
UNIVERSITY OF
CAMBRIDGE
enterprise
/Where ideas thrive
Annual Review
2019

"At the heart of our University's mission is a commitment to nurturing research that has social, economic and cultural impact. This Annual Review offers further evidence of the many ways in which Cambridge Enterprise helps our globally-leading researchers to have world-changing impact through the development and deployment of their extraordinary ideas."

Professor Stephen J Toope
Vice-Chancellor

Part of the University of Cambridge, Cambridge Enterprise supports academics, researchers, staff and students in achieving knowledge transfer and research impact. We do this by helping innovators, experts and entrepreneurs use commercial avenues to develop their ideas and expertise for the benefit of society, the economy, themselves and the University.

Liaising with organisations both locally and globally, we offer expert advice and support in commercialisation and social enterprise, including help with academic consultancy services; the protection, development and licensing of ideas; new company and social enterprise creation and seed funding.

Contents

The carbon nanotube illustration on the cover was chosen to celebrate major developments this year with Granta Design and CASTEP. Both pioneers in materials software, Granta Design and CASTEP are also two of Cambridge Enterprise's longest-standing cases.
See pages 2-5 for the full story.

A letter from the Chief Executive

Looking back over the past year, a clear theme emerges: Cambridge Enterprise's work does not end when a deal is complete. This was illustrated twice over in our work helping Granta Design and CASTEP reach important commercial milestones. In 2019 Granta Design was acquired by US-based ANSYS, and CASTEP's licence was renegotiated to allow it to reach new markets. Both pioneers in the invention of materials software, Granta Design and CASTEP are also two of our longest-standing cases. It is a great pleasure to have supported both through 25 years of change and growth.

The past year also saw Cambridge Enterprise supporting cutting-edge technologies, including quantum cryptography spin-out Nu Quantum and PolyProx Therapeutics, which is developing a new class of drugs to treat undruggable cancers. These projects—and the brilliant people behind them—make Cambridge one of the richest sources of deep tech innovation in the world.

In 2019 Cambridge Enterprise also supported a wide array of consultancy projects outside the University, enabling researchers and staff to share their expertise with governments, businesses, agencies and other entities around the world. Experts from the Institute of Criminology, for instance, have trained Indian Police Service officers and leaders in Evidence-Based Policing, an approach developed and championed by University researchers that is changing police work globally.

This year also marks the midpoint of a two-year pilot to advance the support Cambridge Enterprise provides to our colleagues in the arts, humanities and social sciences. We want to find better ways to aid the creation of impact in areas as diverse as video gaming, climate change, ethics and regulation, public health and the societal adoption of new technology.

In 2016 we surveyed 4,344 University research staff to find out their perception of our services. The response then was that 87 percent of those who had worked with Cambridge Enterprise would recommend us to their colleagues. This past year we went back to University staff again. I am pleased to report that now 91 percent of those who had worked with Cambridge Enterprise would recommend our services.

In the coming year we will continue to refine and expand our services. Along these lines, this year's Annual Review takes a different tack, focusing on a few representative stories and individuals. We hope you find this approach engaging. Please let us know your thoughts on this or any aspect of our work.

Dr Tony Raven

Granta Design and CASTEP

Supporting materials software pioneers for 25 years

Cambridge Enterprise's work does not end when a new licence is signed or a new company spins out of the University. After intellectual property (IP) is licensed, Cambridge Enterprise remains involved, making sure that the IP is developed properly and stepping in if changes need to be made. When a new company spins out of the University, a member of our staff often sits on its board, ready with advice and connections. Sometimes they remain for decades. As spin-outs grow and commercial contexts change, we continue to help inventors and founders realise their vision.

This point is illustrated twice over by Cambridge Enterprise's work with Granta Design and CASTEP, two of our longest-standing cases. Both are materials software cases, and both reached important commercial resolutions in 2019.

After 25 years in operation, Granta Design's founders and management decided it was time to determine its next steps. Following a thorough search, supported by Cambridge Enterprise, the company was acquired by US-based ANSYS Inc. It was the happy union of a materials information software pioneer with an engineering simulation pioneer.

In the case of CASTEP, the company that had licensed and distributed the software for many years, Accelrys, was acquired by Dassault Systèmes. After a revision of the licensing and support agreements, new agreements came into effect in January, paving the way for broader application of CASTEP for years to come.

Granta Design

Founded by Professors Michael Ashby and David Cebon, Granta Design spun out of the Department of Engineering in 1994. Richard Jennings, then Director of the Wolfson Cambridge Industrial Unit, joined the company's Board at the outset and remained until its exit was completed 25 years later.

Ashby and Cebon's work revolutionised the way materials are selected when products—from silicon chips to aircraft—are developed. With advances in metals, plastics and other materials, including innovations in composites, industry has ever more options from which to choose. And as the number of available materials has multiplied, industry has also needed accurate and traceable materials information to ensure that decisions about design, manufacture, maintenance and recycling are fully informed. Granta Design's software for managing materials information and its extensive databases of reference materials information make this not only possible, but optimal.

Ashby and Cebon's innovation began with gathering broad information about the properties of materials. Using this data, they devised a graphical approach (commonly known as an 'Ashby plot') for visualising this complex information and implemented it in software, originally named the Cambridge Materials Selector. The software guides the choice of material using a performance index based on the functions required of a potential product.

Granta Design spun out in 1994 and for several years focused on the educational sector. It moved into the industrial market in 2000, with investment from ASM International, a large professional society for materials engineers. At this time Granta Design also brought on board another Cambridge Enterprise contact, scientific software entrepreneur Patrick Coulter, as chief operating officer. The company took no further outside investment, instead growing organically. It expanded its product range, added offices in Germany and the US, and saw its annual turnover grow to £14.5 million and its staff to 180 by 2019.

