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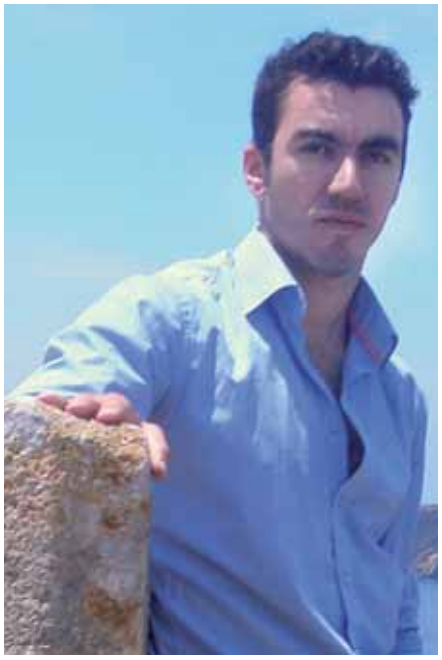

Young Greek scientists: Science today for tomorrow's world

Despite the brain drain, caused by the continuing economic crisis, many graduates of Greek universities are following their paths in respective research fields, at an international level. Here are three exceptional examples

By Eugenia Anastassiou

Greeks make up less than 0.2% of the global population and yet the percentage of Greek scientists in the world totals 3%. This phenomenal statistic highlights the disproportionately large contribution a small country like Greece has on scientific thought and research internationally.

Sadly however, only 14% of Greek scientists live and work in Greece and the current economic crisis is fuelling a further brain drain of its brightest and best to the US and other European countries.

This report examines the work, choices and achievements of three young Greek scientists, all under 40 years old and all graduates from Greek universities, who are making great strides in their respective fields of research on an international level; one of them in the UK and the other two based in Greece.

Dr Dionysios Xenos – An entrepreneurial innovator abroad

Dr Dionysios Xenos **was born and raised in Athens and studied Mechanical Engineering at the National Technical University of Athens, completing a PhD in Chemical Engineering at Imperial College, London, UK. His expertise is in data analytics, optimisation (writing computer programmes to maximise efficiency and speed) and automation.**

In May 2016, he co-founded *Flexciton*, an innovative software company which increases efficiency in manufacturing and industrial plants through data analytics and artificial intelligence. Maintenance becomes more effective by applying state-of-the-art web software technology, which saves industrial companies thousands in operation costs. This innovation can be used successfully in the chemical, oil & gas, power generation, steel making and automotive industries.

In 2017, *Flexciton* was selected as the most innovative SME in a recent UK Industry Summit from industry experts such as Tata Steel, Rolls Royce and Siemens.

Flexciton **was incubated by leading European tech accelerator Entrepreneur First and since its inception last year it has raised a significant amount of seed money from UK, German and US venture capitalists, as well as other angel investors to enable the business grow.**

What was the impetus behind the creation of *Flexciton* and how are you hoping to develop the company?

Flexciton was founded to create added business value using the latest developments in artificial intelligence (AI), optimisation and data analytics, to help small, medium and large manufacturing and industrial plants become more efficient by reducing their energy costs and improving customer service.

Jamie Potter, my co-founder, and I carried out many months of customer development to understand how inefficiently companies operate their industrial plants; the reason being that they have to deal with many uncertainties, such as volatile energy prices, unexpected maintenance and repairs, as well as inundated with thousands of customer orders. At *Flexciton* we provide a sophisticated approach to solving the problems of operating a complex plant.

We are aiming to build a high quality international company which understands customer needs and solves their difficult technical problems. To achieve this, we are hiring talent from top universities and the smartest engineers with significant practical experience, including Greeks, who also have an entrepreneurial mindset.

As a scientist, how are you finding the role of entrepreneur?

The role of entrepreneur involves huge responsibilities to your company and the people related to it: business partners, customers, colleagues, investors, but also to society, in general. My role is to create value, use resources efficiently and promote economic growth for the company. This is both challenging and exciting at the same time.

My background as a scientist complements the entrepreneurial side because the company needs to build technology based on the latest developments coming from research. My strengths are in mechanical and chemical engineering; through these disciplines I have developed strong analytical skills, as well as the right work ethic, which I believe are necessary to build a company. Of course, academia prepared me for certain areas but not others, so I spend my free time on improving my weaknesses.

