

BBSRC support for research and commercialisation contributed to the creation of award-winning spin-out company Elasmogen¹ by Dr Caroline Barelle² and Professor Andrew Porter³ at the University of Aberdeen. The company is developing new medicines based on the discovery of certain antibody-like molecules found in sharks.

Since it was founded in February 2016 the company has raised £1.1M investment and an additional £800K Innovate UK grant funding and now employs six people. It has also established collaborations with major pharmaceuticals companies to use its patented technology to develop new medicines to treat certain solid tumours and for the bioprocessing of therapeutic agents.

Elasmogen arose from more than 16 years of research and innovation supported by BBSRC and others into shark antibody-like domains called VNARs (variable-domain new antibody receptors).

BBSRC investments included a PhD studentship that contributed to the original research, a £435K follow-on



Elasmogen is developing new medicines based on antibody-like molecules originally found in sharks. Image: Elasmogen Ltd

fund award to enable the researchers to develop their technology, a Royal Society of Edinburgh/BBSRC Enterprise Fellowship and a small Sparking Impact award. “The BBSRC funding was absolutely critical,” says Dr Caroline Barelle, now CEO of Elasmogen and previously a Senior Research Fellow at Aberdeen.

Shark proteins

Researchers and clinicians have been exploiting the properties of proteins known as antibodies for many decades. Antibodies have complex structures that allow them to bind to specific targets in much the same way as a key fits a specific lock. In nature, these form part of our adaptive immune system, as the antibodies recognise and bind to pathogens or toxins and stimulate an immune response to protect us from infection. Their ability to identify a specific target means antibodies are now widely used in research and in medicine, both to detect the presence of specific substances and micro-organisms and to accurately deliver medicines to specific sites within the body.

In 2000 researchers from Aberdeen, led by Professor Andrew Porter, and the University of Maryland in the USA, discovered antibody-like molecules called VNARs that play an important role in the immune systems of sharks⁴, one of the oldest groups of vertebrates with an adaptive immune system.

VNARs share many of the same specific binding properties as antibodies. They are, however, much smaller – just one tenth the size of a typical human antibody – and are the

IMPACT SUMMARY

University of Aberdeen researchers Dr Caroline Barelle and Professor Andrew Porter established award-winning spin-out company Elasmogen to develop new medicines based on antibody-like molecules isolated from sharks, called VNARs.

BBSRC investment contributed to the initial research that led to the discovery and patenting of the shark VNARs. Further investment from BBSRC supported commercialisation of the technology, including a £435K follow-on award and a BBSRC/Royal Society of Edinburgh Enterprise Fellowship.

Elasmogen is currently collaborating with Almac Discovery Ltd to develop anti-cancer drugs targeting solid tumours and with Merck Group in the area of bioprocessing.

Since it was founded in early 2016 the company has received £1.1 M private investment. It employs six people and has won several awards for new start-up companies.

smallest known antibody-like molecules in vertebrates. However, crucially, according to Porter, “these are not antibodies, and provide a route around the very complicated antibody IP space, yet deliver the benefits of the smaller domain antibodies that were progressing towards the clinic at the same time we were discovering the presence of these domains in sharks.”

The researchers then showed they could produce monoclonal VNARs – VNARs that all come from a single source and bind to the same target – and that they were amenable to genetic engineering and could be used to build a VNAR library that could be searched to identify potential new drugs; both essential steps if VNARS were to be developed into new medicines.

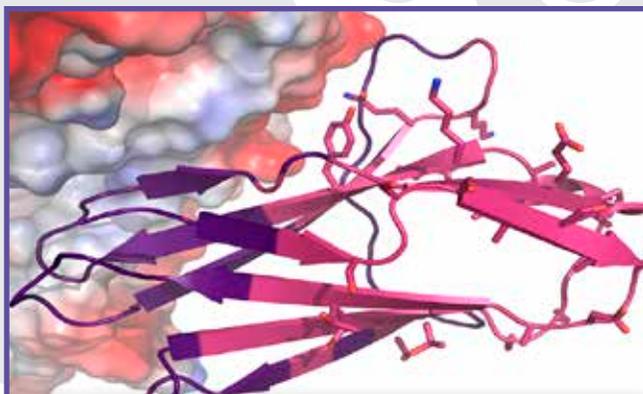
The University of Aberdeen and University of Maryland jointly protected the intellectual property (IP) from the research. In 2002 Porter established discovery spin-out company Haptogen to commercialise protein drug discovery, licencing the VNAR technology from Aberdeen in 2006. “The original piece of work that resulted in the original patent filing was a BBSRC-funded PhD,” says Professor Andrew Porter, Chair in Molecular and Cell Biology at the University of Aberdeen and Chief Technical Officer at Elasmogen.

Haptogen was subsequently bought by the US pharmaceuticals company Wyeth in 2007 for an undisclosed sum, before Wyeth itself was acquired by Pfizer in 2009.

