KENNETH HENDERSON JACK OBE

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BY DAVID JACK¹,* AND STUART HAMPSHIRE²

¹13 Stivichall Croft, Coventry CV3 6GP, UK
²The Bernal Institute, University of Limerick, Limerick V94 T9PX, Ireland

For all but 5 of his 94 years Kenneth Henderson Jack lived, studied, and worked within 10 miles of where he was born, in the North-East of England. Educated in chemistry, he became an X-ray crystallographer. He applied his knowledge of chemistry and his skills in crystallography to the three main areas of materials science: metals, glasses and ceramics. In the 1940s and 1950s he carried out classic studies of the interstitial alloys of the iron–carbon–nitrogen system; between 1957 and 1964, when he worked in industry, he made seminal contributions to glass technology; from 1964 onwards he pioneered a whole new field of oxy-nitride ceramics and glasses, the sialons, and by doing so put his beloved North-East firmly on the international map as a centre of excellence in ceramic science. Ken Jack was fond of saying that, had it not been for World War II, which interrupted his teacher training and took him into university research, he would probably have remained a school teacher and been happy to do so. But, in fact, he did remain a teacher. He was an inspiring lecturer and the researchers who learned their trade by his example went on to lead academic and industrial research groups around the world.

GROWING UP ON TYNESIDE, 1918–1936

Kenneth Henderson Jack was born at his grandmother’s upstairs terraced flat in Coburg Street, North Shields. He weighed 2 lbs. Luckily his grandmother, who had given birth to eleven children herself, was the unofficial neighbourhood midwife and she covered him with olive oil, wrapped him in cotton wool and kept him warm in the side oven of the kitchen range.

* david.jack@cantab.net

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Two miles from the mouth of the Tyne and ten miles downriver from Newcastle, North Shields is a fishing port. Ken’s father was John Henderson Jack, born in Aberdeen, the son of a fisherman. Little else is known of John’s family, other than at one point his parents came to North Shields but then moved away, leaving John abandoned as a youngster. At 16 he was apprenticed to a local shipping company, progressing to obtain his master’s certificate in 1915 before being commissioned into the Royal Navy for the duration of World War I. Ken’s mother, Emily, was the second oldest in a family of five girls and six boys, the Cozens family, and her mother was born Sarah Duff, also from Aberdeen and the daughter of a seaman. Emily’s father, Frank, was a joiner, originally from Wisbech in Cambridgeshire.

In 1915 John had bought a three-bedroom Edwardian terraced house in the same neighbourhood as Coburg Street and it was there that Ken and his two younger brothers, Hilton and Robert, were brought up (figure 1). With Ken’s father away at sea for long periods, the company of the many aunts, uncles and cousins in his mother’s family was a big part of growing up. There were just five years between him and his youngest uncle, Frank, who became like an older brother. Frank delivered groceries on Saturday afternoons, and took Ken along to ride in his barrow. He took him camping and showed him how to build machines with Meccano.

Ken attended the local King Edward’s Primary School and then Tynemouth Municipal High School. Knowing how Emily’s brothers had had such difficulty in finding work during the Great Depression, Ken’s parents were determined that their sons would go into ‘safe’ jobs. For Hilton and Robert that would be the civil service. For Ken it meant teaching, and in 1936 he successfully applied for an Earl Grey Memorial Scholarship to study chemistry at Armstrong College, which, with the School of Medicine, formed one division of the federated University
of Durham. In 1937 this Newcastle division was renamed King’s College. A condition of the scholarship was to train as a teacher after graduation.

**FORMATIVE YEARS, 1936–1945**

The years between 1936 and 1945 shaped Ken’s career and gave the first indications of those personal characteristics that would come to define him. His zest for foreign travel and pleasure in sharing his adventures were evidenced by the postcards and letters he sent home from the month spent youth-hostelling in Germany with three friends in the summer of 1938. College provided an outlet for his sporting competitiveness. At school he had played rugby and football; wiry and naturally athletic, but at only 5 feet 6 inches tall, he never made the first teams, only the seconds. At university he discovered hockey, to which his agility and low centre of gravity were better suited. He played for both the Durham University and the King’s College teams, becoming the College club captain in his final year. In 1939, as anticipated by all who had taught him as a student, Ken graduated with First Class Honours in Chemistry, coming top in his year, and receiving the Freire-Marreco Medal and Prize. He was an achiever, and took delight when his achievements were recognized.

After a course compressed to six months because of the outbreak of war, Ken then qualified for the Diploma in the Theory and Practice of Teaching, First Class, specializing in science and physical training. His three months of teaching practice in early 1940 were carried out at Cockermouth Secondary School in Cumbria, where he kept a meticulous record of his lesson planning and outcomes. He was particularly critical of a lesson that had not gone smoothly because he had not rehearsed it sufficiently. His future lectures and speeches were invariably prepared and scripted in detail, whether he was giving an invited lecture at an international conference, delivering an evening talk to a local society or making a speech at the leaving dinner for final year undergraduates. Ken was a perfectionist.

World War II thwarted his plans to become a schoolteacher and he was directed into war work at the Chemical Defence Research Establishment, Sutton Oak, before the Professor of Inorganic and Physical Chemistry, H. L. Riley, brought him back to Newcastle in October 1941.

Riley wanted Ken back to help with teaching, but research was also carried out in the department on behalf of the Ministry of Supply. Riley led a group on case-carburizing of armour-plated steel and one day he came back from a meeting in London at which steel hardening by nitriding had been discussed. He suggested Ken take a look at the literature on the subject, which he did, discovering the seminal work of Gunnar Hägg on interstitial alloys, and the fact that, while there had been much fundamental work on the carbides of iron, there had been little on iron nitrides. Ken had found the niche in which to start his research, using chemical techniques for specimen preparation and X-ray powder diffraction to determine crystal structures.

Between 1942 and 1945, by day Ken was lecturing to undergraduates and service personnel on short courses, and doing research for an MSc; at night he was manning an anti-aircraft rocket battery as a lieutenant in the Home Guard. Unflagging energy was another of his characteristics. He also got married and had his first child. Through family friendship, Ken and Freda Hughes had known each other since childhood and they married in 1942. David was born in 1944 and Stephen in 1950.
In 1944 Ken’s research became known to Sir Charles Goodeve (FRS 1940), who was on the point of becoming the first director of the British Iron and Steel Research Association (BISRA). The embryonic organization had no laboratories of its own and one of Goodeve’s ideas was to appoint scientific officers to carry out fundamental research within university departments. Ken was appointed a Senior Scientific Officer in April 1945.

