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Astronomy

From ancient times, humans have tried to understand the workings of the world around them. The roots of modern physical science go back to the very earliest mechanical devices such as levers and rollers, the mixing of paints and dyes, and the importance of the heavenly bodies in early religious observance and navigation. The physical sciences as we know them today began to emerge as independent academic subjects during the early modern period, in the work of Newton and other 'natural philosophers', and numerous sub-disciplines developed during the centuries that followed. This part of the Cambridge Library Collection is devoted to landmark publications in this area which will be of interest to historians of science concerned with individual scientists, particular discoveries, and advances in scientific method, or with the establishment and development of scientific institutions around the world.

An Introduction to Practical Astronomy

Although astronomical guides were available in the early nineteenth century, they tended to come from continental presses and were rarely in English. This two-volume work by the clergyman and astronomer William Pearson (1767–1847) aimed, with brilliant success, to compile data from extant sources into one of the first English practical guides to astronomy. Most of the tables were updated and improved versions, and some were wholly reconstructed to streamline the calculation processes. Sir John Herschel dubbed it 'one of the most important and extensive works on that subject which has ever issued from the press', and for his efforts Pearson was awarded the gold medal of the Astronomical Society. First published in 1824, Volume 1 chiefly comprises extensive tables to facilitate the reduction of a range of astronomical observations, including solar and sidereal movements, alongside thorough instructions. In the history of science, Pearson's work reflects the contemporary challenges of celestial study.

An Introduction to Practical Astronomy

Containing Tables For Facilitating the Reduction of Celestial Observations, and a Popular Explanation of Their Construction and Use

VOLUME 1

WILLIAM PEARSON

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AN

INTRODUCTION

TO

PRACTICAL ASTRONOMY:

CONTAINING

TABLES,

RECENTLY COMPUTED,

FOR FACILITATING THE REDUCTION OF CELESTIAL OBSERVATIONS;

AND

A POPULAR EXPLANATION OF THEIR CONSTRUCTION AND USE.

BY THE REV. W. PEARSON, LL.D. F.R.S. ETC.

RECTOR OF SOUTH KILWORTH, LEICESTERSHIRE, AND TREASURER TO THE ASTRONOMICAL SOCIETY OF LONDON.

"The labour of an Astronomer, in reducing his observations, is so great, that the construction of *convenient* Tables is a matter of considerable importance."

WOODHOUSE. [ASTRON. VOL. I. P. 285.]

VOL. I.

London:

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1824.

G. Woodfall, Printer, Angel Court, Skinner Street, London.

TO THE PRESIDENT, VICE-PRESIDENTS, AND MEMBERS AT LARGE,

OF THE

ASTRONOMICAL SOCIETY OF LONDON,

This Volume of Tables,

UNDERTAKEN WITH A VIEW TO PROMOTE THE OBJECTS OF THE SOCIETY,

AND, AT THE SAME TIME, TO SPARE ITS FUNDS,

IS MOST RESPECTFULLY DEDICATED,

BY THEIR OBEDIENT AND VERY HUMBLE SERVANT,

THE TREASURER.

PREFACE.

WHOEVER undertakes to write a work on PRACTICAL ASTRONOMY must suppose his readers acquainted with the general principles of the science, from having previously read some elementary work on the subject; otherwise he would be under the necessity of demonstrating a variety of mathematical formulæ, on which his calculations are founded, and of explaining even the terms, which he must necessarily use, in correcting operations that are purely practical. Fortunately several works are before the public, which give all the information that can be wanted on the THEORY of ASTRONOMY; and many of them are written with that method and perspicuity, which are calculated to render the subject not only intelligible, but highly interesting. The names of VINCE, WOODHOUSE, BRINKLEY, GREGORY, ZACH, DELAMBRE, BESSEL, BIOT, and LITTROW are too well known, from their labours, to require any recommendation; and their works will amply supply what may be considered, by some readers, as omissions in the plan that has been prescribed to the present volume. The Author professes not indeed an intimate knowledge of the more abstruse branches of mathematical science, but flatters himself that he possesses such information as enables him to supply that link, which will connect the theoretical with the practical astronomer, and which was the principal object of his undertaking.

