JOHN ZACHARY YOUNG

(18 March 1907–4 July 1997)

Raye Parsons

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John Z. Young was one of the most influential and respected biologists of the twentieth century. Trained in zoology and comparative anatomy at Marlborough and Magdalen College, Oxford, he always laid great emphasis on the functional and behavioural aspects of morphology, and his best-known researches, such as his discovery of the squid giant axon and his work on the cellular events underlying the establishment of memories in the octopus, were accompanied by the writing of classical studies that are still in print, *The Life of Vertebrates* published in 1950 and *The Life of Mammals* published seven years later. These books were based on the philosophy that zoologists have a duty to consider not only particular aspects of animal life, but also the whole system on which that life depends. He sometimes said regretfully that he seemed to be better known for them than for the research that he was still actively pursuing in his ninetieth year.

After graduating at Oxford with first class honours in 1928, he became a Christopher Welch scholar, and for a year occupied the Oxford table at the Stazione Zoologica "Anton Dohrn" in Naples in order to study the visceral autonomic nervous system of fish. This yielded two excellent papers, but more significantly introduced him to the cephalopods, the class of molluscs comprising Nautilus, squids, cuttlefish, and octopus. His first paper, published in collaboration with Enrico Sereni in 1929, was concerned with the degeneration of the mantle connectives and stellar nerves in octopus, and their subsequent regeneration, while the second reported their discovery of the epistellar bodies at the back of the stellate ganglia. Returning home, he looked in this position for a similar organ in squid, and, working at the laboratory of the Marine Biological Association in Plymouth, found instead a group of some hundreds of nerve cell bodies whose fine processes were fused together in a syncytium to form large tubes having a diameter of 0.5 mm or more that radiated out into the muscle of the mantle. During the next year or two, electrical recordings convinced him that the tubes were giant nerve fibres, able to conduct impulses very much more rapidly than the normal mantle nerves around two hundred times smaller.

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Such fibres had evidently evolved as part of the squid's jet-propelled escape reaction. In 1934 he published a brief note on the squid giant axon, the first of many papers on different aspects of the anatomy of cephalopod nervous systems. During a visit to Woods Hole in the summer of 1936, he briefly made some observations on the axoplasm of squid axons with Frank Schmitt and R. Bear, and on their conduction of impulses with Ralph Gerard, Detlev Bronk and Keffer Hartline, and talked with Kacy Cole and Howard Curtis. In 1938 he and R. J. Pumphrey made some valuable measurements at Plymouth of the conduction velocity in cephalopod axons of various sizes, but he was already becoming interested in the brains of cephalopods, and this was his last venture into the field of axonology opened up by his discovery of the squid giant axon, which in due course led to the award of the Nobel Prize to Alan Hodgkin and Andrew Huxley.

During the Second World War, John Young was leader of a Medical Research Council unit for basic research into the repair of peripheral nerve injuries, manned among others by his Oxford pupil Peter Medawar. Young and Medawar developed a fibrin glue that successfully bridged gaps in damaged nerves of the same individual, but because of the homograft reaction would not work for others. Valuable pioneer studies were conducted on the physical properties of axoplasm, and the mechanisms of degeneration and regeneration.

In 1945, John Young was offered and accepted the chair of anatomy at University College London, a step that at first gave rise to some public controversy because before then professional anatomists had invariably been medically qualified, though criticism was soon quietened by the success of his innovations. Leaving the dissecting-room teaching to medically trained members of his staff, he explored new ways of teaching anatomy, modernized the research facilities of the department, and set up an intercalated B.Sc. course in anatomy for medical students who might later wish to pursue research. With funds from the Science Research Council and the Life Sciences Division of the American Air Force more than a hundred B.Sc. students had eventually taken part in his experiments at Naples on the organization of a memory system in octopus.

From 1947 he worked every summer for the next twenty-five years at the Stazione Zoologica, first in collaboration with Brian Boycott, and later with Martin and Joyce Wells, W.R.A. Muntz, Stewart Sutherland, Marion Nixon, and others. The main aim of his experiments was to investigate cellular mechanisms of memory and behaviour in octopus, typically through studying the effects of small brain lesions on the ability to learn modes of visual and tactile discrimination. A

considerable advantage of the octopus for such studies was that its central nervous system consists of two sets of paired centres that are anatomically well defined, communication between which can be interrupted surgically to throw light on their precise roles. It appeared initially that memory was primarily located in the vertical lobe system, but it then transpired that although long-term memory was dependent on it, a short-term memory could be established without its participation. The tactile and visual memory systems were shown to be similar in their mode of operation although anatomically distinct. In the visual system, the output from the retina proceeded to the outer layers of the optic lobes, where it was processed by classifying cells capable of distinguishing between horizontal and vertical rectangles, and the information was then transferred to command cells controlling the higher motor centres to initiate either retreat or attack. If during the training the attack was rewarded with food, this was recorded by the memory cells in another part of the optic lobe, but if punishment was the outcome, other memory cells duly recorded the appropriate response as retreat. In this way a particular classifying cell could become associated with groups of motor cells so that a given stimulus would elicit the correct response. Such a group of cells constituted what he termed a "memnon," linked to a specific memory, but when inevitably the experiments revealed further complications of various kinds, requiring the existence of an inordinately large number of memnons, Young came in the end to feel that although his search for basically cellular components of a memory system had been rewarded by considerable success, it had little prospect of providing a final answer to the problem of memory. In the larger and more anatomically complex brains of vertebrates, a solution appears to be even further out of reach, and it has to be admitted that across the whole field, progress is currently slow.

After his retirement, Young lectured and published on philosophy and research on the brain, but came back in the end to a series of masterful studies on the detailed anatomy of the brains of a variety of cephalopods. This work is due to be summarized shortly in *The Brains and Lives of Cephalopods*, on which he had been working for some years with Marion Nixon. But he never neglected wider problems of the whole animal, and at the time of his death he had just completed a paper on the action of the rasping rows of radular teeth in cephalopods and other molluscs.

He was a man of immense vigour and charm, an inspiring lecturer and teacher who excelled at stimulating his audience with his ideas. He was a scientist whose research was his whole life, and who received many honours that included the Royal Medal of the Royal Society, and

the Gold Medal of the Linnean Society. Two of the awards that he most appreciated were his election, as a scientist, to an honorary fellowship of the British Academy, and his honorary citizenship of Naples, where he had worked for so many years.

For many years his visits to Naples and Plymouth were organized by his second wife, the artist Raye Parsons, as was his ninetieth birthday party in April 1997 in Magdalen College, Oxford. Attended by his son and daughter of his first marriage, Raye's daughter, many grandchildren, and some great-grandchildren, and pupils and colleagues from all over the world whom he greeted as his "scientific family," it was a memorable occasion.

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RICHARD KEYNES
Emeritus Professor of Physiology
University of Cambridge