Hans Duistermaat (1942–2010)

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On March 19, 2010, mathematics lost one of its leading geometric analysts, Johannes Jisse Duistermaat. At age 67 he passed away, after a short illness following a renewed bout of lymphoma the doctors thought they had controlled. "Hans", as Duistermaat was universally known among friends and colleagues, was not only a brilliant research mathematician and an inspiring teacher, but also an accomplished chess player and very fond of several physical sports.

Hans was a student at Utrecht University, where he continued to write his Ph.D. thesis on mathematical structures in thermodynamics. The geometer H. Freudenthal is listed as his advisor, but the thesis was directed by the applied mathematician G.K. Braun, who died one year before its defense.

Hans dropped the subject of thermodynamics, because the thesis had led to dissent between mathematicians and physicists at Utrecht University. Nevertheless, this topic exerted a decisive influence on his further development: in its study, Hans had encountered contact transformations. These he studied thoroughly by reading S. Lie, who had initiated their theory. In 1969–70 he spent one year in Lund, where L. Hörmander was developing the theory of Fourier integral operators; this class of operators contains partial differential operators as well as classical integral operators as special cases. Hans's knowledge of the work of Lie turned out to be an important factor in the formulation of this theory. His mathematical reputation was then firmly established by a long joint article with Hörmander concerning applications of the theory to linear partial differential equations. In 1972 Duistermaat was appointed full professor at the Catholic University of Nijmegen, and in 1974 at Utrecht University, as the successor to Freudenthal.

It is characteristic for Hans's work that on the basis of a complete clarification of the underlying geometry deep and powerful results are obtained in the area of geometric analysis: in his case, in ordinary or partial differential equations, discrete integrable systems, classical mechanics, analysis on Lie groups, and symplectic differential geometry. Furthermore, after a period of intense concentration on a particular topic, he would move to a different area of mathematics, thereby bringing acquired insights often to new fruition. Nevertheless, on closer inspection, most of these transitions are not as abrupt as they look at first sight.

For example, Hans's interest in semisimple Lie groups was stimulated by efforts to improve, in the more specific setting of such groups, error estimates for the asymptotics of the eigenvalues of elliptic partial differential operators, obtained in previous joint work with V.W. Guillemin. In turn, some results derived along the way acted as a catalyst for the Duistermaat–Heckman formula in symplectic differential geometry. The latter field forms the structural basis for large parts of classical mechanics.

In the later part of his life, Hans had an intense interest in application of mathematics elsewhere in society. For instance, he worked with geophysicists on the inversion of seismic data, and on modeling the polarity reversals of the Earth's magnetic field; with mathematical economists on barrier functions, and on options; and with biomedical technologists on computer vision.

In 2004, Hans was honored with a special professorship at Utrecht University endowed by the Royal Netherlands Academy of Arts and Sciences. This position allowed him to focus exclusively on research. He frequently described his work at that time as "an obsession." It concerned QRT mappings; these arise in mathematical physics, and Hans studied them with methods from dynamical systems and algebraic geometry. His final work was concerned with Painlevé functions.

While Hans clearly exerted a substantial influence on mathematics through his own research, often with co-authors, and through that of his 23 Ph.D. students, the eleven books that he was involved with cover a wide spectrum of mathematical exposition, both in topic and level of sophistication. But in this case, again, there is a common characteristic: every result, how hackneyed it might be, had to be fully understood and explained in its proper context. In addition to this, when writing, he insisted that the original works of the masters be studied. He often expressed his admiration for the depth of their treatment, but he could also be quite upset about incomplete proofs that had survived decennia of careless inspection.

On many occasions Hans worked together with colleagues from the US. Even though several US departments offered him a position and he enjoyed coming to the US for sabbatical periods, he preferred Utrecht as his permanent basis. There he had easy access to mathematicians with a wide range of expertise, while he could still enjoy his favorite physical activities, like biking and skating.

Hans took teaching seriously and considered it as an indispensable counterbalance for his tremendous concentration when involved in research. As a lecturer, he was quite aware that not every student was as gifted as he. Despite the fact that he could ignore all restrictions of time and demanded serious work from the students, he was very popular among them. On several occasions he gave non-scheduled courses on their request.

In mathematics, Hans's life was a search for exhaustive solutions to important problems. This quest he pursued with impressive single-mindedness, persistence, power and success. In our minds he remains very vivid, one of the most striking among the mathematicians we have met. We, as his students, co-authors, and colleagues at Utrecht University, deeply mourn his loss; yet we can take comfort in memories of many years of true and inspiring friendship.

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For more on Hans's scientific work, one may consult *Geometric Aspects of Analysis and Mechanics. A Conference in Honor of the 65th birthday of Hans Duistermaat*, to be published by Birkhäuser, Boston. WONDER (The Dutch Research School in Mathematics) has decided to establish the Hans Duistermaat Chair for Visiting Professors.

$$\int_M e^{J_X}\, e^{\sigma} = \sum_j \int_{N_j} \frac{e^{i_j{}^* J_X}\, e^{i_j{}^* \sigma}}{\det \frac{L_X + \Omega}{2\pi i}}$$

Formula of Duistermaat–Heckman