Peter Zagalsky: an appreciation
(23 December 1938–28 December 2019)

Personal life
Peter Francis Zagalsky was born on 23 December 1938 in Cannes, France. Following the death of his Russian father Boris, in 1940, Peter escaped to England from occupied France with his mother Joan, flying from Cannes to Paris, on a private plane belonging to a friend, then on to Croydon Airport in the UK.

Education and career
After attending Haileybury School, he read biochemistry at Queen's College, Cambridge, graduating with a BSc in 1961, followed by a Master's in 1965. He joined Bedford College, London as a demonstrator in biochemistry. He was appointed assistant lecturer in 1962 and lecturer in 1965, in which year he completed a PhD degree under the supervision of Professor Dudley Cheesman. He was promoted to a senior lectureship in 1982. Following the merger between Bedford College and Royal Holloway, Peter continued his research and teaching at the campus in Egham, Surrey.

Teaching
Undergraduates recall that Peter was an incredibly dynamic and enthusiastic teacher, and he has been recalled “bouncing into the lecture introducing us to the structures of amino acids and the manner in which these are assembled into functional proteins”.

X-ray crystallography was at an early stage at that time, with the 3-dimensional structure of only one protein, the enzyme lysozyme, having been determined. Structural information regarding protein structure was thus inferred from biophysical and spectroscopic methods, including circular dichroism and optical rotatory dispersion.

Contributions to research
Peter's work on the purification of proteins responsible for the colouration of the marine invertebrates Homarus gammarus (lobster) and Velella velella (the sea raft) commenced in the 1960s, with collaborators including Dudley Cheesman, Hubert Ceccaldi and Rhoda Quarmby, using spectroscopic, biophysical and chemical methods to obtain information on their structure. This area remained the major focus of his lifetime research.

Peter collaborated with a large number of scientists. The sequence of crustacyanin was determined in a collaboration with Professor John B.C. Findlay's team (University of Leeds). The crystallization of this protein by Professor Naomi Chayen at Imperial College, London, enabled the determination of its structure by X-ray diffraction by Professor John Helliwell's team (University of Manchester and the Daresbury Laboratory). The crystal structure provided an explanation for why a lobster changes colour when boiled. The carotenoid prosthetic group of the protein, astaxanthin, is orange-red, but assumes a blue-black colour when bound to crustacyanin. On boiling, denaturation of the holoprotein results in the release of astaxanthin, accounting for the colour change. This publication attracted interest not only by scientists but also by the media.

Peter was also part of a collaboration on the crystallization of β-crustacyanin on board the EURECA space vehicle – the first attempt by a UK group to achieve crystallization of a protein under conditions of microgravity.

Peter died on 28 December 2019 and is survived by his wife, Dikea, his children, Boris and Alexandra, and several grandchildren.

We thank Alexandra Zagalsky and professors John Findlay, John Helliwell and Naomi Chayen for their contributions to the preparation of this obituary. An extended appreciation of Peter's life and work can be read in the online supplementary material 1.

John Lagnado
(Royal Holloway, University of London, UK)
Gitendra Wickremasinghe
(University College London, UK)

It was incorrectly reported in The Biochemist volume 42 issue 2 that Peter Zagalsky died at the start of 2020. The Biochemist apologises for this mistake.
Peter Zagalsky – an appreciation

John R. Lagnado (john_laniado@yahoo.com), R. Gitendra Wickremasinghe (rmgvrgw@ucl.ac.uk) and John R. Helliwell (john.helliwell@manchester.ac.uk)

Personal life

Peter’s beginnings were quite remarkable. He was born in Cannes, in the south of France, on 23 December 1938 to a Russian father, Boris Zagalsky, and English mother, Joan (nee Poulton). His father died in 1940, but Joan managed to escape with Peter to London (via Paris) on a friend’s private plane—the last plane out of Nice! Peter’s English mother was a cabaret dancer (with her sister Faye) at the Cannes Casino (where Peter’s father worked). Peter also cherished his mother’s other sister—the silent film star Mabel Poulton.

Peter married Dikea Neamonitos at St Sophia Greek Orthodox Church, Moscow Road, London, UK in 1970. Both of the Orthodox faith, they had met at a party in 1967. Undergraduates of the early 1970s recall Peter learning Greek prior to his marriage. Their son, Peter Boris, was born in 1971 and their daughter, Alexandra Angela, a journalist, in 1976. Alexandra recalls that some of Peter’s crustaceans, from Billingsgate, were brought home by him and would take refuge under the TV. Lobster sandwiches were often a feature at teatime. A chicken called Chirpy, who laid double-yolked eggs, also became a much-loved member of the Zagalsky household, and would follow Peter around the house.

Peter passed away on 28 December 2019 and is survived by his wife, children and several grandchildren.

Education and career

Peter attended Haileybury School before heading to Queen’s College Cambridge where he was awarded a BA in Biochemistry in 1961. He was appointed Demonstrator in the Department of Physiology, at Bedford College, University of London, transferring shortly thereafter to Biochemistry (under Professor Dudley Cheesman) where he was promoted to a Lectureship in 1965, the year after he was awarded his PhD from the University of London (thesis title: ‘The association of carotenoids with proteins in certain invertebrates’).

In 1983, Bedford College and Royal Holloway were merged as Royal Holloway and Bedford New College (RHBNC) and, following the gradual move to the Egham site, the merged colleges became known as Royal Holloway University of London (RHUL) in 1992.