**The BISRA years, 1945–1949**

Ken spent one year as a BISRA employee at Newcastle (figure 2) before moving to Cambridge with his family for three years while he worked for his PhD. Goodeve had persuaded the Cavendish Professor, Sir Lawrence Bragg (FRS 1921), to provide space for some of his BISRA researchers. Ken joined the crystallography group of W. H. Taylor, which occupied the top floor of the Austin wing, where he shared an office at one end of the corridor. The X-ray machines were at the other end and P. B. (now Sir Peter) Hirsch (FRS 1963) was in a lab halfway in between. Sir Peter has a vivid memory of Ken doing everything at the double, always with more than one X-ray camera in use, and running the length of the corridor to set up a camera or take one off at the end of an experiment. Bragg also had cause to comment on Ken’s energetic style. In a reference to support his application for the research manager’s job at Thermal Syndicate in 1957, Sir Lawrence wrote that, ‘He has an attractive enthusiasm, explaining his work to me with such energy that I often had to beg him to go slower so that I might attempt to follow’ (Bragg 1957). Throughout his life, Ken was one of those who took the stairs two at a time.

**Research on interstitial alloys**

By reacting iron powder with NH₃ and NH₃/H₂ mixtures over a range of temperatures, Ken was able to explore the whole of the Fe–N system. He determined the positions of the N atoms in the known phases, γ-iron, γ′-Fe₄N and ε-Fe₃N, and confirmed the existence of ζ-Fe₂N, only reported previously by Hägg. He interpreted the structure of nitrogen martensite—and by analogy carbon martensite—in a new way and discovered a new nitride phase, α′′-Fe₁₆N₂, occurring as a metastable transition phase when N-martensite is tempered. He then went on to react some of these nitrides with carbon monoxide and to react iron carbides with ammonia to produce a series of carbo-nitrides and to explore the ternary Fe–C–N phase system.

Determining the positions of interstitial carbon and nitrogen in a unit cell by X-ray diffraction was not straightforward. The intensities of the diffraction lines due to the positions of those low-atomic-number elements could be very faint. Exposure times needed to be long and steps taken to minimize background radiation. But with his chemist’s painstaking approach to material preparation and analysis, and with similar attention to detail in obtaining measurable X-ray powder photographs, Ken was able to make the crystallography of the Fe–C–N system peculiarly his own.

In what was described as the ‘very beautiful X-ray work of Jack’ (Hume-Rothery 1962), Ken confirmed that nitrogen occupies the octahedral interstices in all the phases of the Fe–N system, and discovered the outstanding feature of all the iron nitrides—the ordering of the nitrogen atoms in such a way that they keep as far away from each other as possible, irrespective of whether the metal atom arrangement is face-centred cubic (fcc), hexagonal close-packed (hcp) or body-centred cubic (bcc) (1–3).
In $\alpha''$-Fe$_{16}$N$_2$, for example (figure 3a), the bcc metal atom arrangement is distorted by the presence of nitrogen, but even at this low interstitial content the nitrogen atoms are fully ordered, each surrounded by a regular octahedron of iron atoms. This is also the nitrogen environment in N-martensite and Ken proposed his own way of representing the structure, as a mixture of structural units in which the non-regular octahedral interstices of bcc iron are distorted to regular octahedra by the presence of nitrogen or carbon, and units with no interstitial atoms which, to a first approximation, have the same dimensions as bcc iron (figure 3b).

Ken then went on to show that reacting $\varepsilon$- and $\zeta$-iron nitride with carbon monoxide produced isostructural carbo-nitrides. Prolonged reaction below 500°C resulted in the total elimination of nitrogen and a product whose X-ray diffraction pattern was identical to that of the carbide obtained by Hägg in 1934 and assumed to be Fe$_2$C (figure 4). Ken proposed an orthorhombic unit cell with composition Fe$_{20}$C$_9$ which he termed iron percarbide, but was frustrated by not being able to fully refine the structure. In his 1949 PhD thesis he
speculated that the structure could be monoclinic, ‘in which case its determination from a powder photograph is virtually impossible’. But Ken didn’t like being beaten—in a game, in an argument or by a puzzle—and returned to the problem periodically. In 1957 he tried to resolve the structure by observing shifts in the X-ray reflections when some iron atoms were replaced by manganese. He established the existence of a continuous range of solid solution between the iron carbide and manganese carbide with a common diffraction pattern the same as that of Mn₅C₂. Ken then left university for industry and only reported the results privately (Hume-Rothery 1966). By the time he returned to Newcastle in 1964 the structure of Pd₅B₂ had been fully determined from single crystal data (Stenberg 1961), and Ken deduced it might be isostructural with Hägg carbide. Together with an MSc student, Stan Wild, who went on to become Professor of Construction Materials at the University of South Wales, he confirmed the structure of Hägg carbide, or χ-carbide as it came to be called, as monoclinic with composition Fe₅C₂. The atomic positions were determined, and subsequently refined by least-squares methods using newly available computer programs (13). Ken later confided to one of his grandsons that solving the structure of Hägg carbide, something that he had been puzzling over for years, was one of the most personally satisfying achievements in his career.

In 1951 Ken published a landmark paper on the tempering of plain carbon martensite (4), probably the most studied phenomenon in ferrous metallurgy. In the 1940s Morris Cohen and his co-workers at the Massachusetts Institute of Technology had suggested that the first stage of tempering below about 200°C involved the formation of a transition carbide which was too finely divided for unequivocal identification by X-ray diffraction. Ken’s results provided direct
evidence that the transition carbide had an hcp metal-atom arrangement the same as ε-iron nitride and carbo-nitride, so he designated it ε-carbide with a composition between Fe₃C and Fe₂C. The widths and intensities of the X-ray reflections indicated, however, that the particles only had regular crystalline continuity in the direction normal to the (101)ₐ plane, which had a spacing almost identical to the (101)ₐ planes of the parent martensite. Ken proposed a specific orientation relationship between the matrix and what he suggested were coherent ‘stringlets’ of ε-carbide growing preferentially normal to (101)ₑ.

At higher tempering temperatures Ken found that the transition carbide was replaced by a phase whose X-ray reflections had the same positions as those of cementite (Fe₃C), but not the same intensities. Again, the anomalies were resolved by realizing that there were directional variations in crystallinity, in this case implying that the cementite occurred as thin platelets parallel to their (001) planes. Ken went on to show that only very small movements of iron atoms were needed to transform hexagonal ε-carbide to ‘thin’ cementite. He found no X-ray evidence for the formation of χ-carbide, but given the structural relationship between χ-carbide and cementite he proposed that χ-carbide could well occur as a precursor to cementite in the tempering of high-carbon martensitic steel, something that was confirmed subsequently using electron microscopy (Ohmori & Sugisawa 1971). The relationships between the structural units in the various iron carbides, and how these help explain some of the conflicting evidence regarding which phases occur, and how they transform from one to the other, were discussed in an invited review on carbides and nitrides in steel that Ken co-authored (19).