As the co-founder of a tech start-up which is only a year old, how are you finding the process of looking for investment? Who are you approaching and what is the overall reaction to your company?

Building a new technology company requires a great deal of investment up front. Luckily, my co-founder *Jamie Potter* led the fundraising and he did an incredible job in convincing major European and US investors to invest in *Flexciton*. We managed to raise more than $1,000,000 of seed-round funding from VCs and angel investors.

We were successful with our fundraising because we exceeded investors' expectations – one of our investors thought it would take us two years to get our first customers, but it took us a few months. We demonstrated to our first customer that we could save their business £100,000 per year; they were so impressed they ended up investing in *Flexciton*.

In simple terms, how is computer technology advancing mechanical engineering?

The advance in computer technology, data acquisition and connectivity among machines is creating new markets in an industry worth many billions.

The way it works is that computer technology analyses vast amounts of data, solves mathematical models and provides informative output, which the operators of these machines can use. With AI, these algorithms are trained consistently with new data which make them learn or behave like humans.

Technology companies, such as *Flexciton*, use these smart algorithms to create value for businesses, for example reducing costs, improving customer service and increasing production.

The concept of AI is one that instils many concerns, especially regarding skills and employment. Will its advancement mean greater unemployment as machines become more efficient and take over many jobs currently carried out by people?

Milton Friedman visited a worksite where the government ordered people to use shovels instead of modern tractors in order to create more jobs. The famous economist then replied: "I thought you were trying to build a canal; if you want to create more jobs then give these workers spoons, not shovels."

So, AI is another sophisticated tool, like the modern tractor, which enables people to complete repeatable tasks more efficiently. It helps us to build new products, remove repetitive low-level tasks from the work-place, eliminate inefficiency and increase the quality of our lives. Consider the value of AI and machine learning in medicine, used in the objective and consistent diagnosis of patients. *Flexciton* uses AI to reduce energy costs and waste by improving inefficient operations; jobs are not removed, but factory operators are empowered to run their plants more effectively.

AI will probably remove some jobs in some sectors, mainly those which require low-level skills, but they will be replaced by different highly-skilled jobs. For example, programmers will be needed to write and maintain AI algorithms.

What do you think of the assumption that Greeks develop and flourish better working in institutions abroad than they do in Greece? Would you ever consider going back home?

I think this assumption does not necessarily hold true. There are some very good engineers who are still in Greece, producing significant research which is published internationally. There are also Greek-based engineers and entrepreneurs building successful and sustainable businesses in Greece. An example is BETA CAE, a thriving engineering software company, based in Thessaloniki. However, other countries do offer more opportunities compared to Greece, but it is up to those Greeks abroad to make good use of these opportunities in order to develop and flourish.

There are some very good engineers who are still in Greece, producing significant research which is published internationally. There are also Greek-based engineers and entrepreneurs building successful and sustainable businesses in Greece

Personally, I am not considering returning back to Greece in the near future because I see the benefit of living abroad. This is especially true in London, where you can access many resources to build a successful business, you can still find the best talent and you can meet customers from all over the world because of the strategic position of London.

Entrepreneur First

Entrepreneur First aims to attract the top graduates in computer science and engineering, with the goal of encouraging them to start their own businesses rather than enter traditional career tracks in the corporate or banking world. The program also accepts applicants who are already working in tech firms. Applicants do not need to have an idea for a business or a team in place before applying, but are evaluated solely on the basis of technical talent.

The six-month, cohort-based program is divided into two parts. The first three months are devoted to building a team and "identifying a problem they want to solve before creating a product to solve it". During the second three months, participants receive guidance in running a business from mentors in the science academic and venture capital fields. Participants also meet with senior business executives and government officials at 10 Downing Street. The program furnishes each startup team with a monthly stipend for living expenses, office space, and administrative and legal assistance.

Entrepreneur First invests £16,600 to £19,900 in each startup in London, and SG$30000 in Singapore. In return, it claims an 8 percent equity share. In its first four years, Entrepreneur First helped establish 75 startups valued at $450 million Among its successful startups are Adbrain, Echobox, Blaze bike lights, Pi-Top, Permutive, Tractable, Code Kingdoms, and Magic Pony Technology.

