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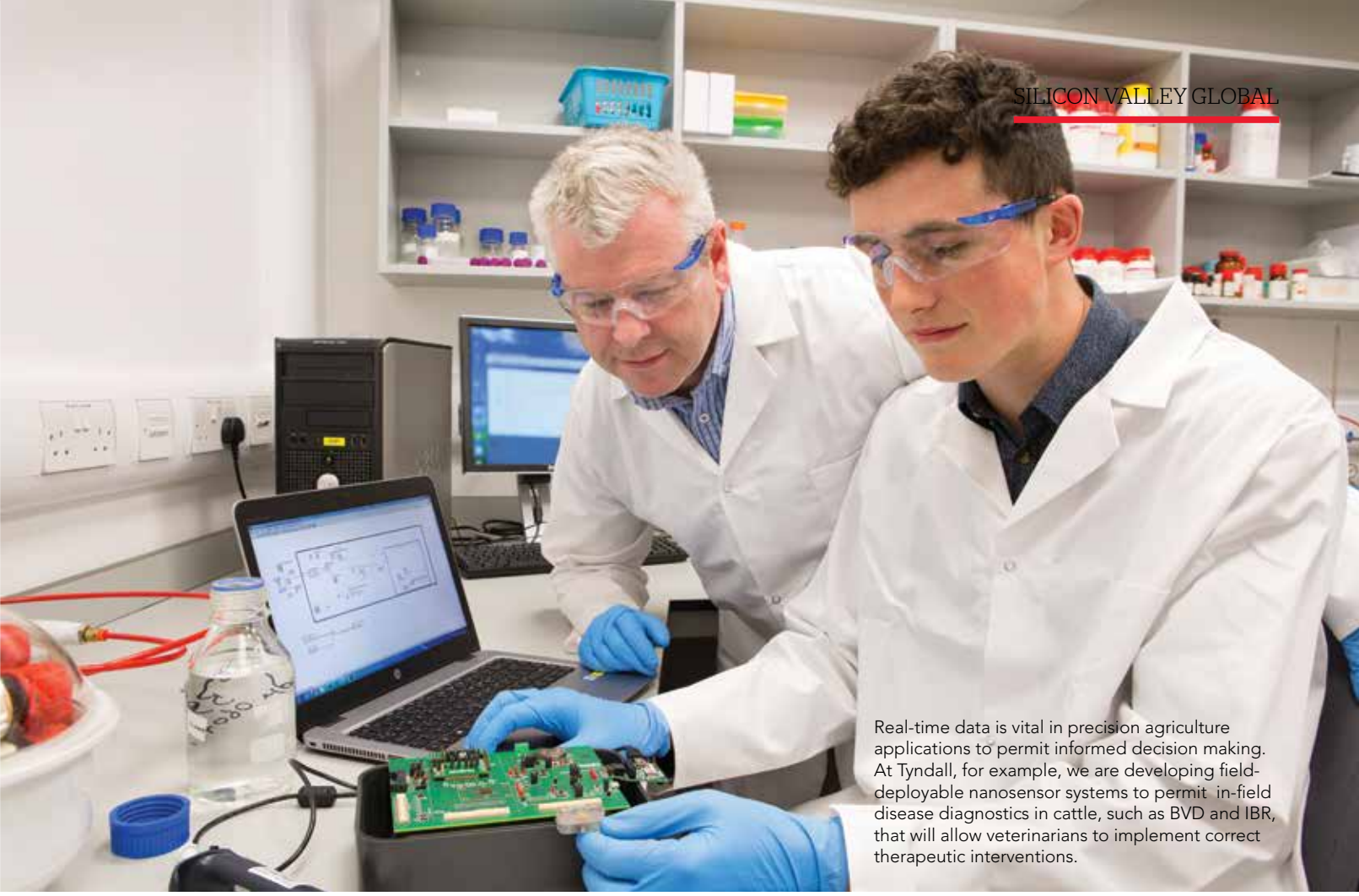

Real-time data is vital in precision agriculture applications to permit informed decision making. At Tyndall, for example, we are developing field-deployable nanosensor systems to permit in-field disease diagnostics in cattle, such as BVD and IBR, that will allow veterinarians to implement correct therapeutic interventions.

