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Interview



CONNECTING THE DOTS WITH DR. DAN SHECHTMAN: AN INTERVIEW WITH A NOBEL LAUREATE IN CHEMISTRY

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Filled with excitement, I was looking forward to the visit of Dr. Dan Shechtman, a 2011 Nobel Prize Laureate in Chemistry, to our country, but at the same time, I was also nervous if our hospitality will be on the expected level. We have planned a busy schedule for him filled with lectures, visits, and ceremonies. It was a “mission” filled with events that are happening for the first time in our country - it will be for the first time for a Nobel Prize Laureate to give a lecture at the Faculty of Natural Sciences (St. Cyril and Methodius University, Skopje); it will also be the first time to have a Nobel-Prize-winning-plenary-speaker at the Conference in Materials Science organized by the Macedonian Academy of Sciences and Arts (Skopje); and yet, another type of a first time will be to be given a Honorary Professor Causa title to Dr. Shechtman at the University St. Kliment Ohridski in Bitola.

Nowadays, months after the visit of Dr. Shechtman to N. Macedonia, I still have memories filled with nothing else, but pleasant moments of our conversations, all the talks he gave at different institutions in our country and the time spent together. I can proudly write that our “mission” was successfully accomplished. Dr. Shechtman was very impressed by the hospitality in our country and the efforts and motivation of the Macedonians who are trying hard to “catch-up” with the world trends. In addition, Dr. Shechtman visited many landmarks with historic, religious and ethnic importance, such as museums, the Citadel, churches and monasteries, archaeological sites, like Stobi, Plaoshnik (Ohrid), and many more. There are so many pleasant memories that come to my mind now, but I will choose the ones below that touched me the most.

We all know that St. Clement of Ohrid was one of the first pupils of the founders of our alphabet St's. Cyril and Methodius; he was the main architect of the medieval alphabetization and education of the Macedonian people. St. Clement and his associates educated over 3,500 pupils, who, after his death, further spread his teachings and literacy among the Macedonians, as well as contributed to the expansion of Christian religion across the country and abroad. What is most fascinating for me is that more than 1,000 years later, Dr. Shechtman, a strong supporter of good education, received the Honorary degree at the University that holds the exact name of St. Clement of Ohrid (Figure 1). More than 10 centuries later, the Macedonian mission of promoting the education, which started with St. Clement of Ohrid, his teachers and his followers, continues. A

strong education is our national symbol, tradition and vision to generate educated youth, so they can make an impact in the world one day.¹

With his visit, Dr. Shechtman became a member of the Macedonian academic family – he connected the dots in my mind: from our first educator St. Clement, who started the roots of the education in this part of the world, to the promotion of a Nobel Prize Laureate for the highest honorary degree at the University that holds St. Clement name. And along the way, these pleasant memories are intertwined with the rich Macedonian history, culture, ethnical and religious diversity, which were noticed by our Visitor, Dr. Shechtman (Figure 1).

Since I have spent a lot of time with Dr. Shechtman and have had lengthy conversations with him during his visit to N. Macedonia, I'd like to reflect on and share them with the broader audience through my interview with him:

Q: We are all honoured and grateful to have you here in N. Macedonia. What are your first impressions of our country?

DS²: Macedonia is a beautiful country. I visited several places and I thoroughly enjoyed being here thank to the warm welcome and detailed care of my hosts. You have the potential to use your resources and natural beauties, but most important is to develop your human ingenuity in a proper way in direction required by the global trends and according to the current events and issues worldwide. Human ingenuity is your most important natural resource, and properly developed, it will never be exhausted.

Q: As a professor, what do you think are the most important skills to teach the younger generations to be more persistent and determined in achieving their goals? I often see eager students starting MS or PhD projects, motivated, energetic, and then, they lose the interest when the results are not as planned, or the experiments failed, or they cannot apply their knowledge in the country. Not sure how to teach them the grit, determination, and passion that you have shown over many years to sustain and stand by your results, which were disregarded by people with higher voice pitch and more "decorated" than you at the time. Many of the new generations will give up in such situations and/or leave the country.

DS: As you mentioned, grit, determination and passion are very important character traits for everyone, regardless of the profession. I usually tell my students to look at each project with a "bigger picture in the mind". Regardless of how the project would end, as a success or as a failure, the students would learn something from it; the knowledge gained, the experience and how they dealt with the project at that moment will stay with them longer than the project (maybe, forever). I tell them - not to worry about the output of the project. Of course, we are all humans, we want to be successful all the time, with all the projects that we touch, but that is rarely happening. And by the way, as you know, we learn more from a failure, than from a success.