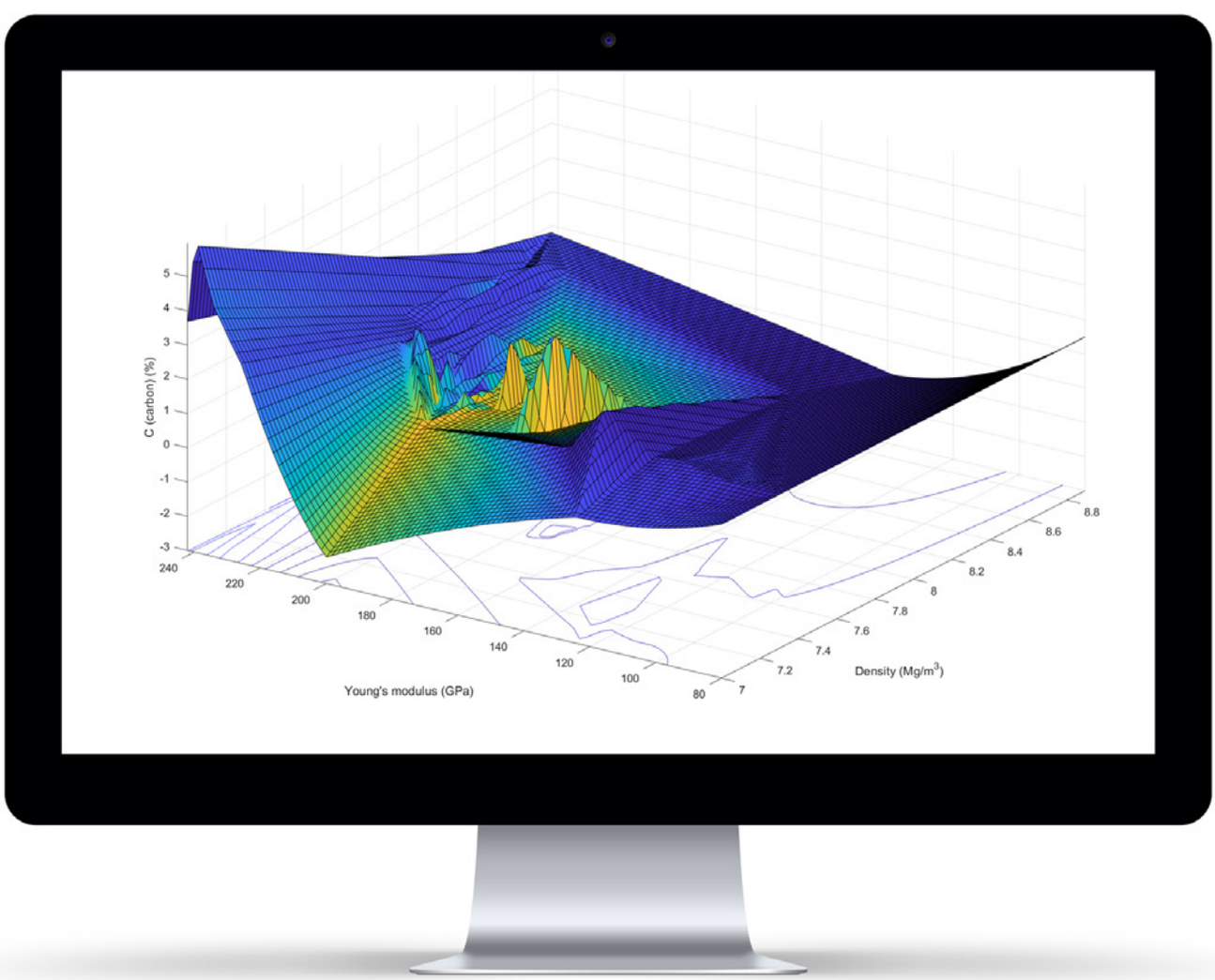
Granta Design's customers include Airbus, General Motors, Emerson Electric, Lockheed Martin, NASA and Rolls-Royce. Granta Design's pedagogical work continued as well. Its CES EduPack was the world's leading teaching resource for materials engineering, science, processing and design, used by over 1,000 universities and colleges worldwide and approximately 100,000 students per year.

As Granta Design celebrated 25 years in operation, its founders were still actively involved but had started to think about the next steps. At about the same time, a semi-retired investment banker and angel investor, James Viggers, approached Cambridge Enterprise to offer his expertise. The timing was fortuitous. Viggers joined the Granta Design board and worked closely with the founders and management to ready the company for sale and guide it through the process.

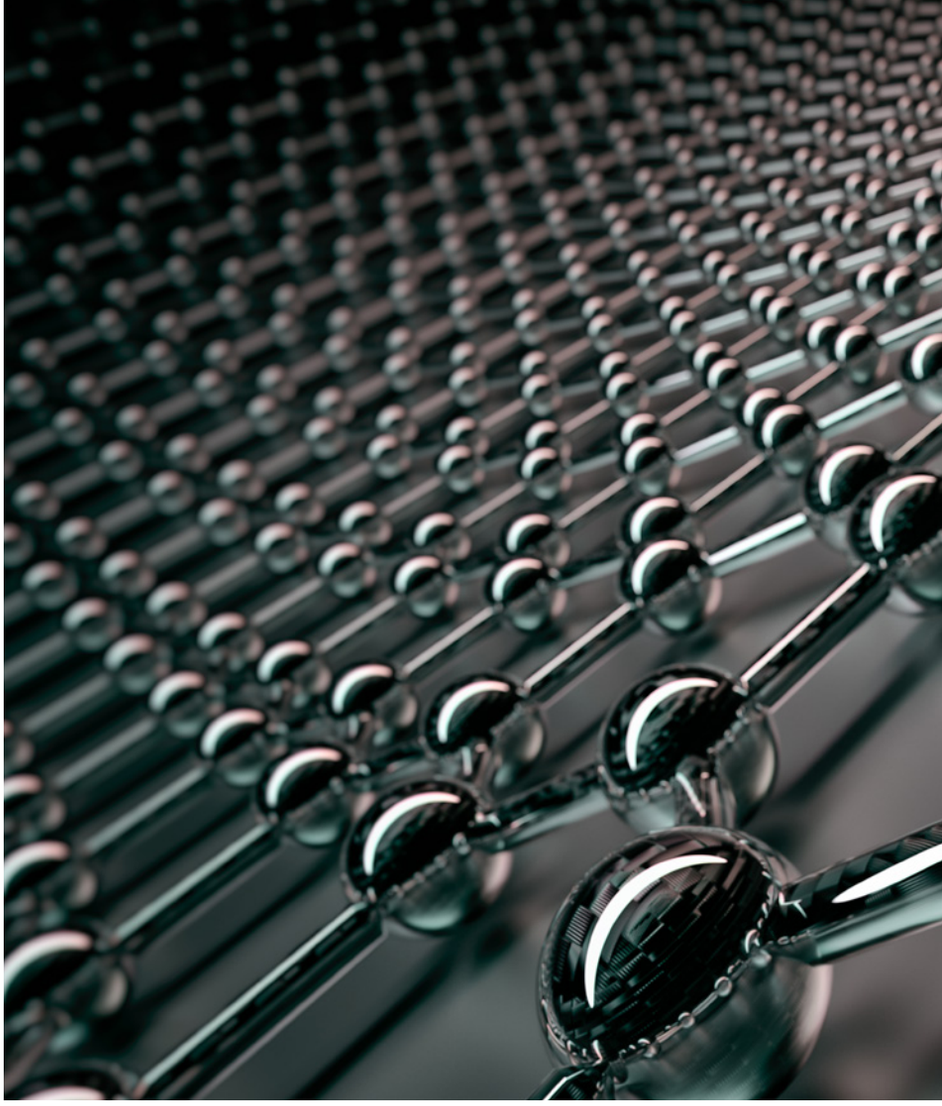
Key priorities for the management team were finding a partner that was a proper cultural fit and making sure that this partner fully shared Granta Design's mission for advancing materials intelligence. The end result of a highly competitive sale process was the successful exit in 2019 to ANSYS, with which Granta Design had collaborated for some years.

It was an excellent match. A publicly-traded company, ANSYS develops and sells software to simulate engineering systems. Founded in 1970, it has over 3,000 employees and 40,000 customers worldwide, including leading companies in aerospace, automotive, defence, electronics, energy, materials and chemical processing, turbomachinery and consumer products. The sale of Cambridge Enterprise's equity returned a large sum to the Department of Engineering and the University.

Former Deputy Director of Cambridge Enterprise, Richard Jennings, who steadfastly supported Granta Design through its spin-out and development and served on its board for 25 years, said "Granta represents the best of technology transfer. Its acquisition confirms the outstanding quality of the technology and once again enables the work of leading Cambridge academics to have a true global impact."



GRANTA MI, the leading system for enterprise materials information management, analyses property data captured in the system.



