## Surveys in Differential Geometry

- Vol. 1: Lectures given in 1990 edited by S.-T. Yau and H. Blaine Lawson
- Vol. 2: Lectures given in 1993 edited by C.C. Hsiung and S.-T. Yau
- Vol. 3: Lectures given in 1996 edited by C.C. Hsiung and S.-T. Yau
- Vol. 4: Integrable systems edited by Chuu Lian Terng and Karen Uhlenbeck
- **Vol. 5:** Differential geometry inspired by string theory *edited by S.-T. Yau*
- Vol. 6: Essays on Einstein manifolds edited by Claude LeBrun and McKenzie Wang
- **Vol. 7:** Papers dedicated to Atiyah, Bott, Hirzebruch, and Singer *edited by S.-T. Yau*
- **Vol. 8:** Papers in honor of Calabi, Lawson, Siu, and Uhlenbeck *edited by S.-T. Yau*
- **Vol. 9:** Eigenvalues of Laplacians and other geometric operators *edited by A. Grigor'yan and S-T. Yau*
- Vol. 10: Essays in geometry in memory of S.-S. Chern *edited by S.-T. Yau*
- Vol. 11: Metric and comparison geometry edited by Jeffrey Cheeger and Karsten Grove
- Vol. 12: Geometric flows edited by Huai-Dong Cao and S.-T. Yau
- **Vol. 13:** Geometry, analysis, and algebraic geometry *edited by Huai-Dong Cao and S.-T.Yau*
- Vol. 14: Geometry of Riemann surfaces and their moduli spaces edited by Lizhen Ji, Scott A. Wolpert, and S.-T. Yau
- **Vol. 15:** Perspectives in mathematics and physics: Essays dedicated to Isadore Singer's 85th birthday *edited by Tomasz Mrowka and S.-T. Yau*

## Surbeyz in Differential Geometry

Proceedings of the conference on geometry and topology held at Harvard University, April 27–29, 1990

> edited by H. Blaine Lawson, Jr. S.-T. Yau



Surveys in Differential Geometry, Vol. 1 Proceedings of the conference on geometry and topology held at Harvard University, April 27-29, 1990

Editors:

H. Blaine Lawson, Jr., State University of New York, Stony Brook S.-T. Yau, Harvard University

Copyright © 1991, 2011 by Lehigh University, Bethlehem, Pennsylvania

Published by International Press, Somerville, Massachusetts, U.S.A.

All rights reserved. Individual readers of this publication, and non-profit libraries acting for them, are permitted to make fair use of the material, such as to copy a chapter for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgement of the source is given. Republication, systematic copying, or mass reproduction of any material in this publication is not permitted without written consent of the publisher.

Excluded from these provisions is material in articles to which the author holds the copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author.

ISBN 978-1-57146-231-2

Paperback re-issue 2012. Originally published in 1991 under ISBN 0-8218-0168-6 (paperback). The preface and papers herein are reproduced in facsimile from the original publication.

Printed in the United States of America.

## Contents

Stable bundles revisited R. BOTT	1
Lectures on transformation groups: geometry and dynamicsl G. D'AMBRA & M. GROMOV	9
Flips, flops, minimal models, etc11 J. KOLLÁR	3
A report on some recent progress on non-linear problems in geometry20 R. M. SCHOEN	1
Two-dimensional gravity and intersection theory on moduli space24 E. WITTEN	3

## PREFACE

As a service to the mathematics community, the editors of the Journal of Differential Geometry decided to organize a conference, to be held every three years, at which invited speakers would survey the field of differential geometry and related subjects. In choosing the speakers, we look at geometry in a very broad way and hope geometers will go beyond the classical perception of other fields. (Among the speakers at our first conference were people working in algebraic geometry, mathematical physics and other fields.) We decided that the speakers should be prominent specialists in their respective areas who are able to give a broad overview of recent trends and make predictions and suggestions for future research. We believe that these conferences will be useful gatherings for experts and nonexperts alike, and in particular for those who are isolated from the mainstream activity in geometry.

Our first conference, held at Harvard University from April 27–29, 1990, was made possible by the generous funding of the Journal of Differential Geometry. We are also grateful to Harvard University and the faculty of the Mathematics Department who were strongly supportive of this endeavor. Dean Michael Spence delivered the opening remarks commending our efforts to bring together geometry and other fields.

Central to the success of this conference were the speakers who prepared not only two hours' worth of lectures, but also the manuscripts published here. Their lectures were enthusiastically received by several hundred participants. We would like to express our gratitude to them for their efforts.

It is our hope that these conferences will become a tradition. We look forward to the next conference, which will take place at Harvard University in 1993.

> S. T. Yau H. Blaine Lawson, Jr.