JOURNAL OF COMMUTATIVE ALGEBRA
Volume 5, Number 1, Spring 2013

PREFACE

WINFRIED BRUNS, ALDO CONCA,
VOLKMAR WELKER AND SIAMAK YASSEMI

Jürgen Herzog was born in December 1941 in Heidelberg, Germany. He grew up in the nearby town of Eberbach, where he graduated from the local gymnasium. Following his army service, he started studying mathematics and physics at Kiel in 1963, but soon returned to his hometown, transferring in 1964 to the University of Heidelberg.

At Heidelberg he became a student of Ernst Kunz. In the sixties, commutative algebra spread quite rapidly, and because of their importance in number theory, field theory, algebraic geometry and complex analysis, the study of modules of differentials and derivations was a hot topic. Volume 38 of the Springer Lecture Notes, *Differentialrechnung in der analytischen Geometrie* (1967) by Berger, Kiehl, Kunz and Nastold reflects this trend.

Under the influence of Abhyankar and Lipman, Purdue University was one of the centers of local algebra and geometry at the time and Kunz, like other German mathematicians, spent a year at Purdue, together with Jürgen who had finished his Diplom thesis in Heidelberg (1967). The year at Purdue was followed by a year at Louisiana State University. In the U.S., Jürgen earned an M.S. from Purdue (1968) and the Ph.D. from Louisiana State (1969).

Jürgen returned to Germany to complete his Diplom examination at Heidelberg, and then became Wissenschaftlicher Assistent at Regensburg, earning his Habilitation in 1974 with the thesis *Komplexe, Auflösungen und Dualität in der lokalen Algebra*. In 1975, he was appointed professor of mathematics at the University of Essen, where he remained until his retirement in March 2009.

Beginning with his graduate studies, Jürgen has worked in commutative algebra with great enthusiasm and endurance. He has left his footprints in almost every subfield that touches homological or combinatorial problems. His tremendous productivity has resulted in over 160 papers and several books.

DOI:10.1216/JCA-2013-5-1-1

The book *Der kanonische Modul eines Cohen-Macaulay-Ringes* (1971) edited by Herzog and Kunz played an important role in the popularization of Grothendieck's local duality. The structure of the canonical module and of Gorenstein rings has been a recurring theme in Jürgen's mathematical work. Another leitmotif, originating from his mathematical youth and often pursued in collaboration with Rolf Waldi, is the investigation of differentials, derivations and deformations.

Serre asked if the Poincaré-Betti series of local rings are rational. This question was a driving force in local algebra during the sixties and seventies and, in particular, stimulated the investigation of Koszul algebras. Koszul algebras have played a central role in Jürgen's work through the years, in particular, recent work with Luchezar Avramov and Srikanth Iyengar.

In the late seventies, Jürgen, Aron Simis and Wolmer Vasconcelos developed the theory of approximation complexes, an important tool for the study of Rees algebras. Since then, he has been interested in the asymptotics of powers of ideals, above all in their homological and arithmetical invariants and especially their Castelnuovo-Mumford regularity whose asymptotic linearity he proved in collaboration with Dale Cutkosky and Ngô Viêt Trung.

Jürgen's 1978 article in Math. Ann. on rings of finite Cohen-Macaulay representation type marks the start of an important trend connecting representation theory and commutative algebra. A key aspect is matrix factorizations of polynomials defining Cohen-Macaulay modules over hypersurface rings. Matrix factorizations, introduced by David Eisenbud, have now found their way into string theory, see `http://www.birs.ca/events/2012/5-day-workshops/12w5117`.

When the topic of Cohen-Macaulay modules was suggested to Jürgen by Cambridge University Press, he and Winfried Bruns responded with the book *Cohen-Macaulay rings*. The fundamental importance of Cohen-Macaulay rings was highlighted in the seventies by the work of Mel Hochster on determinantal rings and rings of invariants. Published in 1993, their book has been extremely successful, quickly becoming the standard reference in the area. In fact, it is quoted in Wiles's 1994 paper on Fermat's last theorem! Nowadays *Cohen-Macaulay rings* is, in combination with David Eisenbud's book *Commutative algebra with a*

view towards algebraic geometry, the backbone of any advanced course in commutative algebra.

A substantial part of *Cohen-Macaulay rings* is devoted to the cross-pollination between combinatorics and commutative algebra, following the seminal work of Richard Stanley. The fascinating interplay between algebra and combinatorics has had a tremendous influence on Jürgen's work. Annetta Aramova and Dorin Popescu have been companions in this area, and, in particular, Takayuki Hibi. Jürgen's third book *Monomial ideals* (2011, with Hibi) gives an excellent overview of an area in which objects of commutative algebra directly represent finite multi-sets, simplicial complexes, graphs and their higher dimensional analogues. Jürgen has also contributed significantly to other aspects of combinatorial commutative algebra, for example, semigroup rings and determinantal rings. His most recent book, *Gröbner bases in commutative algebra* (2012, with Viviana Ene) reflects Jürgen's profound interest in computational and effective methods.

Free resolutions are the source of homological invariants, and graded free resolutions connect them to combinatorics. One can perhaps say that free resolutions, openly or in disguise, have been the most important topic in Jürgen's work. This interest stretches from monomial ideals to free resolutions over the exterior algebra. The seemingly innocent 1984 article *On the Betti numbers of pure and linear free resolutions* is one of the foundations of Boij-Söderberg theory whose creation was triggered by Jürgen's and Hema Srinivasan's multiplicity conjectures.

Jürgen, a keen traveler, has visited many universities all over the world. His stockpile of mathematical problems seems inexhaustible, and he has generously helped 23 Ph.D. students so far to find their way into mathematics. In recent years he was instrumental in building the Ph.D. program at Abdus Salam School of Mathematics in Lahore, Pakistan, where he is still taking care of several young mathematicians. Jürgen's infectious appetite for interesting mathematics and his communication skills are witnessed by more than 60 coauthors.

Over the years, Jürgen has served on the editorial board of several journals, *Mathematische Zeitschrift*, *Algebra and Representation Theory*, *Communications in Algebra*, *Homology, Homotopy and Applications*, *Journal of Prime Research in Mathematics*, *Bulletin Mathématique de la Societé des Sciences Mathématiques de la Roumanie* and

Bulletin of the Iranian Mathematical Society. He has also been a vital member of the mathematical community by organizing numerous conferences all over the world. In view of his mathematical achievements, Jürgen was elected corresponding member of the *Academia Peloritana dei Pericolanti di Messina* in 1999.

The authors and editors of this volume wish him many years of happiness with his family, productive work on challenging mathematical problems, and inspiring encounters with the new generation.

May 2013

Winfried Bruns
Aldo Conca
Volkmar Welker
Siamak Yassemi