CASTEP

CASTEP is a computer code that utilises quantum mechanics to predict the properties of novel materials before they are created. Its origins date to the late 1980s in the Theory of Condensed Matter Group, which was led by Professor Mike Payne, in the Department of Physics. The code could compute a system's total energy, the forces on the atoms and the stresses. It was named the CAmbridge Serial Total Energy Package. CASTEP can determine what the most stable structure of a new material will be, what its surfaces will look like and how both the bulk and the surface will behave when exposed to different chemicals.

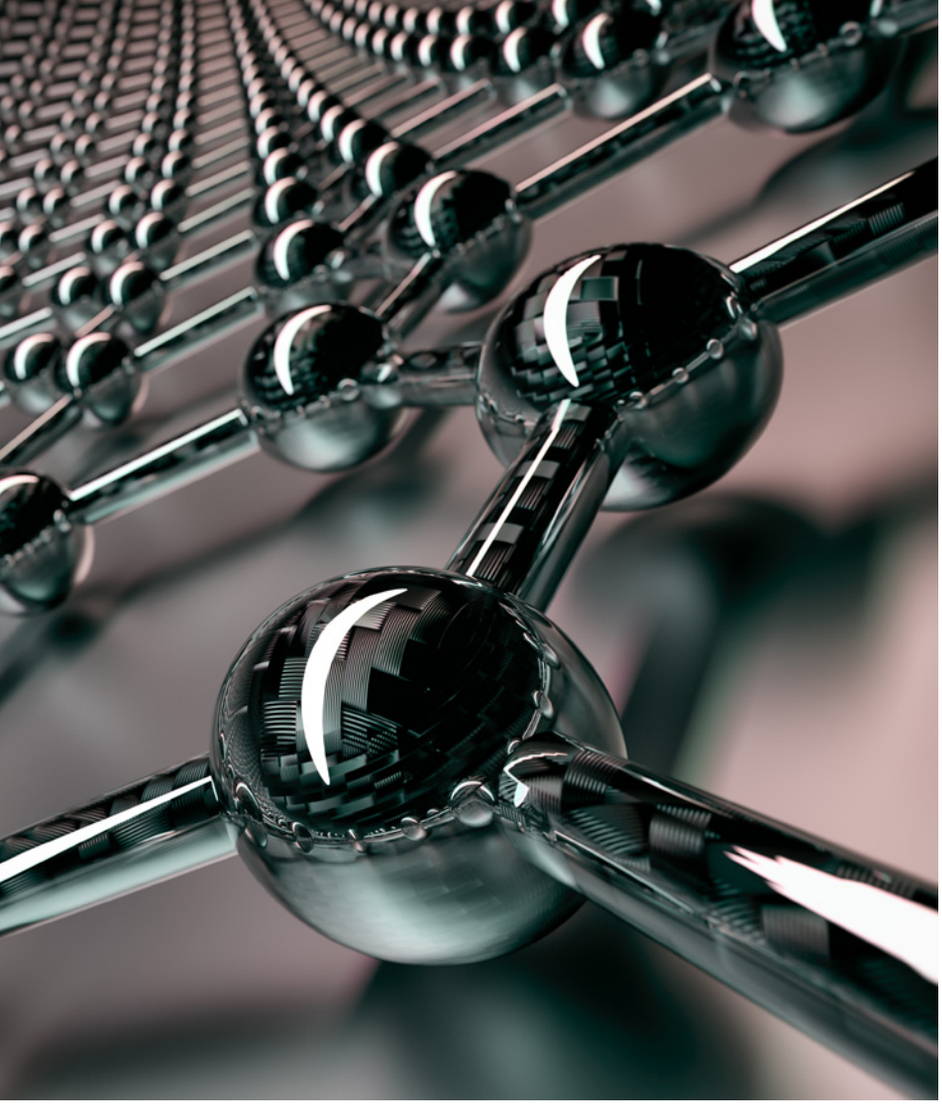
CASTEP supports research on materials and processes by offering a unique 'atom by atom' perspective. The code is based on density functional theory, which allows the energy of a system of electrons to be calculated from the density of those particles. Researchers can 'pour' electrons into the CASTEP box, and the software works out how the electrons will be distributed and, from this, determines the energy of the system. It can determine whether the atoms are located where they should be and help rearrange them more favourably. CASTEP can also predict many different spectra, such as infrared or nuclear magnetic resonance, allowing numerous physical and chemical properties to be determined using a single piece of equipment.

"When CASTEP came along, for the first time you could learn something about the system before the system was even made," says Payne. "It was basically the first materials code where all of the complexity was taken out, and you are left with a black box that is rigorous, robust and reliable."

Available as shared source code to researchers, CASTEP was first licensed, in 1994, to Molecular Simulations International. The terms gave a share of the royalties to the University and allowed the original authors to retain control of the code's development. In 1995, Molecular Simulations was acquired by Accelrys Inc., which handled sales of CASTEP for almost 20 years.

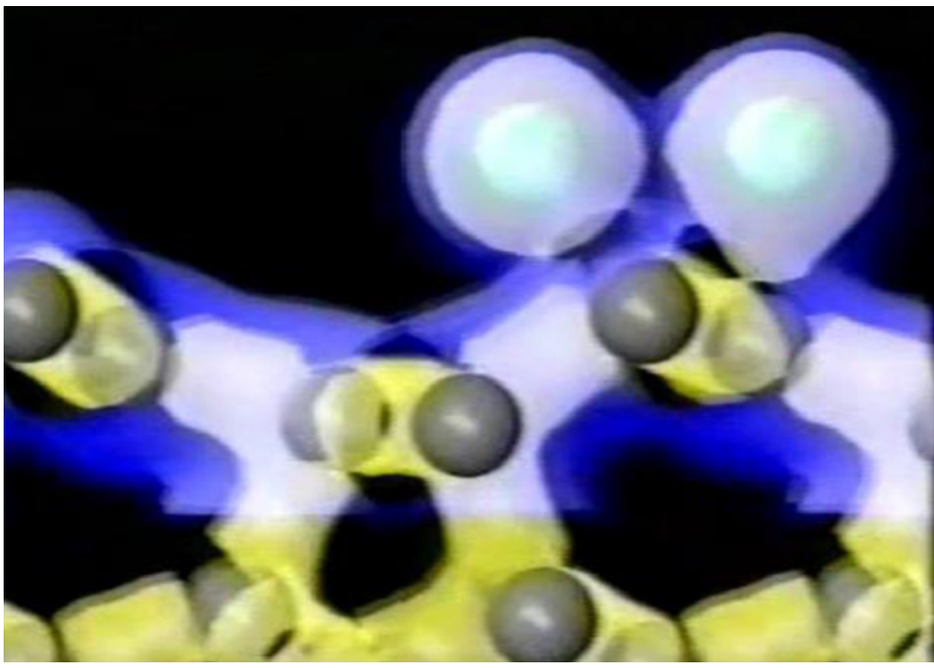
In 2000 a group of young researchers, dubbed the CASTEP Developers Group, rewrote the code in a more robust form. They have continued to develop and improve it ever since. One of the CASTEP Developers Group is Chris Pickard, now the Sir Alan Cottrell Professor of Materials Science. Cambridge Enterprise negotiated revised terms for CASTEP with Accelrys at this time, as well as subsequently licensing new and complementary software packages to Accelrys.

Through the Accelrys distribution channel, CASTEP was widely used in a variety of manufacturing industries. In 2014 Accelrys was acquired by Dassault Systèmes and renamed BIOVIA. The CASTEP Developers Group turned to Cambridge Enterprise to work with Dassault to conclude new licences that came into effect at the start of 2019. We now look forward to many more years of success and the broader application of CASTEP to new industrial problems.



