# A COURSE OF PRACTICAL ASTRONOMY FOR SURVEYORS WITH THE ELEMENTS OF GEODESY

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649036578

A Course of Practical Astronomy for Surveyors With the Elements of Geodesy by J. R. Oliver

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd. Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

J. R. OLIVER

# A COURSE OF PRACTICAL ASTRONOMY FOR SURVEYORS WITH THE ELEMENTS OF GEODESY

Trieste

# A COURSE

-OF-

# PRACTICAL ASTRONOMY

# FOR SURVEYORS

-WITH-

THE ELEMENTS OF GEODESY

-BY-

LIEUT.-COLONEL J. R. OLIVER, R.A.,

1.0

Professor of Surveying at the Royal Military College of Canada.



KINGSTON : PRINTED AT THE DAILY NEWS OFFICE. 1883.

:8384 e. 1.

# PREFACE.

This manual has been drawn up for the use of the Cadets of the Royal Military College of Canada. The first five chapters on Practical Astronomy embrace that portion of the subject with which all Land Surveyors in this country ought to be familiar. The remaining chapters, together with the part of the work which treats of Geodesy, touch on the more important parts of the additional course, as regards those subjects, laid down by Government for candidates for the degree of Dominion Topographical Surveyor. It has become absolutely necessary to draw up some compilation of this kind, because, while many of the Cadets are anxious to qualify themselves as far as possible in the above-mentioned course, the number of different books they would have had to refer to in order to obtain the requisite knowledge would have entailed on them a heavy expense. In order to make the work as cheap as possible the number of diagrams has been cut down to a minimum, it being intended to supply the place of expensive plates of instruments et cetera by lecture illustrations. The author has also made the higher portion of the Astronomical course

			÷.,			
Ł	~.	e	La.	1	ø	
	1	41	- 44	٠	۲	٠

as brief as possible. It will be found treated in the fullest manner in Chauvenet's Astronomy.

Geodesy being both a difficult and a very extensive subject no attempt has been made to write anything like a treatise on it. All that has been aimed at has been to give a sketchy account of its most salient points, adding a few details here and there. The student who wishes to pursue the subject further is referred to standard works, such as Clarke's Geodesy.

The author has to acknowledge having made more or less use of the following:

Chauvenet's Astronomy, Puissant's Géodésie, Clarke's Geodesy, Frome's Trigonometrical Surveying, Loomis' Practical Astronomy, Gillespie's Higher Surveying, Deville's Examples of Astronomic and Geodetic Calculations, the U. S. Naval Text Book on Surveying, and Jeffers' Nautical Surveying. He has also to thank Lieut.-Colonel Kensington, R.A., for valuable assistance in investigating some doubtful formulas.

KINGSTON, CADADA, January, 1883.

IV

# CONTENTS.

÷

# PART I.

# PRACTICAL ASTRONOMY.

## CHAPTER I.

PAGE.

2

General view of the universe. The fixed stars. Their classification, magnitudes, and distances. The sun. The planets. Their rela-tive sizes and distances from the sun. Apparent motions of the heavenly bodies. Their real motions. Motion of the earth with reference to the sun. The solar and sidereal day. Mean and apparent solar time. The equation of time. Sidereal time. The sidereal clock..... т

## CHAPTER II.

CHAPTER II. Idea of the great sphere. Meaning of the terms "pole," "meridian," "declination circle," "hour circle," "zenith," "latitude," "longi-tude." "declination," "right ascension," "altitude," "azimuth," "sensible horizon," "rational horizon," "parallels of latitude," "declination parallels," "circumpolar star," "transit," "paral-lax." Refraction. The Nautical Almanac. Sidereal time. The celestial globe. Illustration of the different co-ordinates on the great sphere. great sphere..... II

# CHAPTER III.

CHAPTER III. Uses of practical astronomy to the surveyor. Instruments employed in the field. Their particular uses. Corrections to be applied to an observed altitude. Cause of the equation of time. Given the sidereal time at a certain instant to find the mean time. To find the mean time at which a given star will be on the meridian. Given the local mean time at any instant to find the sidereal time. Illustrations of sidereal time. To find the hour angle of a given star at a given meridian. To find the mean time by equal alti-tudes of a fixed star. To find the local mean time by an observed altitude of a heavenly body. To find the time by a meridian transit of a heavenly body. 22

# Contents.

### CHAPTER IV.

To find the latitude by the meridian altitude of the sun or a star. The longitude. Differences of longitude measured by differences of local time. The meridian. To find the azimuth of a heavenly body from its observed altitude. To find the meridian by equal altitudes of a star. To find the meridian by the greatest elonga-tion of a circumpolar star. To find the meridian by observations of high and low stars. Azimuth by observations of the pole star at any hour. star at any hour ..... 36 \*\*\*\*\*\*\*\*\*\*\*\*\*

# CHAPTER V.

Sun dials. Horizontal dials. Vertical dials..... 49

# CHAPTER VI.

The Refracting Telescope. The Micrometer. The Reading Micro-scope. The Spirit Level. The Chronometer. The Electro-Chronograph. The Sextant. The Simple Reflecting Circle. The Repeating Reflecting Circle. The Prismatic Reflecting Circle..... \$3

# CHAPTER VIL

The portable Transit Telescope. Its uses and adjustments. Methods of correcting the meridian line. Effect of inequality of pivots. To apply the level correction to an observation. To find the latitude by transits of stars across the prime vertical. Effect of an error of deviation on the latitude. The personal equation... 66

# CHAPTER VIII.

The Zenith Telescope. Its use in finding the latitude. To find the corrected latitude. To find the level correction. Value of a revolution of the micrometer screw, Reduction to the micrometer screw, Reduction to the meridian. The portable transit instrument as a zenith telescope ......

## CHAPTER IX.

Additional methods of finding the latitude.—By a single altitude taken at a known time. By observations of the pole star out of the meridian. By circum-meridian altitudes..... 84

#### CHAPTER X

Interpolation by second differences. Examples. To find the Green-wich mean time corresponding to a given right ascension of the moon on a given day. Interpolation by differences of any order. To find the longitude by moon-culminating stars. To find the longitude by lunar distances..... 80

### CHAPTER XL

To find the amplitude and hour angle of a given heavenly body when on the horizon. To find the equatorial horizontal parallax of a heavenly body at a given distance from the centre of the earth. To find the parallax in altitude, the earth being regarded as a 

VI

Contents.

VII

# PART II.

# GEODESY.

#### CHAPTER L

### CHAPTER II.

#### CHAPTER III.

#### CHAPTER IV.

Determination of the geodetic latitudes, longitudes, and azimuths, of the stations of a triangulation, taking into account the ellipticity of the earth. Formulo and series employed. Use of the imaginary sphere described with radius equal to the normal of the spheroid. Heduction of a difference of latitude on the spheroid to the corresponding difference of latitude on this sphere. Given the lalitudes and longitudes of two points to find the length and direction of the line joining them. To compute the distance between two points, knowing their latitudes and the azimuths of one from the other. To compute the distance, knowing the latitude of one point, the azimuth of the line connecting it with the other, and the difference of the longitudes of the points. Numerical examples. Method of correcting the azimuth adopted

# Contents.

#### CHAPTER V.

#### CHAPTER VI.

#### CHAPTER VII.

VIII