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### Éloge: christian klixbüll jørgensen (1931-2001)

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## OBITUARY

### Éloge: Christian Klixbüll Jørgensen (1931–2001)

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*(Received in final form 3 July 2004)*

The life and career of polymath and polyglot Christian Klixbüll Jørgensen, who contributed to inorganic chemistry, coordination chemistry, physical chemistry and spectroscopy over a period of more than four decades, are briefly discussed.

*Keywords:* Christian Klixbüll Jørgensen; Biography; History of chemistry; Inorganic chemistry; Coordination chemistry; Physical chemistry; Spectroscopy

On January 9, 2001 Christian Klixbüll Jørgensen (figure 1), Professor Emeritus of Inorganic and Analytical Chemistry at the University of Geneva, died in a nursing home near Paris. Internationally known for correlating the spectra of coordination compounds with their electronic structure, he began in 1997 to suffer from frequent lapses of memory and exhibited erratic behavior. In 1993, when reviewers and I suggested changes in his article on his mentor Jannik Bjerrum [1], Christian uncharacteristically refused, a possible indication of the initial phase of his final illness.

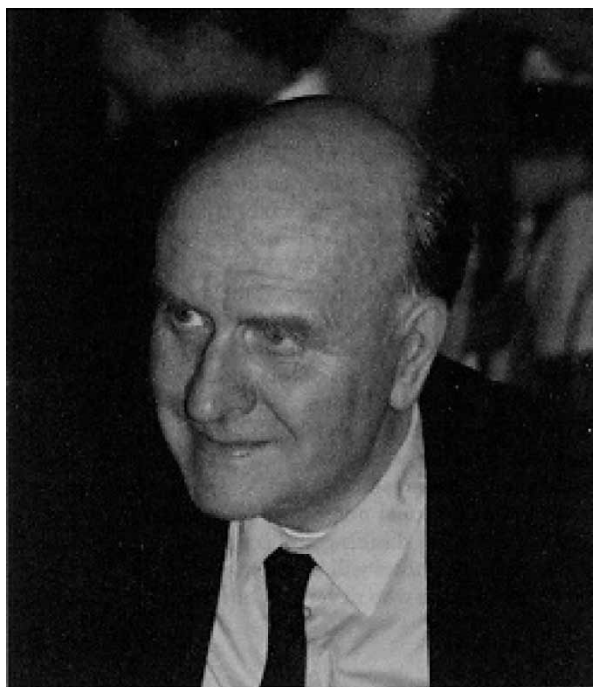
After a bookcase fell on him, Christian was hospitalized and diagnosed with dementia, forcing him to retire in 1997. He moved to France to be close to his son Philippe (b. 1963) and daughter Estelle (b. 1969), who survive him. He was predeceased by his wife, Micheline (née Prouvez), whom he married on June 26, 1957 and who died in 1978. In view of the major role that intellectual pursuits played throughout his entire life, his final years were especially poignant to us who worked with him and loved him [2].

Axel Christian Klixbüll Jørgensen was born on April 18, 1931 in Ålborg, Jutland, Denmark, the son of Sven Klixbüll Jørgensen, an officer on a Danish training ship, and his wife Ingrid (née Sørensen) [3–6]. When Christian was 1 year old, the family moved to Copenhagen, where he grew up and was educated. A child prodigy and avid reader of books, he told me:

The municipal libraries in Copenhagen were excellent. I borrowed 3,000 books on very diversified subjects. This extensive reading left me with two lasting impressions: how rapidly accepted theories change and how microscopically little we know compared to what is unknown [7].

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Axel Christian Klixbüll Jørgensen (1931–2001)

Figure 1. Christian Klixbüll Jørgensen (1931–2001) [30]. Copyright Springer-Verlag.

By his teens he had already acquired two of his lifelong interests – spectroscopy and the lanthanides:

Beginning at the age of 12, I had a small laboratory at home where I began observing colored flames and later carried out separations of rare earths by recrystallization. Shortly before that time, I met the astronomer Luplau C. Janssen, who permitted me to look through his fine telescope and to borrow books from his impressive collection. Professor Ebbe Rasmussen discussed atomic spectra with me and allowed me to use a large spectroscope to observe the line spectrum of cesium. I was baffled that the long series corresponding to excited ns, nd, and nf states were not even in the catalogs [7].