Granta Design and CASTEP are pioneers in the field of materials software. They are also two of Cambridge Enterprise's longest-standing cases.

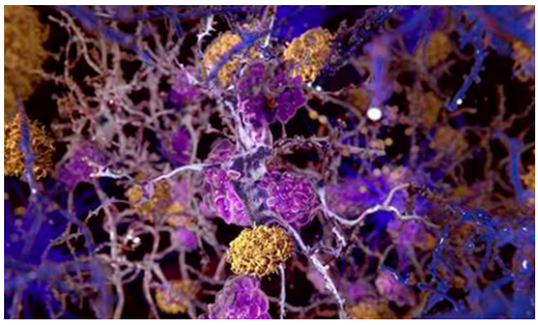
This still image from a dynamic simulation represents a breakthrough moment for CASTEP, in the early 1990s. It shows a chlorine molecule as it bonds with a silicon surface and dissociates into two chlorine atoms. Chlorine atoms are shown in green and silicon atoms in grey. The diffuse clouds show the electron density.



"When CASTEP came along, for the first time you could learn something about the system before the system was even made."

Professor Mike Payne

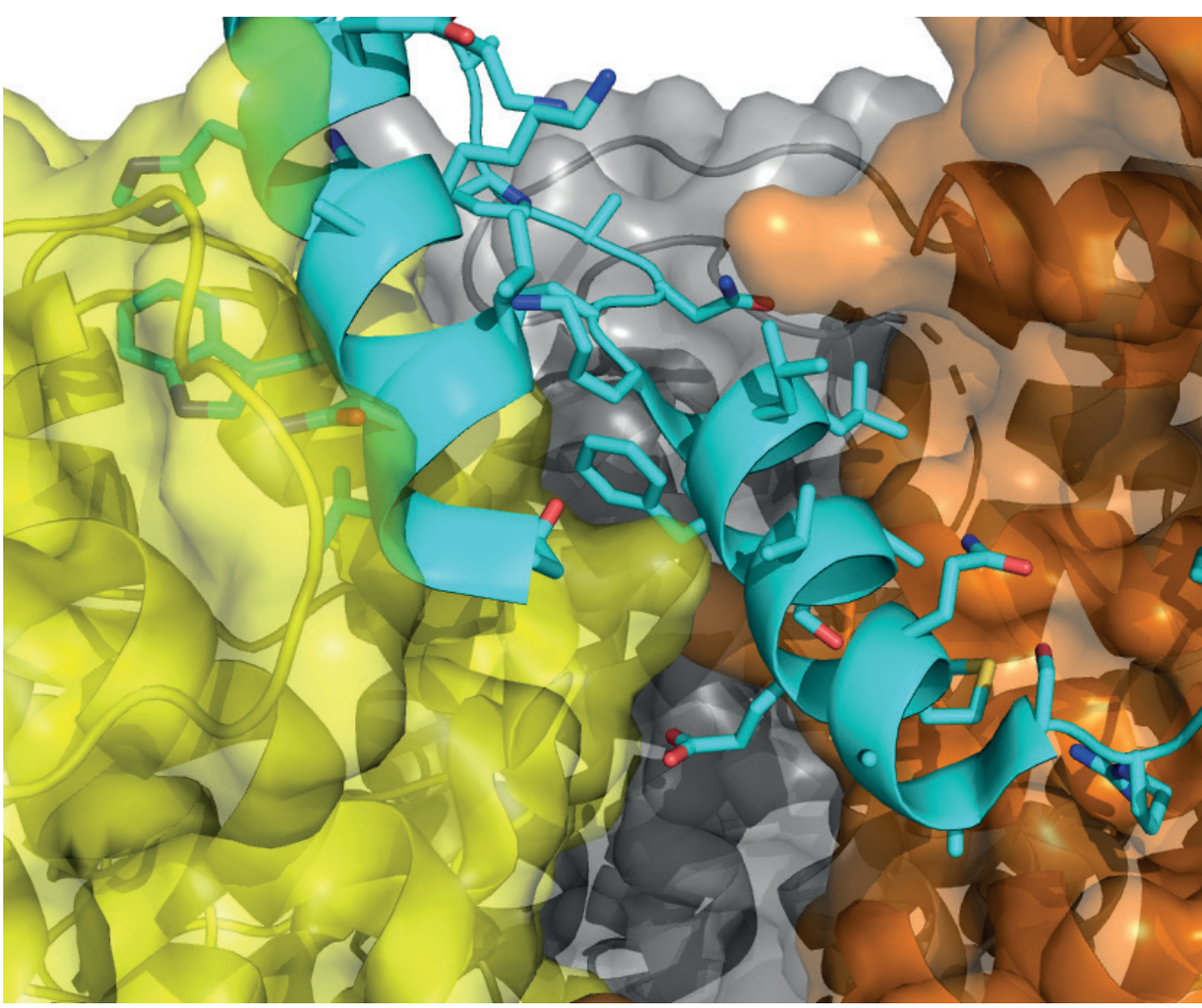
The protein-degrading drugs PolyProx Therapeutics is developing are not just potential cancer treatments. They could also help to treat other diseases involving faulty proteins, such as Alzheimer's.



"Without the intellectual input and strategic, business and IP know-how of Cambridge Enterprise, I would not have been able to realise the commercialisation of my research. It has been a great privilege to work with them. They are most definitely unsung heroes of the University."

Professor Laura Itzhaki

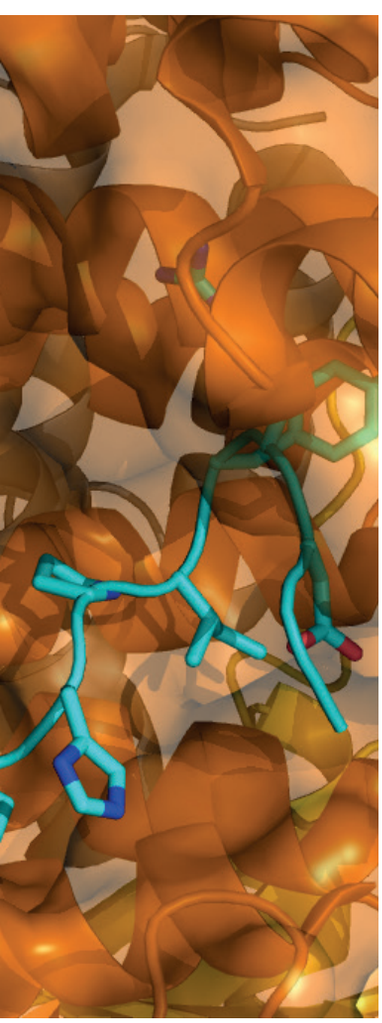
Spin-out PolyProx Therapeutics is developing a new class of drugs, Polyproxin® molecules, that selectively target disease-causing proteins and use natural cellular pathways to destroy them.



PolyProx Therapeutics

A new class of drugs to halt difficult-to-drug cancers

In April PolyProx Therapeutics announced it had raised an impressively large seed round of £3.4 million. A spin-out of the Department of Pharmacology, PolyProx Therapeutics is based on over a decade of research and intellectual property from founder Professor Laura Itzhaki's lab—as well as six years of support from Cambridge Enterprise.