Entrepreneur First was founded in 2011 by *Matthew Clifford* and *Alice Bentinck*, who had worked as management consultants at McKinsey & Company since 2009. Believing that the model would best succeed independently, *Clifford* and *Bentinck* left McKinsey and started the program themselves. Clifford serves as CEO while Bentinck is the COO.

The logo of Entrepreneur First, chosen by *Clifford*, is a "fierce and scrappy" honey badger. *Bentinck* founded Code First: Girls in late 2012 to address the decline of women working in the tech and digital workforce which has led to a lack of diversity in the sector.

Dr Ioannis Baziotis – A Greek first in Antarctica

Dr Ioannis Baziotis **was born in Athens and graduated from the Department of Geology of the University of Athens, receiving his PhD from the School of Mining and Metallurgy of the National Technical University of Athens. He is currently the Assistant Professor of Mineralogy and Petrology at the Agricultural University of Athens.**

Dr Baziotis **has spent his entire career in Greece and is actively involved in meteoric science, his studies on Mars having been published in various international scientific publications. From his position at the Agricultural University he has built up a high level of collaborations with major universities and global organisations around the world.**

He is the first Greek scientist to be selected to participate in NASA's Antarctic Search for Meteorites (ANSMET) mission in November 2017.

What are you looking for in meteorites and what information do you get from studying them?

Through the study of meteorites we can learn the hidden details of how our solar system formed and subsequently evolved into the Sun and the planets of today. Meteorites are often the clearest and best-preserved samples from the era when Earth-like planets were forming, and yet they also record details of processes which continue today and will be likely to influence our planet in the future.

Additionally, they also offer clues into how the Earth's moon was formed, as well as the history of both the interior and surface of Mars, the sources of Earth's water and much more. For example, a particular class of primitive meteorites (the carbonaceous chondrites) have an age of 4.56 billion years and reveal the best-preserved records of the first stages of our solar system.

How were you chosen by NASA to participate in their Antarctica mission –especially, coming from a Greek university– when there are so many prominent US and international institutions they could pick candidates from?

I began applying to ANSMET in 2013, although the probability of selection was very low. ANSMET receives inquiries from a hundred or more candidates each year and only 3-4 new people are selected each season.

Of course, my selection, as the first Greek ever on this mission –set to travel with a number of high-profile scientists from around the world– is a great honour for myself, my family, Athens University and Greece. I will try to do my best to accomplish the goals set by ANSMET, by giving more than 100% to help the team recover many high-quality meteorites in Antarctica.

What do NASA and you hope to find in Antarctica and how does it help in meteorite research?

Before the Antarctic meteorite searches began in 1976, there were only a few hundred known meteorites – none were known from the Moon and only six from Mars. The modern, organised collecting programmes in Antarctica and hot deserts have now raised the number of known meteorites to about 56,000, including about 150 from Mars and 200 from the Moon.

> My personal vision is to create favourable conditions to keep the best students in Greece and in a small way reverse the brain drain phenomenon. This requires equilibrium between hard work, patience, coordinated programmes and outstanding high-level collaborations

NASA funds ANSMET in order to add more samples to the inventory and to reveal the breadth of mineralogical, geo-chemical, and textural characteristics present within the solar system. The history of the solar system is incomplete, and these heaven-derived rocks may show us how the universe evolved.

You are going on a three-month mission from November 2017. What are you looking forward to and what are you "dreading" in such a challenging environment?

Antarctica represents the furthermost southern frontier of the earth and it is a pure cold desert, which is a thoroughly inhospitable and difficult environment. Our deployment is scheduled for 25th November and this year the mission will field two 4-person teams, who will stay for 6 weeks, living in double-insulated Scott Tents, enduring average temperatures between -15 and -25 ˚C with constant winds around 3-4 Beaufort. In addition, for virtually all of the trip we will be days away from professional medical care.

We will be exposed to environmental, physical and mental stresses that rival those experienced by astronauts and special military services. However, I keep saying to myself that accomplishing my dream will overcome any obstacle or difficulty presented.

