# CHAPTER 5

# THE DAWN OF A NEW CENTURY: FROM CHANIA TO PATRAS AND THEN TO CHALKIDA

## 1. The 13th School at Chania and the 14th School at Patras

And that is how the 20th century ended and the 21st one began, with new hopes and dreams for us as well as the rest of mankind. This time, our voyage was going to stop for the first time at the port of Chania, on the northwestern coast of the beautiful and world – famous island of Crete!

Our colleagues at the Technical University of Crete (TUC), who undertook the organization of our 13th Summer School are Mathematicians, belonged at that time to the so – called "General Department" of TUC, whose main aim was to provide students of the other Schools with instruction on such fundamental disciplines as Mathematics, Physics, Chemistry, Biology and Geology, necessary for students of TUC to complete their undergraduate education. In fact, such "General Departments" were present in all other Greek Technical Universities, but no longer exist, since they were abolished by the Ministry of Education in 2016, and their faculty members were absorbed by the other Schools.

In the year 2000, however, it was such colleagues from the "General Department" of TUC who took the initiative to organize our 13th Summer School on "Nonlinear Dynamics: Chaos and Complexity", 17 – 28 of July, 2000. The head of the organizing committee was Demosthenes Ellinas, now Professor at the Department of Electrical Engineering of TUC, aided by his mathematician colleagues Yannis Saridakis, Elena Papadopoulou and Ioakim Gryspollakis. They were joined by George Tsironis and Stavros Farantos, then assistant professors of Physics and Chemistry respectively at the University of Crete in Heraklion.

**Figure 24.** Two views of the picturesque port of the city of Chania.

The educational activities of the 13th stop of our journey were held at the main building of the "French School" of Chania, built at the turn of the 20th Century, as a school for girls belonging to the most prominent families of the city (see Figure 25). It is situated two kilometers to the east of the port of Chania, and its original purpose was the instruction of young ladies of the social elite in the French language, which was the main foreign language of the Greek intelligentsia at that time.

The School was later donated to the TUC to serve as a place where activities such as lectures and conferences could be held. Since 2017, it has become a museum of folklore, history and technology. It was wonderful for the lectures of our Summer School, and had several nice hotels nearby where the elders would reside, but what about the young sailors?

**Figure 25.** The 'French School" building at Chania, where the 13th Summer School was held.

Fortunately, our colleagues at the Technical University solved the problem. Our younger participants would be accommodated at comfortable student housing facilities located at the Kounoupidiana site of the TUC, some 3 – 4 kilometers further to the east of the French School. As long they could wake up on time there would be mini-buses of TUC to transport them to the French School!

This was the second time our journey stopped at Crete since the 5th Summer School at Heraklion in 1992. In 2000, the 13th Summer School had come of age and its title acquired an extra name, that of a "Conference". The elders decided that this new characterization was necessary to account for the great number of distinguished foreign scientists, who would henceforth come to lecture in most of our future Summer Schools.

Before I recall here some of these scientists and their presentations at Chania in 2000, I need to mention one more special feature of our 13th School – Conference: It was held in memoriam of the 10 years that had passed since the loss of one of the first senior captains of our journey: Stephanos Pnevmatikos (see Chapter 2). Ten years had passed since the tragic event that had shaken us all, and yet our travels had continued, with Stephanos still inspiring us all through the presence of his students and colleagues from all over the world, who came to speak about new developments in the fields of nonlinearity and disorder that he had pioneered.

One of the most prominent "descendants" and promoters of the work of Stephanos in Greece was George Tsironis, then already professor at the Physics Department of the University of Crete, and recipient of the 1997 "Stephanos Pnevmatikos Award", given every two years to outstanding nonlinear scientists by the Research Center of Crete, since the passing of Stephanos in 1990.

George gave a lecture at the 13th School entitled “Nonlinearity and Disorder in Solid State Physics: The Legacy of Stephanos Penvmatikos”. Next to him stood a number of other great mathematical physicists from other countries who were working on closely related topics: There was Alex Zolotaryuk from Kiev University who spoke on “Collective Proton Transport in Hydrogen-Bonded Systems” - another direction that Stephanos had worked on - and Serge Aubry from Saclay, France, who talked on “Latest Developments in Discrete Breathers”, also an area related to nonlinear solid state physics.

As was already well – known at that time, in parallel with developments in nonlinear dynamics and chaos theory, representing the complex and unpredictable evolution of natural phenomena, another highly exciting direction in applied mathematics was gaining in popularity and continues to thrive to this day. It involves the so – called “integrable systems”, which describe the evolution of a class of physical phenomena characterized by orderly and predictable behavior. Perhaps the most exciting such phenomenon is the discovery of “solitons”, or solitary waves which travel in time “intact”, without changing their shape or velocity even under mutual interactions, and are often encountered in nature.

In 2000, at Chania, we were fortunate to have with us one of the greatest names in the field of integrable systems and soliton theory, Professor Thanassis Fokas (Figure 26), then at Imperial College and today at the Chair of Nonlinear Science of Cambridge University. Thanassis had just been awarded the Naylor Prize of the London Mathematical Society, the first non-Englishman recipient in the award’s history, and had come to Chania to speak about the topic that had made him famous: “A generalized approach to the solution of boundary value problems”.

**Figure 26.** Professor Thanassis Fokas, University of Cambridge (Naylor Prize, 2000), Member of the Academy of Athens.

To help our young sailors avoid drowning in the mathematical waves of integrable systems, I had given on the previous day an introductory lecture on solitons and the theory of Inverse Scattering. Thus, everyone was more or less prepared to understand the fundamental concepts of phenomena that are on the antipodal point of chaos and complexity. Then, Thanassis surprised us all by emphasizing, at the beginning of his talk, the contribution of Stephanos Pnevmatikos in acquainting physicists with the importance of soliton theory in many areas of applied science.

Of course, our favorite elder sailors were also present: George Contopoulos lectured on fundamental signatures of chaos in conservative systems, John Hadjidemetriou and Simos Ichtiaroglou on Hamiltonian systems and stability of periodic orbits, John Nicolis on stochastic resonance and cognitive processes, Spyros Pnevmatikos (then at the University of Patras) on fundamental

mathematical concepts of nonlinear systems, the main organizer of the School Demosthenes Ellinas on "What will be a quantum computer?" and Spyros Evangelou on quantum chaos, quantum localization and quantum computation (you see how ahead of the times our Schools were?) and others.

Beyond the mathematical theory of fractals and the applications of solitons in nonlinear dynamics (Ch. Vassilikos from Cambridge on "Turbulence in a Fractal's Wake" and Panos Kevrekidis from University of Massachusetts at Amherst on "Solitary wave propagation in crystals") we started entering seriously in the realm of biological and biomedical processes. Astero Provata (Research Center "Demokritos" in Athens) spoke about "the statistical dynamics of DNA sequences", while Frank Starmer (Duke University, USA ) lectured on "the nonlinear dynamics of excitable cells".

Next, we moved on to cardiac dynamics, as Anastasios Bezerianos and his collaborators at the University of Patras explained how nonlinear models can be used to describe cardiac electrical activity. Professor George Kostopoulos of the University of Patras presented "indications of nonlinear neural functioning in the brain", introducing us to the field of brain dynamics about which we shall have a lot more to say later in this journey.

