Preface to the English translation

This book is an extended English version of the author's book "$K3$ surfaces" in Japanese, which forms volume 5 of the series "Suugaku no Kagayaki", published in 2015 by Kyoritsu Shuppan, Japan. Chapters 0–10 are an English translation of the above book by the author himself. Chapters 11 and 12 are new and added to this English version by the author.

In Chapter 11 we discuss finite groups of symplectic automorphisms of $K3$ surfaces. In particular we study a relation, discovered by S. Mukai, between these groups and the Mathieu group, a finite sporadic simple group. We give a lattice-theoretic proof of Mukai's result by using the classification of even definite unimodular lattices of rank 24, called Niemeier lattices.

In Chapter 12, we study the Kummer surface associated with the Jacobian of a curve of genus 2. It is known that the automorphism group of the Kummer surface is discrete and infinite. During the 19th century and at the beginning of the 20th century, geometers constructed many automorphisms of the Kummer surface. We show that these generate the automorphism group of a generic Kummer surface. Roughly speaking, we realize 32 non-singular rational curves on the Kummer surface forming a beautiful configuration, called the (16_6)-configuration, in terms of 32 octads appearing in the Steiner system. Here we use essentially a description of the fundamental domain of the reflection group of the even unimodular lattice of signature $(1, 25)$ discovered by J. H. Conway.

In this book we restrict ourselves to complex $K3$ and Enriques surfaces. Moreover, the last three chapters are based on the author's work. References are not complete and are kept to a necessary minimum. We refer the reader to the book on $K3$ surfaces by Huybrechts [Huy1] and a survey paper on Enriques surfaces by Dolgachev [Do3] for the case of positive characteristic and for recent progress.

Finally, Gerard van der Geer kindly encouraged the author to publish an English version and, moreover, he read the manuscript and pointed out many misprints. Matthias Schütt also read the manuscript and suggested several improvements to the author. The editors of the series "Suugaku no Kagayaki" and Kyoritsu Shuppan willingly accepted the English translation. In taking this opportunity the author would like to thank them heartily.