You have spent your scientific career in Greece, when so many other Greek scientists take posts abroad, primarily for better facilities and funding. Why did you decide to remain in Greece?

Prior to my official appointment as lecturer professor in 2014, I set myself a 5-year plan with the major goal being to develop a competitive, internationally rated laboratory, which has the ability to attract funds nationally and overseas, both from the private and public sectors, as well as producing high-quality data, employing and training the best PhDs and postdoctoral students. Currently, three years after my initial appointment, I am able to claim that we are more than two-thirds of the way towards fulfilling this primary aim.

A few months ago, we installed the first electron probe microanalyser in Greece, through the generosity of the Stavros Niarchos Foundation and our collaborators at the University of Muenster in Germany. This cutting-edge instrument is an important tool for our research, since it performs precise, measurements and X-ray mapping of the most minute elements very quickly and it helps us characterise the type of meteorite investigated, its provenance and evolution. It is the only one of its kind in Greece and we are very proud as a laboratory and university to have one.

Furthermore, I bring in collaborations with leading international universities and organisations, including California Institute of Technology, Jet Propulsion Laboratory, NASA, the University of Tennessee, the University of Muenster, the Natural History Museum of Vienna, the University of Vienna and others. This enables the students in my team –as well as others from the Agricultural University of Athens and other Greek universities– to work with excellent world-class collaborators.

My dream is to transform our laboratory into a springboard for international success.

What are your hopes for the development, future and impact of scientific research in Greek institutions?

Obviously, the Greek economic crisis has had a negative effect on scientific research opportunities and funding for science has become increasingly scarce, although by the end of 2016 some small signs of recovery began to appear; for example, the newly formed Greek Foundation for Research and Innovation (ELIDEK) granted 505 scholarships for PhD students.

This offers some hope, but it is not enough to reverse the trend of emigration among young Greek scientists. However, if this policy continues in a positive direction, it is very possible that Greece might become competitive enough to attract and promote top-level research and researchers.

So, I am optimistic and believe, if every one of us works towards producing visionary and original scientific study, then Greece could reclaim its place among the world's top incubators of scientists.

My personal vision is to create favourable conditions to keep the best students in Greece and in a small way reverse the brain drain phenomenon. This requires equilibrium between hard work, patience, coordinated programmes and outstanding high-level collaborations.

I also hope to pass inspiration to the next generation of scientists. If we invest in these goals, then hopefully we should reverse the downward path Greek universities have been taking. It is all in our hands...

ANSMET

Antarctic Search for Meteorites is a program funded by the Office of Polar Programs of the National Science Foundation that looks for meteorites in the Transantarctic Mountains. This geographical area serves as a collection point for meteorites that have originally fallen on the extensive high-altitude ice fields throughout Antarctica. Such meteorites are quickly covered by subsequent snowfall and begin a centuries-long journey traveling "downhill" across the Antarctic continent while embedded in a vast sheet of flowing ice. Portions of such flowing ice can be halted by natural barriers such as the Transantarctic Mountains. Subsequent wind erosion of the motionless ice brings trapped meteorites back to the surface once more where they may be collected.

This process concentrates meteorites in a few specific areas to much higher concentrations than they are normally found everywhere else. The contrast of the dark meteorites against the white snow, and lack of terrestrial rocks on the ice, makes such meteorites relatively easy to find. However, the vast majority of such ice-embedded meteorites eventually slide undiscovered into the ocean.

The search for the meteorites is done visually. A team of four to ten explorers, typically meteorite scientists, lives for 5–7 weeks on the ice field. Using snowmobiles spaced 30 m apart they scan the blue ice for meteorites. Once a specimen has been located its position is found using GPS and it is given an identification number. It is then placed in a sterile Teflon bag. The teams make sure that the specimen remains frozen throughout its journey back to the Antarctic Meteorite Curation Facility at the Johnson Space Center in Houston, Texas. Since 1976, ANSMET has returned over 20,000 meteorites. Meteorites of greater interest and undergoing detailed study are kept at JSC for distribution to the scientific community, though, ultimately, all samples collected by ANSMET are transferred to the Smithsonian Institution for permanent storage and curation.

