The country lost Autar Singh Paintal, one of India’s insightful scientists on 21 December 2004 in Delhi. He was not only a towering figure in the field of physiology, but also a colourful and uncompromising personality in Indian science. He was born on 24 September 1925 in Mogok, in the then British Burma, where his father Man Singh was serving in the British Medical Service. He came to Lahore at the age of fourteen to complete his Matriculation. He studied for the Intermediate Examination at the Forman Christian College and later joined his parents who chose to settle in Lucknow. He joined King George’s Medical College in 1943, with financial help from the Burmese Government.

That Paintal had an extraordinary intellect became evident even during his undergraduate days when he was recipient of distinctions and gold medals, including the much coveted Hewitt Gold medal given to the best graduate of the class. He was also unique in that he chose to pursue research in a basic subject like physiology instead of equipping himself to become a clinician. Those were the days when a ‘proper doctor’ meant one who treated patients and who did not ‘dabble’ with test tubes or equipment in the laboratories. Paintal started his research career during the M.D course by studying the ‘electrical resistance of the skin in normals and psychotics’. He not only built the equipment to measure skin resistance himself, but also went on to collect 400 psychotic patients, which required even greater ingenuity. He introduced a new index for evaluation of galvanic responses in man, which came to be known as the Paintal index (1951) and was used by clinicians to diagnose psychosis at a time when objective methods were not available. He continued in his alma mater, where he was appointed as Lecturer to the Department of Physiology.

The next stage of his career began when he chose to join Whitteridge for a Ph.D programme in the Department of Physiology in the Medical School at Edinburgh. Interestingly, he was supported by a fellowship from the Rockefeller Foundation, which is usually given to pursue research in the United States and not in other countries. It was in Edinburgh that the foundations for the later discovery of J-receptors were laid. At a time when dissection of single nerve fibres was difficult, his innovative use of liquid paraffin to embed the whole nerve and isolate the single fibres without impairing their activity, was a tremendous boost for the measurement of single-fibre conduction velocities. At that time he also made a discovery that is now considered an established fact. He showed that the receptors (type B atrial receptors) which are now known to have a major role in fluid volume regulation were located in the atrium (1953) and not in the great veins/pulmonary veins as his mentor Whitteridge had thought. Thus began his legendary journey into the world of visceral receptors.

He returned to India in 1953 and joined the Defence Laboratories in Kanpur as a Technical Officer. His innovativeness once again helped locate visceral receptors (1954) by injecting chemicals to discover these ‘silent’ receptors. Soon after, he described the location of ventricular pressure receptors (1955). In 1958 he moved to New Delhi as Research Professor in the Physiology Department of the All India Institute of Medical Sciences (AIIMS). Six years later he became the Director of V. P. Chest Hospital, a post he held till 1990. He later became the Director General of the Indian Council for Medical Research even while continuing his research at the V. P. Chest Institute. He continued his intellectual quest with support from the Department of Science and Technology, New Delhi in modest surroundings in a two-roomed laboratory in his favourite institute till his death.

Paintal is best known for the discovery of J-receptors (1955), which he went on to study in great depth. He coined the name J-receptors to indicate their location in ‘juxta’ pulmonary capillaries in the lung. He introduced the concept of visceralosomatic inhibition by showing that these receptors were responsible for the J-reflex, which acted as a feedback mechanism to limit muscle activity during exercise.

Physiologists for long had sought to identify a particular event which would have direct effect on the termination of exercise brought about by muscle fatigue. An intriguing quest had been to find out which signals in cardiovascular, respiratory, neural or metabolic pathways would determine continuation of exercise or its stoppage. The intracellular changes that occur in muscles during exercise were well known; however, it was difficult to identify a single or combination of events that would explain how muscle activity is terminated during physical exercise. The lungs and the heart are richly supplied with unmyelinated fibres which are capable of sending signals following chemical or mechanical changes in the local surroundings. Paintal showed that the J-reflex is elicited when pulmonary flow increases as a result of exercise, and this in turn sends a negative feedback signal to the muscles to limit further activity. Some scientists believe that such a negative control is necessary for protecting the muscles from toxic damage caused by the metabolites produced during physical activity. It appears to be one of the earliest evolutionary reflexes as even fish appear to have a similar mechanism. Paintal went on to also show that the J-reflex explained the tachypnoea (fast heart rate), breathlessness (1969, 1970), dry cough and throat sensations (1986) that are associated with such activity. The J-receptor activity would also explain some of the symptoms associated with disease conditions as in left heart failure, some lung diseases and blockage of major lung vessels due to blood clots (pulmonary embolism), as these are associated with increase in pulmonary capillary pressure. He also showed that J-receptor stimulation signalled increase in the permeability of pulmonary capillaries, thus introducing a new method for measuring the in vivo concentration of J-receptor excitants (1991, 1993).