It will probably be expected, that, in a work of this nature, the instruments at present used in practical astronomy be described in the first place, for this appears to be the most natural order to adopt; but the connexion between the observations to be made on the celestial bodies, and the necessary corrections to be applied to them is such, that, before any useful inference can be drawn from instrumental operations, reference must be had to computations depending on suitable formulæ, or to Tables already computed, when they are to be obtained: for until the observer is enabled to convert the *mean* places of the heavenly bodies into the *apparent*, and conversely, he can neither assign a rate to his clock with any degree of accuracy, nor determine the latitude of his observatory. Hence the Author has been induced to divide his work into two volumes; the first, which may be considered in some measure as a compilation, contains a selection of Tables calculated to facilitate the application of all the requisite corrections, and to abridge the labour of computation in a variety of cases that occur in practice; and it is proposed that the second should comprise descriptions of the most useful instruments, illustrated by a series of copper-plate engravings executed in the best style of the art; an account of the most approved methods of making the necessary adjustments; appropriate directions as to the different modes of using the instruments respectively; the

exemplification of those various modes in actual practice; and the application of all the requisite corrections, derived from the first volume, for determining the final results of the different operations.

This plan has been adopted, partly with a view of leading the young astronomer by degrees, from one step to another of his progress, lest he should be discouraged by being surrounded at once by difficulties, that might conspire to deter him from persevering in his purpose; and partly from an understanding, that a wish has been expressed by several members of the Astronomical Society of London, to procure a collection of Tables, that may be generally useful, and that may afford the ready means of comparison between the results deduced from the observations of different astronomers. While the co-efficients in the different formulæ, on which Tables of Corrections are founded, vary from one another, it cannot be ascertained whether the discrepancies, in a variety of instances, are principally derivable from the observations themselves, or from the reductions of those observations: but should the same Tables of Corrections be adopted by different astronomers, an estimate may be made of the comparative merits of different instruments, that are used for the same purpose; and it would then appear what confidence may be placed on the powers of an individual instrument. And finally, when the deductions of several astronomers concur in pointing out defects in the corrections thus adopted, the co-efficients themselves may be varied, until it is found that the Tables, arising out of such variations, may constitute a general and permanent code of corrections.

The materials, which the practical astronomer had formerly to consult, lay scattered about in different books; and the explanations were frequently misapprehended by being published in foreign languages; besides, it was no easy matter to select out of the various Tables, that different countries have produced, those particular ones which are most entitled to credit. How far the compiler of the present volume has obviated these difficulties, or any of them, is left to the public to determine. In converting the productions of other more eminent authors to his own purpose, he has found it expedient, frequently to alter the form of a Table when it appeared capable of improvement, either by an enlargement of its subdivisions, or by an alteration in the arrangement of its arguments, or both. In conformity with the modern plan of constructing Tables on the continent, he has avoided, as much as possible, Tables of *double entry*, that require several proportions to be worked; and where such Tables were unavoidably requisite, he has generally extended the subdivisions, so that the quantities may be taken out by simple inspection, except in cases where extraordinary accuracy is required. Into several of the old Tables modern co efficients have been introduced, so as to require re-computation, and *time* has frequently been substituted for *space* in the arguments; but in these cases, and indeed generally, the formulæ have been either annexed to the Tables founded on them, or form a portion of the subsequent explanation. The reader will not be obliged to draw on the credit of the Editor, with respect to the Tables that bear their own marks of authenticity, except so far as the alterations extend; but for several new Tables, and some of them long ones, computed by himself or his assistants, he has to request the indulgence of his readers, who may discover inaccuracies that have escaped detection. He must claim also the same indulgence on behalf of several new Tables, computed and supplied by his friends, whose names they bear, and to whom he begs to express his obligation. The volume has been prepared in a comparatively short space of time, while the Editor resided above eighty miles from the press, so that final revision of single faults has been sometimes confided to the superintendent of the press. But under all these disadvantages it is hoped that few typographical errors will be found beyond what are contained in the pages of *Errata*.

In arranging the plan of tabulating the various quantities that constitute the series of general Tables for finding the precession, and constants of aberration, lunar nutation, and solar nutation, from I. to XIV. inclusive, and in selecting the co-efficients most likely to be depended on, in the present state of practical astronomy, the Compiler could not but distrust his own competence, and therefore gladly availed himself of the advice and labours of the Cape Astronomer, whose wants had directed his attention to this subject, and whose talents are too well known and appreciated to require eulogium.

With such valuable assistance, the Author is encouraged to hope, that his labours may at least tend to promote the objects, for encouraging which that Society was established, of which he has the honour to be Treasurer; though he can hardly expect that the limited circulation of such a work will repay more than one-fourth of the expense that has been incurred in its execution.

