Lucian Bădescu

## **Algebraic Surfaces**

Translated by Vladimir Maşek

With 15 Illustrations



Lucian Bădescu Institute of Mathematics Romanian Academy PO Box 1-764 Bucharest 70700 Romania Lucian.Badescu@imar.ro

Editorial Board (North America):

S. Axler Mathematics Department San Francisco State University San Francisco, CA 94132 USA

K.A. Ribet Mathematics Department University of California at Berkeley Berkeley, CA 94720-3840 USA Translator Vladimir Maşek Department of Mathematics Washington University in St. Louis Box 1146 St. Louis, MO 63130 USA vmasek@math.wustl.edu

F.W. Gehring Mathematics Department East Hall University of Michigan Ann Arbor, MI 48109-1109 USA

Mathematics Subject Classification (2000): 14-01 14Jxx, 14C17

Library of Congress Cataloging-in-Publication Data Badescu, Lucian. Algebraic surfaces / Lucian Badescu. p. cm. —(Universitext) Includes bibliographical references and index. ISBN 978-1-4419-3149-8 ISBN 978-1-4757-3512-3 (eBook) DOI 10.1007/978-1-4757-3512-3 1. Surfaces, Algebraic. I. Title. II. Series. QA571.B32 2001 516.3'52—dc21 00-059551

Printed on acid-free paper.

© 2001 Springer Science+Business Media New York Originally published by Springer-Verlag New York, Inc. in 2001 Softcover reprint of the hardcover 1st edition 2001

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher, Springer Science+Business Media, LLC, except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden. The use of general descriptive names, trade names, trademarks, etc., in this publication, even if the former are not especially identified, is not to be taken as a sign that such names, as understood by the Trade Marks and Merchandise Marks Act, may accordingly be used freely by anyone.

Production managed by A. Orrantia; manufacturing supervised by Jerome Basma. Photocomposed copy prepared by Vladimir Maşek.

987654321

ISBN 978-1-4419-3149-8

SPIN 10698148

## Contents

Fo	reword to the English Version	v
Pr	eface	vii
Co	Conventions and Notation	
1	Cohomological Intersection Theory and the Nakai–Moishezon Criterion of Ampleness	1
2	The Hodge Index Theorem and the Structure of the Intersection Matrix of a Fiber	17
3	Criteria of Contractability and Rational Singularities	23
4	Properties of Rational Singularities	53
5	Noether's Formula, the Picard Scheme, the Albanese Variety, and Plurigenera	69
6	Existence of Minimal Models	81
7	Morphisms from a Surface to a Curve. Elliptic and Quasielliptic Fibrations	87
8	Canonical Dimension of an Elliptic or Quasielliptic Fibration	111

x Contents

9	The Classification Theorem According to Canonical Dimension	123
10	Surfaces with Canonical Dimension Zero $(\mathrm{char}(\Bbbk) \neq 2,3)$	137
11	Ruled Surfaces. The Noether–Tsen Criterion	165
12	Minimal Models of Ruled Surfaces	181
13	Characterization of Ruled and Rational Surfaces	195
14	Zariski Decomposition and Applications	215
15	Appendix: Further Reading	245
References		247
Index		256