Teaching

Undergraduates and colleagues recall that Peter was extremely modest and also an incredibly dynamic and enthusiastic teacher. One of us (RGW) recalls him literally bouncing into the lecture theatre at Bedford College, in 1968, to introduce us to the basic structures of amino acids and the manner in which these were assembled into functional proteins. X-ray crystallography was at an early stage at that time, with the 3-dimensional structure of only one enzyme, lysozyme, having been determined. Much of the structural information regarding protein structure was thus inferred from biophysical and spectroscopic methods, including circular dichroism and optical rotatory dispersion. We were introduced to the elegant structures of β-pleated sheets and α-helices. Peter’s teaching extended to topics close to his own research interests—especially the role of carotenoproteins in the biochemistry of vision. His enthusiasm was no less present when dealing with subjects more remote from his own
areas, however, such as steroid biosynthesis, and the biological transfer of single carbon units in biosynthesis, via folic acid and vitamin B12. In pre-PowerPoint days, Peter’s handouts were drawn by hand and reproduced in a trademark purple ink using a spirit-based Roneo machine.

Sid Verber, an undergraduate student who carried out a summer project with Peter, offered the following recollection: ‘I knew Peter was doing some research on why lobsters turned red when boiled, but couldn’t imagine how I could help with the research. Some chromatography, perhaps, or protein analysis? Imagine my surprise when I was presented with bags of large, raw, defrosting lobsters and was asked to shell them and discard the flesh. Of course, Peter wasn’t interested in the meat, only the shells.’

One of Peter’s colleagues, John Lagnado, vividly recalls bringing generous lashings of lobster meat home for a tasty evening meal!

**Contributions to research**

Peter’s work on the purification of the proteins responsible for the colouration of the marine invertebrates *Homarus gammarus* (lobster) and *Velella velella* (common names: the sea-raft or by-the-wind sailor) commenced in the 1960s. In his very first publication [1], entitled ‘Purification and properties of crustacyanin’—an apt title of his life’s work—he was able to isolate from a carapace extract a blue fraction which showed complete homogeneity in electrophoresis on starch gel. Further work in the early 1960s, with collaborators including Dudley Cheesman, Hubert Ceccaldi and Rhoda Quarmby [2–5], used spectroscopic, biophysical and chemical methods to obtain information on their structure. This area remained the major focus of his lifetime’s research.

His first major paper [2], in collaboration with D.F. Cheesman (Bedford College) and H.J. Ceccaldi (Station Marine d’Endoume, University of Marseille), contained an introductory sentence which clearly reflects the authors’ enlightened attitude towards priority:

‘The present paper is concerned with the first stages of a detailed investigation of pure crustacyanin. It recently came to our notice that independent studies in our two laboratories were leading to very similar conclusions. We have therefore decided to circumvent questions of priority by combining our findings in a single publication.’ [authors’ italics]

Peter went on to work with a large number of scientists, who recall him as an enthusiastic and generous collaborator. The sequence of crustacyanin was determined in a collaboration with Professor John B.C. Findlay’s team at the University of Leeds [6]. The crystallization of the β-crustacyanin protein proved to be immensely difficult but was ultimately achieved by Professor Naomi Chayen at Imperial College, London, UK. This enabled the determination of its structure by X-ray crystallography by Professor John Helliwell’s team at the University of Manchester and the Synchrotron Radiation Source at the Daresbury Laboratory, Warrington [7] based on the apocrustacyanin A1 structure solved with softer X-rays from the Daresbury synchrotron [8]. The resulting X-ray crystal structure of β-crustacyanin provided an explanation for why a lobster changes colour when boiled. The carotenoid prosthetic group of the protein, astaxanthin, is orange-red, but assumes a blue-black colour when bound to crustacyanin. On boiling, it can be readily imagined then that the denaturation of the holoprotein results in the release of the astaxanthin, accounting for the colour change, or bathochromic shift [7]. The publication [7] attracted a huge amount of interest not only by scientists but also by the media—newspapers, TV, radio stations worldwide, including the BBC’s *Today* programme and a thankyou letter from Proceedings of the National Academy of Sciences of the United States of America (PNAS).
Another important feature of the structural studies was the use of Small Angle Solution X-ray scattering (SAXS) at room temperature, again measured at the Daresbury synchrotron [9]. The solution was blue and the structure of the β-crustacyanin in the crystal (also blue) fitted that measured by the SAXS curve. The significance of these additional results was that the crystalline solid-state structure at 100K was specific to the live lobster colouration. The colouration provided then the essential functional assay. Other major collaborative works extended these observations [10].

This collaborative work on marine colouration was presented by Professor John Helliwell at a Friday evening discourse at the Royal Institution, London, entitled ‘Why do lobsters change colour on cooking?’, in April 2004, to an audience comprising both scientists and non-scientists. The photograph (see below) shows Professor Helliwell (left) and Peter Zagalsky, with Baroness Susan Greenfield, then director of the Royal Institution. These discourses were initiated in 1826 by Michael Faraday. Note the colour of the Baroness’ dress!

Peter was also part of a collaboration on the crystallization of crustacyanin on board the EURECA space vehicle. This was one of the earliest efforts achieving crystallization of a protein in space [11].

Microgravity crystallization in a vapour-diffusion apparatus, observed by CCD camera, allowed the detection of ‘halos’ around growing crystals of apocrustacyanin C1 (see photo below). The apoprotein was faintly coloured blue due to some residual astaxanthin in the solution. These experiments, carried out European Space Agency’s Advanced Protein Crystallisation Facility in microgravity, provided for the first-time evidence for the depletion zones around crystals growing in microgravity [12]. Again the colouration providing an essential observation.

The implications of Peter’s work are highly relevant today and are included in the topical review by John Helliwell [13].

We thank Alexandra Zagalsky, Dr John Prebble and Professors John Findlay and Naomi Chayen for their contributions.
Marangoni Convection

In the vapor diffusion case Marangoni convection occurs due to surface tension differences. This effect is masked on the ground.
References


