

## ***Collaborations between the Iranian School of Mathematical Chemistry and the Late Professor Ante Graovac***

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Professor Ante Graovac who passed away in November 2012, was the secretary of the International Academy of Mathematical Chemistry. His activities span from applications to basic research in mathematical chemistry. Here, we would like to write about a person who was one of our mentors in mathematical chemistry, a scientist who was well known not only for his knowledge, but also for his humanity. Professor Ante Graovac was a hard-working, charming and cheerful Croatian chemist. He was born on 15 July 1945 in Split, where he finished his primary and grammar school. In 1970, he graduated in Physics in Zagreb. Specializing in theoretical chemistry, he passed the American University of Utah in 1973. Years between 1981 and 1983, Ante was a visiting professor at the Max-Planck Institute in Germany. He also was working at the Ruder Boskovic Institute from 1970 until 2010.

In the world Mathematical Year (WMY 2000), the Shahid Beheshti University at Tehran organized an inaugural meeting for the heads of mathematics departments of the country. In the end of meeting the representative of the Ministry of Culture and Higher Education (MCHE) announced that the country needs some experts in mathematical chemistry. I (ARA) participated in this meeting and decided to start working on the subject. The papers by Smeyers and his co-authors led me to choose Chemical Group Theory mostly in the topic of “symmetric groups of molecules” for the first attempt. The first work on the subject in the country was related to our first collaboration with Ante. Until then, we did not know anything about the annually conference of “MCC” holding at Dubrovnik, Croatia. When I realized that such a conference exists, I sent two joint papers with my colleague Masoud Hamadian to “MCC 2002”. Unfortunately, we could not get our visas

and sent an email to professor Ante to explain him what had happened. He apologized and told us that he was disappointed with the events and then added he would send the papers to the process of arbitration. The papers presented in the MCC conference were published at "Croatica Chemica Acta", probably the best chemistry journal of Croatia. Our papers were published in that journal and surprisingly, they were one of the first papers of the country in the field "Chemical Group Theory". In the mentioned paper, we had used the computer algebra system GAP in our works and chemists probably did not know about this software those days. That conference was the beginning of our relationship with Ante Graovac.

In 2003, I took a nine months sabbatical leave in Manchester. Unfortunately, the cost of going to Croatia from England was too much and so I did not attend the conference. I sent an email to Ante and apologized. Again, I did not participate in the next year conference. In 2005, I sent a joint paper with Moghani which was published in the same journal. In 2006, I and many other Iranians went to Croatia. Ante was very warm and friendly.

Years later, I and some of my colleagues participated in the conference annually till 2011. We always had very good times with Ante. In the last trip to Croatia for a conference, his sister brought a car and took us to see some parts of the Croatia.

Now, please let me tell you about one of my best memories of Ante, in the summit academy of mathematical chemistry in 2010, in Croatia. The procedure in this academy is in such a way that a member of the academy can invite a scientist who has valuable research works in mathematical chemistry to the academy. I was nominated by my great friend Ivan Gutman and Ali Iranmanesh by Ante. What is the most important factor to choose people as academicians, is their works and the activities done to improve the knowledge in the world and also in their country. I was invited to this academy in 2010. I remember very well Ivan Gutman and Ante Graovac on that day. Before election, Ante said me that, "please don't worry. We are all scientists and after all discussion our decision will be taken by vote". As I remember, in the morning Damir Vukičević knocked the door and waked me up. I had to be introduced to the other members of the academy. It was unbelievable, I was quite surprised. I went downstairs. Ante came towards me and kissed my cheek.

The first Iranian conference in mathematical chemistry was held in 2008 in Tarbiat Modares University. One of my friends, Ali Iranmanesh was the chair of that conference. Ali tells about those days:

"In 2008, I and Ali Reza Ashrafi decided to hold a conference in mathematical chemistry. Since Ali Reza did not have enough facilities in Kashan, he asked me to hold this conference at my university, Tarbiat Modares, and then he would continue in Kashan. Therefore, we decided to hold the first Iranian conference in mathematical chemistry in Jan 2008. By the suggestion of Ali Reza, I invited professor Ante Grovac who was a senior in this field. Although he had never seen me before, but his responses to my emails were very

warm and friendly. He accepted my invitation to be one of the main speakers in the conference. In Jan 2008, Ante and his wife came to Tehran for the conference. They stayed in Tehran for about one week. This period was an opportunity for me to become more familiar with him. He was very warm, quite like Iranians. In my opinion, Croatian people are very similar to Iranians in many aspects. Something interesting for me was their proverbs which were like Iranian's, just translated in Croatian. This shows that the people of these two countries are culturally similar. Ante had a special habit, smoking a lot. I and my colleagues always warned him about the dangers of smoking. I took Ante and his wife to visit different parts of Tehran. Ante enjoyed a lot and told me he wants to see other cities of Iran. Therefore, we tried to hold other conferences in different cities."

