Smart Ideas Phase 2 - 2015 Science Investment Round Successful Proposals

Short Title	Organisation	Term (yr)	Total funding (excl GST)	Summary
Selective Insecticides - Phase 2	University of Otago	2	$1,000,000	Modern primary production requires both insecticides, to protect crops and stored food, and insects, for pollination and ecosystem services. To break the conflict between the use of insecticides and their damaging effects on beneficial insects, we have developed a screening assay to identify potential bee-friendly insecticides. Here we propose to use this assay to identify and test novel compounds that kill pests and leave our bees alone thus providing the crop protection needed for economic production, while supporting beneficial insects. We also propose to reanalyse the new body of genomic information to find new pathways to target pests, while leaving beneficial insects untouched. A multi-pronged, continuous strategy is important to prevent rapid emergence of resistance to sole compound (over)use. Contact: peter.dearden@otago.ac.nz
Engineering high value enzymes using forward and reverse evolution	University of Waikato	2	$1,000,000	Enzymes are the catalysts for life. They drive practically all the chemical reactions that are necessary for cells to live and divide. They are also very useful reagents and have been harnessed for practical purposes - they can be found in your washing powder and in your bread mixture, and are used in the manufacture of drugs. We have been able to use reverse evolution to make ancient enzymes in the laboratory, some of which are more than 2 billion years old. These ancient enzymes have remarkable properties that make them very useful in commercial situations. For example, some of our ancient enzymes work very fast and are resistant to temperatures that would normally destroy common commercial enzymes. This probably reflects the extreme environments in which the billion-year-old ancestral organisms lived. One particular application where our ancient enzymes are superior is in DNA sequencing for forensics where the DNA samples are very small and often very difficult to extract. This phase II application will combine both forward and reverse evolution to provide us with a toolbox to discover, develop and refine these enzymes so that they are suitable for sale as core technology within kits to extract, amplify and sequence DNA and RNA.
3D printed adsorptive media	University of Canterbury	2	$1,000,000	In Smart Ideas Phase 1 we demonstrated the feasibility of using 3D printing to create porous materials with finely controlled structure. Our approach enables us to produce new geometries that, while they could be imagined or designed on a computer, have been impossible to physically manufacture until now. Such structures can be used in applications such as biological product purification, drug delivery, catalysis, adsorption and filtration. We also developed new material formulations and printing methods that will allow 3D printing of porous hydrogels, which have even wider applications, including tissue engineering for regenerative medicine and surgical implants as well as in analytical laboratories. In Phase 2, we will extend our knowledge of hydrogel materials to design rapid, high-resolution 3D printers that can print finely structured hydrogel products at the point of use, on demand, such as in a research lab, an operating theatre, or in a pharmaceutical production facility. In addition, we will continue to refine our novel printer materials to improve their strength and other physical properties, and alter their surface chemistry to enable printing of structures with specialised, built-in chemical functionalities for specific applications such as adsorption or catalysis. We will unlock the exciting potential of 3D printing technology to build a library of novel product ideas not yet available due to limitations of conventional manufacturing methods. For example, we will create not only the porous media but also the vessels in which they are contained, together with connectors to external tubing and appropriate systems to evenly distribute a fluid across the whole internal surface of the porous bed. With our approach, it will be possible to print these normally separate pieces of hardware directly in a single, integrated product. Current production technologies constrain the shape of porous bed vessels to simple, straight cylinders, whereas we can create very different configurations, e.g. coiled tubes that offer advantages in certain areas. Our research will test some of these new ideas, allowing us to further refine them and to demonstrate their superior performance to potential end-users, thus creating significant new market opportunities for New Zealand companies. Finally, while we anticipate advances in 3D printers will enable much higher resolution printing in the future, thus expanding our approach to new applications, we have already identified an ideal match between our current technical capabilities and an unmet need in biopharmaceutical production facilities. We will therefore develop a prototype product for end-user testing that has the potential to significantly lower the cost of production for biopharmaceuticals such as monoclonal antibodies and therapeutic enzymes.
Mitigating livestock methane emissions using	University of Auckland	2	$836,000	New Zealand has a very unusual greenhouse gas emission profile for a developed country. About 45% of our total greenhouse gasses are

methanogen secondary metabolites				from agriculture and our livestock farms are a major contributor with 30-35% of emissions consisting of methane from the rumens of livestock. Hence, developing ways of reducing ruminant methane production is vital in order to successfully put us on track to meet our global greenhouse gas reduction pledges. This research continues to explore a previously untouched aspect of the biology of rumen methanogens, the microbes that produce the methane. Specifically, we are investigating secondary metabolites (small molecules with biological activity) produced by methanogens that can have a profound influence on their biology. In this research we aim to develop inhibitors of methanogens based on these secondary metabolites. Successfully inhibiting the growth of methanogens in the rumen will dramatically reduce the production of methane from ruminant livestock. As the release of methane from the rumen represents a significant loss of energy, we expect the reduction in methane production to be coupled with increased animal productivity. Successfully mitigating methane emissions will have a transformative effect on the sustainability of our livestock production sector. It will protect and enhance our green branding and increase the competitiveness of all sectors of the economy that rely on this branding, resulting in increased export growth for New Zealand. This research will also have worldwide environmental impact by reducing the threat of global warming.
Total over 2 years			**$3,836,000**	