Establishing Elasmogen

Throughout the company acquisitions, the VNAR IP remained with the University of Aberdeen, exclusively licenced to the companies involved. In 2011, when Pfizer exited the UK, the University took the bold step of taking back the licence.

“The technology itself has had the benefit of both biotech innovation plus pharma development spend,” says Barelle.



Humanised VNAR or soloMER binding its target – purple areas of the binding protein remain shark whilst the pink areas are now human.
Image: Elasmogen Ltd

Spin-out success

Barelle and team at Elasmogen have won several awards for the company. These include winning the “Perfect Pitch” competition at the BioTrinity 2016 conference, which brings together investors, pharmaceuticals executives and life science companies. Elasmogen was one of 10 companies selected from 104 showcase companies at the conference to pitch to a panel of experienced investors, and eventually won the competition.

The company was also the runner-up in the 2016 Converge Challenge – a “company creation competition and entrepreneurship development programme for staff, students, and recent graduates of Scottish Universities and Research Institutes” that aims to promote entrepreneurial skills in Scotland. They received a cash prize and in-kind support for various activities.

Elasmogen was short-listed for the OBN Awards 2016 in the Best Start-up Biotech category. The awards recognise



innovation and achievement in UK life sciences. OBN is a not-for-profit membership organisation supporting UK life science companies and bringing them together with investors and corporate partners.

BioTrinity: www.biotrinity.com/

Converge Challenge: www.convergechallenge.com/en/challenge/converge-challenge-2016

OBN Awards: www.obn-awards.com/

“However there were still considerable gaps left in taking VNARs from the lab to patients. When Pfizer exited the UK, [the IP] all rolled back to the University of Aberdeen and Andy [Porter] and myself took the opportunity to start a new company. What we needed was the kind of funding to take where the technology had got to, towards something that would be clinically acceptable.”

To do so, the researchers were awarded a BBSRC follow-on fund grant⁵, which enabled Porter and Barelle to develop NDure™; NDure can be used alongside other protein based medicines to increase the amount of time they spend in the body from hours to many days, thus increasing their therapeutic potency.

The BBSRC investment also allowed the researchers

to humanise the VNARs, to prevent them from being targeted and removed by a patient’s immune system. By tweaking the sequence of amino acids from which the VNAR proteins are built, the researchers could make the molecules effectively invisible to the human immune system without altering how they function. The team named these humanised VNARs soloMERs™.

The researchers patented both the NDure domain itself and the process by which they humanised the VNARs. “Even more important than the domain itself is the process of humanisation,” says Porter. “While the domain is a very useful and licensable asset - we now call it NDure - the blocking IP we get from humanisation is absolutely fundamental to our business.”

“Probably the most important thing to come out of the

BBSRC follow-on fund grant, commercially, is going to be that soloMER IP, and the ability to block others moving into our space.”

In 2015, Barelle received a Royal Society of Edinburgh/ BBSRC Enterprise Fellowship which enabled her to establish the company, together with funding from Scottish Enterprise. A small BBSRC Sparking Impact award also supported commercialisation consultancy work to help develop plans for the new company.

“The BBSRC played a key role for me personally as well, because I was very fortunate to receive a Royal Society/ BBSRC Enterprise Fellowship,” says Barelle. “What it effectively did was enable me to do all the competitive landscape analysis, the breakdown of finance, cashflows and everything associated with the business. Take a step back and look at the technology: What we had, where the BBSRC grant had taken us.”

“It also provided me with a very useful network of investors



Elasmogen is working in collaboration with pharmaceutical companies Almac Discovery and Merck Group. Image: Elasmogen Ltd

and commercially-savvy people.”

This all came together in February 2016 when Elasmogen was spun-out of the University of Aberdeen.

Licensing the technology

Since its launch, Elasmogen has won several awards (see box ‘Spin-out success’) and is actively looking to licence its technology. For instance, the company is working with major pharmaceuticals company Merck in the field of bioprocessing.

Elasmogen researchers are also collaborating with Almac Discovery to develop a novel anti-cancer medicine. It will incorporate a soloMER domain to target the cancer-causing cells that form the tumour, the NDure domain to ensure the drug lasts longer in the body, and a toxin supplied by Almac, together with the chemistry expertise to attach the toxin to the soloMER, to destroy the cancer cells. The size of the soloMER domains means the resulting drug molecule will be small, allowing it to penetrate within solid tumours and deliver the toxin more effectively.

The company’s own drug development programme is focussing on new ways to treat inflammatory eye disease, particularly for patients that do not respond to existing treatments⁶. “Another area we’re interested in is eye disease, particularly inflammatory eye disease,” Barelle explains. “We were at an ophthalmology conference, a really specialised conference, and we won the pitch competition there as well. The key benefits of the technology for ophthalmology are its small size and stable nature that allows the potential for site-specific delivery of our soloMERs without ocular injection.”

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