In 1947 Christian entered the Vestre Borgerdydskole gymnasium (high school) and received his Abitur degree in 1950. In autumn 1950 he enrolled in the University of Copenhagen to pursue a *Candidatus magisterii* degree so that he could teach at a secondary school. The curriculum consisted of astronomy, chemistry, mathematics and physics, and also practical laboratory work that he avoided by discovering a “legal loophole” [3], making him “a national champion in dodging organic synthesis” [7]. He chose chemistry as his main subject “for an apparently arbitrary reason” [7]. His account of this choice demonstrates his peculiar sense of humor:

Every afternoon in his laboratory at Sølvtorvet, . . . Jannik [Bjerrum], my mentor-to-be, was drinking tea for a few hours with his 12 assistants and two or three students (the yearly production of university candidates was 0.6) [(figure 2)]. I found this egalitarian treatment of undergraduates so attractive that I stayed. I learned not to put less than 28 grams of tea in the 5-liter pot, and I acquired a marathonic rhetoric. Seriously, I’ve always respected Jannik’s tolerance for young collaborators having entirely different interests. . . . My third-year examination had an almost medieval scholastic character.



*"Jannik's Tea Table." From left to right: Flemming Woldbye, Carl Johan Ballhausen, Jannik Bjerrum, Arthur W. Adamson, Edmund Rancke-Madsen, Niels Hofman-Bang, Ingeborg Poulsen, Knud Georg Poulsen, Claus Erik Schäffer, and Christian Klixbüll Jørgensen. (Photo courtesy of Fred Basolo.)*

Figure 2. "Jannik's Tea Table." Jannik Bjerrum is third from left and Christian Klixbüll Jørgensen is at the extreme right [1]. Courtesy of Fred Basolo.

For two full hours we disputed the question of whether scandium or gallium is most similar to aluminum. The representative . . . for the Student's Union, being among the most hilarious public for defending me, went home taking half the lethal dose of acetylsalicylic acid [7].

According to Bjerrum,

Even as a gymnasium student, Christian wrote letters to me about chemical problems. As a university student in 1950 he looked me up in the laboratory, and . . . I gave him a copy of my dissertation, *Metal Ammine Formation* [8]. He must have stayed up all night reading the book, for the next day I was astonished that he had understood everything so well. He started research at the same time as he followed the normal plan for his study. He was extremely good in qualitative analysis and passed the course in one third of the normal time. At that time in Denmark it was a very extensive course dealing with nearly all the elements. On the other hand, he had some trouble with quantitative analysis, in part because of certain disagreements on analytical precision and accuracy [7].

Yet Bjerrum frankly criticized Christian's prolific and highly individualistic, inimitable, "free association" writing style so familiar to his friends and colleagues:

Christian was an extremely gifted student. In his research he had plenty of ideas, and it was a pleasure for me to work with him. However, in my opinion, he wanted to publish his results too quickly before they were sufficiently digested and put into a proper form. I tried, with little effect, to improve his style, the last time being at his defense of his doctoral dissertation in 1957. Christian has a brilliant intuition, and for this reason he has made only a few mistakes in his scientific work. However, I sometimes feel that his very large and valuable scientific production would have been easier to survey and more accessible to readers if as a student he had listened more to my criticism [7].

In 1954 Christian received his *Candidatus magisterii* degree in chemistry mathematics, astronomy and physics, with chemistry as his main subject, and he continued his research in Bjerrum's laboratory, one of the world's leading centers for

coordination chemistry. His photographic, encyclopedic memory was legendary. Fred Basolo, who spent a sabbatical year (1954–55) at Bjerrum's institute, relates his impressions:

I am at a loss as to how to describe Klixbüll. He is an unreal character, perhaps even a genius. He speaks several languages, none of which are easy to understand. One thing about him that amazed me was how often he could recall a specific reference (journal, vol. page, year) of a paper in the literature that he had read. Each day when he arrived in the lab, he would prepare a water solution of some transition metal salt and use the Cary to measure the solution's ultraviolet-visible spectrum. He would interpret the spectrum, making use of the "crystal field theory" . . . Klixbüll's lab space was always a mess, he never labeled any of the containers of the solutions but he always seemed certain that he knew what each was. He was such a strange individual that I felt I had to believe him. Almost every Monday he would arrive in the lab with a paper he had written over the weekend. I was asked to read it to help with his English, which needed help [9].

Harry B. Gray confirms Christian's amazing memory:

CKJ had an element code for phone numbers. He quoted maxima of absorption bands to four and sometimes five significant digits even though errors and conditions suggested that two were too many! He dabbled in the most incredible assortment of projects [10].