W. Hume-Rothery (FRS 1937) referred to Ken’s work on iron–nitrogen alloys being of ‘outstanding value’, and Goldschmidt, in his comprehensive reference work on interstitial alloys, describes the Fe–C–N system having been ‘largely elucidated in Jack’s now classical investigations’ (Goldschmidt 1967). For 70 years those seminal investigations from the 1940s and 1950s have stood up to scrutiny by subsequent workers using experimental and theoretical techniques that were unknown or in their infancy at that time.

**Newcastle, with an American interlude, 1949–1957**

After completing his PhD, Ken returned to King’s College as a Lecturer in Inorganic Chemistry. Taking on his first research students, he continued work on interstitial alloys. He was also retained by BISRA as a consultant, continuing to be an active participant in meetings of their Metal Physics Section. The £50 annual fee was a welcome supplement to his salary of £650 because, with their second son, Stephen, on the way, he and Freda were anxious to buy their own house, having lived in rented accommodation since their marriage. The modest semi-detached three-bedroom house they built was to be Ken’s home for the next 60 years.

By accident, Ken also began another line of research. While at Cambridge, over a lunch they had both been invited to, Viktor Gutmann, a student of the Professor of Inorganic Chemistry H. J. Emeleus (FRS 1946), told Ken he had just prepared VF₂ for the first time and asked him to take an X-ray photograph of it. Ken indexed the unit cell as rhombohedral, with trigonal symmetry, so the only place the two fluorine atoms could be was on the three-fold axis, and there was no room for them there. He told Viktor that he must have prepared the trifluoride, VF₃, and after repeated chemical analysis Viktor agreed. On his return to Newcastle Ken carried out a full structure determination of this and the trifluorides of Mo and Ta that
had also been prepared by Gutmann and Emeleus. This new field for Ken was particularly fortuitous because P. L. Robinson, the Reader now responsible for the inorganic laboratory, was developing a research school in fluorine chemistry that Ken would become involved with in due course. Meanwhile, another lunch led to Ken taking a year’s leave of absence from the university.

In 1951 Morris Cohen invited Ken to present a paper on carbon and nitrogen martensites at the Pittsburgh Diffraction Conference, and assured him he could pay his way by giving lectures at academic institutions and industrial companies. One of those companies was Westinghouse Electric Corporation and, over a canteen lunch after his talk, the director of research, Clarence Zener, told him to send for his wife and kids and come and work there. Ken was persuaded, and he and his family spent the 1952–1953 academic year in the USA.

**Westinghouse 1952–1953**

Westinghouse, with 100,000 employees, made everything from household electrical goods to equipment for large-scale electrical power generation and transmission. The research facility in Pittsburgh employed 500. Zener made Ken responsible for the X-ray laboratory which provided routine analytical services as part of the chemistry department. Ken set about raising its status. He purchased new equipment from Europe and, with the help of the workshop technicians, built a Raymax-type X-ray generator with interchangeable water-cooled targets. But what attracted most attention was the library of ball-and-stick structure models that he made. He couldn’t obtain wooden balls in the USA for less than 50 cents a ball so he ordered a crateful from England. Thereafter his name became associated with balls in numerous ribald ways, but it did result in him and the X-ray section being better known, becoming involved with general consulting work, and transferring to the solid-state physics department.

A particular project involved caesium antimonide, Cs₃Sb, used as a photocathode material in image intensifiers for diagnostic X-ray radiography. The electronics department wanted to know the crystal structure to better understand its properties. Ken started the structure determination but it was only completed after he returned to England.

Ken and Freda were overwhelmed by the kindness and hospitality shown to them. They made many lasting friends, not least because they took full advantage of their rented house being the first they had lived in that was big enough to hold a party. A typical guest list of 40 could include the technician from whom Ken had bought an eight-year-old Chevrolet for $100, and Clarence Zener himself, who insisted on staying behind with his wife, Ruby, to do the washing up. The informality and absence of a rigid social hierarchy were aspects of American life that particularly appealed to Ken.

He was offered permanent positions at both Westinghouse and Pittsburgh University, where he had been a visiting professor, but, as he explained to his American friends, while he could imagine himself settling down happily in America for the rest of his life, he could do so equally well in his own country, where his and Freda’s families were.

**Structure determination by powder methods**

Once back at Newcastle, Ken continued to develop his powder diffraction techniques, and started to apply them to many of the fluorides prepared by P. L. Robinson’s group, working particularly closely with the senior research fellow, Dr M. A. Hepworth.

Structure determination involves an initial assumption regarding symmetry and atomic positions, and testing this assumption by comparing the observed diffracted line positions
and intensities with those calculated from the proposed structure. Accurate measurement is critical. Ken’s methods included measuring the X-ray film blackening at 0.1 mm intervals using an optical densitometer and measuring the areas under the plotted photometer curves with a planimeter. Care was taken to ensure that the density of blackening was within the linear portion of the film response curve. With the strongest line intensities up to 200 times greater than the weakest, this could mean taking several exposures for different lengths of time and scaling the films with respect to each other. Where calculated and observed intensities did not agree it was necessary to refine the atomic positions by trial and error and in the days before electronic methods this was a laborious process involving a mechanical calculating machine and logarithmic tables. Ken’s particular talents were his patient experimental skill in setting up the X-ray camera and specimen, the application of his chemical knowledge in making the initial assumptions, refining those assumptions by imagination and intuition, and persistence in carrying out the time-consuming calculations. His structure determination of monoclinic potassium hexafluoro-osmate, KOsF$_6$ (5), is cited as the ‘standard that can be reached’ (D’Eye and Wait 1960).

Of the many structures that Ken determined during this period, two deserve mention because of their wider significance in chemistry and physics. First, he showed that the rhombohedral structures of the transition-metal trifluorides consisted of regular octahedra of six fluorine atoms. In manganese trifluoride, however, the rhombohedral structure was distorted to monoclinic. After extensive trial-and-error refinement, excellent agreement was found between the observed and calculated intensities (6). The structure determination had been something of a tour de force and Ken was delighted with it, but it left him puzzled. Instead of all six metal–fluorine bond lengths being the same, as in all the other trifluoride structures, there were three different Mn–F bond lengths within each octahedron. When Professor (later Sir) Ronald Nyholm (FRS 1958) got to hear of this he was equally delighted because it was consistent with the crystal-field (ligand field) theory of transition-metal complexes that he had used to explain abnormally long Pd–I bond lengths in palladium diarsine iodide.