And as if all this were not enough, a number of young researchers presented results on the nonlinear analysis of chaotic time series (Dimitris Kugiumtzis and George Papaioannou), applications of nonlinear time series analysis to the Athens Stock Market (Aris Karytinos), and the dynamics of macroeconomic quantities in Economics (George Zombanakis, Andreas Andreou). What more could the young sailors wish? The wonderful world of nonlinear phenomena and the beginning of understanding complex real-life systems lay before them, full of promises for exciting new discoveries in the years ahead.

We had just entered the new century with great expectations and were already witnessing the dawn of an era of deeper understanding of the meaning of Education.

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In 2001, July 23 – August 3, the 14$^{th}$ School brought us once again to the friendly shores of Northern Peloponnese and our familiar "cradle" at the University of Patras, where our voyage had begun in 1987, and where we often stopped to regroup and gather new strength. This time, the occasion was marked by an incredibly sad event, the untimely passing of a great friend and protagonist in so many of our Schools: Hronis Polymilis, assistant professor of Physics at the University of Athens (see Figure 27).

In his eulogy, Professor Contopoulos spoke with very warm words, attributing high praise to his former student. Hronis had obtained his Ph.D. on chaotic Hamiltonian systems under the supervision of Contopoulos in 1985 and had distinguished himself ever since as a researcher and teacher, guiding the doctoral work of many young students in their group. He was one of the "older" sailors, more by wisdom than age, patiently explaining in plain terms the secrets of nonlinear dynamics to our youths, at so many of stops of our journey. As the reader will recall, he was the inspirer and of one of the main masterminds of our 11$^{th}$ School at Livadia (see Chapter 4). As with Odysseus' travels, every adventure has its casualties, and Hronis was one of the most painful ones. He will always be remembered for his devotion to Nonlinear Science, but most of all his humor, his kindness, and his passion for life.

It was for all these reasons that we decided to dedicate to the memory of Hronis, the 8th volume of the series "Order and Chaos", containing many of the lectures of the 14th School and published this time under the expert and professional care of K. Sfakianaki, Thessaloniki, Greece, 2002.

**Figure 27.** Hronis Polymilis (1947 – 2000), assistant professor, University of Athens.

As has become clear from our adventures so far, every year there is a central theme of current interest to which many sessions of the School are devoted. In 2001, at Patras, this topic was Neuroscience, more precisely the application of nonlinear dynamics to brain electromagnetic activity. At the 14th Summer School, we were fortunate to have as one of the main lecturers on this topic, Professor Walter Freeman, M.D., Department of Molecular and Cell Biology, University of California at Berkeley, distinguished scientist and author of many articles and books on brain dynamics (see Figure 28). His lectures were entitled "Bridging the Gap Between Microscopic Neurons and Macroscopic Brain with Mesoscopic Nonlinear Neurodynamics" and "New Developments in the Analysis of Spatial Patterns in Human Electroencephalograms (EEG)".

Professor Freeman, who passed away in 2016 at the age of 89, is considered one of the founders of the field of computational neuroscience, which uses mathematics and computers to understand brain dynamics from the point of view of neural networks. He published nearly 500 research articles in his lifetime, in addition to popular books, such as "Societies of Brains: A Study in the Neuroscience of Love and Hate" (1995) and "How Brains Make Up Their Minds" (2001), in which he made the fields of brain dynamics and chaos understandable by the wider public.

Besides Walter Freeman, we were very fortunate at the 14th School of Patras to have among the lecturers, several other foreign scientists teaching us about the connections of brain dynamics and Nonlinear Science: Frank Hoppensteadt was with us, professor at that time at the University of Arizona, a distinguished mathematician focusing on biomathematics and dynamical systems, who gave three lectures on "Mathematical Neuroscience", "Modeling Networks of Neurons" and "Working With Chaos and Random Noise".

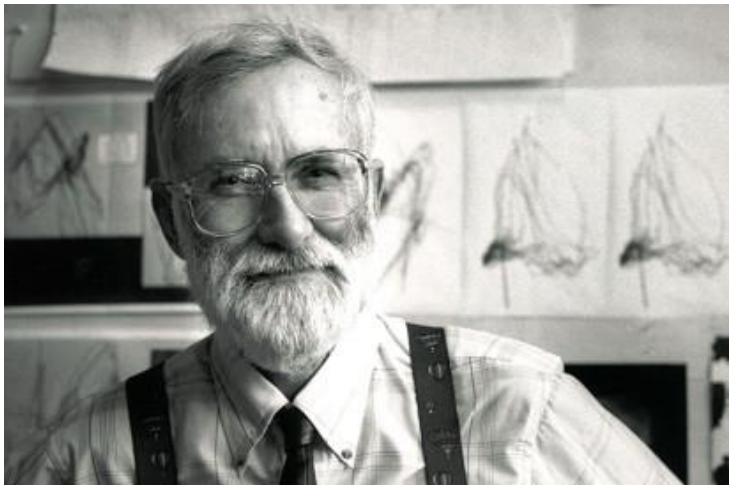

**Figure 28.** Walter Freeman (1927 – 2016), Professor, University of California at Berkeley, world renowned neurophysiologist and philosopher.

Hoppensteadt was followed by Leonidas Iasemidis, professor of Arizona State University, who lectured on "Prediction of Epileptic Seizures and Resetting of the Epileptic Brain", explaining how Magneto-encephalogram (MEG) measurements reveal a sharp decrease of chaotic brain activity minutes before an epileptic seizure occurs, suggesting that the patient could thus receive pre – seizure warnings early enough to take precautionary measures.

Then, there was Professor George Kostopoulos from the University of Patras, who gave lectures on "The Role of Dynamics in the Function of Brain Cells", while Professor Erik Mosekilde from the Technical University of Denmark gave a series of talks on the theory of synchronization of coupled chaotic oscillators and its applications to insulin – glucose feedback regulation, nephron pressure and blood flow regulation.

And as if all this were not enough, Professor Thanassis Fokas from Cambridge University came again to our shores and spoke this time about "Mathematical Aspects of Brain Imaging ", while A. Bezerianos of the University of Patras lectured on **"**Information Measures in Brain Dynamics"!

Thinking about all this today, I cannot believe how lucky we all were, "elders" and youths combined! Who could have imagined that what we just heard at the 2001 Summer School of Patras regarding biomedicine, brain functioning and their connections to nonlinear dynamics and chaos would soon become one of the most central scientific issues and fundamental applications of Complexity Science in the decades of 2010, 2020 and beyond!

There were, of course, many other important talks on a wide variety of theoretical and applied aspects of Nonlinear Science, given by speakers familiar to us from earler Schools: Professor Contopoulos spoke about work he had done with Hronis Polymilis on "Star Escapes in Galactic Dynamics", Loukas Vlachos from Thessaloniki lectured on the "Interaction of Electromagnetic Waves with Plasma" (work in collaboration with H. Polymilis and K. Hitzanidis), Professor Anastassios Tsonis, from the University of Milwaukee (known to us also from the Xanthi adventures) discussed the impact of nonlinear dynamics on atmospheric sciences, while Professor Giorgio Turchetti from the University of Bologna described his work on "nonlinear mapping models of accelerator dynamics".

John Hadjidemetriou from Thessaloniki analyzed Poincaré map applications in non-conservative systems, Simos Ichtiaroglou spoke on integrability in Hamiltonian dynamics, Stavros Farantos,

professor of the University of Crete at Heraklion, compared "saddle dynamics" phenomena in chemistry, biology and physics, and Michael Vrahatis, professor at the University of Patras, described applications of numerical analysis to dynamical systems. Last but not least, a fascinating lecture was given by Kostas Eftaxias, Professor of Physics at the University of Athens, who showed that measurements of electrical activity near epicenters of major earthquakes exhibit similar dynamical characteristics, hours before the earthquake, suggesting that this could be used as an early warning signal to alert the public.