Dr Zoe Cournia – Combating cancer with computers in Greece

Dr. Zoe Cournia **studied Chemistry at the University of Athens and received her PhD summa cum laude at the University of Heidelberg in Germany. She then worked on computer-aided drug design as a postdoctoral researcher in the Chemistry Department at Yale University, followed by a lecturer post at Yale College. During her time there she also served as a co-President of the Yale Pharmaceutical and Biotechnology Society.**

Dr Cournia **returned to Greece in 2009 to take up the post of Researcher at the Biomedical Research Foundation of the Academy of Athens (BRFAA), where she specialises in anti-cancer drug design using computer technology.**

Dr Cournia **has received numerous international awards for her research, including the American Association for Cancer Research Angiogenesis Fellowship, the "Woman of Innovation 2009" Award from the Connecticut Technology Council, USA, the Marie Curie Fellowship from the European Union and the first "Ada Lovelace Award" from the Partnership for Advanced Computing in Europe in 2016.**

What gave you the impetus to go into in the field of computer-aided drug design?

From primary school I was always fascinated by chemistry and later on I became excited by technological advances in computer science, so I decided to combine my two passions and become a "computational chemist", a scientific field where everything from chemical reactions to drugs, food, materials, cosmetics, electronics, and proteins is being simulated. During my PhD studies, I realised that I wanted to use my expertise to help develop products that have the potential to save millions of lives.

I am now an independent researcher working in Athens at BRFAA, where I run a molecular modelling and drug design laboratory, where we_devise anti-cancer candidate drugs inside the computer and predict their interactions with proteins that cause cancer. Computer-aided drug discovery has recently made some important advances, with new discoveries having significantly greater success rates than traditional experimental screening. In other words, using the computer makes the drug discovery process much cheaper and more efficient, compared to just performing experiments.

In 2013, three computational scientists were awarded the Nobel Prize for Chemistry with the Nobel Committee noting that: "Computer models mirroring real life have become crucial for most advances made in chemistry today. Today the computer is just as important a tool for chemists as the test tube. Simulations are so realistic that they predict the outcome of traditional experiments."

Your work "Computers in the Fight Against Cancer" has been the subject of much interest. Can you explain how computer technology is used to fight cancer?

We are entering the era of "precision medicine", which means that disease treatment and prevention takes into account the individual's variability in genes, environment, and lifestyle.

In our laboratory we are working on designing new drugs against specific cancerous mutations which target specific cancer subtypes. For example, we now know that there are over 200 different breast cancer which occur due to different mutations in our proteins, which are expressed by genes in our body.

Each patient may display a different cancer subtype and new therapies can now target that specific type – this goes beyond the traditional chemotherapy approach. If we can block the particular protein with a chemical molecule-drug, then we can stop the progress of cancer. So, we are working to develop drugs specifically for each variety of cancer subtype, which is diagnosed after biopsy and genome sequencing.

How do supercomputers help in this process?

They aid us by reducing the time and cost of conducting an experiment in a laboratory.

At the moment, we are working on two mutations of the PIK3CA protein found in 30% of breast cancer patients and 15% of patients with colon cancer. Our goal is to block the mutant but not the normal forms of PIK3CA with drugs, so that tumours can be treated without toxic side effects to healthy tissue. We developed some of these drug candidates with the computer and then, following experimental evaluations using cell cultures, we conducted preliminary pre-clinical studies in mice with breast tumours, which produced some encouragingly positive results.

What more can be done, in your opinion, to bridge the gap between the world of scientific research and the general public, who often find it difficult to understand?

Many people believe that science is incomprehensible and there is a huge disconnect between the research community and the general public. There is a real need for scientists to communicate their work more effectively and to make it accessible to more people.

I am very aware that I also have a responsibility to promote public awareness and understanding of science in my particular field of computational chemistry since every product we use (from mobile phones, cars, airplanes, clothing and everything else in between) passes a test stage through a supercomputer.

At BRFAA we have a programme where we open our laboratories to high-school students from around Greece for several days a year and talk to them about science. I maintain a blog ("Life is Chemistry"), which explains in simple terms how chemistry is connected with our everyday life and I am also the Editor Elect of the 's "Chemistry in Cancer Research Group Newsletter."