The Use of the Tables has been rendered as familiar as the nature of the subject would admit, by popular explanations prefixed to the examples, and by deducing the results at full length, both from the tabulated quantities, and also by logarithmic computations, agreeably to the formulæ on which the Tables are respectively constructed; thus the Reader is enabled to judge of the accuracy of the Tables, and, at the same time, to see in what cases logarithmic computation is preferable to the tabular method of gaining the corrections. The variety of TABLES of REFRACTION introduced, will afford the means of ascertaining what formulæ are the best adapted for particular situations, in which observatories may be placed, with respect to local refractions; and also, of detecting what differences are produced in observations reduced by different Tables.

Some opinion may be formed of the extent of the Author's labours, when it is stated, that, of the 457 pages constituting the volume, 325 contain new Tables, or explanatory matter; 46 are filled with Tables that have been enlarged, or otherwise improved; and 86 only comprise Tables that have been copied in their original state.

During the printing of this volume various improvements have been made in the tabulation of astronomical corrections; many of which have been introduced towards the end of the volume, which addition, while it in some measure deranges the intended order of the Tables, renders the collection more complete, and will not therefore, it is hoped, be considered as an imperfection.

CONTENTS.

ERRATA.

Page	Argument.	Column.	Instead of	Insert
17	Therm. 16 .0	12	0 .2292	0 .2992
18	Fahr. 0°	8. 9. 11. 12	14°. 17°. 5°. 7°.	14°. 17°. 5°. 7°.
19	at the head	12	Therm. 30°	Therm. 50°
24	at the head	2	— XII —	— XII +
28	at the bottom	2	XII	XI
30	III. 16°	8	13 .249	13 .149
35	at the head	12	0—	6—
36	head	.....	N′	L′
	II. 0	8	0 .89907	0 .89607
	II. 1	8	0 .89962	0 .89662
44	Dec. 31	1	41	31
45	head	.....	Time.	Space.
48	head	.....	47	48
49	V 26° 0′	19	1 .335	1 .325
56	VI 50	17	5 .868	5 .768
	VI 19° 52′	17	5 .878	5 .778
	VI 19 54	17	5 .887	5 .787
	VI 19 56	17	5 .896	5 .796
	VI 19 58	17	5 .905	5 .805
	VI 20 0	17	5 .914	5 .814
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	Tab. 2.	head	$\frac{3\,2\,0}{3\,2\,1}$	$\frac{1}{3\,2\,1}$
106	Lat. 50°	9	.9350	.6350
107	Lat. 28	8	100162	100172
108	.....	head	Lampton.	Lambton.
111	0 46	11ˢ	3 .367	0 .367
113	γ Pegasi	R. A.	0ʰ 3ᵐ 58ˢ.8	0ʰ 3ᵐ 58ˢ.84
	α Cassiopeæ	R. A.	0 30 21 .2	0 30 20 .99
	α Ursæ Min.	R. A.	0 57 2 .4	0 57 1 .51
115	α Arietis	R. A.	1 57 3 .0	1 57 3 .01
		N. P. D.	67° 23′ 37″	67 23 34 .69
	α Ceti	R. A.	2ʰ 52ᵐ 52ˢ.9	2ʰ 52ᵐ 52ˢ.89
		N. P. D.	86° 37′ 18″.0	86 37 18 .19
	α Persei	R. A.	3ʰ 11ᵐ 31ˢ.7	3 11 31 .25
		N. P. D.	40° 47′ 18″.	40° 47′ 17″.87
117	α Tauri	R. A.	4ʰ 25ᵐ 36ˢ.3	4 25 36 .28
		N. P. D.	73° 51′ 43″	73 51 39 .67
	α Aurigæ	R. A.	5ʰ 3ᵐ 24ˢ.6	5 3 24 .59
		N. P. D.	44° 11′ 51″	44 11 48 .49
	β Orionis	R. A.	5ʰ 5ᵐ 53ˢ.6	5 5 53 .56
		N. P. D.	98° 25′ 0″	98 24 59 .85
	α Tauri	Aber.	3′.748	3″.748
119	β Tauri	R. A.	5ʰ 14ᵐ 55ˢ.4	5 14 55 .41
		N. P. D.	61° 33′ 19″	61 33 16 .89
	α Orionis	R. A.	5ʰ 45ᵐ 25ˢ.9	5 45 25 .92
		N. P. D.	82° 38′ 8″	82 38 6 .04
	α Canis Maj.	N. P. D.	106 28 36	106 28 30 .67
121	β Geminorum	R. A.	7ʰ 33ᵐ	7 34
123	θ Ursæ Maj.	An. Var.	+ 15″.34	+16 .01
125	β Leonis	An. Var.	— 20 .04	+20 .04
131	α Cor. Bor.	⊙ Nut.	8″.421	0 .421
133	α Scorpii	R. A.	16ʰ 18ᵐ 22ˢ.23	16 18 23 .23
134	head	.....	β Herculis	α Herculis
135	ε Sagittarii	An. Var.	+ 0″.95	−1 .14
			S S	
136	Com. Arg.	head	IV 15° VII	I 15 VII
138	γ Aquilæ	An. Var.	— 8″.32	−8″.38
			S S	
	Com. Arg.	head	IV 15° VII	I 15 VII
144	α Piscis Aust.	head	1830	1820

