



Hans-Christoph Lüttgau on his 88th birthday (photo by D George Stephenson)

Hans-Christoph Lüttgau 1926 – 2017

Hans-Christoph Lüttgau was an eminent German physiologist, shaped by the British scientific tradition through interactions with the labs of Alan Hodgkin and Bernard Katz. He is best known for pioneering work on excitation-contraction coupling (ECC), the link between surface membrane electrical events and muscle contraction, and for his work on Na-Ca antagonism in cardiac muscle, a foundation for the discovery of the ubiquitous Na-Ca exchanger (NCX) of plasma membranes.

Lüttgau was born in Braunschweig (Brunswick). From 1937 to 1946 he attended the *Gymnasium* in Goslar. Though conscripted into the Wehrmacht (1944), he was not involved in active combat. He studied Physiology, Zoology, Botany, Physics and Chemistry in Göttingen, graduating in 1949. His doctoral studies there, supervised by Hansjochem Autrum, investigated the excitation threshold of myelinated axons.

In 1952, as the border between the British and Russian occupied zones was sealed, Lüttgau was already aware of better research opportunities outside Germany. Seeking a position in Bern, he wrote personally to Alexander von Muralt, whose group enjoyed links to the labs of both Hodgkin and Katz. He moved to Bern in 1954, holding posts there until 1967.

First, he continued research on myelinated axon excitation. Katz invited him in 1956 to University College London (UCL) for a year as an 'Honorary Research Assistant'. He was proud of the 'honorary' position before finding that it simply meant 'unpaid': fortunately, his Swiss salary was sustained.

He vividly described his 'paperless' arrival at Dover in an autobiographical essay in *Physiology News* (PN 32). At UCL, he joined Rolf Niedergerke to examine the influence of Ca-Na antagonism on frog cardiac contractile strength. Their work (1958) prompted the idea of a shared mechanism for inward movements of Ca and Na. This was extended by Reuter and Seitz on guinea pig heart and Baker, Blaustein, Hodgkin and Steinhardt on squid axon, showing that inward movement of Ca is coupled to that of Na outward and vice versa. NCX is now established as a key mechanism keeping intracellular $[Ca^{2+}]$ low, an essential feature of cellular regulation.

Back in Bern, Lüttgau showed that the generation of abnormal action potentials (APs) in Na-free, K-rich solutions, presented by others as evidence against Hodgkin and Huxley's ionic theory of excitation, does not contradict that concept but is indeed explained by it.

After 1961, he changed focus from nerve to skeletal muscle, becoming interested in the role of extracellular Ca (Ca^{2+}) in ECC, initially by studying high $[K^+]_o$ (i.e. depolarisation-induced) contractures in frog single skeletal fibres. This work continued in Cambridge, (where Lüttgau spent a year, 1962–1963, at Alan Hodgkin's invitation) and later at the Ruhr University, Bochum (from 1967, when he became the Founding Professor of Cell Physiology). This body of work settled a major controversy in skeletal muscle research, conclusively showing that – unlike cardiac muscle – a Ca^{2+} -influx is *not* necessary to initiate contraction.

Lüttgau was much influenced by his time with Hodgkin. One anecdote is illuminating: he had given Hodgkin the first draft of a paper to review. On collecting it, he was disappointed by the many remarks on the text. Hodgkin recognised his anguish, saying 'Yes, we all are ready to be corrected, but we don't want to be criticised'. In Bochum, Lüttgau sought to fill 'the infinitely many rooms [in the Department] with scientific life'. Deploying the Cambridge model of small-group working, he remained directly involved in selecting the topic, designing experiments, collecting data, analysing results and manuscript preparation, only coauthoring publications when significantly involved. The Cell Physiology Department provided a happy and stimulating environment, and the two of us (DGS and DJM) relished Christoph's leadership and support whilst working there in the 1970s as young, UK-trained postdocs.

A major contribution was to introduce caffeine and tetracaine as valuable tools to study ECC. Lüttgau's paper with Hans Oetliker (1968) was the first systematic investigation of these agents on the voltage-dependence of contractile activation and inactivation. That work impelled intense study of the (then)

poorly understood mechanism of skeletal muscle ECC. Caffeine remains a versatile tool in muscle research and in the clinical diagnosis of conditions such as malignant hyperthermia. He promoted perchlorate as an investigative tool and performed the first truly quantitative analyses of several Ca^{2+} antagonists (used to treat various cardiac disorders) as tools for understanding ECC. He made major contributions to the characterisation of muscle fatigue, including demonstrating (i) the associated diminution, then failure, of APs, (ii) greatly decreased membrane resistance, and (iii) that caffeine can restore force by facilitating sarcoplasmic reticulum Ca^{2+} release.

Lüttgau became Professor Emeritus in 1991. A highly cited review on the role of Ca^{2+} in skeletal muscle ECC (with Werner Melzer and Annegret Hermann-Frank) appeared in 1995. With Hermann-Frank and one of us (DGS), in 1999 he reviewed caffeine as a research tool. He also wrote insightful biographical memoirs (for *Naturwissenschaftliche Rundschau*) of Alan Hodgkin, Bernard Katz, Silvio Weidmann and (with Rolf Thieleczek) of Andrew Huxley. He collaborated with one of us (DJM) on Rolf Niedergerke's obituary for *Physiology News* (PN 87).

Hans-Christoph Lüttgau was always a reflective and thoughtful man. He was very close to his two sons and his four grandchildren. In later years, he addressed questions of philosophy and religion, notably in 2009 when preparing two lectures for a lay audience to mark the anniversaries of Darwin's birth and the publication of *The Origin of Species*. His mind stayed clear to the end as he followed the scientific literature that he enjoyed discussing regularly with several former students and colleagues, many of whom have gone on to leading academic positions.

Like many fellow-citizens of his generation, he was remorseful and critical of the atrocities perpetrated by Nazi Germany. He was humbled by the support he and other German scientists enjoyed after the war from people who had suffered at the hands of that regime.

Lüttgau was elected to The Society in 1965. He regularly presented at meetings and published in *The Journal of Physiology*. He edited *The Journal* (1988–1993) and became an Honorary Member in 1995, pleased that 'Honorary' then really did indicate an honour, rather than the unpaid position it had flagged some 40 years earlier!

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