High Flying Research

Alan O'Riordan is an accomplished research Fellow at Tyndall National Institute in Cork. He talks to Silicon Valley about his research which focuses on fabrication and characterization of novel nanostructures and their potential applications to the growing Agtech sector.

Can you tell us a little about your background, your qualifications in analytical chemistry and your experience and how it has equipped you with the skills and expertise to lead research projects into new technologies being developed for smart-farming applications?

My primary Bachelors degree is in Analytical Chemistry. On graduation, I moved to, and travelled, around the UK for three years working in various posts as a lab analyst focused on analytical method development and chemical analysis. On return to Ireland, I became interested in the then emerging field of nanotechnology; particularly the interface between chemistry and microelectronics and secured a position at Tyndall National Institute. Working in the Nanotechnology Goup at Tyndall, I have had the opportunity to develop new nanotechnology enabled techniques for silicon chip fabrication and chemical modification, whilst also undertaking a PhD part-time in nanotechnology. The next step was to bring those two experiential strands together and I refocused my research to develop nanotechnology enabled devices suitable for analytical science. Initial work focused on chemical analysis where I developed and patented a new silicon chip based nanosensor suitable for electrochemical analysis. The performance improvements exhibited by these devices, compared to the commercial state of the art, indicate that these devices could also be suitable for biochemical analysis particularly applications where high sensitivity is required.

How did you become interested in Agtech and what lead you to apply your expertise to this field?

About 5-6 years ago I was coordinating a transnational EU funded project aimed at

developing new nanotechnology based optical sensors for pancreatic cancer detection. During that project it became apparent that the barriers to entry to bringing new sensors to market in the clinical space were huge and as a result a lot of emerging technologies were left on the laboratory shelf. At this point I started to look for other applications where our technologies could be deployed.

During this discovery phase I met colleagues in "Teagasc" the Irish Agriculture and Food Development Authority. Having talked with vets in Teagasc, I discovered that they were faced with similar problems to clinicians in that the urgently needed sensor devices that could permit disease detection rapidly on-farm that would allow them to make an informed therapeutic decision. I also discovered that the barriers to entry in terms of clinical trial requirements were lower potentially opening the door for translating our research to the marketplace. To this end, and in collaboration with colleagues in Georgia Tech, Atlanta and Queens University Belfast, we wrote a project proposal (reviewed by the National Science Foundation through the US-Ireland research agreement) to develop an electronic sensor prototype device suitable for on-farm disease detection in bovines.

This was disruptive and was funded on its first submission (which I believe is unusual). Other national; (Irish) projects have been funded since and we have expanded the research into plant pathology. The main driver to enter the Ag field though was our introduction to the researchers in Teagasc. They work closely with Irish farmers and are fully aware of the day to day problems experienced in modern agriculture. They were able to provide us validated problem statements for which we could begin to develop technology solutions that would ultimately be fit for purpose.

Is the application of disruptive technology in the agri-food sector a relatively recent trend and how significantly have technology-lead solutions impacted on traditional processes and established norms in the sector to date?

Yes, it is a recent trend. It's hard to pinpoint when it started but probably within the last 10 years or so with the advent of robotics for

Alan O'Riordan

replacement of on-farm labor and inclusion of GPS controlled/informed farm equipment. In the last 3-4 years it has really garnered interest driven by the hype of the internet of things. The transition of smart cities to smart agriculture occurred quickly with many industry and academic organizations seeing a new application are for their sensor technologies. However, at the moment it mostly technology push rather than technology pull. People are now prophesizing that in the near future, sensors will be distributed ubiquitously across the entire farm with everything talking to everything else but in reality, this is probably not the case. Key problems to be addressed remain (i) who will own the data and (ii) how does one monetize the data. Where an impact has been made is in the area of robotic milking machines and heavy GPS controlled farm equipment.

What are the key challenges facing global agriculture and food production and do new technological innovations represent the best opportunity for addressing some of these critical challenges such as the need to increase output to meet the needs of a rapidly expanding global population?