As with all of our Patras stops, we didn't neglect in 2001 the entertainment and cultural aspects of our Summer Schools: On Sunday, July 29, we went on an excursion to the beautiful "Kourouta" beach 60 km to the west of Patras, on Tuesday, July 31, we attended a performance of Aristophanes' play "Lysistrata", at the Ancient Odeion theater of Patras, and enjoyed on Wednesday evening, August 1, a fantastic Greek dinner at the garden of the "Park of Peace" restaurant of the University of Patras (see also Chapter 4).

By anyone's standards, the 14th School at Patras was a great success. The new century had brought favorable winds to our sails. We were full of hopes and dreams for the future. However, we decided not to hurry. Perhaps, it was a good time to stay a little longer at "Circe's island" to review where we stood and what were our goals, before we planned to sail to new ports in the years ahead.

## 2. The 15th School at Patras and the 16th at Chalkida

Well, as common wisdom tells us, after you have scored a big success in your endeavors, why not try to repeat it? After all, Odysseus and his crew prolonged their stay at Circe's island. Why should we not try to follow their example and stay one more year in Patras to organize our 15th School at its shores?

We were aware, of course, that history does not repeat itself. The funding that was available in 2001 would not be at our disposal again in 2002. Government agencies are not keen to support similar events two years in a row. This meant that we would not be able this time to invite many speakers from foreign scientists telling us about their great new discoveries, as was the case in 2001.

So, what of it? Perhaps it was a good time to regroup our forces and find out from our Greek colleagues, "elders" and youths, where we stood in the worldwide advance of Nonlinear Dynamics, Chaos and Complexity? Well, as it turned out we were not far behind! After 14 Summer Schools, we had made considerable progress.

Moreover, we had one important advantage in the summer of 2002: The University of Patras had just built and begun to operate its impressive Conference and Cultural Center (shown in Figure 12, Chapter 4), which was to house many of our Schools in the years ahead. In fact, the place where we held the most important of our related inaugural, cultural and closing activities was the Small Auditorium of the Center shown here in Figure 29.

**Figure 29:** The Small Auditorium of the Cultural and Conference Center of Patras, where some of our Summer School activities were held after 2002.

Of course, our finances were never sufficient to host all of the lectures in the Small Auditorium, for the full 10 - day duration of our Schools. We, therefore, had to be content with smaller rooms, on the first floor of the Center, which were still quite convenient and comfortable. In Figures 30 and 31 below, we see pictures from the 15th School showing the lecture hall, the outside corridor, and other neighboring rooms for discussions overlooking the Gulf of Patras.

**Figure 30:** A scene from the lecture room on the first floor of the Conference and Cultural Center of the University of Patras, during one of the presentations of the 15th School.

**Figure 31:** Above: The Secretarial Desk of the School at the corridor outside the lecture halls of the 15th School. Below: Discussions went on during the intermission in nearby rooms with a view of the Gulf of Patras.

To appreciate the thematic links we pursued in our voyage at the start of the new century, let me give a brief account of the topics covered and the lectures given by the Greek professors and researchers who attended our 15th School at Patras, 19 – 30 of August, 2002.

I will start with one of the more classical topics of nonlinear dynamics, the evolution of nonlinear waves in physical media. As we have mentioned already, these arise in different forms and in a wide variety of applications. Perhaps the most famous of all are the so – called solitary waves, which move practically unaltered in one or more spatial dimensions and interact with each other in fascinating ways.

They are frequently called *solitons* (see Figure 32, left), but this is somewhat abusive, as the term "soliton" was coined for integrable (mathematically solvable) systems, where these waves enjoy two rather unrealistic properties: They retain their initial shape and speed at all times and interact with each other "elastically", i.e. they remain entirely unaffected by their "collisions". The remarkable

discovery of the last three decades of the 20th century was that "soliton" behavior was discovered in a great variety of physical systems, whose description deviates significantly from being integrable or mathematically solvable!

Another important discovery of the late 1980's was that there exist *localized periodic solutions* in discrete media, such as atomic lattices, which do not travel, but oscillate forever, trapped within very limited domains, in a way that impedes energy propagation along the lattice! These are the so- called *breathers* (see Figure 32, right). They were first found and studied mathematically in integrable systems, but are much more ubiquitous in realistic nonintegrable physical media, with an impressive range of applications.

On the topic of solitons, we learned a lot from the lectures of Dimitris Frantzeskakis, then assistant professor at the University of Athens, on "Solitons in Bose – Einstein Condensates", Theodora Ioannidou, then Lecturer at the University of Kent, on "Bogomolny Yang-Mills-Higgs Solutions in 2+1 anti-de Sitter Space", professor Kyriakos Hizanidis of the Technical University of Athens, on " Nonlinear Phenomena in Magnetohydrodynamic Plasma: A Methodology for Developing the Study of Optical Solitons and Nonlinear Optics".

Regarding breathers, Vassilios Koukoulogiannis, today assistant professor at the University of the Aegean, lectured on the "Existence of Breathers και Multibreathers in a System of Coupled Hamiltonian Oscillators". I also gave a talk about the research of my group at Patras on "Localized Oscillations and Waves in Nonlinear Continuous and Discrete Media" and led an hour's discussion on "breathers, Solitons and Integrable Wave Equations". Finally, an interesting presentation was given by my colleague, professor of the University of Patras, Michael Vrahatis, on "New Numerical Methods for Solving Systems of Nonlinear Equations".

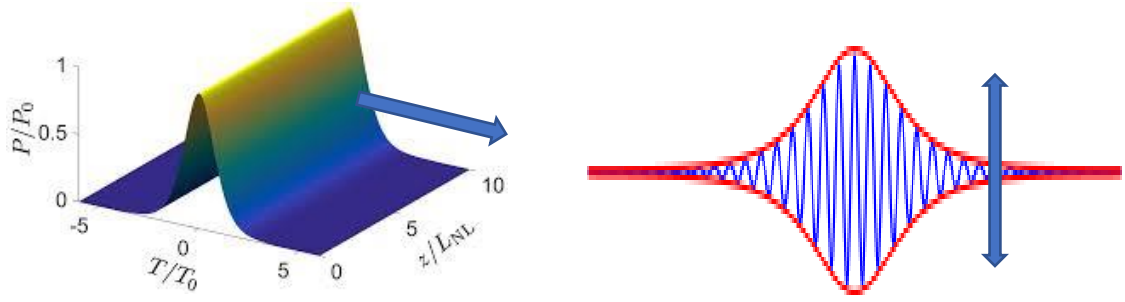


**Figure 32:** A soliton (left) traveling unchanged to the right along the $T/T_0$ axis on a continuous nmedium, and a breather (right) on a discrete medium whose particles oscillate periodically up and down, in the vertical direction.

But there was much more to learn and discuss at the 15th School, beyond solitons, breathers and their applications. First of all, we had with us again Professor Thanassis Fokas, then already at Cambridge University, presenting the continuaton of his studies on the mathematical analysis of brain imaging in his talk "On a Long Standing Open Inverse Problem: The Attenuated Radon Transform" (see Figure 33).