I also give talks on science to the general public, such as "Café Scientifique". Finally, I co-organise the annual Athens Science Festival, which is part of Greek

non-profit organisation Science Communication (SciCo).

The Athens Science Festival has over 30,000 visitors per year, and highlights how science connects with everyday life. It presents the high quality scientific research done in Greece, together with discussions on complex and controversial scientific issues, inspiring and creating new standards in the field of science and encouraging young people to think of a career in the sciences. Most importantly, the Athens Science Festival also manages to demonstrate that science can be entertaining.

You have been a lecturer in the Chemistry department at Yale in the USA. What made you return to Greece and teach/research at the BRFAA in Athens?

I believe that all scientists should leave their home countries for a while to gain new experiences and broaden their horizons, as well as train in new research techniques and technologies. However, it is important that after their time abroad they are able to return to their own country to transfer the expertise they gained.

In the Greek case, this presupposes that the government is able to create the appropriate research positions for both established and young scientists who wish to return to Greece.

When I was at Yale, it was always my goal to return back to Greece; to work towards the discovery of new drugs in my country, but also to educate our students in this new field of research, which I learned in the USA.

What are your hopes for the development, future and impact of scientific research in Greek institutions?

At present BRFAA, together with many other research centres and universities in Greece, is funded through European and other grants, as well as private revenue from high-level medical services.

However, this income does not adequately cover all needs, such as annual salaries for researchers and administration, decent infrastructure and consumables for experiments. In addition, state funding is poor and if there is no steady flow of resources, there can be no continuity in research projects. This lack of regular funding, contributes to the reason why many young researchers are forced to leave Greece and work abroad.

It is worth noting that amongst the other EU countries Greece is ranked at a low 23rd in state research funding, yet Greek researchers achieve an incredible 3rd place in producing original work and publications.

My hope is that the Greek state understands the huge impact scientists have on society. I believe that it must act swiftly to support and fund research institutions and universities, otherwise we will not be able to produce the cutting-edge research which bring worldwide recognition and honours to Greek-based scientists.

Finally, I firmly believe that Greek research centres and universities should exploit the commercial potential of their findings. What is missing is well-equipped technology transfer offices in Greek institutions, which can turn our academic discoveries into profitable ventures. We need urgent political and economic reform to support SME operations in Greek universities and research facilities, to secure this valuable contribution to the economy, which in turn could become the new mecca for tech/science millionaires.

I believe that all scientists should leave their home countries for a while, to gain new experiences and broaden their horizons, as well as train in new research techniques and technologies. However, it is important that after their time abroad they are able to return to their own country to transfer the expertise they gained

The crisis in Greece has brought on serious socio-economic problems, but at the same time it has also forced young people to change their perceptions and embrace entrepreneurship as a means of boosting a stifled economy.

This positive entrepreneurial climate encouraged me to take a step in this direction. I realised that there is a huge gap in business know-how between entrepreneurs and academics. So, I enrolled in the Ekkinisi Lab incubator at the Federation of Hellenic Enterprises (SEV) and the EGG incubator at Eurobank, to learn business basics, and at the same time I also organised a biotechnology start-up competition within the TEDMED conference in Athens in 2013.

You have gained an international reputation for your research at a young age. What are your ambitions?

I work in the design of anti-cancer drugs because my greatest ambition is to make a substantial contribution to discovering new treatments to combat cancer. Of course, this might come about once the necessary pre-clinical tests of the candidate drug are successful.

Then we proceed to clinical trials and to this end BRFAA is collaborating with the Sotiria Hospital, which has set up a unit to conduct tests of prototype drugs such as those designed in our laboratory.

So, one day I hope my dream of being able to produce medicines originating in Greece will be realised.

However, the reality is that clinical trials of new anticancer drugs require a great deal of funding. The pharmaceutical industry invests around $1-4 billion for every new drug which comes into the market – with profits on that investment reaching as much as $20 billion a year.

The ideal would be if a partnership could be established between Greek research institutions and the pharmaceutical industry to address this enormous initial investment cost, which also ensures maximum benefits for society as well. bf