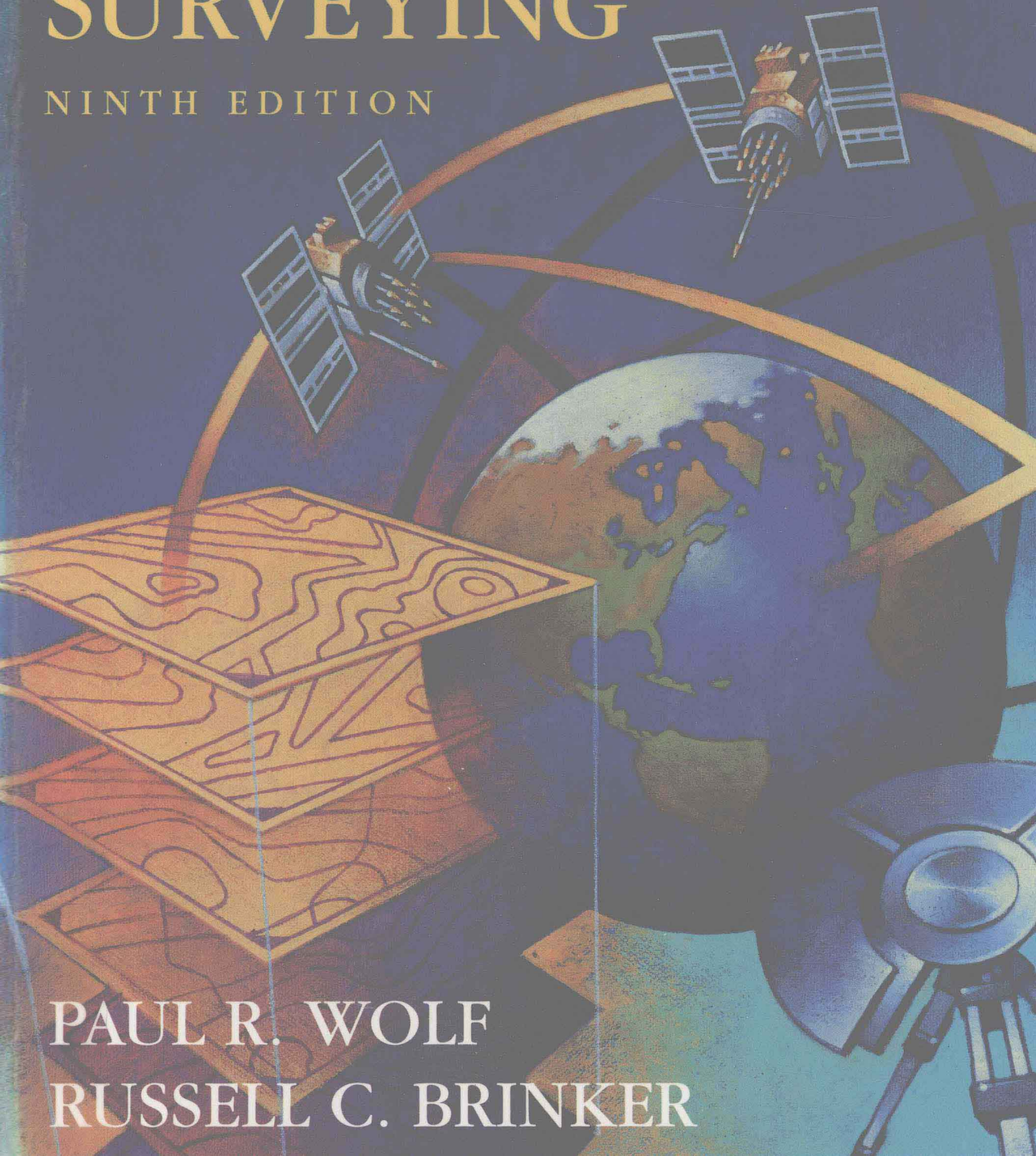


# ELEMENTARY SURVEYING

NINTH EDITION



PAUL R. WOLF  
RUSSELL C. BRINKER

# ELEMENTARY --- --- **SURVEYING** --- ---

NINTH EDITION

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ELEMENTARY

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**SURVEYING**

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# PREFACE

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Surveying is currently in an age of spiraling technological change. Advances are occurring at an unparalleled rate, and are profoundly affecting virtually all areas of surveying field and office practice. New instruments that have revolutionized field activities include the GPS satellite surveying system, electronic digital theodolites, total station instruments with their automatic data collectors (the newest of which are operated robotically), automatic digital levels that read bar-coded rods and employ image processing techniques, new laser alignment devices, and others.

In the office, computer hardware and software improvements affect procedures used for processing information. Personal computers and workstations having greater capabilities and lower cost are continually being introduced. New instruments for plotting maps and scanning documents have been perfected, and software that performs all types of surveying computations, compiling maps, and automatically drawing contours has been introduced.

