

## 2018 King Faisal International Prize for Science and Medicine

The King Faisal Foundation in Riyadh, Saudi Arabia has awarded the 2018 King Faisal International Prize (KFIP) for Medicine (topic: Immunotherapy for Cancer) to James Patrick Allison of USA, for his outstanding contribution to the development of the field of immunotherapy of cancer. The Science prize in the field of mathematics has been awarded to John Macleod Ball of the UK for his fundamental contributions to nonlinear partial differential equations, calculus of variations, and their applications to materials science and liquid crystals. The Prize comprises a 24-carat gold medal weighing 200 g; and a cash award of 750 thousand Saudi Riyal (USD 200,000).

Patrick Allison was born in 1948 in Alice, Texas, USA. He obtained his BS in microbiology (1969) and Ph D in biological sciences (1973) from University of Texas, Austin. At present, he is Director of the Parker Institute for Cancer Immunotherapy at the University of Texas MD Anderson Cancer Center, Houston, USA. Allison is a member of the National Academy of Medicine and the National Academy of Sciences, USA.

The widely used treatment options for cancer are surgery, radiation and chemotherapy, or an appropriate combination of the three. Immunotherapy, also called biologic therapy, is a type of cancer treatment that enhances the body's natural defences against cancer. One of the subtypes of white blood cells called T-lymphocytes or T-cells, identify the cancer cells but are unable to eliminate the disease. Unlike other lymphocytes, T-cells are distinguished by the presence of a receptor on their cell surface, known as the T-cell receptor. Allison first characterized the structure of the T-cell receptor and examined the interactions between T-cells and antigen-presenting cells that activate them<sup>1</sup>. He discovered CD28, the important co-stimulatory molecule on the surface of T-cells necessary for their complete activation. He demonstrated that a transmembrane protein called CTLA-4 (cytotoxic T-lymphocyte-associated protein 4) associated with the cytotoxic T-cells stops the co-activation and transmits an inhibitory signal to the T-cells, preventing them from giving an effective response against the tumour cells. Allison became the first

person to demonstrate that an antibody blockade of CTLA-4 leads to enhanced anti-tumour immune responses and tumour rejection. This was achieved using a monoclonal antibody directed against CTLA-4 (ref. 2). Allison was personally involved with the clinical trials on humans<sup>3</sup>. Such studies have shown positive results in patients with tumours of different types, including the forms of prostatic, pulmonary, ovarian and pancreatic cancers. Allison's work with CTLA-4 gave birth to the new field of 'immunological checkpoint therapy'<sup>4</sup>. His research led to the approval of the first checkpoint blockade drug, ipilimumab (trade name, Yervoy) in 2011, for the treatment of melanoma (a type of skin cancer) in USA. This triggered new drugs, which were approved later for treating different types of cancers. Allison's long list of awards includes the Lasker-DeBakey Clinical Medical Research Award (2015) and the Breakthrough Prize in Life Sciences (2014).

Ball was born in 1948 in Farnham, Surrey, UK. He completed his Ph D in mechanical engineering in 1972 from the School of Applied Sciences at the University of Sussex, Brighton under the supervision of David Edmunds. He was elected a Fellow of the Royal Society of Edinburgh in 1980 at an age of 32 and was knighted in 2006. Ball was the President of the International Mathematical Union during 2003–2006. Currently, he is the Sedleian Professor of Natural Philosophy at the University of Oxford, UK and Director of the Oxford Centre for Nonlinear Partial Differential Equations, UK.

Ball's main research areas are nonlinear partial differential equations, calculus of variations, infinite-dimensional dynamical systems and their applications to nonlinear mechanics, and the mathematics of liquid crystals.

By introducing the notion of polyconvexity, Ball proved the existence of an equilibrium state (to be interpreted as a minimizer of the total energy function) for hyperplastic materials, whose stored energy function is polyconvex, subjected to conservative applied forces<sup>5</sup>. To date, there are only two existence theorems in nonlinear elasticity. The first one (dating to the 19th century) is based on the implicit function theorem, whereas the one

due to Ball is based on the minimization of the total energy<sup>6</sup>. Ball with Apala Majumdar introduced a singular potential resulting in a better mathematical understanding of the Landau-de Gennes theory of liquid crystals<sup>7</sup>.

There are 57 KFIP Science Laureates from 13 countries<sup>8</sup>. Mudumbai Seshachalu Narasimhan is the only Indian to have received the KFIP Science Prize (for mathematics in 2006) and the only Asian to have won it for mathematics<sup>9</sup>. The other notable science prizes established in the Middle East are the UNESCO Sultan Qaboos Prize for Environmental Preservation from Oman<sup>10</sup> and the Mustafa Prize for Science from Iran<sup>11</sup>. For 2019, the topic for the Medicine prize is 'Bone Biology and Osteoporosis' and the Science prize is in the field of chemistry (see <http://kingfaisalprize.org/>).

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