Ken also pursued the solution to the structure of caesium antimonide. The atomic numbers of caesium, 55, and antimony, 51, mean that their X-ray scattering factors are almost the same, making their positions in a structure difficult to determine. There were weak reflections in the diffraction pattern that implied that some of the atom positions deviated from a simple bcc arrangement. But the only solution to fit the data was not that some of the atoms were displaced in a specific way, but that the difference between the vibrational amplitudes of caesium and antimony atoms from their mean positions—their so-called temperature factors—were unexpectedly large (7). Assigning separate temperature factors to different atoms in simple structures was not commonplace at the time, and Dame Kathleen Lonsdale (FRS 1945) referred to the significance of Ken’s work in the memoir she wrote for 50 years of X-ray diffraction (Lonsdale 1962).

At this time Ken was very satisfied with the results of his university teaching and research, but less satisfied with his salary and the prospects for promotion within the chemistry department at King’s College. He made several unsuccessful applications for professorships in chemistry at other universities, for which he asked Sir Lawrence Bragg to act as referee. In one of his references Sir Lawrence made the prescient comment that, in his opinion, Ken ‘would build up a research school which would become widely known, and his keenness and enthusiasm would inspire his staff’ (Bragg 1954).
An application for an industrial appointment was successful, however, and in July 1957 Ken started work as research manager at Thermal Syndicate Limited, a company in Wallsend-on-Tyne.

**Thermal Syndicate Limited, 1957–1964**

Thermal Syndicate Ltd (TSL) was the first company to make vitreous silica on a commercial scale and at the time Ken was appointed it was still only one of six worldwide to do so. The manufacturing process involved melting naturally occurring sand or powdered quartz crystal by electric melting or by melting in a high-temperature flame. The resultant silica glass was fashioned into tubes and crucibles for use in the chemical industry, into laboratory ware and into windows and prisms for use in optical instruments.

Up until then Ken’s research had been self-motivated, on topics he had chosen. At TSL, with a staff of 80 out of a total workforce of 800, he had to focus on the needs of the business. He had inherited a project to make a synthetic product, free from impurities, by hydrolysing silicon tetrachloride in an oxygen–hydrogen flame. Development and day-to-day production of Spectrosil®, its trade name, remained the responsibility of the Research Department throughout Ken’s time at TSL. But that development, and developments to improve the properties of all TSL products, was informed by basic research.

At the time there had been little published on the science of vitreous silica: A. J. Moulson and J. P. Roberts had just started to investigate the diffusion of water in silica glass (Moulson & Roberts 1958). Furthermore, the product descriptions used in the commercial literature of different suppliers were confusing, because they were based on properties, particularly transparency to visible light, rather than on chemical constitution arising from different raw materials and the different methods of manufacture. The research that Ken started, managed and interpreted laid the foundations of the scientific understanding of the relationships between processing variables, material chemistry and properties. His papers with Dr G. Hetherington are still cited today and their classification of the types of vitreous silica has been accepted as standard (9–12). The key property determinants were the metallic impurities in the naturally occurring raw material that made their way into the finished product, and the ‘water’ content that arose from the method of melting. ‘Water’ in vitreous silica was introduced by fusion in a hydrogen-containing flame resulting in water vapour entering the material, rupturing the Si–O bonds to form Si–OH hydroxyl groups. These affected critical properties such as viscosity and refractive index, and variations of hydroxyl concentration within an individual product could lead to failures: drawing a tube of varying viscosity led to variable wall thickness; variations in refractive index made a prism unsuitable for use in an optical spectrometer.

When Ken joined TSL it had just been awarded an Admiralty contract to produce crucibles for contamination-free melting of silicon to make semiconducting silicon wafers. Spectrosil®, with metallic impurity levels less than 2 parts in 10 million, was ideal for the job. The absence of impurities also meant that it absorbed no visible or UV light at wavelengths above 0.2 μm, much better than other grades of vitreous silica, but with much worse absorption in the near infrared because it was made in an oxygen–hydrogen flame and therefore had a high hydroxyl content. This also reduced the viscosity, limiting the temperature at which it could be used as a container.
Under Ken’s direction a method was developed to make a water-free material by directly reacting SiCl₄ with oxygen in an induction-plasma. Spectrosil® WF had outstanding optical transmission as well as a very low impurity content and found important applications in the production of optical fibres for telecommunications.

The Spectrosil® process was also adapted to make single-crystal oxides, and Ken negotiated an Admiralty contract in 1959 to prepare oxide single crystals chemically and physically perfect enough to be used as lasers. It took four years and £100,000 (more than £2M at 2020 values), but by feeding aluminium chloride vapour and chromyl chloride vapour into a hydrogen–oxygen flame at >2,000°C the first UK-made ruby crystal to exhibit laser excitation was produced (14).

**University of Newcastle upon Tyne, 1964–1984**

In May 1963 Norman Petch (FRS 1974), Cochrane Professor of Metallurgy and head of department at King’s College, wrote to Ken wondering if he was interested in the readership which had been established to broaden the department’s teaching and research to include non-metallic materials. The eventual outcome of this letter was Ken’s appointment in October 1964 to a Personal Chair of Applied Crystal Chemistry at what was now the University of Newcastle upon Tyne.

A year later Dr Paul Grieveson joined Ken as a lecturer in the department. Paul had studied chemistry at Newcastle in the 1950s and undertaken research for an MSc with Ken on Ternary Interstitial Alloys. After a PhD at Imperial College London, he had worked in the laboratories of US Steel under the direction of L. S. Darken. With expertise in the application of thermodynamics to metallurgical reactions and first-hand experience of Ken’s experimental techniques, Paul was an ideal collaborator and the two led the research group until he left in 1971 for the chair of Extraction Metallurgy at Strathclyde University.

Ken’s plan for research was to extend his previous work on iron nitrides to systems in which iron was alloyed with a few per cent of a transition metal and then nitrided. At the outset, however, the Metallurgy Department at Newcastle had few of the facilities and little accommodation for the work that Ken wanted to carry out. The department was housed in adapted commercial premises overlooking Newcastle’s main bus station. The three old Raymax X-ray machines had water-cooled interchangeable targets and tripped out whenever the water pressure fell, owing to the inadequate plumbing. The laboratory for preparative work was in an attic above the adjacent Crow’s Nest public house. There was no transmission electron microscope suitable for the high-resolution examination of thin-foil metal specimens, which was a particular drawback when work was started on the Fe–Mo–N system. Specimens with hardness values exceeding 1200 VPN were obtained when nitrogen was introduced from an ammonia–hydrogen gas mixture into iron containing 3.0 at.% Mo at temperatures between 450 and 600°C, yet no second phase was detected using X-ray diffraction. It was only when samples could be examined using the electron microscope facilities at Manchester University, courtesy of Professor R. B. (now Sir Robin) Nicholson (FRS 1978), that micrographs were obtained displaying the classic appearance of Guinier–Preston (GP) zones that occur in age-hardened aluminium copper alloys.