Perhaps the most significant recent development in surveying has been geographic information systems (GISs). These systems, consisting of both hardware and software, enable the user to store, integrate, manipulate, analyze, and display virtually any type of spatially related information about our environment. They are used at all levels of government, in business, and in private industry, and they are being applied in many diverse areas to aid in planning, design, management, and decision making. Geographic information systems are significantly affecting all areas of surveying.

To accommodate these changes, this ninth edition of *Elementary Surveying* has been substantially revised throughout. New material has been added to cover advancing technologies. In particular, coverage of total stations, automatic data collectors, and GPS has been updated and expanded. The chapter on state plane coordinates has been completely rewritten to accommodate changes brought about by NAD83. A new chapter has been added on the subject of geographic information systems, and a new section on least squares adjustment has been included in the appendixes. In addition to these

major changes, numerous other improvements, including revisions to text material and figures, have been made throughout to update the book and improve its clarity of presentation.

Although many changes have been made, this ninth edition follows the same approach of previous editions: it provides a readable textbook of basic theory and practical material for both field and office work. Chapters are arranged in the order generally found most convenient for college courses. Earlier chapters present basic material suitable for a first course in surveying, whereas later chapters cover more advanced and specialized topics in enough depth to provide sufficient material for a second course. More than 900 end-of-chapter problems are included, and to assist students in self-study, answers to many are given in Appendix G.

As in previous editions, the text emphasizes the theory of errors and correlation of theory and practical field methods. To remind students that surveyors must constantly strive to reduce the sizes of errors and eliminate mistakes, lists of typical errors and mistakes are given at the ends of most chapters. Practical suggestions that stem from the authors' many years of experience are interjected throughout the text so that students can benefit from them.

As noted above, much new material has been added to cover recently developed equipment. However, traditional instruments such as tapes, levels, and theodolites continue to be used in large numbers for many surveying jobs. These traditional instruments continue to be covered in this book, but coverage of older outdated equipment and procedures has been reduced or eliminated. Taping, dumpy and wye levels, transits, plane table, stadia, and triangulation are not covered in the same depth as in earlier editions, and the number of tables at the end of the book has also been reduced.

Although automatic data collectors are gradually being used in larger numbers for recording field measurements, clear and complete handwritten field notes continue to be important in surveying. For this reason, the subject of noteforms is discussed in a separate chapter, and sample noteforms for many of the common types of surveys are collected in Appendix D. Noteforms for a few others are given within the text.

An **Instructor's Manual** is available to adopters of the book. It contains answers to all end-of-chapter problems and a diskette with several valuable computer programs. The diskette has its own documentation, and the menu-driven programs include traverse computations, with area calculation; astronomical azimuth reduction; two-dimensional coordinate transformation; horizontal and vertical curve computation; least squares adjustment; oblique triangle solution; and stadia reduction. At the instructor's discretion, copies of this diskette can be made available to students.

In addition to the changes noted above, numerous other improvements have been incorporated in this ninth edition. A summary of major changes follows:

1. A new chapter covering the subjects of geographic and land information systems has been added.
2. Discussion of total station instruments has been substantially expanded, and modifications in field and office procedures that result from their use are presented throughout the book.
3. Coverage of the global positioning system has been completely updated and expanded.
4. The material on automatic data collectors has been modernized and enlarged, and the use of these devices for various types of field surveys described.

5. The new NAD83 and NGVD88 horizontal and vertical datums have been described and discussed.
6. The chapter on errors and their analysis has been significantly revised.
7. A new section on least squares adjustment has been included in the appendixes. It features several practical examples illustrating applications of this important adjustment procedure.
8. A description of the new electronic digital level has been included.
9. Discussion of new laser equipment for construction layout has been updated.
10. Coverage of radial traversing with total station instruments has been expanded.
11. The chapter on topographic surveying has been completely revised and includes discussion of the new topographic detailing procedures of radial surveys by total station and the use of portable GPS units.
12. Digital elevation models (DEMs) and triangulated irregular networks (TINs) have been described, and the impacts they have on field surveys for topographic mapping discussed.
13. The discussion on computer-aided drafting (CAD) systems has been substantially updated and expanded.
14. The new GPS high-accuracy reference networks (HARNs) that are being installed in most states are described.
15. The chapter on state plane coordinates has been completely revised to include methods of computing in both NAD27 and NAD83.
16. Coverage of boundary surveying has been augmented. Discussion on single- and double-proportionate measurement has been increased, and examples given.
17. The chapter on construction surveys has been revised and new material added to reflect recent changes in equipment and procedures in this important area.
18. The method of staking a circular curve by coordinates with total station instruments has been described, and an example given.
19. The chapter on photogrammetry has been updated to introduce digital or “soft-copy” photogrammetry, and the use of GPS in aircraft to reduce or eliminate the need for traditional photogrammetric ground control surveys.
20. The bibliographies at the end of each chapter have been updated and expanded.

Paul R. Wolf  
Russell C. Brinker

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P. R. W.

R. C. B.

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