**Figure 33:** Professor Thanassis Fokas lecturing at the 15th Summer School of Patras in August 2003.

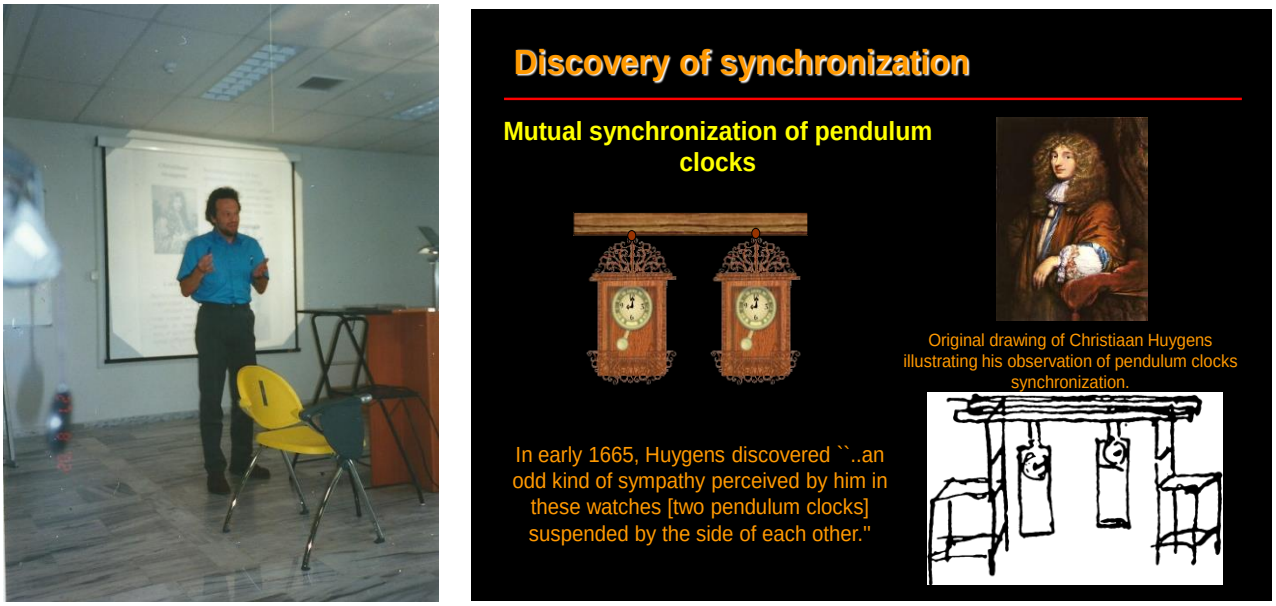


**Figure 34:** (Left) Professor Michael Rosenblum lecturing on synchronization. (Right) The two – pendulum experiment by which C. Huygens demonstrated the phenomenon of synchronization in 1665.

The topic of *synchronization* was already emerging as a very important phenomenon in physical as well as biological applications. In 2002, we were very fortunate to have with us in Patras a famous scientist from the University of Potsdam, Germany, Michael Rosenblum, whose group was already colalborating with Anastasios Bezerianos at the University of Patras Medical School. Michael gave a very instructive review on this topic, entitled "Synchronization: From Pendulum Clocks to Chaotic Oscillators and Data Analysis" (see Figure 34). Following his talk, Yannis Kyprianidis, then assistant

professor of the University of Thessaloniki, spoke on a related subject in his talk entitled "Nonlinear Electrical Circuits: Dynamics and Chaotic Synchronization".

On different biological topics, we learned a lot from the talks of Anna Korol, researcher of the University of Argentina, on "Deterministic Chaos in Dyslipidemic Erythrocytes Deformation" and our well known professor of the University of Patras, Yannis Nicolis, on "The Role of Noise in Cerebral Cognitive Dynamics: A Syndrome of Self – Organized Criticality?" Then we turned to the application of statistical methods, especially time series analysis to Biology, where assistant professor of the University of Thessaloniki Dimitris Kugiumtzis lectured on "Static and Dynamic Analysis of DNA Series Using Statistical Methods", while young researchers from the University of Athens Stavros Nikolopoulos and Panagiotis Katsaloulis spoke, respectively, on "Experimental Evaluation of Time Series Obtained From Electrocardiograms of Long Duration" and "Statistical Analysis of the Distribution of Oligonucleotides in the Genetic Material of Higher Organisms".

The subject of nonlinear time series analysis, where one tries to differentiate between randomness and deterministic chaos to improve prediction, had already become the center of very intensive investigations worldwide. After listening to Dimitris Kugiumtzis give an excellent introduction entitled "The Methodology of Time Series Analysis", we heard the very interesting presentations by Theodore Karakasidis on "Time Series Analysis in Molecular Dynamics of a Lenard-Jones Material in the Solid and Fluid Phase", and Aris Karytinos, now general manager in the National Bank of Greece, on "Chaos and Complexity in the Financial Markets: Application to the London and Athens Stock Exchange".

Finally, Alexandros Vakakis, now professor at the University of Illinois in Urbana, lectured on "Passive Attractors of Energy in Systems of Coupled Oscillators: Analytical and Experimental Results", Stavros Farantos of the University of Crete spoke on "Metachemistry: The Modern View of Chemistry", while Kostas Eftaxias of the University of Athens presented his fascinating "Study of Pre – Seismic Electromagnetic Disturbances Using Phase Transition Concepts".

What more could the young sailors ask for? Here were Greeks bearing gifts! Ah yes, of course, I forgot, to mention that on Sunday, August 25, we enjoyed one of our most popular activities appreciated by "elders" and youths alike: a day excursion to the beach!

And thus, ended one more Summer School filled with exciting scientific news in the fields of Nonlinear Science and Complexity. At our $14^{th}$ and $15^{th}$ stops at Patras we had accumulated a vast amount of information and made sure that Greek participation in these fields, on an international level was alive and well.

Perhaps it was time now to return to the other most important goal of our journey, the discovery of the meaning of education. What had we all really learned so far from our adventures? This is what we would venture to find out in our next School at the beautiful city of Chalkida!

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To appreciate the $16^{th}$ Summer School at Chalkida, one must first understand the lifetime contribution to European education by Spyros Pnevmatikos, Stephanos' older brother (see Chapters

2 and 3). Part of this contribution took the form of an Erasmus Network of 30 universities 1990 – 2000, already mentioned in Chapter 4. During the years of 1994 – 1996, while still an associate professor of Mathematics at the University of Crete, Spyros had been close advisor to George Papandreou, then Minister of Education of Greece. As one of the "elders" on our travels in search of the meaning of education, he had a great idea.

He proposed to George Papandreou that one of the abandoned buildings at a wide open area of 1200 acres at the western part of Athens (known then as "Queen's Castle" and today named after Antonis Tritsis, former Minister of the Environment) be turned in to a "House of Education and Science". Spyros' idea was that, with the help of university colleagues and many of his friends in Middle Education, a wide variety of exhibits could be constructed on separate tables, each of which would reveal to the visitor a fundamental principle of mathematics or a basic law of physics.

**Figure 35:** Professor of Mathematics, Spyros Pnevmatikos, conceived, formulated and led the construction of the "House of Education and Science" in Athens in 1996 and the "Patras House of Science" in 2009. Both of them are still in operation today.

This would be an interactive, or "hands on" experience. In other words, the visitor of the "House of Education and Science" would not be a spectator. He or she would not be told the answer to each riddle but would have to search for it alone. Spyros did not have to invent everything himself. He was already aware of similar exhibitions in "Museums of Science" in other European cities. His novel idea, however, was that the Greek "House of Education and Science" would not be a museum. The visitors would not be "spectators" but "participants"!