But the university then acquired one of Newcastle Breweries’ redundant bonded warehouses and Ken and Paul were able to design a laboratory for their particular research and
teaching needs. The 12,000 sq.ft. of space comprised a basement for X-ray machines and, in due course, transmission electron microscopes; on the ground floor there were teaching rooms and a laboratory for material preparation and mechanical testing. There was also one room that Ken regarded as essential for the success of the research—a tea room where everyone had the opportunity to meet twice a day. The move to what was named the Crystallography Laboratory, and what soon became a self-contained autonomous sub-department of Metallurgy, took place in December 1969.

Meanwhile, almost by chance, Ken started to explore what was to become rich research territory. Just before he had left the university to join Thermal Syndicate, BISRA had asked him to examine two types of silicon nitride (Si$_3$N$_4$) that had precipitated in Fe-3% Si transformer steels. Ken determined that both forms, α and β, had a hexagonal unit cell with a similar $a$-dimension but with the $c$-dimension of α about twice that of β. He made a complete determination of the β structure which was the same as that of the silicate mineral phenacite, Be$_2$SiO$_4$ (8), but there was no time to determine the detailed structure of α.

At that time, silicon nitride was starting to be investigated in the UK as a promising candidate for use in a ceramic gas turbine for sea and land transport. During the late 1950s and early 1960s extensive research on fabrication was carried out by industry, universities and the British Ceramic Research Association, largely funded by the Admiralty Materials Laboratory. By the time Ken returned to Newcastle, silicon nitride was being hailed as ‘the ceramic of the decade’, but the crystal structure of α was still undetermined. Ken, Stan Wild and Paul Grieveson carried out the first structure determination of α. Their controversial conclusion was that in the α samples that they studied, 1 in 30 nitrogen atoms was replaced by oxygen, with some vacant nitrogen sites to maintain the charge balance (16). Ken went on to persuade the Admiralty Materials Laboratory to provide a grant for Stan Wild, as a postdoctoral research associate, to continue the work. The first six-monthly report, ‘Progress report no. 1 of MoD contract N/CP.61/9411/67/4B/MP.387, Jan–June 1968’, was largely a survey of the literature but did include a vision of what would become a new field of ceramic science.

As a chemist Ken had a detailed knowledge of mineral silicates and how their chemistry depended on the way SiO$_4^{4-}$ tetrahedra are arranged, and the extent to which Si$^{4+}$ is replaced by Al$^{3+}$ if appropriate valence charge compensation is made elsewhere in the structure. The crystal structures of both α and β silicon nitride are silicate structures based on SiN$_4$ tetrahedra, and in α some N atoms are replaced by O atoms with compensating cation vacancies. Why not, Ken argued, replace much more N by O, which could be done by simultaneously replacing Si$^{4+}$ by Al$^{3+}$ to maintain the charge balance. Hence, he wrote in the first progress report:

Oxygen replaces nitrogen in α-silicon nitride to a limited extent, but further replacement seems possible if network silicon atoms are replaced by aluminium or by another substituent of valency lower than silicon. Furthermore, replacement of network silicon by aluminium would allow accommodation of other metallic cations in the silicon nitride structure in a manner similar to that occurring in crystalline silicates and in glasses. There seems a good possibility of developing a completely new range of nitride and oxynitride materials—vitreous as well as crystalline—based on the Si–Al–O–N system.

Attempts to obtain support to work on these ideas failed until, two years later in 1970, the Lucas Group Research Centre agreed to finance the work. As Dr W. J. Arrol, the research director, subsequently told Ken, this was in order ‘not to find anything’. Lucas had been
investing in the development of hot-pressed silicon nitride for several years and did not welcome any suggestion that a better or cheaper material could replace it.

Meanwhile, work had been progressing on the effect of substitutional alloying elements on the behaviour of nitrogen in iron. The discovery of GP zones in Fe–Mo–N made in-house access to a transmission electron microscope essential for materials characterization. Furthermore, the growing research group needed more technician support and the experience of postdoctoral researchers. In 1970 Ken and Paul Grieveson successfully applied for a substantial grant from the Wolfson Foundation.

The Wolfson Research Group for High Strength Materials

Ken’s team soon grew to comprise about 25 staff, more or less equally divided between postdoctoral workers, research students and technicians, and funded almost entirely from external sources. Among the research associates, Dr Derek Thompson and Dr Alan Hendry would later be appointed to university lectureships, sharing the direction of the group and undergraduate teaching with Ken until he retired in 1984.

The laboratory had the means to prepare ceramic materials by sintering or hot pressing in controlled atmospheres at temperatures up to 2000°C and to introduce nitrogen and carbon into iron alloys by gas–metal equilibration. It continued to be one of the few groups using X-ray methods for the complete determination and refinement of crystal structure from polycrystalline powder specimens. Eventually there were four transmission electron microscopes in the laboratory, but, as Ken admitted when he gave the 1980 Materials Lecture of the Royal Microscopical Society, he wasn’t actually allowed to touch them because of the ‘protective attitude of those responsible for such delicate machines’. He remained, however, quite capable of teaching a colleague how to align an X-ray monochromator on a Hägg–Guinier focusing camera.

The Wolfson Group’s research quickly acquired an international reputation. In 1970 Stan Wild, Paul Grieveson and Ken had presented a number of papers at the Fifth Symposium on Special Ceramics organized by Paul Popper of the British Ceramic Research Association. As the distinguished American ceramist Fred F. Lange later reminded Ken, this was the occasion when ‘your group first bombarded the world with the science of silicon nitride’. Within a year of obtaining Lucas support, Ian Wilson at Newcastle and researchers working independently at the Toshiba and Toyota laboratories in Japan confirmed that up to three-quarters of the silicon and nitrogen in β-Si₃N₄ could be replaced by aluminium and oxygen without change of crystal structure. Ken’s first public use of the acronym ‘sialon’ to describe such compounds was when he gave the 1973 Mellor Memorial Lecture at the invitation of the British Ceramic Society.

In relation to the group’s work on nitrogen steels, nine current or former researchers from the Crystallography Laboratory presented papers at a 1972 British–Swedish symposium on Interstitials in Steel, jointly organized by Uddeholms Steel and the Swedish Institute for Metals Research (18). The group was also well represented at the first NATO Advanced Study Institute on Nitrogen Ceramics, held in Canterbury in 1976—at which Ken presented, among others, the first paper on sialon glasses—and at the second of such meetings, held at the University of Sussex in 1981. Indeed, Ken took every opportunity to present the group’s work to an audience, always delivering his material with energy, clarity and enthusiasm. Conference organizers welcomed him as a participant because he was always an active contributor to any
discussion, although he did have a reputation for being characteristically direct and making any points of disagreement with emphasis on scientific rigour rather than on tact or diplomacy.