Christian was fluent in a number of languages but sometimes was difficult to understand. According to Alan F. Williams, "Although his command of languages was excellent, he always kept a strong inflexion which prompted a colleague to comment that 'he speaks Danish in six languages' [6]. Christian served as an Instructor in Chemistry Department A (Inorganic Chemistry) of the Technical University of Denmark (1953–58). In 1957 he received his D. Phil. degree with a dissertation [11] to which he appended 11 of the 38 articles that he had already published [3,5].

Christian served as Director of the Office of Science Adviser to the North Atlantic Treaty Organization (NATO) in Paris (1959–60), where he helped to organize the summer schools that subsequently became the NATO workshops and Advanced Study Institutes [3]. He next became Director of the Group of Theoretical Inorganic Chemistry at the Cyanamid European Research Institute (CERI), in Cologny, near Geneva, Switzerland (1961–68).

I first met Christian in 1961 at the Sixth International Conference on Coordination Chemistry (6th ICC), Detroit, Michigan. Because of our common interests, we decided to collaborate on a study of isomers of iridium(III). The following year I accompanied him, his wife, and several chemists on a Swedish midsummer tour from Göteborg to Stockholm (June 22–25, 1962), where the 7th ICC was held, along with sessions in Uppsala (June 25–29, 1962). We both presented papers, he on absorption spectra and I on our collaborative investigation of what we thought were the *cis* and *trans* isomers of  $[\text{IrCl}_3\{(\text{C}_2\text{H}_5)_2\text{S}\}_3]$  as well as a new binuclear iridium(III) complex. With Christian's expertise we found that the yellow isomer was indeed *cis*-(1,2,3)- $[\text{IrCl}_3\{(\text{C}_2\text{H}_5)_2\text{S}\}_3]$ , but the red "isomer" was actually an electrolytic "polymerization" isomer, *trans*- $[\text{IrCl}_2\{(\text{C}_2\text{H}_5)_2\text{S}\}_4]^+$  *trans*- $[\text{IrCl}_4\{(\text{C}_2\text{H}_5)_2\text{S}\}_2]$ .

Hoping to find the largest possible audience for our work, I submitted our manuscript to *Science*, a journal in which articles of biological interest predominated. Our paper was rejected. Christian's letter to me, handwritten in blue ink, like all his letters (figure 3), is gracious, prophetic about *Science*'s future decision, and typifies his dry sense of humor:

Thank you very much for the occasion to write in journals in which I would never have expected myself to write. If you do not get it accepted, write a paper demonstrating that it is not impossible that