PolyProx Therapeutics exists to develop a new class of drugs, called Polyproxin® molecules. The molecules selectively target disease-causing proteins inside tumour cells and trigger their natural degradation mechanism, halting tumour growth. The technology behind this approach uses protein 'scaffolds' to hold —and link together—an element targeting the cancer-causing protein at one end and a degradation trigger at the other. It's an approach that has the potential to hit key drivers of tumour growth in lung, colorectal, pancreatic and liver cancers that cannot be targeted with current technologies.

Itzhaki first met with Cambridge Enterprise's Technology Transfer team in 2013. Over the next four years they discussed several possible translational projects, including the one that became the basis of the PolyProx IP, which captures a platform to make Polyproxin® molecules.

In 2017 Cambridge Enterprise made the first two of what would ultimately be 15 patent filings and arranged initial meetings with venture capitalists to gather feedback. The response was positive, and the following year the Seed Funds team awarded PolyProx a £20,000 Pathfinder loan to hire a consultant to help frame the value proposition, articulate the commercial strategy and build the pitch.

Activity intensified in 2018 as the Tech Transfer and Seed Funds teams worked to support PolyProx's creation, developed its business plan, identified an executive chair, negotiated the legal agreements and set up revenue-sharing arrangements with the charitable funders that had supported Itzhaki's lab. "We worked very intensively together, including almost daily meetings over a period of several weeks during patent filings and investor pitches," said Itzhaki. "I can honestly say that those weeks were some of the most enjoyable, exciting and intellectually stimulating of my 30-year research career—to the extent that in the following weeks I missed our daily interaction!"

The financing, which was co-led by Cambridge Enterprise, sister organisation Cambridge Innovation Capital (CIC) and RT Capital, supports research operations to validate the technology across a range of tumour targets over the next two years.

Nine months after the deal closed, PolyProx Therapeutics is settled in its own labs at the Babraham Research Campus with an experienced science and management team including serial Cambridge biotech entrepreneurs Andy Sandham as executive chair and Kevin Moulder as chief operating officer. They are building libraries of Polyproxin® molecules and generating data. A member of the Seed Funds team continues to provide support as part of the company's board.

Building a quantum cryptography company

A conversation with Nu Quantum co-founder Dr Carmen Palacios-Berraquero

Q: Carmen, you submitted Nu Quantum to our Postdoc Business Plan Competition in 2018 on your own. Now you have a co-founder, Matthew Applegate. How did that change occur?

A: Matthew and I both did our PhDs and postdocs here at the Cavendish. Each of us came up with a technology that led to a patent.

Q: And you subsequently found out the technologies fit together?

A: Yes. Matthew and I met in 2019 and saw that our technologies made sense together, in systems and components and as a vision. I had a patent for a device that emits single photons. And Matthew had a patent for a device that detects single photons. They both work at room temperature, on a chip, and they are compatible in wavelength.

And we saw not only that our technologies made sense together, but we, as two people, also make a lot of sense together. I wanted to have the CEO role, and he wanted to have the CTO role—and our personalities completely matched to those roles. We just actually get along really well and have a lot of fun together.

Q: So, Nu Quantum now has technologies for the two ends of a quantum system: one device that generates quanta and another that detects them?

A: Not only that, actually. Matthew spent his whole PhD working on quantum random number generation and has quite a lot of IP around the design and algorithms that one needs to generate encryption keys out of quantum measurement. We have several components that can also be put together into systems, and we have three quite strong areas of IP and know-how.

"If Cambridge Enterprise hadn't encouraged me to commercialise our patent, I would never have even thought about starting anything. And that's continued: they helped with our business plan and strategy and made introductions to many of our current investors. I'd say that Cambridge Enterprise has been instrumental."

Q: So, you don't need to go outside of the two of you. And you have the IP depth behind that, which will enable you to get more investment.

A: Yes. That's why we've had investment already, because we have a strong technology, a big, exciting market and a strong team. It's what they tell you in Entrepreneurship 101 that investors look at. But it's just actually what makes sense for us, in order to plunge into this.

Q: Nu Quantum is just the two of you?

A: We're actually four co-founders. Matthew and I are both 100 percent fulltime working on this. Professor Mete Atatüre, who was my PhD supervisor, is our chief scientific officer. He's a world expert on quantum optics and quantum devices and their applications. And our chief business officer is Yuri Andersson, who's founded many, many start-ups and is very involved in the quantum technologies area.

Q: He's been there before.

A: Yes, many times. He gives us that solid business entrepreneurship advice.

Q: Tell me about your vision for Nu Quantum.

A: Quantum technologies is about manipulating single quanta—the smallest packets of matter or of energy, of light—to make either very, very powerful computations or very sensitive measurements. There's a third thing that you can do, which is to improve cyber security. This is what we are focusing on first.

We're doing so in two ways, by working with different partners. I mentioned that we have IP related to random number generation. One can utilise these single photons to make a measurement. The unpredictability in that measurement can be used to extract very secure encryption keys.

Q: Because it's truly random?

A: That's right. According to quantum theory, and barring any imperfections in physical systems, quantum measurement is unpredictable. So, if you have something that emits quanta and something that detects it, you can make a quantum measurement. From that you can extract these very unpredictable numbers, which make for very secure keys.

Q: How are they used?

A: The encryption keys can be used for many applications. Random numbers are what seed many encryption processes across many industries. With Nu Quantum, we're trying to establish national and global capability for single photon components. We're focusing on communication first. The vision is to work with telecoms companies, integrating our key generation and key exchange into the 5G communication infrastructure.

Q: Can you explain that, please?

A: There's two things that quantum can make a difference with in terms of cyber security. One, you can generate keys. The second thing is to use the single photons to communicate these very secure keys between parties in a way that is absolutely secure because any interception will leave a trace. We have the components that could go into both the generation and the distribution of the keys.

Q: Is this in your business plan?

A: The roadmap is we're developing our components, which could be the backbone for many quantum systems. These technologies are unique in the UK and globally. We think we have a very strong advantage in that we have components that are flexible.

Q: You've made amazing progress with Nu Quantum in a very short time. Did you ever think, when you were doing your PhD or your postdoc, "I'm going to leave academia and become an entrepreneur?"

A: No, I thought I was going to be an academic! But this is really fun. I'm learning so much about so many different things. It was unexpected, but it seems natural.

Q: It suits you and it suits Matthew?

A: Yes, yes, for both of us. Perhaps we didn't see this coming, but now that it's happening, we're almost not so surprised. It seems like it fits.

Q: Other than the Postdoc Business Plan Competition last year, have you had much interaction with Cambridge Enterprise?

A: Working with Cambridge Enterprise has really, really made a difference. For Nu Quantum to happen, it's been very important to spend time with them. If they hadn't encouraged me to commercialise our patent, I would never have even thought about starting anything. And that's continued. They provide context and push, helped with our business plan and strategy and made introductions to many of our current investors. I'd say that Cambridge Enterprise has been instrumental.

Dr Matthew Applegate and Dr Carmen Palacios-Berraquero, two of the co-founders of Nu Quantum.

Sharing expertise outside the University

Evidence-Based Policing goes to India

About 30 years ago, Professor Lawrence Sherman made a shocking discovery about crime in Minneapolis. "We found that 3 percent of the addresses had over half of all the crime," he says. "This huge concentration created an opportunity to use massive increases in the proportion of time police spent in high-crime locations to see whether that would reduce crime." Beefing up police presence in these hotspots cut the overall number of crimes in the city dramatically.