His personal reputation was a factor in attracting research workers as PhD students, postdoctoral associates and visiting fellows, not just from the UK but from around the world. Ken encouraged interaction between researchers working in different disciplines and at different stages in their careers, both through formal seminars and through the informality of the tea room. The group acquired a reputation not just for its science, but for the close-knit way it appeared to work together—the term ‘Newcastle mafia’ was sometimes used by outsiders to describe it.

Ken had a hands-on management style. He made himself accessible. If you could see him at his desk through the open office door you could interrupt him with a problem or a new idea. He took a personal interest in the welfare of group members, particularly ones from overseas. Those who could not travel home at Christmas were invited to join family festivities at his home. But he also demanded the highest standards, in the science, and also when it came to spelling, grammar and punctuation. Instinctively argumentative and sometimes cantankerous, he was, in turn, loyal and selfless in the development of the careers of those who worked with him, with no hesitations in calling on friends and acquaintances to explore the possibilities of a job offer to a student or staff member whose research funding at Newcastle was coming to an end. With his active encouragement and financial support, two of the technicians in the group obtained their PhDs.

As the group’s work became better and better known there were many invitations to give lectures overseas in Europe, the USA, Japan, India, Pakistan and China. Ken’s seven-week visit to India and Pakistan in early 1981 was particularly memorable. He gave talks at 21 university departments and research institutes in 12 different cities, armed with a battery of slides from which he could pick and mix for lectures on various aspects of nitrogen steels, nitrogen ceramics or vitreous silica. In the case of power cuts or malfunctioning projectors he resorted to blackboard and chalk. Ever eager for new experiences, he also took himself off for a two-day solo trip to Nepal, and in Pakistan he went alone by train from Peshawar to Landi Kotal, the gateway to the Khyber Pass on the border with Afghanistan. He took photos of his fellow passengers, with cockerels under their arms, rifles over their shoulders, and bandoliers of bullets across their chests. They offered him cocaine and hashish, which, he said, he refused.

**Research on nitrogen in iron and steel**

Ken used the term ‘constant-activity ageing’ to describe the process by which Fe–X–N alloys were equilibrated in ammonia–hydrogen or nitrogen–hydrogen mixtures. By this means any nitrogen removed from solid solution by combining with a substitutional solute was immediately replenished from the gas phase and the driving force for any precipitation reaction was maintained until all the substitutional solute was consumed.

The use of constant-activity ageing led directly to the discovery of substitutional–interstitial solute–atom clustering in α-iron, a phenomenon analogous to the formation of GP zones in age-hardened Al-4wt.% Cu, but something that had not been established hitherto in bcc α-iron. Zone or cluster formation was detected by high hardness increases without any change in the lattice parameter of the iron solid solution, consistent with the observations of Guinier and Preston in the late 1930s that the unit-cell dimensions of a non-random solid solution of Al-4wt.% Cu are the same as those of a random solid solution of the same concentration. It is only when a precipitated phase diffracts independently that the lattice parameter changes
to reach the value of the solute-depleted solvent. In $\alpha$-iron the occupation of an octahedral interstice by N pushes the iron atoms apart to such an extent (see figure 3b) that the lattice parameter is very sensitive to nitrogen concentration in random or non-random solid solution.

The evidence of cluster formation in Fe–X–N alloys prompted a re-examination of the behaviour of Fe-0.07wt.% N, quenched from the 590°C nitriding temperature and aged at room temperature, something Ken first looked at in 1952. Repeating the experiment showed that there was hardly any decrease in lattice parameter after ageing for a day, at which stage transmission electron micrographs displayed a homogeneous dispersion of disc-shaped clusters about 150 Å in diameter and less than 10 Å thick on the $\{100\}$ matrix planes, images virtually identical to those from constant-activity aged Fe-3at.% Mo and age-hardened Al-4wt.% Cu.

The addition of a substitutional solute changed the detail of the precipitation sequence but the generalized model proposed at Newcastle was for homogeneous clusters—containing Fe, alloying element X, and N—to form from the supersaturated solid solution, then for clusters to become coherent particles of a metastable transition phase, and finally for non-coherent precipitates of the equilibrium nitride phase to nucleate and grow—work that has explained the reasons for the very high hardness values obtained when steels are surface-hardened by commercial nitriding, and that has led to a better understanding of the variables controlling the process (20), something Ken set out to do in 1942.

**Research on nitrogen ceramics and glasses**

The contribution of Ken and his co-workers to the basic science of nitrogen ceramics and glasses started by defining the $\alpha$ and $\beta$ silicon nitride structures (16), in both of which the Si atoms lie at the centre of N-atom tetrahedra, joined at the corners to form eight-membered Si–N puckered rings (see figure 5), which join in turn to form sheets perpendicular to the $c$-axis. In $\beta$ the sheets are stacked periodically ABABABAB, with large diameter channels parallel to the $c$-axis. In $\alpha$ the stacking sequence is ABCDABCD with the CD sheets rotated with respect to AB by 180° about the $c$-axis. The rotation blocks off the continuous channels but creates large interstices capable of accommodating metal cations. The additional conclusion that up to 1 in 30 nitrogen atoms in $\alpha$ can be replaced by oxygen has remained controversial, but in his comprehensive review of *Silicon nitride and related materials*, Professor F. L. Riley concluded that ‘there was no doubt that $\alpha$-Si$_3$N$_4$ could accommodate oxygen within the crystal lattice, even though oxygen appeared not to be essential for stability of the crystal structure’ (Riley 2000).

The next major contribution was to propose the mechanism by which additions of MgO to mainly $\alpha$-Si$_3$N$_4$ powders, followed by hot-pressing, produce high-strength silicon nitride ceramics (15). The function of MgO was to react with amorphous silica on the surface of the silicon nitride powder particles to form a silicate liquid (containing N) in which $\alpha$-Si$_3$N$_4$ could dissolve and reprecipitate as $\beta$. On cooling hot-pressed material, the liquid formed at high temperature remained as a vitreous phase between the grains of silicon nitride, explaining why the strength of hot-pressed silicon nitride decreased rapidly above 1000°C. This mechanism of densification by liquid phase sintering and transformation of $\alpha$ to $\beta$ silicon nitride via a high temperature liquid, which cooled to form an intergranular glass, was the foundation for much of the subsequent work on nitrogen ceramics, nationally and internationally.