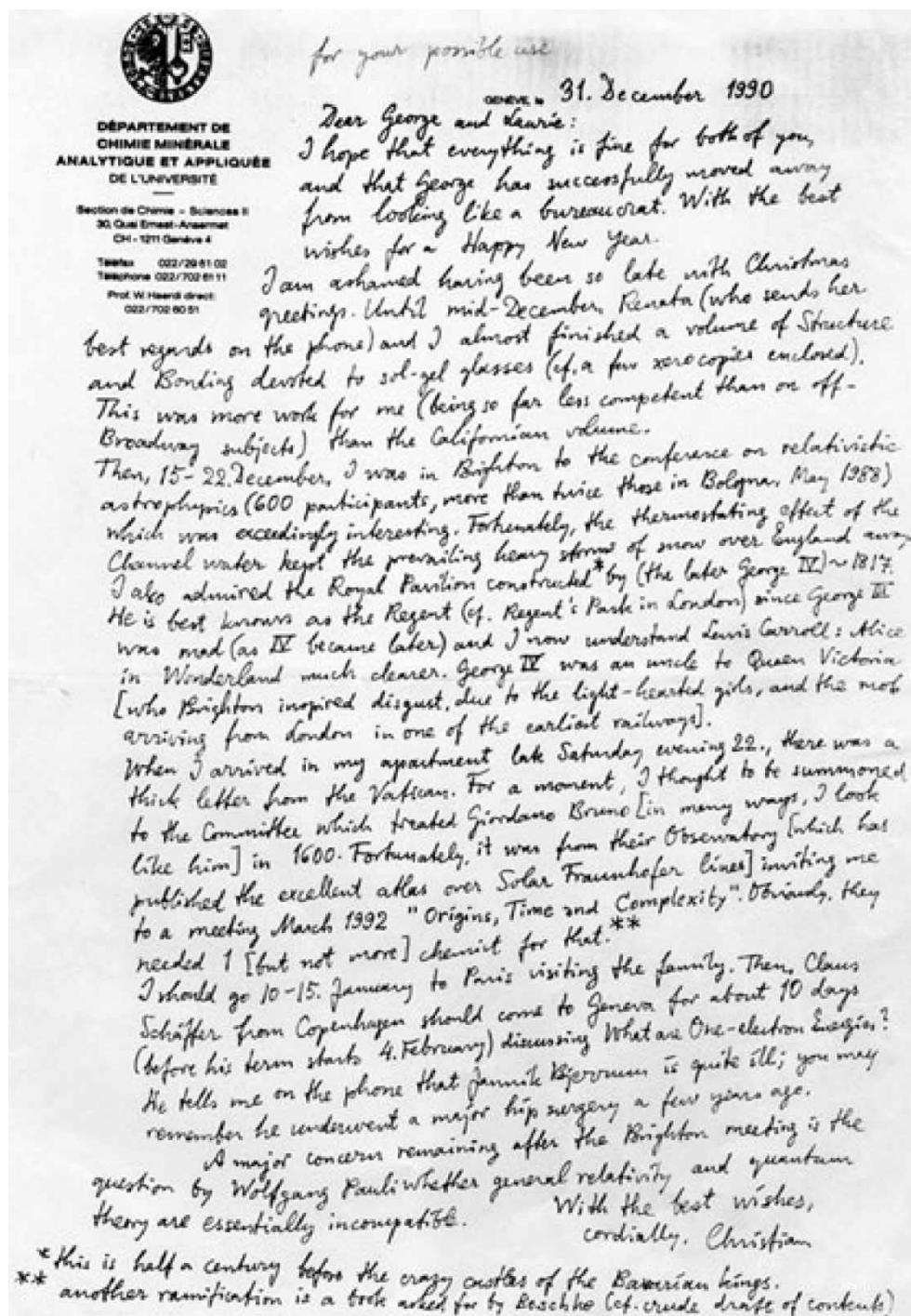


Figure 3. A typical Jørgensen handwritten letter, December 31, 1990. Courtesy of George B. Kauffman.

$\text{Ir}(\text{Et}_2\text{S})_2\text{Cl}_4^-$  provokes an increase in female off-spring of green frogs from  $49.1 \pm 0.7$  to  $49.3 \pm 1.8\%$ , and they will print it [12].

Our article was published in an inorganic chemistry journal [13].

I spent my first sabbatical leave (1963–4) at the Universität Zürich working on my first book, a biography of Alfred Werner [14], and Christian invited me to speak at CERI, where I presented my very first seminar, “Alfred Werner: The Man and His Theory.” Turnabout is fair play so I invited him to present a paper at my Werner Centennial Symposium, the 152nd National Meeting of the American Chemical Society, New York, September 12–16, 1966 [15]. We also met again at the 10th ICCS, Tokyo and Nikko, Japan, September 12–16, 1967, where we both presented papers. After CERI closed, Christian became Invited Professor (1969–70) and Professor (1969–74) in the Department of Physical Chemistry at the University of Geneva, where he then served as Professor in the Department of Inorganic and Analytical Chemistry from 1974 until his retirement.

On April 29, 1983 Christian was awarded an honorary doctorate by the Universität Zürich “as a pioneer in the bridging of quantum mechanics and chemistry, which has explained in a prominent manner the electronic spectra of metal complexes and has proved fruitful for chemistry” [16]. Through the years Christian and I collaborated on a dozen articles. He stayed with my wife Laurie and me twice in Fresno. On one occasion, he presented a seminar entitled “In What Sense Does Matter Have Constituents?”

We next saw Christian briefly at the “Organic Chemistry: Its Language and Its State of the Art: A Commemorative Symposium on the Centennial Anniversary of the ‘Geneva Conference,’ The First International Conference on Organic Chemical Nomenclature,” held in Geneva on April 22–24, 1992. He appeared at my acceptance address for the Marc-August Pictet Medal of the Société de Physique et d’Histoire Naturelle de Genève and then departed. One of his colleagues told us that he was not in good health and that his daughter was visiting him frequently. The last time that we saw Christian was when he presented three invited papers [1,17] at my Coordination Chemistry Centennial Symposium, 205th National Meeting of the ACS, Denver, Colorado, March 28–April 2, 1993 (figure 4).