The Minneapolis experiment was a decisive moment in the development of what Sherman would later term "Evidence-Based Policing" or EBP. The approach, which emphasises statistical analysis and randomised controlled trials to inform policing strategy and tactics, would eventually lead Sherman to Cambridge, where he is now Wolfson Professor Emeritus at the Institute of Criminology. He has collaborated with over 50 police and justice agencies around the world, and is known as a founder of experimental criminology.

EBP, developed and championed by Cambridge researchers, is changing police education and police work around the world. Sherman's research, and that of colleagues such as Dr Heather Strang, an expert in police-led restorative justice, Director of the Police Executive Programme and Director of Research at the Jerry Lee Centre for Experimental Criminology, have made the University's criminologists widely sought-after for educating police officers in the application of EBP.

Cambridge Enterprise's Consultancy Services team was created to facilitate precisely this sort of expertise-sharing outside of the University. The team first worked with Sherman in 2015, when he led a large-scale policing experiment to cut homicides in Trinidad and Tobago, the first of its kind worldwide. The project involved training 200 police leaders in EBP, through seminars, discussions, research projects, data management, supervisions and exams.

The outcome of the experiment? Hotspot policing was found to reduce murders and shootings by 40 percent.

Last year Sherman, Dr Peter Neyroud and other colleagues from the Institute of Criminology were contracted to run a two-year programme to train 600 mid-career police chiefs in India. Working with the Sardar Vallabhbhai Patel National Policy Academy, the top police training institute in India, the programme covers police professionalism, EBP, hotspot policing, drug trafficking, hostage negotiation, body-worn cameras and police ethics. Having concluded its first two years, the programme has been judged a success. It was recently presented to Prime Minister Narendra Modi and the Indian Director-Generals of Police at the PM's annual conference with senior police chiefs in Pune.

Changing the culture of a police force is not a simple task, but it is one that the University is well-equipped to handle. "We don't see police leadership training as a process of getting people to memorise things; we see it as a process of getting people to understand," Sherman said. "This is the way that organisations should be learning, and the University has a definite role to play in that. Applying scientific testing, targeting and tracking of police resources to make police more effective, especially during times of budget constraints, is a winning formula."

A crime scene investigator marks the location of discarded bullet sleeves.

Indian Police Service officers attending a Mid-Career Training Programme pose with Professor Sherman in front of New Scotland Yard in June 2019.

"We don't see police leadership training as a process of getting people to memorise things; we see it as a process of getting people to understand. This is the way that organisations should be learning, and the University has a definite role to play in that."

Professor Lawrence Sherman

Lessons from a master

A conversation with Professor Florin Udrea

Q: You have an incredible record of commercialising research. Can you give me a summary?

A: I've co-founded five University spin-outs: Cambridge Semiconductor [CamSemi], Cambridge CMOS Sensors, Camutronics, Cambridge GaN Devices and Flusso. The first two have been sold, with tens of millions of pounds evaluation. I've also worked through Cambridge Enterprise's Consultancy Services team for years.

Q: When CamSemi, a fabless semiconductor company, spun out of the University in 2000, it was the first academic spin-out in the power devices field anywhere in the world. Cambridge Enterprise didn't exist yet. That must have been a very steep learning curve.

A: Yes. In 1999 Professor Gehan Amaratunga and I met with Richard Jennings, who was the head of Cambridge University Technical Services (CUTS) and Nick Slaymaker, a CUTS director, to discuss a new power device. We'd been researching and developing the technology for 15 years. And we had worked with seven major semiconductor companies, some of which had funded our research, so we had some experience with technology transfer. But the new device was a blue sky invention.

That meeting with Richard and Nick was the beginning of CamSemi. Fifteen years later, CamSemi chips were in 25 percent of all the chargers for Nokia phones. CamSemi would ultimately sell over a billion chips for power supplies.

Q: Academics often are told that forming a company is smart because it protects them from legal risk and gives investors clarity. Is that why you decided to spin out CamSemi, rather than licensing the technology to an existing company?

A: We weren't motivated by any of that! All my co-founders and I have wanted to form companies because we wanted to see our 'academic' technology put to work in commercial products. We dreamed of revolutionising the world with our 'avant-garde' technologies.

The original idea behind CamSemi was disruptive, but well ahead of its time, but we kept innovating once we formed the company. Credit should also be given to all the employees who really believed in CamSemi.

"There is always excitement in very fundamental research, there is no question. But there are a lot of interesting things happening when you actually try to translate an idea into practice. Innovation can be at different levels."

Q: What lessons did you learn from CamSemi?

A: We learned a lot. We were known in the field before as people who are very active in academia, doing our studies using semiconductor simulations or occasionally carrying forward to the proof of concept stage, but never beyond the prototype stage. After we deployed our first products in the market and they became very successful, the community took us very seriously. Suddenly our profile in the field was raised. We were not seen as merely 'interesting' academics any more but as successful entrepreneurs who were able to move freely from the academic circle to the industrial stage.

Of course we didn't do everything right. There were many things we did wrong. We were not used to the world of venture capitalists. We didn't know, for example, what preference shares were. We didn't know and, to be honest, neither did the University. We have sort of experimented, and the University was experimenting as well, there's no question about it.

Q: Can you elaborate on this mutual 'experimenting' and learning that CamSemi and the University did together?

A: For example, there was no University director on CamSemi's board. The University invested in us right at the beginning, and yet they did not take a seat on our board. Things have changed so radically since then. With my second company, Cambridge CMOS Sensors, Anne Dobrée stayed as a director, all the way from the beginning to the exit. She's been a great asset. The University director's mission is to protect the University's investment and to protect the founders.

Ultimately their mission is also to create value for the University in more ways than just returns to the investment fund. There are so many ways this impact can be measured, which is different from the impact, for example, you create for angels or venture capitalists.

Working in a spin-out company allows one not only to carry out leading-edge research, but also to have access to the resources of implementing new ideas and concepts in sophisticated products, which creates real societal value. Job creation, enabling carrier opportunities, carrying out joint research projects with the University and other partners are other important metrics in the hidden impact of spinning out a company.

Q: As a scientist, have you found applied research less intellectually engaging than pure research? And how does entrepreneurship compare?

A: There is always excitement in very fundamental research, there is no question. But there are a lot of interesting things happening when you actually try to translate an idea into practice. Innovation can be at different levels. Then from applied research there is the question of how to actually make a business out of it. That's also an interesting and possibly innovative part.

Q: As exciting as doing fundamental research?

A: Yes.

Q: Because you're seeing it actually used?

A: Yes. Some people have the idea that it's much more superficial. It isn't. It's very exciting, because you have different kinds of constraints. Maybe the analysis is different, but in terms of innovation, in terms of the ideas that are emerging from the applied research to translate to the market, in terms of innovation, it's as fascinating as research at the PhD level.

Q: So, it wasn't the money that drew you back to founding companies?

A: [Laughs] Yeah, another four times! Some people believe that spinning out a company is all about money. It's not. There is, as I said, a level of innovation that is extremely exciting. And there is something else that happens. In a new company, things move at a very fast speed. In a spin-out things are happening all the time; it's much, much faster. You see your ideas tried almost instantly. And that allows you to generate new ideas in a cascaded manner. The process of innovation is in fact hugely accelerated. There is also the sense of venture, excitement and team spirit that surrounds a spin-out.

Q: You're forced to seize the moment?