The main challenge facing the entire Agri-food industry is "sustainability" or lack thereof, whether this is in food production of food processing. There is the project population growth issue and the transition of the BRIC countries to a more westernized diet driving the need to produce more food. This problem is further impacted/compounded by desertification & climate change, the land required for building houses &infrastructure, and the depletion of biodiversity and natural resources caused mostly through modern agricultural processes. Going forward therefore there is a need to produce more food from scarcer and scarcer resources. Optimization of processes, regardless of what they are requires real-time and accurate information. Development of sensor systems to digitize the process is the only way to garner this information and what is ultimately required going forward.

SVG: Which counties are among the leading nations in terms of their commitment and expertise in Agtech and where does Ireland rank in this regard?

Hard to call this at the moment. Although there has been a lot of venture capital investment globally, a return on investment has yet to be realized. Within a European context, Ireland is leading in some aspects particularly driven by collaborations between different research institutes and Teagasc. Ireland has a number of advantages in this regard as we are still very much an agriculture-based economy but also have a highly educated workforce most of which to 3rd level. Ireland is a major ICT hub with multiple multinationals with R&D and manufacturing sites here. In addition, as a nation Ireland is small enough to allow most of the actors in this space to know each other but large enough to have a critical mass. In this regard Ireland is perfectly place to function as a test bed for the new technologies to be developed in this exciting nascent area.

As an agriculture and food dependent economy, is the development of a vibrant and innovative Agtech sector of particular importance to Ireland?

In a word yes. The government has recognized that the convergence between ICT and Agri-food will yield tremendous opportunity particularly for Ireland. One area in particular is in the Dairy sector where Ireland already has a global green image and currently produces 15% of the global infant formula market. With the abolition of the European milk quota systems, producers in Ireland are reaping up production to increase this market share. To this end, through Science Foundation Ireland, the government has announced funding

Researcher, Mariusz Wilk, monitoring soil parameters in real-time

~€35M for a major new distributed research Centre "FutureMilk". This was called out as a specific line in the National budget speech

Are there visible signs of an Agtech ecosystem emerging and are the necessary supports available for new innovation and start-ups?

Yes as per above. A number of SFI research centers are now tuned to smart AGri-food. Future milk is the first directly funded smart Agtech Centre. The Centre consist of four major RPOs and 45 industry partners who are contributed ~15% direct cash investment into the Centre as well as significant benefit in kind contributions.

Can you tell us about what is taking place at the Tyndall National Institute to support and drive Agtech innovation.

Tydnall has over 10 active research projects working in the smart Agtech area. Of different monitory sizes these project are nationally and internationally funded. Tyndall has signed a MOU with Teagasc and undertakes joint research where Tydnall is tasked to provide the Tech solutions to the Ag problems identified by Teagasc. Tyndall members sit on various national policy working groups, has regular contact with the Irish Department of the Agriculture and is also working on the European stage pushing the Agtech agenda meeting the EU Agriculture commissioner and delegates in Brussels. We are also forging links with leading Agriculture universities such as Wageningen. Tyndall is also working with Irish and European industry partners to develop solutions for them in the smart Agri-food and the environment sector.

What kind of groups engage with the Tyndall Institute in terms of the research activities carried out and do you engage closely with industry?

We work with all sectors. As discussed above we have a very strong relationship with Teagasc and operate within the research agenda with them as partners. We work on direct research with multinationals and SMEs. We have recently made a direct hire into our business development team to expand our industry work.

What is the key focus of your research at present and can you provide an outline of some of the high-potential projects on which you are currently working?

Our research focus is to develop smart sensor systems for the Agtech sector. It is important to note that we are a technology Centre not an Ag Centre and that shall remain. We do however wish to develop our existing and create technologies that are fit-for-purpose for this sector. As an example we are developing disease diagnostic sensors for rapid disease detection on farm. These sensor systems enable accurate detection of bovine virus in about 10 minutes. We are now pushing this technology into the horticulture space

Have you had success in commercializing any of your innovations to date and what is the typical route to market pursued by the Tyndall Institute?

We have applied for commercialization funding for the above technology and, if successful, should have a pre-commercial prototype available within the next few years.