The second and the third conferences in mathematical chemistry were held in Kashan and in Tarbiat Modares, in 2009 and 2010, respectively. We invited Ante in both of them. Ali Iranmanesh narrates: "After the second conference in Kashan, I decided to continue this process by holding another conference in Tarbiat Modares University. Consequently, the third conference in mathematical chemistry was held in 2009 and Ante was one of the invited speakers. Since more students participated in that conference, the interest in the field of mathematical chemistry increased dramatically in Iran. In fact, it was a successful meeting between Iranians and some of the best scientists of the world."

The fourth conference held in Dezful in 2011 and in the next year, the fifth one held in Yazd. Mohammad Ali Iranmanesh and Saeed Alikhani were its scientific chair and a member of the scientific committee. They tell us about their memories of Yazd conference: "The last visit of Ante from Iran was in Feb 2012, when we organized the '5th Conference and Workshop on Mathematical Chemistry (FCWMC)' in Payame Noor University of Yazd, in 15-17 Feb 2012. He was one of the invited speakers. Like the others, we took him to visit Yazd. He loved the historical places of Iran, specially Yazd. Yazd is a desert town and full of historical places. He had a camera and took a lot of photos while visiting 'Dakhmeh', 'Atash Kade', 'Masjed jame' and other places. Ante liked Iranian foods like 'Fesenjan' very much. He also loved pomegranate juice, that in the conference night he drank a lot."

Some days before Ante died, one of my Italian friends, Ottorino Ori sent me a message on November 4, 2013 as follows:

*I've bad news. I met ANTE few days ago and he is in a very bad and risky situation. His spirit is still ok but he has a cancer that, I understood, leaves him hopeless. BISERKA and all his family is around him.*

Ciao  
OTTO

And then on November 12, Otto sent the following message:

Carissimi,  
*Our Friend and Master Prof. Ante Graovac died this morning.*

It was unexpected and unbelievable news which made me very sad. In fact, this tragedy struck the mathematical chemistry community of Iran. I and my colleagues at the University of Kashan, Shahid Rajaei Teacher Training University, Tarbiat Modarres University and Yazd University declare our deep condolences to Croatian scientific society, his wife Biserka and other members of his family. The sixth conference was held in Bushehr. We all were so sorry, since his death did not let him to visit 'Persian Gulf, where he liked to visit impatiently.

With the best of our knowledge until now there are three published papers of Iranian colleagues jointed by Ante in ISI journals as follows:

1. Fath-Tabar, Gholam Hossein; Ashrafi, Ali Reza; Graovac, Ante, ON ESTRADA INDEX OF TWO CLASSES OF DENDRIMERS, *STUDIA UNIVERSITATIS BABES-BOLYAI CHEMIA* Volume: 55 Issue: 4 Pages: 97–100.
2. Fath-Tabar, G. H.; Vaez-Zadeh, B.; Ashrafi, A. R.; Graovac, Ante, Some inequalities for the atom-bond connectivity index of graph operations, *DISCRETE APPLIED MATHEMATICS* Volume: 159 Issue: 13 Pages: 1323–1330.
3. Graovac, Ante; Ghorbani, Modjtaba, A New Version of Atom-Bond Connectivity Index, *ACTA CHIMICA SLOVENICA* Volume: 57 Issue: 3 Pages: 609–612.

Here are some photos in the memory of professor Ante Graovac:



The First Iranian Conference on Mathematical Chemistry, Tarbiat Modares University, Tehran, Iran (2008).



The Second Iranian Conference on Mathematical Chemistry, University of Kashan, Kashan, Iran (2009).



The First Iranian Conference on Chemical Graph Theory, Shahid Rajaei Teacher Training University, Tehran, Iran (2011).