A: Yes, exactly. So, it's not all about making money. In fact, CamSemi honestly didn't make that much money. It did, however, create so much impact for the University. It raised the profile of our group. It brought many projects to the University, not because the University was famous in the field, but because the company itself became famous. And that's very, very interesting. And because we had the power to do what the University couldn't do. The University was able to do very deep analytical modelling and simulations. So, in effect, the company and the University worked extremely well in tandem.

Q: Are there other lessons from your experience with CamSemi you can share?

A: Money does not necessarily enable things. You need to be careful with the resources used, grow organically and not give up shares immediately. "Do not take preference shares" was a very strong lesson that I learned, and I'm trying to teach that lesson. Unfortunately, at the later stages, other investors and especially venture capitalists want preferences.

The problem is that it makes different classes of shares, which means you are valued less than a later investor is. This is something that I can't approve of. While they put in money, I put in my time, my energy, my expertise and my soul and this should be as valuable as the money. With Cambridge CMOS Sensors we had one class of shares, and it worked. Investors made a lot of money in the exit. As a founder, I would like to be equal to the people that put money in because I put my effort and my soul into the business.

Q: You've used the word 'soul' several times.

A: Yes, that's a very important lesson. A company needs a soul. Because if you don't have a soul, in the company, you are not going to succeed. There are a million things which can cause a small company to fail against big competitors. The only chance of succeeding is that strong soul of the founders or the founding team and the team spirit of the employees.

Cambridge Enterprise is almost like a co-founder because they invest exactly that sort of energy and incredible enthusiasm for the business. I experienced that myself with Cambridge CMOS Sensors. In the new spin-outs, Cambridge GaN Devices and Flusso, Giorgia Longobardi and Andrea De Luca are the new souls. Their dedication as founders and CEOs is key to the success of the new spin-offs.

Sharing expertise outside the University

Bringing Shakespeare's London to life through a videogame

How can a historian use the preoccupations of ordinary 21st-century people to understand the lives of ordinary 16th-century Londoners? It's a question that Professor Lauren Kassell of the Department of History of Science and Medicine took to a Wellcome Trust-organised workshop about five years ago. There Kassell was introduced to Jennifer Schneidereit, a programmer and founder of Nyamyam, an independent game developer.

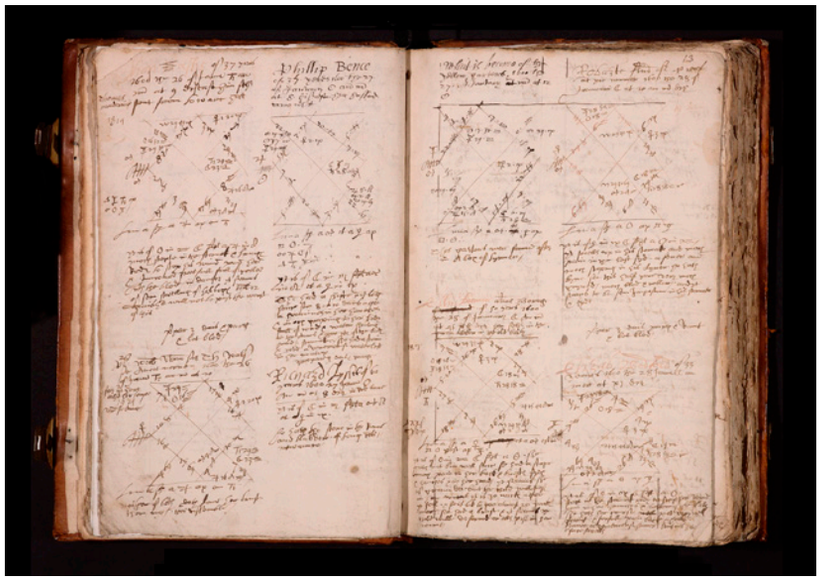
Kassell described to Schneidereit a remarkable trove of manuscripts at the Bodleian Library, University of Oxford. Written by the medical astrologers Simon Forman and Richard Napier in the decades around 1600, the papers constitute one of the world's largest surviving sets of private medical records. Kassell leads a team of scholars transforming the papers into an accessible digital archive, dubbed the Casebooks Project. Intrigued, Schneidereit visited the Casebooks Project and discussed Forman, his patients and the history of medicine and astrology with Kassell.

In 2015, Nyamyam decided to create a videogame in which players would assume the role of Forman. When they asked Kassell to serve as a consultant on the project, she turned to the Consultancy Services team for advice. "It was a new world for me," says Kassell. "Cambridge Enterprise explained why I needed a contract to work with Nyamyam and put everything in place without any hassle."

Kassell and the Casebooks team read drafts of the character summaries, storylines and scripts, checking for historical accuracy. They focused closely on the social dynamics of early modern medical practice, the politics of the early modern medical marketplace and how patients and practitioners understood health and disease. Kassell and the Casebooks team also endorsed the use of humour and deliberate anachronism, and discouraged the use of nostalgia, to push players to think about meanings of health and illness in the past and in the present.

Astrologaster, the game born from this unusual collaboration is, by all accounts, a hit. In December *Paste* magazine included it in its "30 Best Videogames of 2019". The magazine's reviewer wrote: "It's fitting that *Astrologaster* is based on the stars, because frankly it's a gas. It exhibits a merciless wit that is immensely effective in dismantling the romanticism and historical revisionism that often accompanies period pieces. But more importantly, it doesn't seem too impressed—with the Church, with so-called literary greats, or with men, and in that sense, I identify with it a lot."

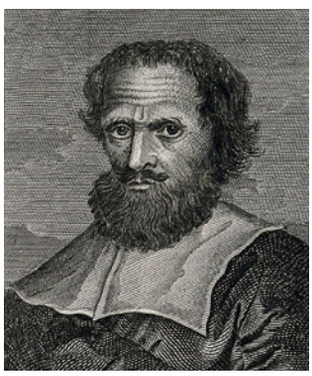
The University's involvement may have had a wider impact as well. An article in the magazine *Prospect* noted Kassell's role not merely in this game, but in laying out a new, more sophisticated genre for computer games in general, noting "video games grew up—and became an art form to rival Hollywood".



"*Astrologaster*, a period comedy… draws on the work of the Cambridge academic Lauren Kassell. Its central figure is Simon Forman, a notorious Elizabethan magician, astrologer, medic and quack, and its central mechanism is an unusual combination of cold-reading patients… and interpreting arcane zodiacal houses to offer advice. It's a fascinating mixture of historical enthusiasm and subversive modern comedy."

***Prospect* magazine**

One of the Casebooks, which were written and compiled by Simon Forman, who is pictured at right. The original Casebooks are owned by the Bodleian Library, University of Oxford.