The J-receptors elicited worldwide excitement, whose impact is being felt even today.
As often happens in the history of science, Paintal’s initial discovery was temporarily mired in controversy. Many workers, including his own earlier students, investigated the J-receptors giving rise to a period of debate regarding their functions, the neural level at which the negative control took place, etc. It was also debated as to whether these receptors existed in a modified form in man compared to the cat, the animal used by Paintal in his studies. Later workers even gave another name to this phenomenon and the current literature uses the newer terminology of pulmonary C-fibres and J-receptors synonymously. But Paintal’s name became inextricably linked to the J-receptors. He viewed the respiratory effect from the one associated with muscle activity as two different functions of these receptors. Moreover, he felt that chemical stimulation of these receptors by drugs, etc. was not physiological.

Thus the versatility of Paintal’s intellect combined with his technical innovativeness made measurement of single nerve fibre conduction velocities possible, and led to the discovery of visceral receptors such as atrial receptors (1953), ventricular pressure receptors (1955), stretch receptors in the stomach which explain the sensation of satiation after food (1954) and pressure-pain receptors of muscle (1960). His classic discovery that non-medullated fibres are blocked at lower temperatures, has now become a routine tool to distinguish medullated nerve fibres from non-medullated ones. Till his death, Paintal along with A. Anand continued to pursue the varied dimensions of J-receptors, including in later years, high altitude physiology and exertional breathlessness. The latter had implications for the better acclimatization of Indian soldiers posted in the Himalayas.

Paintal’s interest in science went beyond the esoteric. He became concerned with ethical issues in the practice of science and founded the Society for Scientific Values (SSV). In his opinion, his major contribution was the SSV. That it was the need of the day was evidenced by the large number of young and old scientists who were attracted to it. He set high standards for membership to the Society, which in itself antagonized some. Moreover, as cases of malpractice were brought to his attention, the moral power of the Society became one with his personal reputation. He and his team investigated such cases with vigour and spent their time and often their own money in the pursuit of truth. Newsletters were brought out and symposia held on important themes, with little finances and support. Today, the SSV addresses both positive and negative aspects of the practice of science and is often called upon both by agencies and individuals to provide advice. Paintal’s idealistic standards were sometimes misunderstood by his peers. He believed that science meetings should not be held in five-star hotels, but in the simple academic environs of the university. He refused to attend inaugurations or meetings in hotels. When malpractice was proved and the relevant institute did not take appropriate action, he never visited the institution again when invited for having an honour bestowed on him. This did not make him popular and in an era of changing value systems, he was considered an eccentric.

It is difficult to describe what made Paintal an inspirational teacher. Though I was not formally taught by him as I had completed the physiology course by the time he joined AIIMS, I consider him to be one among those who helped shape my thoughts. My first glimpse of him was in his shorts, repairing the electrical circuit of his equipment. This was not the usual behaviour of an Indian professor. Later on, when I became associated with him at various stages of my life, I became aware of even more peculiarities! Absorption in his work to the exclusion of all else was itself inspirational. His high standard of integrity was difficult to emulate. His advice to students was that work undertaken should contribute to the ‘body of knowledge’ and not be imitative or superficial. As one of his students P. S. Rao quotes, Paintal believed that ‘dependence on other people’s labours is doing research by piracy’. He also believed in defending one’s research findings (not to be confused with advertising) and used to say, ‘dang ladna seekho’ (learn to fight battles). His lectures were not didactic, but more in a narrative form replete with his own experiences in the field, including anecdotes and descriptions of scientific debates. This was exasperating to the more conventional student who required information that was well classified and orderly. It was, however, informative to those who saw it as real time emergence of knowledge, as and when it happened. The excitement of discovery was never far away when he was in his narrative mode. He was a difficult person to work with, as he was uncompromising in his standards and unwavering on what constituted right and wrong. He was not an opportunist and saw no reason to change his views in the interests of pragmatism or societal approval.

It is customary to list the various honours that a man like him would have acquired over his extraordinary career. There are not many that he missed acquiring and listing them would be monotonous and not worthy of a man like him. They can be found on the websites of academies and the V. P. Chest Institute. He was elected to the Fellowship of the Royal Society of London (1981) and Edinburgh (1996). He was President of the Indian National Science Academy and General President of the Indian Science Congress. He was a Founder Member of the Third World Academy, whose cause he espoused rigorously. The country honoured him with Padma Vibhushan in 1986. He is survived by his wife and partner in science Anand, two daughters, one son, many students and admirers. It has been my privilege to know him.

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