



# Knud Hermann Nierhaus

## 1941–2016

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Albert Einstein has said, “Most people say that it is the intellect which makes a great scientist. They are wrong: it is character.” However, in some special cases there are great scientists that display both. Knud Nierhaus was such a person. In addition, Knud coupled his sharp intellect and charismatic character with an energy and enthusiasm to discover and understand the secrets of all facets of life. Unfortunately, Knud died suddenly on his 75th birthday in April 2016 in Berlin.

Knud was born on 7 April 1941 in Bochum, a German city in the state of North Rhine–Westphalia. From 1960 to 1966, Knud studied Medicine in Tübingen and Vienna, officially obtaining his medical degree in 1967 from Eberhard Karls University in Tübingen. During his dissertation under Klaus Betke, Knud developed an assay for the detection of fetal hemoglobin and erythrocytes in maternal blood during pregnancy and delivery<sup>1</sup>. After working as a medical assistant in various hospitals for several years, Knud accepted a research scientist position within the group of Heinz-Günter Wittmann at the Max Planck Institute for Molecular Genetics in Berlin–Dahlem. At the time, the major focus of the Wittmann group was on the ribosome and protein synthesis, a fundamental cellular process that would fascinate Knud for the rest of his life.

In 1970, Knud became a group leader within the Wittmann department, attained his professorship from the Technical University of Berlin in 1980 and was elected as a member of the European Molecular Biology Organization in 1984. After Wittmann's untimely death on 31 March 1990, Knud remained at the Max Planck Institute, as part of the Ribosomes department, together with ribosomologists Richard Brimacombe and François Franceschi. In spite of his compulsory retirement in 2006, Knud continued his research activities, initially at the Max Planck Institute and then within the group of Christian Spahn at the Charité Berlin, Institut für Medizinische Physik und Biophysik. In 2014, Knud obtained a Human Frontiers of Science Program grant to investigate ribosome assembly, the process that he had initially started investigating in the 1970s, soon after arriving at the Max Planck Institute.

One of the major achievements from the Nierhaus laboratory in the 1970s was the total reconstitution of *Escherichia coli* large ribosomal 50S subunits from purified ribosomal RNA and proteins. This method was subsequently used to unravel the assembly process *in vitro* by identifying defined assembly intermediates and by studying the effects of the various ribosomal proteins on assembly as well as determining their interdependencies. This work culminated in the construction of a complete assembly map for the *E. coli* 50S subunit in the 1980s (ref. 2), which has so far withstood the test of time.

Another important contribution from the Nierhaus group was the detection of the third ribosomal tRNA-binding site, the exit (E) site, on the *E. coli* ribosome<sup>3</sup>, which was thereafter also confirmed to exist in archaeal and eukaryotic ribosomes. Until recently, many textbooks still portrayed ribosomes with an outdated model including two tRNA-binding sites, despite clear structural evidence for three tRNA-binding sites on ribo-

somes from all kingdoms of life. In this respect, it is worth noting the fruitful collaboration in the 1990s between Knud and the cryo-electron microscopy group of Joachim Frank, which led to the direct visualization of the aminoacyl (A), peptidyl (P) and E tRNAs in the *E. coli* ribosome<sup>4</sup>, among many other findings. Although the presence of the E site in ribosomes has now been fully accepted, the role of the E site still remains to be fully understood. In this regard, Knud demonstrated a role for the E site in fundamental aspects of protein synthesis, such as the accuracy of decoding, the translocation of tRNA and the maintenance of the reading frame during translation.

During the past 20 years, Knud's group applied *in vitro* translation assays to dissect the mechanism of action of numerous ribosome-targeting antibiotics as well as canonical and noncanonical translation factors that interact with the ribosome. One notable example is the discovery of a fourth translation elongation factor, EF4, which is present in all bacteria as well as in the mitochondria and chloroplasts of eukaryotes<sup>5</sup>. Knud's group also demonstrated that EF4 performs the unique function of ribosomal back-translocation, which has been suggested to help remobilize stuck ribosomes and to accelerate protein synthesis under unfavorable conditions, such as osmotic stress or low temperature.

In addition to supervising over 50 doctoral students, Knud supported, inspired and mentored many students and researchers worldwide. Indeed, at any given time, there were always visiting students and



Knud, dressed in ceremonial regalia, receiving his honorary doctorate from the University of Patras, Greece, on 3 June 2009.

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guest scientists from different countries in Knud's laboratory, thus making research there a multicultural experience. For such support of international researchers, Knud was appointed Adjunct Professor of Molecular Biology by the Moscow Lomonosov State University, Russia, in 1999, and he received an honorary doctorate from the University of Patras, Greece in 2009 (pictured). Anyone who has visited and/or spent time working in Knud's lab will be able to tell you about the ten 'golden rules' for performing *in vitro* translation assays, about Occam's razor and about the importance of being up to date with the literature. But they will also tell you about Knud's love of art and music as well as his encyclopedic knowledge of history, religion and culture. Anyone lucky enough to have received the famous Nierhaus tour of Berlin will know of the architects Karl Friedrich Schinkel and Andreas Schlüter, will have heard the story of Telephus depicted on the Pergamon Altar and will have gazed upon the beauty of the bust of the Egyptian queen Nefertiti. Knud was always the first to suggest taking a few extra days

before or after a scientific meeting to explore an exotic land—an offer that was enriched by the presence of a passionate, erudite and insightful tour guide!

Upon hearing of Knud's death, scientists from all over the world contacted us to pass on their condolences to family and friends, to express their sorrow at the loss of such a vibrant personality and to remark how much Knud was admired and respected. For us, Knud was a friend, a mentor and a collaborator, and his presence will be sorely missed. We are nevertheless comforted by the knowledge that Knud's legacy will provide inspiration for many future discoveries and will live on in the fond memories of his family, friends and colleagues.

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