Financial performance 2018-19

Cambridge Enterprise income

Year to 31 July

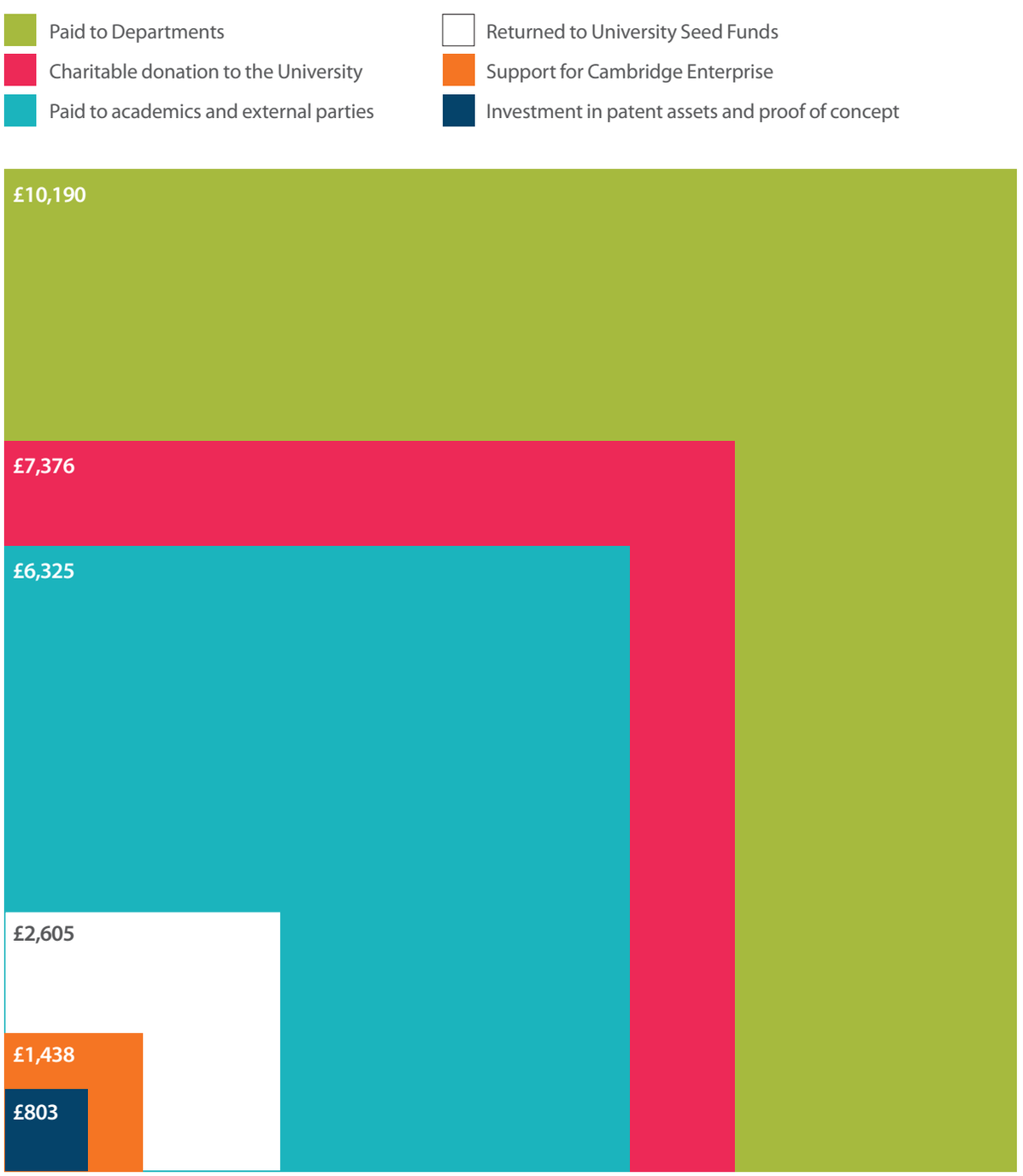
	2018-19 £'000	2017-18 £'000
Income generated by Cambridge Enterprise operations	11,003	10,288
University and Higher Education Innovation Fund (HEIF) funding	2,199	2,199
Income for services & other income	1,325	1,056
Income before returns from equity realisation	**14,527**	**13,543**
Equity realisation; income to Cambridge Enterprise and University Seed Funds	17,734	597
Total Income	**32,261**	**14,140**

Cambridge Enterprise IP investment, distributions and operating costs

Year to 31 July

	2018-19 £'000	2017-18 £'000
Investment in IP assets (patent and proof of concept)	(803)	(1,129)
Distributions to academics and external parties	(6,325)	(3,940)
Distributions to University (departments' share of IP income and Gift Aid from academics)	(10,190)	(2,195)
Returns to University of Cambridge Seed Funds (USF)	(2,605)	(185)
Operating costs (staff and other costs)	(5,408)	(4,813)
Total Expenditure	**(25,331)**	**(12,262)**
Net Operating Surplus/(Deficit) for the Year	**6,930**	**1,878**

Where Cambridge Enterprise's income goes
£'000



Governance and structure

Chair

Sir Keith O'Nions

Non-Executive Directors and Advisors

Professor Alan Blackwell	Professor of Interdisciplinary Design *(until September 2019)*
Charles Cotton	Cambridge Phenomenon Limited
Professor Russell Cowburn	Professor of Experimental Physics *(from March 2019)*
Tony Hickson*	Chief Business Officer, Cancer Research UK
Professor Patrick Maxwell	Regius Professor of Physic *(from March 2019)*
Lesley Millar-Nicholson*	Director, Technology Licensing Office, MIT
Professor Andrew Neely	Pro-Vice-Chancellor, Enterprise and Business Relations
Anthony Odgers	Chief Financial Officer, University of Cambridge
Dr Jane Osbourn	Chair, BioIndustry Association
Debu Purkayastha	Non-executive director
Professor Florin Udrea	Professor of Semiconductor Engineering *(until December 2018)*
Professor Anna Vignoles	Professor of Education *(from March 2019)*

* Advisors to the Board

Executive Directors

Dr Tony Raven	Chief Executive
Dr Paul Seabright	Deputy Director

Company Secretary

Emma Rampton	Registrary, University of Cambridge

Nominated Officer of the Shareholder

David Hughes	Director of Finance, University of Cambridge

Senior Management Team

Dr Tony Raven	Chief Executive
Dr Paul Seabright	Deputy Director
Boris Bouqueniaux	Head of Business Support
Dr Anne Dobrée	Head of Seed Funds
Dr Malcolm Grimshaw	Head of Physical Sciences
Mark Parsons	Head of Finance and Accounting
Christian Pratt	Head of Marketing and Communications
Ruth Queen	Head of Human Resources
Dr Iain Thomas	Head of Life Sciences
Matt Whiting	Chief Technology Officer
Dr Amanda Zeffman	Head of Consultancy Services

Investment Committee

Professor Chris Abell	Pro-Vice-Chancellor, Research
Dr Keith Blundy	CEO, Storm Therapeutics
Charles Cotton	Cambridge Phenomenon Limited
Dr Barbara Domayne-Hayman	Biotechnology entrepreneur
Pam Garside	Fellow, Judge Business School
Dr Iris Good	Chairman and MD of Good Relations India
John Halfpenny	Technology entrepreneur
Dr Hermann Hauser	Amadeus Capital Partners Limited
Andrew Herbert	Computer technology entrepreneur
Dr Richard Jennings	Technology transfer consultant
Derek Jones	CEO, Babraham Research Campus
John Lee (Chair)	DisplayLink Limited
Professor Patrick Maxwell	Regius Professor of Physic
Andrew Sandham	Biotechnology entrepreneur
Professor Steve Young	Professor of Information Engineering

Equity portfolio

In 2019 there were 105 companies in the Cambridge Enterprise portfolio. As spin-outs grow and succeed, they exit the portfolio, either via sale or public listing. Collectively this process has generated billions of pounds in value. Below are a few examples of the current holdings.

Cambridge Enterprise
University of Cambridge
Hauser Forum
3 Charles Babbage Road
Cambridge, CB3 0GT

We also have a satellite office close by Addenbrookes NHS hospital.

School of Clinical Medicine (OTR)
Cambridge Biomedical Campus
Hills Road
Cambridge, CB2 0SP

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