

### ***Fundamental Australian medical research is fundamentally important for Australia***

One hundred years ago this year, a young Australian made a discovery that would change the world. His discovery would also transform the landscape of medical research, though this would not become apparent for another 50 years.

The young man in question was Lawrence Bragg, Australia's first Nobel prize-winner and grandson of Charles and Alice Todd (of the Overland Telegraph, Todd River and Alice Springs fame). Lawrence had deduced a formula that related the X-ray diffraction pattern from a crystal to the atomic structure of the crystal contents. The formula – Bragg's Law – unlocked the secrets of matter.

Lawrence and his father William Bragg (with whom Lawrence shared the 1915 Nobel Physics Prize) used the formula to establish the first atomic structures: sodium chloride (rock salt) and diamond amongst many others. The science of crystallography has since revolutionized chemistry, biology, physics, mineralogy and materials and has led directly to dozens of other Nobel prizes.

Most importantly, crystallography has transformed medical research because it allows us to see, at an atomic level of detail, the three-dimensional structures of proteins that cause disease. It allows us to see how drugs interact with disease-causing proteins to exert a therapeutic effect. And it allows us to design new drugs: drugs to treat diseases that we haven't been able to treat before; drugs that are more potent and safer than those previously available.

In 1912, no-one could ever have imagined that Bragg's discovery would lead to the determination of protein crystal structures, let alone to the 2012 crystal structure of the opioid receptor that binds morphine and heroin (leading to drug addiction). Yet as a direct result of Lawrence Bragg's fundamental discovery we now have the opportunity to use that crystal structure to design and develop new analgesic drugs that just might avoid the addictive properties of opioids. Other researchers are now working towards the structures of proteins associated with the world's great health threats, antibiotic resistance, TB, diabetes, mental health, cancer, asthma, chronic inflammatory disease etc etc etc.

Australians also led the way in using protein crystal structures to design drugs. In the late 1970s, Graeme Laver's virology group at ANU identified the protein neuraminidase that is critical for the influenza virus lifecycle. In the 1980s Peter Colman's protein crystallography group at CSIRO in Melbourne determined the structure of influenza neuraminidase, and Mark von Itzstein's medicinal chemistry group at the Victorian College of Pharmacy used the crystal structure to design a chemical to block neuraminidase. That fundamental interdisciplinary medical research, one of the first examples of structure-based drug design, led to the development of Relenza, the first drug to treat flu. This discovery, and the subsequent development of Tamiflu means we now have weapons to combat influenza pandemics, including swine and bird flu. These weapons were not available one hundred years ago. The impact of this research can hardly be overestimated: the Spanish flu pandemic of 1918 is reported to have killed 40 million people.

Quite simply, medical research saves lives. Without groundbreaking fundamental research like that of Lawrence Bragg, and academic-driven discoveries like that of Laver, Colman, and von Itzstein there would be no structure-based design and there would be no drugs to treat flu pandemics. These are but two examples – there are many, many more Australian discoveries that will no doubt be raised by others.

Medical research clearly benefits our own country; not only by generating new knowledge that drives new medical practice, diagnosis and treatment; it also brings international recognition and rewards in the form of prestigious prizes and Fellowships that continue to place our country prominently on the world stage, by showcasing Australians ability to discover, invent and innovate.

Most importantly, wealthy nations like Australia have a responsibility to support a strong and vibrant medical research community. The medical research of today impacts on the world of tomorrow: the legacy of fundamental and applied medical research is a safer, healthier, and more-informed Australia and a better world for our children and grandchildren and for those born into less fortunate countries.