undeniable leader in dynamical meteorology in the Soviet Union from the beginning of the 1940s to the end of the 1960s. This chapter also sketches a highly risky rupture: my fruitful first steps as a (Soviet!) researcher and my return to France on 2 September 1966, with my family, Natalia and Christine!

Chapter 3 is devoted to the essential part of my French scientific career: the time at the Météorologie Nationale in Paris (1966–1967), then at ONERA (1967–1972), and at the University of Lille-I (1972–1996), my collaboration with Jean-Pierre Guiraud from 1970 to 1986 playing a decisive role in the steady development of the RAM approach—associated with this, my seven books published by Springer, Heidelberg, from 1974 to 1994, which all arose out of my teaching at the University of Lille-I.

Chapter 4 is an elaboration of the Navier–Stokes–Fourier equations and the RAM approach. Here, I sketch the historic developments of the relevant aspects in Newtonian fluid mechanics inspired by asymptotics during the period considered and refer to our research within that context discussing various aspects of the RAM approach.

In the *Retrospective Summary*, I first show the advantage of the RAM approach in finding new solutions for certain classical fluid flow phenomena and give comments on how RAM can assist numericians engaged in computational simulations of complex problems of engineering interest with the help of high-speed computers. RAM is the ultimate approach for solving fluid dynamics problems with the help of high-speed computers.

Particularly, I wish to thank Jean-Pierre Guiraud, who has provided stimulation and encouragement, who read most of Chaps. 1–3 and made many useful suggestions and who also kindly proposed to draw up the above Foreword.

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