And guess what he wanted from me: Since several of the exhibits would involve mathematical and physical concepts related to chaos, fractals and complexity science, would I be willing to help him with their construction? How could I refuse? We had already been "on the voyage" together through so many of our Summer Schools and certainly had collected many ideas…

Spyros' plan was officially approved and in the spring of 1996 the work was completed and the "House of Education and Science" was inaugurated by George Papandreou himself! At some point during the guided tour, Spyros called me and introduced me to the Minister and his wife: "Mr. and Mrs. Papandreou, here is the man who brought chaos to Greece, Tassos Bountis!" "Oh, really", replied the Minister, "and I thought this was the work of the Greek Conservative Party!"

The Athens “House of Education and Science” was a great success for a while but was severely damaged during the Athens 1999 earthquake. By the end of the 1990’s, however, Spyros had come to the University of Patras as associate professor of Mathematics and was working with me to establish a similar “House of Science” at his new hometown. It took us several years of searching and planning to find the right “cradle” that would host our dream.

By 2004, Spyros had managed to convince a wealthy sponsor, originally from Patras, to donate funds for building and maintaining such a “House” at one of the available city buildings. After some unsuccessful attempts to reach an agreement with the local authorities, in 2006 land was finally granted to us by the “Arsakeiα - Tositseia” Schools of Middle Education, one of which had, in fact, relocated from inside the city to a large expanse of land a few kilometers outside Patras! It was on its premises that in the following years our “Patras House of Science” would be finally built, as we had envisaged it: a monument devoted to the meaning of education.

It was a formidable task. Spyros overlooked all aspects of its construction and advised the architects and engineers where to place the exhibitions of Mathematics, Physics and Informatics, which rooms would be used for teaching and studying, where and how to build an amphitheater sitting an audience of 120, even where to set up a cafeteria with tables and chairs overlooking the Gulf and the spectacular bridge of Patras a few kilometers away (see Figure 36)!

**Figure 36:** The Patras House of Science with a view of the majestic bridge in the background, joining the villages of Rion, on the coast of Peloponnese, and Antirion, on the coast of mainland Greece seen in the distance.

Those were great times of excitement and creativity. I helped Spyros as he envisioned, designed, and constructed every exhibit of Mathematics, Physics and Informatics, from its inception to its realization on a separate table, as a puzzle, an enigma to be unraveled by the visitor. I contributed as much as I could, especially about the exhibits related to nonlinear science, chaos, and complexity, but he was the mastermind behind this amazing feat.

We had, of course, invaluable help from a great number of graduate students and young researchers, who took active part in the realization of our dream. They were meticulously instructed on all details of the exhibits, and some of them, in fact, became the “animateurs”, who later guided the visitors in search of the truths hidden at every table. Their faith in us, their dedication and, above all, their hard

work and selfless contribution were indispensable for the realization of our dream. It took us a few years to complete it, but by its inauguration in 2009, the "Patras House of Science" was ready to receive its first "customers".

**Figure 37:** Scenes from the 1st European Ph.D. School on "Mathematical Modeling of Complex Systems", one of our first major international events, held at the "Patras House of Science" in the summer of 2011 (see Chapter 11). Above: Learning about Foucault's pendulum inside the main building. Below: A group of participants of the 2011 event at the entrance of the main building.

In Figure 37, the reader can get an idea of the "Patras House of Science" from photos taken during an educational activity - to which we will return in Chapter 10 - entitled 1st European Ph.D. School on "Mathematical Modeling of Complex Systems" held in the Summer of 2011. Among the many interesting scientific exhibits inside the building, perhaps the most popular one was Foucault's pendulum, hanging from a high ceiling, around which we often gathered to explain to students how it demonstrated unequivocally that the earth is turning around itself (see top of Figure 37).

Back in 2003, however, Spyros and I were fighting a different battle. We were trying to convince the mayors of different Greek cities to provide us with space where we could set up some of the exhibits that we had salvaged from the ill – fated House of Education and Science of Athens. One of those who responded positively was the mayor of the city of Chalkida, the beautiful seaside capital of a large island – like region of Central Greece called Evia.

**Figure 38:** Front (left) and back (right) view of "The Red House" of Chalkida, a municipal building devoted to arts, culture and science, hosted in July 2003 the activities of our 15th Summer School, together with a number of exhibits brought over from the "House of Education and Science" of Athens.

And so, the adventure began: First, a number of representative exhibits from the Athens House of Education and Science (that had survived the 1999 earthquake) had to be transported to the Red House of Chalkida (see Figure 38). Thanks to the brave efforts of colleagues from Middle Education like Dionysis Vavougios, Giorgos Fakiolakis (who had already worked at HES), these exhibits were placed at two rooms near the entrance, where they could be accessible to visitors independent of the Summer School activities taking place in the basement.

Dionysis and Giorgos spent part of their time explaining the exhibits to the visiting public, while, during intermissions, they also guided School participants around the tables, attempting to discover connections with what was being discussed below, under the title "Nonlinear Dynamics: Chaos and Complexity, 14 – 24 of July, 2003".

We were especially fortunate to have with us that year, besides the "usual suspects" that presented the basic theoretical background at all stops of our journey, several distinguished newcomers from outstanding international institutions. There was the famous mathematician (also poet, historian and political analyst**)** Nikos Lygeros, from The Mathematics Department of the University of Lyon, who gave a pedagogical "Introduction to Complex Random Networks", Professor Alexander Vakakis, then at the University of Athens and later at University of Urbana-Champaign, Illinois, USA, lecturing on "Modeling Nonlinear Effects in Structural Dynamics", and Peter Leach, Professor at University of Kwazulu Natal, South Africa, speaking on "Integrability of Ordinary Differential Equations and Applications to Epidemiology and Mathematical Biology", who was in fact to join us at several future Schools.

But it was not only the lectures of the main speakers that we were all trying desperately to understand at the basement of the Red House. There was also an abundance of posters with an equally advanced

variety of titles and topics presented by the more mature of the young sailors: “Molecular Dynamics Methods Under Noise Perturbation of the Thermostat” (J. Andreadis and Th. Karakasidis), “Dynamics of Asteroids in the Edgeworth-Kuiper Zone” (G. Vougiatzis), “Invariant Spaces and Low Order Models of Nonlinear Dynamical Systems in Elastodynamics” (Ch. Kanavis and J. Georgiou), “Block Entropy Analysis of Long Recorded Electrocardiograms” (K. Karamanos and S. Nikolopoulos), “Nonlinear Mathematics in Economics and Finance” (A. Portokalakis), “Chaotic Scattering and Applications” (S. Rafailidou) and so many others!

Spyros Pnevmatikos, by then professor at the Department of Mathematics at the University of Patras gave a very educational lecture on a topic of his specialty entitled “Fundamental Problems of Geometrical Mechanics”. He was succeeded by two colleagues who had helped him considerably in developing and setting up many of the educational exhibits of the Athens and Patras Centers of Education and Science: Giorgos Fakiolakis, who described the educational approach of these Centers and Dionysis Vavougios who presented an analysis of the famous tidal phenomenon of the Evian Gulf, clearly visible every 6 hours at Chalkida, a few hundred meters away from the Red House!