Christian’s research activities were as broad as his wide-ranging interests. They included, but were not limited to, the following: visible, near-infrared and ultraviolet spectroscopy connected with internal  $3d^q$ ,  $4d^q$  and  $5d^q$  transitions and ligand field treatment (extended with Claus E. Schäffer) to the angular overlap model; electronic transfer spectroscopy and optical electronegativity; the nephelauxetic effect and spin-pairing energy; narrow-band  $4f^q$  transitions including luminescence of lanthanides and uranyl compounds; vitreous state and glass-ceramics; luminescent flat-plate solar energy concentrators; laser materials; the chemistry of helium; photoelectronic spectroscopy (ESCA) of solids; critical analysis of quantum chemistry for two-digit  $Z$ ; isoelectronic arguments including predicted chemical properties of fractionally charged species or systems containing unsaturated quarks and hypothetical heavy “elementary” particles; cosmic abundances, geochemical fractionation and the concept of matter (with positive rest-mass) having “constituents.”

Christian used his knowledge of linguistics and idiosyncratic use of language to coin new words and find new meanings to those already in existence [18]. His neologisms



Figure 4. Group photograph, Coordination Chemistry Centennial Symposium including Linus Pauling with trademark beret (front row, seventh from left), George B. Kauffman (front row, eighth from left), and Christian Klixbüll Jørgensen (front row, second from right), Colorado Convention Center, Dallas, 205th National Meeting of the American Chemical Society, March 29, 1993. Photograph by Ernest L. Carpenter, courtesy of the American Chemical Society.

include “preponderant configurations,” “additivity of ionic colors,” “innocent” [19] as applied to ligands, “taxonomy,” and his best-known term “nephelauxetic” (from the Greek for “cloud expanding”) [20,21]. He even extended the term “symbiosis” to denote “the tendency of hard or non-polarizable ligands to come together around a metal center, or of soft with soft” [18].

Christian was the author or coauthor of seven books [11,21–27] and some 400 articles in numerous journals, most frequently in *Chemical Physics Letters* (49 papers), *Acta Chemica Scandinavica* (43 papers), *Chimia* (32 papers) and *Structure and Bonding* (21 papers). Although by his own admission a solitary worker, he collaborated with a number of authors. When I asked him what he considered his most important contribution to science, he declared:

At least chronologically, there is one plausible answer to your question: explaining why d- and f-group compounds are colored and have excited states in the 1 to 6eV range. However, the explanation developed into group-theoretical engineering and the angular overlap model [28] elaborated with my comrade Claus E. Schäffer, who is now Jannik’s successor. Also, the electron transfer bands (due to transfer of one electron from reducing to oxidizing atoms) provided optical electronegativities which turned out to be linear functions of the molecular orbital ionization energies later determined from photoelectronic spectra. There is a second field, for which I am grateful to have lived long enough to have seen a beginning of a rationalization. Just as the “element” concept was elaborated during the century between Boyle and Lavoisier, so the constitution of matter by quarks and leptons recently has begun to clarify. I do not feel frustrated working as a “tame geochemist” trying to predict chemical properties of systems containing unsaturated quarks. I think that by their inductive approach chemists add something that is needed by deductive physicists [7].



Although most of Christian's research was theoretical, he believed, "In many areas of chemistry, an ounce of observations is worth more than a pound of theory or a ton of computer output" [7]. In his memory, Springer-Verlag published two special volumes of *Structure and Bonding*, the review series that he initiated with his famous article, "Recent Progress in Ligand Field Theory" [29], and supported for almost 25 years (1966–89) as a member of the editorial board [30,31]. Christian was also an editorial board member of *Chemical Physics Letters* (from 1967), *Inorganica Chimica Acta* (from 1967) and *Chimia* (from 1975).

I have quoted Christian here at length. For those who knew him, his words should awaken memories of an amiable, sweet, brilliant, unassuming, witty and lovable man with no trace of guile or self-aggrandizement. For those unacquainted with this gentle, solitary (but not aloof) polymath, who never realized that others did not share his brilliance or towering intellect, his words should give some insight into the personality and character of one of the twentieth century's greatest and most prolific chemists and spectroscopists. Christian Klixbüll Jørgensen was the type of person for whom the Latin expression *sui generis* was devised. He was truly one of a kind. We shall not see his like again anytime soon.

### Acknowledgements

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