The outstanding contribution was pioneering the whole new field of sialon ceramics and glasses, leading to worldwide interest in their science and technology. The first experiments to
prove the validity of Ken’s predictions showed that up to 65% Al₂O₃ could be accommodated in an expanded β-Si₃N₄ solid solution (17), and formed the basis of patents applied for in early 1972, naming K. H. Jack and his research student W. I. Wilson as inventors. Patent applications were filed by Japanese researchers at almost exactly the same time, but both groups had made the same mistake, relying on X-ray diffraction and bulk chemical analysis to determine the extent of the β-sialon phase field. It was Dr R. J. (John) Lumby and colleagues at the Lucas Group Research Centre who first raised doubts and showed by careful creep measurements that glass, undetectable by X-rays, must also be present at many compositions.

Subsequent detailed work at Newcastle and by the group of Professor G. Petzow at Stuttgart established not only the extent of the β-sialon phase field but also characterized the phases in the Si₃N₄–Al₄N₄–Al₄O₆–Si₃O₆ system, and mapped their relationships over a range of temperatures (figure 6a). There was a robust but respectful rivalry between the two groups, who both revised and modified their descriptions of this and related systems in the light of each other’s results. Knowledge of the phase equilibria was critically important for workers studying other aspects of these systems to understand how material properties depended on composition, processing and microstructure.

α-Sialon was first prepared pure at Newcastle in 1978 by reacting silicon nitride with aluminium nitride and oxides of Ca, Li or Y (22). The addition of a fifth component to the
system required representation by a triangular prism in which concentrations are expressed as chemical equivalents, so that any point on the prism represents a combination of 12 positive and 12 negative valencies. Figure 6b uses such a Jänecke prism to illustrate the relationship between $\alpha$ and $\beta$ sialon phase regions. In 1981 Ken suggested that the tentatively determined phase relationships in the Ca–Si–Al–O–N system could lead to the possibility of producing mixed $\alpha/\beta$ sialons (23). This proved to be the case, and by varying the starting composition and the heating and cooling cycle during sintering it was possible to vary the $\alpha/\beta$ phase ratio and particle morphology to tailor material properties for particular applications (Ekström & Nygren 1992).

By using oxide additives such as MgO and Y$_2$O$_3$, sialons sinter to full density without pressure via a high-temperature liquid phase. The liquid cools to form a nitrogen-containing intergranular glass whose quantity and characteristics critically affect the mechanical properties of the product. Ken believed that oxynitride glasses were also worth exploring in their own right, with the prospect of producing material more refractory and more resistant to devitrification than the vitreous silica made by his former company Thermal Syndicate Ltd (21). Together with Robin Drew and Stuart Hampshire, a systematic study was made on glass formation in M–Si–Al–O–N systems, where M = Y, Mg, Ca and Nd. Stuart Hampshire continued this work at the University of Limerick and has extended it to study the crystallization of sialon glasses and to consider the prospects for producing oxynitride glass ceramics (Hampshire 2008).

**Commercialization of sialons**

As soon as Ian Wilson’s work at Newcastle validated Ken’s prediction that sialons could be synthesized, a small team at the Lucas Group Research Centre started to prepare sialon material and to measure properties. The preliminary results showed it to be superior to silicon nitride and prompted Lucas to set up a pilot plant for sialon production and prototype product manufacture. The undoubted product champion was Dr John Lumby, who continued the close co-operation with Newcastle but also worked with Dr M. H. Lewis at Warwick University on process optimization and characterization of microstructure. The initial Lucas $\beta$-sialon materials used Y$_2$O$_3$ as a sintering aid to avoid the need for hot-pressing and these were trademarked Syalon®. One of the prototype products was the replaceable inserts used in cutting tools for machining metals. Trials were made in-house at Lucas in machining cast iron, but, through John Lumby’s contacts with Professor S. K. (later Baron) Bhattacharyya (FRS 2014), Rolls–Royce were persuaded to carry out tests machining the nickel-alloy compressor blades for the RB211 jet engine. Their success led to licences being acquired in 1979 by the major cutting tool manufacturers Kennametal and Sandvik. In 1983 licences were also granted to six Japanese companies involved in the production of ceramics for engineering applications, but the use for metal machining has turned out to be the most commercially successful sialon application.

Ken took a passionate interest in all of these developments, making frequent reference to them in his publications. He also brokered the involvement of the Cookson Group, an international metals and chemical company based on Tyneside. A Cookson company, Anzon, started to produce both the raw materials for sialon synthesis and pre-formulated sialon powders; a joint venture company, Lucas Cookson Syalon, was established on the former Lucas site in the Midlands to carry out R&D, product development, marketing and licensing. In 1984 Ken and John Lumby were jointly awarded the Prince of Wales Award for Industrial
Innovation and Production for their work on sialon discovery and development. The award was presented by HRH Prince Charles at Highgrove House and the presentation featured on the BBC programme *Tomorrow’s world* (figure 7).

**RETIRED, 1984–2013**

*Professional activities in retirement*

Ken retired from the University of Newcastle at the end of September 1984 after 32 years’ service. This meant more time to accept invitations to receive awards and give lectures overseas—and to visit licensees on behalf of the Cookson Group, for which he became a consultant in 1987. He relished every opportunity to travel, and to refresh his many friendships; in the ten years to 1994 he went to Japan ten times, China three times and the USA and Canada nine times, in the process accumulating a wealth of knowledge on the industrial applications and world markets for nitrogen ceramics. So while many of Ken’s lectures in retirement involved the science of nitrogen ceramics and glasses (24), he found himself being asked to talk more and more about their future prospects as engineering materials (25,26), something he embraced enthusiastically. His exhibit on sialon engineering ceramics for a Royal Society Industrial Soirée in 1986 emphasized their commercial applications (figure 8).

Ken’s frequent trips to Japan led to his work probably being better known in that country than in his own and he was recognized by the Ceramic Society of Japan not only by a Centennial Award on the occasion of its 100th anniversary in 1991, but by Honorary Membership, an honour awarded to only three non-Japanese in the history of the society.

Figure 7. John Lumby and Ken Jack being presented with the Prince of Wales Award trophy by HRH the Prince of Wales. (Image used courtesy of the BBC Photo Library.)
His last visit to Japan was in 1997, on a six-week tour that included China. At the 6th International Symposium on Ceramic Materials and Components for Engines he presented a paper entitled ‘A reappraisal of nitrogen ceramics for engine applications’ (28). At that time Japan was the only country that still had a nationally co-ordinated and funded ceramic gas turbine programme. Ken’s controversial contention was that, in terms of its commercialization, the most important property of silicon nitride was its high cost; that all ceramic engine components were being produced at a loss; and that the prospect of a ceramic engine before 2050 was negligible. Future emphasis, he said, should be on lower temperature applications using cheaper raw materials, cheaper densifying additives and cheaper processing routes. This did not go down well with the 400 Japanese in the audience—but in subsequent visits to Nippon Steel and Hitachi Metals his opinions were received enthusiastically and he was able to discuss his own ideas on cost reduction.