¹ I am also proud that I have gained most of my education and the knowledge in the educational institutions in my country. I went abroad to continue my studies, which was a great experience, but I came back and do not regret it. I felt I owe this to my country and my great teachers, educators, and professors, who unselfishly shared their knowledge with me; I wanted to give back to the community where I came from.

² DS stands for Dr. Dan Shechtman.



Figure 1: Connecting the dots with Dr. Shechtman: a) from St. Clement of Ohrid who was one of the first pupils of the alphabet 's founders, b) monument of St. Clement of Ohrid in front of the Rector's office St. Clement of Ohrid University in Bitola, c) Dr Shechtman is standing in front of the Monument of St. Clement of Ohrid (Ohrid), d) Dr. Shechtman in front of St. Panteleimon, Plaoshnik (Ohrid), e) speech in honour of Dr. Shechtman given by Dr. Trajkovska Petkoska, f) Rector Dr. Nedelkovski is giving Honorary degree Professor Honoris Causa to Dr. Shechtman, g) addressing speech of Dr. Shechtman in front of the academic community of St. Clement of Ohrid University, Bitola (May 27th, 2023).

Q: If you are in a process to hire younger researcher in your team, what personal trait do you look for besides his/her technical skills and background? In other words, what are the most important personal characteristics for a researcher or scientist today in your opinion?

DS: First, I will choose a person with integrity – confident yet humble, responsible, trustworthy, life-long learner and curious. Getting the academic degree is just a starting step; it serves you to open the door of challenges and exploration for someone to apply the knowledge and the skills. However, as the science and technology are developing very fast, the person needs to be willing, needs to be eagerly looking for continuous learning and applying it to solve challenges. In today's world, the science and technological development are moving very fast, so the individual needs to be proactive and "catch-up" with the news in his/her professional field.

I will also choose a person who knows to listen to others. When someone listens, he/she could learn a lot, for example, about the challenges and the issues that others have had to solve the same problem. That is important to see where others have "struggled" and one could find out if he/she can help. However, although listening is great, one does not need to believe 100% in what he/she hears or reads in the books. Critical approach and analysis to the information are needed. I always teach the younger – *"Listen, but do not allow someone else's opinion to reduce your value, believe in your own dreams, ideas, in your own success. Our time on the Earth is limited, therefore do it now, not tomorrow."*

Q: You made a statement *"Life is governed by the chance"* during some of your talks and conversations in the country. What do you mean?

DS: Most people feel that they control their destiny and everyday life. This is true, of course, when people make sure that they stay out of harmful ways and govern their everyday lives. However, we do not control the most important events and actions. A basic example of the role of luck is our chance to be born. Think about the process in which 100 million sperms race to reach your mother's egg. Only one won the race, and it is yours. So, the chance is 1 per 100 million. However, your father had to be born too, and so had your mother and their parents and so on back to the first cell in the swamp. Your chances to be born are practically zero, and yet, because you are unbelievably lucky you are here. Life is an amazingly rare gift. We should not take life for granted. More than that, most of our important decisions are affected by random interactions with people or events. I have examples from my own experience that illustrate the idea. A 20 second conversation in the laboratory corridor with a colleague directed me to study rapidly solidified metallic alloy. This in turn enabled my discovery of quasi-periodic crystals, a discovery that made a paradigm shift in crystallography and made me a Nobel Laureate.

Most of us end up being married and manage to create a family. Are we married to the ideal spouse? Of course not, but we manage. Does a more suitable partner exist? Yes, but the chances to meet him/her are very limited because most likely they live far away and do not belong to our very limited group of acquaintances.

Q: Almost everywhere, you talked about entrepreneurship. Can you please tell us why you always stress out the entrepreneurship as an important part of teaching the younger generations?

DS: I believe that technological entrepreneurship is key to world prosperity and peace. I also believe that human ingenuity is the most important natural resource of every society. To link these two, I promote teaching the young how to open a startup, based on a good idea, and succeed in making it a thriving technology business. In some societies, people do not take risks because of

the fear of failure, since failure is a shame. In my teaching I say – "*Failure is not a shame, failure is OK, start again*". In your second attempt you may have a better chance to succeed since now you are an experienced entrepreneur. More than that, why learn from your own experience; learn from the experience of other entrepreneurs. This is why I opened a class called "Technological Entrepreneurship" at the Technion, my Haifa university. I started the class in 1987, and at the time it was one of the largest Technion class, I had 600 students in my class every week. I conducted the class for 30 years, and it is still going on, managed by another colleague professor. In a survey we conducted several years ago we found that 25% of the class graduates were involved in startups. Israel is called a startup nation, for its large number of startups. There are several reasons to this success, but one of them is our technological entrepreneurship class. An idea well thought off and well run, can help make a change in a life of a country.

