J. Symbolic Computation (1987) **4**, 1–2

Introduction

This volume has been compiled in honour of the well known mathematician Hans Zassenhaus on the occasion of his 75th birthday. As colleagues, collaborators and friends, we dedicate this work to him in the hope that it might inspire present and future researchers, in a similar fashion to the way in which his brilliant ideas filled us with the creative urge.

Hans Zassenhaus was born in Koblenz (West Germany) on 28 May 1912 and brought up in Hamburg. There he studied mathematics under the supervision of E. Artin, E. Hecke, and E. Sperner, and was also a student of physics and biology. He was awarded his PhD at the early age of 22 with a thesis on "Kennzeichnung linearer Gruppen als Permutationsgruppen". In the subsequent two years, which he spent at Rostock as a teaching assistant, he wrote his famous monograph on group theory which is still among the standard textbooks on that subject. In 1938—back in Hamburg—he qualified for a full teaching appointment with a paper on Lie rings of prime characteristic.

In 1946 he was appointed associate professor and director of the Institute for Applied Mathematics which he had founded at Hamburg University in the same year. Accepting the challenge of an offer to help McGill University in the building up of Canadian graduate education in mathematics he left his country in 1949 for Montreal, Canada, where he was later joined by his wife and children. As Peter Redpath Professor at McGill University he supervised the PhD studies of many Canadian students. In 1957 he became a Canadian citizen.

In 1959 he moved to the USA where he taught at Notre Dame (1959–1963) and at Ohio State University in Columbus. At OSU he held the position of research professor until his retirement five years ago. During these years he frequently visited other universities as a guest professor. We briefly mention the academic year 1955–56 at Princeton, two years at the California Institute of Technology as a Fairchild Distinguished Scholar, a Gauss professorship at Göttingen in 1967 and the US Senior Scientist Award of the Humboldt-Stiftung. In 1956 he became a Fellow of the Royal Canadian Society and in 1969 Editor-in-Chief of the *Journal of Number Theory*.

Among the mathematicians of our time he is one of the few still active in different areas—we have already mentioned his contributions to group theory. Most graduate students learn his famous "butterfly lemma" which nowadays forms a substantial part of the proof of the Jordan–Hölder–Schreier theorem. In 1978 (jointly with R. Bülow, J. Neubüser and H. Wondraschek) he wrote a book on crystallographic groups which seems to be better known to physicists than to the mathematical community.

Orders (and their ideal theory) are also among the central objectives of his research. The constructive approach clearly dominates. In a joint paper with E. C. Dade and O. Taussky it was proven that the $(n-1)$st power of a fractional ideal of an order of rank n over the integers is always invertible. The authors obtained the idea of that theorem by numerical calculations on a computer and then each of them gave a different proof. This was an early and powerful demonstration of the usefulness of mathematical experimenting by computer. Later on he developed several algorithms for the embedding of an order into its maximal order. Each algorithm improved the preceding one and the numerical results obtained by each algorithm led to further theoretical improvements—

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p-adic methods especially became more and more important. Consequently he improved Hensel's lemma and his version is nowadays a standard tool for factoring polynomials.

The connections to algebraic number theory—the construction of an integral basis—are obvious. He declared the central tasks of constructive number theory to be

(i) The computation of the group of an equation.
(ii) The computation of an integral basis.
(iii) The computation of the unit group.
(iv) The computation of the class group of an algebraic number field.

For the solution of each of those problems he presented powerful algorithms which were further improved during recent years. They will all be presented in a forthcoming book written jointly with myself.

Lie algebras are another of his important research objectives. He especially studied their applicability to mathematical physics. Many papers (jointly with J. Patera and P. Winternitz) and a forthcoming book with P. Winternitz deal with the subject.

Evidently a substantial part of his many papers is written from a constructive point of view. This was certainly exceptional for mathematicians after Hilbert up to some ten years ago. Contrary to many of his colleagues he was always on good terms with computer scientists and strongly favoured co-operation between the mathematician and the computer scientist. We would like to thank him for these efforts.

From the preceding summary of his research it is obvious that every description of his work is necessarily incomplete. Not to mention that we cannot go into detail of how he is capable of developing new ideas and writing up these new results faster than many others can read and understand the preprints appearing. Even though this can be frustrating, other workers usually profit a great deal from his brilliant ideas. Discussions with him are, in general, exceptionally fruitful.

Though he held a research professorship at OSU he still felt that teaching was among his principal obligations. It is usually not easy to follow his ideas in a standard course, but knowing a little about the subject his approach inspires the students towards mathematical experimentation of their own and thus to obtaining new insights by themselves. For example, he took part in the Arnold Ross summer school project for gifted children whenever he could.

His friends and colleagues wish him many more years of good health and enjoyment of mathematics.

Michael Pohst
Guest Editor

This special issue of the *Journal of Symbolic Computation* is dedicated to Professor Hans Zassenhaus on the occasion of his 75th birthday. Professor Zassenhaus was one of the earliest pioneers in symbolic and algebraic computation. His approach to solving problems in algebra was always strongly directed towards actual construction and design of algorithms. Thus, his research work that started 50 years ago not only shaped crucial areas of mathematics but is also an innovative stimulus to most recent developments of integration between mathematics and computer science. The *Journal of Symbolic Computation*, therefore, is proud to dedicate this issue to Professor Zassenhaus.

Professor Michael Pohst very kindly accepted the invitation of the *Journal* to edit this special issue and we are indebted to him for all the knowledge and effort he put into compiling this collection of papers.

The Editor