Among the lectures of young sailors who were already “coming of age” at our Summer Schools and spoke at Chalkida, I mention Efi Meletlidou from Thessaloniki on “Integrability of Dynamical Systems”, Vassilis Drakopoulos from Athens on “Nonlinear Dynamics of Complex Mappings”, Theodora Ioannidou from the University of Kent on “Solitons in Problems of Advanced Physics”, Christos Efthymiopoulos from Athens on “Singularity Analysis of Differential Equations”, Dimitris Kugiumtzis from Thessaloniki on “Introduction to Chaotic Time Series Analysis”, George Papaioannou from Athens on “Applications of Complexity Science to Business Administration” and Yannis Kontogiannis “Criticality and Intermittency in Pre-seismic Electromagnetic Waves”.

Like most other of our Summer Schools, funding of our 16$^{th}$ stop at Chalkida was also scarce. The small amounts we could scrape from the Ministry of Civilization, and the Secretariat of Young Generation of the Ministry of Education, was used to cover the hotel expenses of our invited speakers. Our low budget registration fees contributed largely by the young sailors were used to buy provisions necessary for the coffee breaks and the sandwiches and soft drinks offered at lunch time.

But the youths were not to be deprived of a “Gala Dinner”, which had become by that time a ceremonial event at the end of every Summer School. A Chalkida Fund Drive was launched and contributions from young and old sailors were collected that were sufficient to order nearly 30 pizzas, 100 “souvlaki” rolls and 50 beers from nearby restaurants. Blankets were stretched out over the green lawn in front of the Red House (see Figure 37 left) and no sound was heard from 10 o’clock to midnight. Then guitars, harmonicas, flute and drums were readily produced. Music and singing, performed with great enthusiasm (and little regard for artistic excellence) filled the night air.

It was a wonderful experience of chaotic laughter and dynamic conversation, until exactly 3:00 in the morning. Then, as the science of Complexity often dictates, the unpredictable happened. I have often since thought how it must have looked to an unsuspecting late night passer-by: All of a sudden, some fifty individuals jumped up and started running in circles all over the lawn of the Red House, waving strange objects in their hands and shouting as if in some psychotherapeutic dance session!

Had this passer-by been more curious to see what happened, he would have realized that, according to the rules of the municipality of Chalkida, at precisely 3: 00 a.m. every night, the sprinklers of the Red House were automatically switched on to fulfil their role of keeping green the front yard of the place we were so fortunate to enjoy during the ten days of our 16$^{th}$ Summer School.

# CHAPTER 6

# THE OLYMPIC YEAR 2004: AN INTERNATIONAL CONFERENCE AND THE 17TH SUMMER SCHOOL

## 1. An "Olympic" event in Patras dedicated to Complexity

As everyone knows, the Olympic Games, ever since they were revived in 1896 A.D., take place every four years, just as it was when they first began in 776 B.C., at a site in northwestern Peloponnese, where a magnificent temple of Zeus was situated. These games were athletic events in honor of Zeus, lasting two weeks, and involving athletes from many Greek cities that vowed to stop all their wars during the duration of the games. As Zeus was the king of the 12 ancient Greek gods living on Mount Olympus, these events were called Olympic games.

2004 was a very important year for Greece: First of all, we won the 2004 UEFA European Football Championship, which took place in Portugal, from June 12 to July 4. Secondly, Greece organized the 28th Olympic games, 13 – 29 August, at Athens. Well, we may not have enjoyed an equally worldwide acclaim, but in between these two events, we organized at Patras and Olympia, July 11 – 25 of that year our 17th Summer School as a joint activity with an International Conference, appropriately called "Complexity in Science and Society" (see Figure 39).

In hindsight, it was an "Olympic" task. I cannot recall how many Ministries, Mayors, Prefects and private organizations we had to appeal for funding, in addition to what the University of Patras and the Mayor of the Town of Olympia were able to offer. Each contribution was small, but in the end the total amount was sufficient to guarantee a respectable Summer School – Conference with speakers from many European countries, USA, Mexico, Brazil, Israel even Japan! Naturally, we could not pay travel tickets, but even local expenses at respectable hotels in Patras and later in Olympia, for nearly two weeks, were not negligible to cover!

The benefits for our young sailors were invaluable: There were one and two – hour introductory lectures each day from 9:00 – 1:30, which resumed after an afternoon break, 5:30 – 8:00. The language, even for our Greek speakers, was English, which did not seem to bother any of our youths. Each day 1:30 – 2:00 and 8:00 – 8:30 were allocated to posters and the best 3 were given awards at the end of the event. It would take much space to recall all major lectures, but I would like indicatively to mention a few:

We started with Itamar Procaccia from Weizmann Institute lecturing on "Drag Reduction by Polymers in Turbulent Flows: A Complex Problem and its Resolution", followed by Leon Iasemidis and Kostas Tsakalis (University of Arizona) on "Complex Dynamics of Epileptic Phenomena: Prediction and Control of Epileptic Seizures", Sergej Flach (Max Planck Institute for Complex Systems at Dresden) on "Nonlinearity and Discreteness plus Localized Excitations: Computational Studies of Discrete Breathers" and Rudolph Dvorak (University of Vienna) on "The Role of Resonances in Planetary Systems".


**Figure 39:** The poster of the 17th Summer School – Conference at Patras and Olympia, 2004.

We then heard lectures from Constantino Tsallis (Center of Physics Research, Rio de Janeiro) on "Nonextensive Statistical Mechanics: Introduction and Dynamical Foundations", Yannis Kevrekidis (Princeton University) on "Equation – Free Complex Systems Modeling", Thanassis Fokas (University of Cambridge) on "From Tschebycheff Polynomials to Functional Brain Imaging: A Riemann-Hilbert and Dbar Approach", Theo Geisel (Max Planck Institute, Göttingen) on "Nonlinear Dynamics in Neuroscience".

For the second week, we moved to at a hotel in the town of Olympia, where the Summer School – Conference continued with lectures by Giulio Casati (Universita Insubria, Como) on "Classical and Quantum Fidelity Decay and Correlation Functions in Dynamical Systems", Massimo Vergassola (then at CNRS, Institut Pasteur, Paris) on "Modular Control of Gene Regulation", Peter Tass (Jülich Institute of Neuroscience and Medicine) on "Novel Deep Brain Stimulation Using Techniques from Nonlinear Dynamics", Gregory Chaitin (IBM Research Center, Yorktown Heights) on "Is the Universe Intelligible?" and "Against Real Numbers", Felix Izrailev (University of Puebla, Mexico) on "Increase of Entropy in Quantum Systems With Complex Dynamics: Quantum-Classical Correspondence" and Manuel Velarde (Complutense University, Madrid) on "Complex Phenomena at Interfaces and/or Driven by Interfaces".

There were also many lectures by Greek scientists, notably "older sailors" like John Nicolis (Patras) lecturing on "Superselection Rules – Instrumental in Reducing Complexity", John Hadjidemetriou (Thessaloniki) on "Chaotic Motion of Small Bodies in the Solar System: Is the Earth in Danger?", and George Contopoulos (Athens) on "Attractors in Conservative Dynamical Systems", and the

"middle aged" ones like Kyriakos Hizanidis (NTUA, Athens): on "Complex Problems in Nonlinear Optics", Simos Ichtiaroglou (Thessaloniki) on "Non-Integrability in Hamiltonian Mechanics", Stavros Farantos (Heraclion) on Nonlinear Dynamics in "Bond – Breaking and Bond-Forming in Triatomic Molecules", Michael Vrahatis (Patras) on "Topological Degree: Computation and Complexity" and George Tsironis (Heraclion) on "Intrinsic Localization at the Micro -scopic Scale: Theories in the Light of Recent Experiments".