Q: You have also said "*Money is a by-product of business success*". Can you please explain a little bit more about the meaning of it?

DS: You do not need to chase the money, it come afterwards. Show your spirit, ingenuity, talent and start your business whatever it is. Be bold, do not fear setbacks and do not be afraid to ask for help. You will always find someone who is willing to help you. Take a risk, focus on the goal, and again, do not be afraid of failure. Failures and setbacks should not deter you. Stand up, learn from the failure, and continue. The faster you recover, the better it is for you and your business.

Q: How about revolution and evolution processes that you mentioned during your addressing speech after receiving the title Professor Honoris Causa at one of the universities in our country? You mentioned that we cannot predict the revolution, but we might predict the evolution process.

DS: Science and technology progress in two avenues, one is revolution and the other one is evolution. The revolution arrives unexpectedly. Like a bolt from the blue, an announcement appears, usually in a form of an important scientific article, about a new discovery, or new understanding of a natural phenomenon. Many studies follow to confirm and advance the science. As more data is announced, the evolution path starts.

Products and technologies are developed based on the revolution, and then they arrive on the market. This path can be lengthy and may take years until the technology is mature and works well, but in other cases, when the new product is in very high and urgent demand the evolution path can be shortened. A good example of this path is the development of the vaccines for the corona virus. Both Moderna and BioNTech (Pfizer) produced a huge number of very innovative and effective vaccine doses in a record short time. This was possible because the revolutions and understanding the structure and functions and interaction of the ribosome and messenger RNA. A huge number of lives were saved thanks to the physiology science and technology.

For comparison, earlier in history, we did not have such fast responses. Penicillin was discovered by Alexander Fleming in 1928, but it took 17 years for its commercialization. Only in 1945 penicillin was available in pharmacies for the first time.

Q: Can you compare your home country Israel and Macedonia in terms of similarity and differences? I can see similarity in the size of the countries, and maybe, in religious diversity and tolerance, but still in overall achievements, Israel is ahead of us.

DS: A comparison between our two countries is available on the Internet. Many aspects are presented in a clear way. This is all objective and has nothing to do with my opinion. However, I can add a few remarks. Macedonia is a rich country. It has minerals and wood, a fertile land and

plenty of water. Israel does not have any of that. Most of the country is dry, and it had very little natural resources, but it has the most important natural resource – human ingenuity.

Every difficulty is a source of innovation, and so, Israel overcame the lack of water by desalination of sea water, the defense issues were met by development of defense weapons and the lack of fertile land, by development of innovative agriculture. The products of all these, and more, are exported around the world. Thanks to the high GDP per capita and traditional family values, Israel has constant immigration and high birth rate. Both GDP per capita and population grow fast in Israel.

Q: I read that your life completely changed after receiving the Nobel Prize. You have been invited all over the world to give talks, and sometimes, you cannot fulfill all the requests. Are you tired of travels, or still looking forward to meeting new people and cultures, and visit new places?

DS: Yes, indeed, my life changed thanks to the Nobel Prize. After receiving the Prize, I had several good options and had to choose the best for me. I could continue to do research and enlarge my lab and research budget or travel the world giving lectures and affecting young students. Because of my age, I was 70 years old when the invitation to Stockholm came, I decided to dedicate myself to lecturing around the world and to spread my ideas and beliefs. Ever since, I travelled many countries, met many thousands of students, educators and national decision makers and learned a lot about cultures and people's lives in very interesting countries and societies. This is my humble contribution to the world, and I very much enjoy the process.

Q: What are your final thoughts and message to Macedonians? How strong do you believe in the thought: *"Now it is time to believe in ourselves, be content and use what we have, rather than focus on what we wish to have."*

DS: I agree with the first half of the statement – believe in yourself. However, if you are content and satisfied in what you have, you may have peaceful life, but you and your country will not make great progress. The unsatisfied people look for more, make progress, invent, and create. These are the people that build economies, modern living and flourishing, active societies. I wish the wonderful people of Macedonia active and prosperous life.

Thank You, Dr. Shechtman! Your visit, conversations and lectures in our country will be in our memories for a long time. Looking forward to our next meeting, Dr. Shechtman. Until then, stay safe and healthy.

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