Ken also visited Tohoku University to discuss research on $\alpha''$-$\text{Fe}_{16}\text{N}_2$, the nitride he had first discovered in the 1940s. Claims in the early 1990s that $\alpha''$-$\text{Fe}_{16}\text{N}_2$ in sputtered Fe–N thin films had an abnormally high-magnetic moment remained controversial. Ken had followed this work closely in retirement, and had contributed to the discussion in papers and at conferences (figure 9), drawing on his original work on the preparation of $\alpha''$ and on the subsequent work at Newcastle on the effect of alloying elements on its stability (27).
In his later years Ken relied on contacts around the world to keep him briefed on newly published work. In 2010 he received a paper concerning direct evidence for oxygen in $\alpha$-Si$_3$N$_4$, using electron-microscopy techniques. Ken felt that their 1970s work, although cited, was not explained fully and, persistent to the last in pursuing scientific rigour, he contacted Stan Wild and Paul Grieveson suggesting they write a discussion paper elaborating on their previous findings. Stan produced a draft but Ken was too ill to provide input. Subsequently, Stan made the paper available publicly, in Ken’s memory (Wild 2015).

**Personal life in retirement**

After retirement in 1984 Ken was to live for another 29 years, all but the last alone in the house he had lived in since 1951. His wife, Freda, had died suddenly from a cerebral aneurysm in 1974. Ken had never had a hobby. In his early *Who’s who* entries he listed his only recreation as ‘playing with grandchildren’. By the time he retired they were becoming too old for this to be appropriate but his four grandchildren, and later his four great-grandchildren, were a source of great pride and pleasure to Ken. They were not, however, immune from his innate urge towards perfection. Any announcement that they had come second, in an exam or a race, would be cause for congratulation, but also the question, ‘Why did you not come first?’

His last five years were something of a struggle. In 2007, owing to health problems, he was unable to travel to Detroit to accept the award of Distinguished Life Membership of the American Ceramic Society. Stuart Hampshire accepted the award on his behalf and delivered the acceptance speech in which Ken expressed wry delight that his life had become distinguished just in time before it became extinguished.

Ken continued to drive and continued to correspond with contacts at home and abroad, in long hand with pen and ink. His family had given him a desktop PC one Christmas and with typical determination he enrolled in evening classes to learn how to use email and the internet,
but became increasingly frustrated. The keys on his pre-war Remington portable typewriter needed to be firmly pressed and he never got used to the fact that doing the same thing on his keyboard resulted in a long string of the same character. He was, however, adept at using his printer to copy his correspondence.

Ken was persuaded to look at suitable retirement accommodation nearer his sons in the Midlands but found the prospect too daunting. In the event a move was forced upon him. He spent Christmas 2011 with his son David and family, but further health problems forced him to stay. The following year saw numerous hospital visits and surgery and Ken became reconciled to never returning home again. In January 2013, following a fall, blood tests showed impaired kidney function and he died in hospital shortly afterwards.

**HONOURS AND AWARDS**

1944 Saville Shaw Medal, Society of Chemical Industry  
1951 Sir George Beilby Memorial Award, Institute of Metals, Royal Institute of Chemistry, Society of Chemical Industry  
1973 Mellor Memorial Lecturer, British Ceramic Society  
1979 Kroll Medal and Prize, Metals Society  
1980 Fellow of the Royal Society  
1984 Fellow of the American Ceramic Society  
1984 Harold Moore Memorial Lecturer, Metals Society  
1984 Membre d’Honneur, Societe Francaise de Metallurgie  
1984 Prince of Wales Award and Prize for Industrial Innovation and Production (shared with Dr R. J. Lumby of Lucas Cookson Syalon Limited)  
1986 W. Hume-Rothery Memorial Lecturer, Oxford Metallurgical Society  
1988 Armourers & Brasiers’ Company Award, Royal Society  
1988 World Materials Congress Award, ASM International  
1989 Sosman Memorial Lecturer, American Ceramic Society  
1989 The A. A. Griffith Silver Medal and Prize, Metals Society  
1991 Centennial Award, Ceramic Society of Japan  
1991 Honorary Membership, Ceramic Society of Japan  
1997 Officer of the Order of the British Empire  
2007 Distinguished Life Member, American Ceramic Society

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The portrait photograph was taken in 1980 for the Royal Society and is Copyright © Godfrey Argent Studio.
AUTHOR PROFILES

David Jack

Dr David Jack is Ken Jack’s elder son. Following a first degree and PhD in metallurgy at Cambridge, he spent 1969–1970 as an ICI postdoctoral fellow in his father’s research group at Newcastle, before being appointed Lecturer in the Metallurgy Department at Leeds University. In 1981 he took up a research manager position in Coventry with the Swedish industrial group Sandvik, soon moving on to general management roles in technical marketing and production. From 1997 to retirement in 2009 he worked for the Japanese machine tool company Yamazaki Mazak, which has its European HQ and factory in Worcester, UK, ultimately becoming responsible for its total European business.

Stuart Hampshire

Professor Stuart Hampshire is Professor Emeritus of Materials Science at the University of Limerick, Ireland. Following a first degree from Sheffield in ceramics technology he worked in industry on nitride-bonded refractories, and a lecture given by Ken Jack on sialons inspired him to undertake a PhD under Ken’s supervision at Newcastle on sintering of nitride ceramics. Stuart stayed on as a postdoctoral fellow, researching oxynitride glasses, which he continued after his appointment in 1981 as lecturer at Limerick. He developed the first degree programme in Materials Science, established a research group on ceramics and glasses, collaborating on European-funded projects with other laboratories, and was subsequently promoted to full Professor in 1996. By that time Stuart was Director of the Materials Ireland Research Centre, working with Enterprise Ireland to support Irish industry in areas of materials technology. In 1999 he was a founding member of the Materials and Surface Science Institute (now the Bernal Institute) and successfully led the university’s proposals for government infrastructure funding. He is a Fellow of both the American and European Ceramic Societies and has received various honours, including the European Ceramic Society Stuijts Award (2007), the American Ceramic Society International Bridge Building Award (2008) and an Honorary Doctorate from the University of Limoges, France (2009). The American Ceramic Society Engineering Ceramics Division held a symposium in his honour in 2014. He continues to publish and is a member of the European Ceramic Society Council.

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