Then there was the new generation of young starts all of whom today have high positions in academic and research institutions worldwide: Yannis Kominis (NTU, Athens) spoke on "Solitary Wave Interactions with Continuous Waves", Dimitris Kugiumtzis (Thessaloniki) on "Statistical Analysis of Oscillating Time Series and Long Term Dynamics", Vassilis Koukouloyannis (now at Samos) on "Existence and Stability of Discrete Breathers in a Triangular lattice", George Magoulas (London) on "Learning Processes in Neural Networks: a Nonextensive Statistical Mechanics Approach", Ioannis Kourakis (now at Abu Dabhi) on "Theory of Nonlinear Excitations in Dusty Plasma Crystals" and Vassilios Basios (Brussels) on "Self-organization Phenomena and Collective Motion in Crystallization of Protein Colloids and Crystals in Colloid Plasmas: Why Microgravity Matters".

The younger sailors were listening and waiting for their turn. At least there were the poster sessions where some of them were already making their first stage appearance. In fact, many of them had the chance to feature with all other participants in the photo of the 17$^{th}$ Summer School – Conference shown in Figure 40.

**Figure 40:** The Olympic Conference photo showing most of the "older" and "younger" participants in front of the Patras Cultural and Conference Center.

For the everyday sessions we used the Small Auditorium of the Cultural and Conference Center of Patras (see Figures 29, 40), but when the time came for the cultural evening of the event we used the Large Auditorium of the Center, occupying about one third of its full capacity of 1000 seats (see Figure 42).

**Figure 41:** Professor Fokas delivering his lecture on Functional Brain Imaging.

On the evening of Saturday July 17, all our participants and their guests were first treated to a rather unusual conference cultural event, performed 8:00 – 9:00 p.m., at the Large Auditorium by the male choir of the Church of Pantanassa, named after Giorgios Triantis, a very important composer of Patras origin, http://malechoir.gr/. The choir sang in its distinct 4 – voice European style two religious songs, a hymn by Triantis and "Glory of God" composed by Beethoven.

**Figure 42:** The cultural event of the program consisted of traditional songs of the Patras region, well-known international ballads as well as ecclesiastical hymns by the Patras 4 – voice male Church Choir of Patras "Georgios Triantis", performing here in the church of Pantanassa.

At the beginning, the audience was quiet and listened politely and respectfully. Then, as the choir turned to more popular songs by Mikis Theodorakis and Greek traditional ballads, some became livelier and started to rhythmically applaud. Then, the choir surprised everyone with some internationally known songs like the "Kossack Dance" (or Katyusha") by Rubashkin, and the applause became louder, while some participants even joined in the singing!

Of course, the evening was not over. Everyone migrated slowly towards the "Park of Peace", ten minutes walking distance, where the tables of the conference dinner were already set in the open air. What the participants did not know was that the choir had also been invited to the dinner! In fact, some of its members had been instructed to bring along their guitars and thus the singing continued past midnight. At some point, we had to insist that our participants return to their hotels and get some rest. The following day had more surprises for them in store…

**Figure 43:** Photo of some of the Thessaloniki participants, enjoying themselves during the Conference dinner at the "Park of Peace".

## 2. A Sunday trip and the Conference experience at Olympia

The Conference excursion on Sunday July 18, the free day of the event, began with a visit to the Achaia Clauss Wineries at the top of a hill, overlooking Patras, about 8 km from the city (see Figure 44 left). The wineries are in operation to this day and produce many varieties of excellent wine, that was once offered to kings, and famous personalities in many countries around the world. They are located near a castle built by the first owner of the wineries, the German entrepreneur Gustav Clauss, in the 1860's, next to 60 sloping acres of grape producing fields.

So, starting at 10:00 a.m. and after a 20' ride on a comfortably big tourist bus, our Conference and Summer School participants were treated to an hour - long site seeing tour of the castle grounds, complete with wine tasting from a selection of vintages, which included, of course, the famous 6 – year old *Mavrodafni* sweet wine. Our visitors were particularly impressed by the "Mavrodafni cellar", where barrels of the celebrated wine are stored dating back to 1872 (see Figure 44 right). There, our guide explained the fascinating process of periodically pouring some of the wine of each year into the barrel of the year before to avoid sugar solidification.

**Figure 44:** (Left) View of the Achaia Clauss castle housing the wineries that operate to this day. (Right) The cellar where the famous Mavrodafi wine is stored in barrels that date back to 1872!

There is an interesting story connected with the naming of this wine: As the legend goes, Gustav Clauss was engaged to a local girl called Dafni, with beautiful dark eyes, who unfortunately died at a young, age and in honor of whom the wine was called Mavrodafni. Another famous white wine, still produced at this location since 1881, is called *Demesticha*, named after a nearby mountain village, whose inhabitants helped Clauss with the cultivation of his vineyards.

By 12 noon everyone was ready for a swim! Well, it so happens that about an hour's drive from Patras is a 16 km long sandy beach, with enough attractions to please our participants called Kourouta beach (see Figure 45). So, after we jumped on our bus, owned by our friendly expert driver Mr. Kostas, we arrived at a long stretch of sand, where everyone could swim in clear blue waters, walk for miles, find shelter under thatched umbrellas and get lunch at nearby restaurants.

As usual, some participants had brought beach balls, others carried wooden rackets for beach tennis and some laid on their beach mats under the umbrellas and asked to be awakened half an hour before departure time. Everyone's main concern was to make the day as complexity free as possible. Only those who formed networks of volley-ball players could be scale free, or Erdös-Renyi, but with equal probabilities between all nodes.

**Figure 45:** Images of Kourouta beach, located on the western side Peloponnese nearly 50 km west of Patras, right across from the island of Zakynthos.

And all that happened in the first week of the event.

On the second week of our Conference and 17th Summer School it was time to get out of Patras and give everyone a chance to visit the place everyone was talking about those days: The holy grounds of "Altis" and the site where the actual Olympic Games of Ancient Greece were held.

So, in the morning of Monday, July 21, our friendly bus driver took most of our guests on a two hour trip to the village of Olympia, a short walk from Ancient Olympia, and left us at the door of a nice hotel called "Olympic Village", which was going to be our "home" for the next few days (see Figure 46).


**Figure 46:** Views of the "Olympic Village" hotel, which hosted the activities (educational and otherwise) of the second week of our Conference and 17th Summer School.

As far as recreation goes, our new hotel was fine: There were nice open spaces with swimming pools and restaurants, as well as pathways through orange groves to find peace and quiet. The lecture room, however, left a lot to be desired. First of all, we had to bring our screens, projectors and sound equipment from Patras, place them at the end of a large hall, and ask the personnel to set up before them 20 - 30 semi-circular rows of tables and chairs in close proximity so as to maximize the ability of the audience to see the slides!

Well, that was not so bad. The real visibility problem we had to solve was caused by the bright Greek sunlight flowing in the room through a row of large windows on one side of the hall, which were all made of transparent glass! Fortunately, I had already thought of a solution when I first visited the hotel a few weeks before the Conference. I had asked the owners to find rolls of dark colored paper, which would be wide and long enough to cover most of the windows of the lecture hall. Now was the time to put them up! Indeed, after gathering enough members of the hotel's employees and

equipping them with enough strong tape, the windows were duly covered and the lectures of the next morning were ready to start!

Thus, our Conference and Summer School activities were over in the evening of Saturday, July 25, with handing out the Awards for Best Posters and Short Presentations to a few of our young participants. Finally, we all joined in a final dinner at a nearby open restaurant, with Greek music and a variety of lamb and other meats cooked on large barbecue hearths and cut in generous portions on big wooden boards in front of our wide-eyed foreign guests.

We cannot end, however, our account of our "Olympian" experience without mentioning our guided tour on Sunday July 25 to the archeological site of "Altis", the temples of Zeus and Hera, the stadion where the ancient games were held and our visit to the Archeological Museum of Olympia. Led by an experienced lady guide, we walked fist through the locations where the athletes trained for 2 weeks before the games, like the "Palestra" of Figure 47 (left), where one would find the wrestlers).

Then we walked past small structures where kings and other wealthy distinguished participants would store the treasures they brought to Olympia as gifts to Zeus ore Hera, partly to entice their support for their athletes, like "Philippeion", shown in Figure 47 (right), housing donations of Philip B' and Alexander the Great from the kingdom of Macedonia.

**Figure 47:** Left, the "Palestra" where athletes trained in wrestling. Right: The "Philippeion" built by Philip B' father of Alexander the Great, containing treasures donated by the Macedonians, who took part in the games.

We then walked past the temples of Zeus and Hera (see Figure 48). It was in the middle of the Zeus temple that the renowned sculptor Phidias created in the 5th century B.C. a colossal gold and ivory statue of Zeus, in the spirit of his famous statue of Athena on the top of Parthenon in Athens.

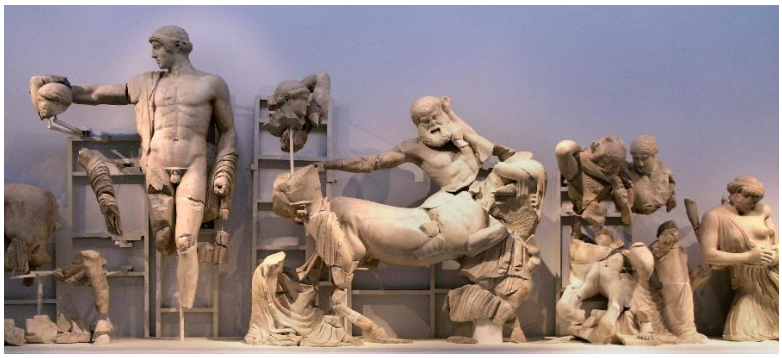
Continuing our walk through the ruins we reached eventually the famous Stadion, where the games were held every four years since 776 B.C. (see Figure 49 left). Its name derives from the Greek word "stadion" (called "stadium" in Roman times) meaning a straight length distance of nearly 185 meters. This is where all the races took place, especially the most important one having to do with running.

**Figure 48:** Left, the temple of Zeus. Right: The temple dedicated to Zeus' wife Hera.

Figure 49 (Left) shows an image of the Stadion where the ancient Olympic games were held. In the lower left of the figure we see the corridor through which the athlete made their entrance. The spectators were sitting on the left and right sides of the field. In the middle of the right side, a spot has been marked to indicate where the "Hellanodikes", or judges of the outcomes of the races, were sitting. In Figure 49 (Right), we see a reenactment of a running race by some of the participants. More specifically, Professor Felix Izrailev is looking in desperation as I am running past him on my way to the finish line.

**Figure 49:** Left, the Stadion where the Olympic games were held in ancient times. Right: Some of the Conference – Summer School participants reenacting the race of speed running on location, during our visit to the archeological site.

Our tour ended spectacularly around with our visit to the remarkable Archeological Museum, where many of the celebrated statues found at the site are exhibited (see Figure 50, upper row). Among the most famous of them are those on the two *pediments* of the eastern and Western sides of the building depicting, respectively, the chariot race between Pelops and Oenomaus, and the battle of the centaurs stealing the women of the Lapiths (see Figure 50, lower row, left). On the other hand, the two *metopes* of the northern and southern sides of the Temple of Zeus depict the twelve labours of Heracles (see Figure 50, lower row, right).



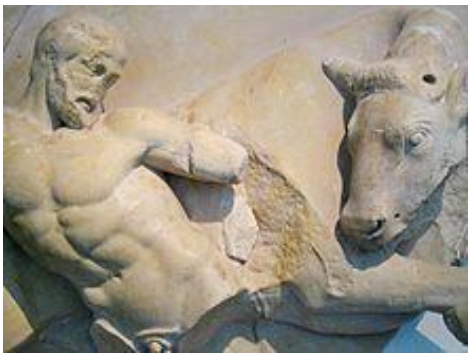


**Figure 50:** Upper row, left: one of the rooms of the wonderful Archeological Museum of Olympia. Right: The famous statue of Hermes the "messenger" God of Olympus standing alone in one of the rooms of the Museum. Lower row, left: Part of the western pediment of the Temple of Zeus. Right: Hercules fighting against the Cretan bull on one of the metopes of the temple.

After our visit to the archeological site, we went for another swim to a nearby beach and returned for our last evening at the "Olympia Village" hotel. On the morning of the next day, Monday July 26, our bus took everyone back to Patras for the official closing ceremony of our 2004 Conference – 17$^{th}$ Summer School experience.

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Closing this chapter, however, about our "Olympian" Conference – Summer School, we must not forget that its title did not refer only to "Complexity in Science", but also to "Complexity in Society". How was it that we were faithful to this part of the title?

First, it is important to recall that on Thursday, July 15, there was a one-and-a-half-hour session on

"Challenges, Innovation and New Technologies in the Development of European Countries", a presentation by Greek policy makers working in the EU, organized by the Center for Research and

Applications of Nonlinear Systems and the Laboratory of Automation and Robotics of the University of Patras.

What really demonstrated, however, the importance of Complexity in addressing Society was a series of lectures during the Conference that focused on important topics of social significance. Among them, it is important to recall the ones given on Tuesday, July 20 by Professor Mukul Majumdar (Cornell University, USA) on "Optimization and Chaos in Economics" and Hideki Takayasu (Keio University and SONY CSL, Tokyo) on "Physics of Markets: From Dealer Models to the Hyper-Inflation Theory".

On Thursday July 22 we heard Misako Takayasu (Tokyo Institute of Technology) on "Phase Transition of Internet Traffic and a New Control Strategy", and another talk by H. Takayasu on "An Econophysics Model of Power Law Distributions of Cash Flows of Companies", while Krzystov Urbanowicz (Max Planck Institute for Complex Systems, Dresden) spoke on "Noise Level Estimation for Stock Market Data: Application to the Investment Portfolio Optimization". Finally Ioannis Katerellos (Panteio University, Athens) lectured on "Chaos and Order in Social Systems: Entropy and Group Formatting" and Alexandros Gulielmos (Professor of Piraeus University) spoke on "How Can Complexity Theory Help Shipowners Understand Cycles in a Second Hand Ship Tanker Market and Predict Future Prices"!

Our young sailors had to admit that Complexity and Nonlinear Dynamics were encompassing not only problems of the physical and biomedical sciences but were also offering solutions to urgent questions of relevance to the social sciences as well.

As a testimony to the seriousness with which we were all taking these developments was the fact that many of the lectures of our "Olympian" event were published in two volumes of the "International Journal of Bifurcation and Chaos": Vol. 16, (issue 6), June 2006, and Vol. 16 (issue 7), July 2006.