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144	α Pegasi	An. Var.	+19″.43	−19 .43
			S S	S S
	Common Arg.	head	III 0° IX	I 15° VII &c.
145	α Ceti	Bessel	53ˢ.92	52 .93
	α Tauri	Maskelyne	35 .00	35 .95
		Bessel	36 .02	36 .12
	β Tauri	An. Var.	2ˢ.785	3 .785
		An. Var.	3″.747	3 .717
	α Virginis	An. Var.	3ˢ.444	3 .144
	α Scorpii	Pond.	23ˢ.32	23 .23
	α Herculis	Bessel	26 .57	26 .67
	γ Draconis	An. Var.	9″.153	0 .714
	ε Sagittarii	An. Var.	3ˢ.974	3 .983
		An. Var.	1″.068	1 .138
	α Aquarii	Piazzi	33ˢ.06	31 .96
146	α Cassiopeæ	Prop. Mot.	−0ˢ.005 Piazzi	−0 .003
			−0 .004 Bessel	−0 .003
		An. Var.	3 .312 Piazzi	3 .314
			3 .317 Bessel	3 .316
		Prop. Mot.	+0″.05 Piazzi	+0 .07
		An. Var.	19 .85 Piazzi	19 .83
			13 .853 Bessel	19 .853
	β Orionis	An. Prec.	5ˢ.878 Mask.	2 .878
	α Hydræ	An. Prec.	3 .952 Mask.	2 .952
		An. Var.	3 .946 Mask.	2 .946
	β Virginis	Prop. Mot.	+0 .041 Bessel	0 .049
		An. Var.	3′.114 Bessel	3 .122
	γ Ursæ Maj.	Prop. Mot.	+0 .019 Bessel	+0 .013
		An. Var.	3 .225 Bessel	3 .219
	α Bootis	An. Var.	18″.007 Bessel	19 .007
	β Ursæ Min.	An. Prec.	0ˢ.315 Bessel	0 .319
		An. Var.	0 .325 Bessel	0 .329
	α Scorpii	An. Prec.	2ˢ.657 Piazzi	3 .657
		An. Prec.	8″.698 Bessel	8 .695
		An. Var.	8 .688 Bessel	8 .685
	β Draconis	An. Prec.	1ˢ.344 Bessel	1 .348
		An. Var.	8″.330 Piazzi	1 .330
			1 .337 Bessel	1 .341
	α Ophiuchi	Prop. Mot.	+0 .18 Piazzi	−0 .18
		An. Var.	3 .18 Piazzi	2 .82
	α Lyræ	An. Prec.	3ˢ.013 Mask.	2 .013
	α^2 Capricorni	Prop. Mot.	+0 .008 Bessel	+0 .005
		An. Var.	3 .341 Bessel	3 .338
	α Andromedæ	Prop. Mot.	−0 .009 Piazzi	+0 .009
			−0 .008 Bessel	+0 .008
		An. Var.	3 .054 Piazzi	3 .072
			3 .053 Bessel	3 .069
			S	
153	⊙ 1823	5	0 10° 19′ 39″.9	9 10 19 39 .9
158	19° 20′	4	0ˢ.15	0 .85
162	24 40	2	9° 33′ 57″. 00	9 33 57 .90
	27 20	4	43 .85	42 .85
166	9 50	10	15 .96	14 .96
	10 0	9	38 .88	39 .88
	10 0	10	15 .86	14 .86
168	head	.....	Table 5.	Table 8.
180	Tab. 25. Alt. 0.	18	1″.6	8 .7
182	56′ 6″	.....	15′ 17″. 50	15 17 .58
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	58 16	.....	15 52 .91	15 53 .01
183	26	14	2 .33	2 .23
	38	16	4 .58	4 .48

ERRATA.

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	49	13	6 .32	6 .34
185	Table 6. 85°	3	2′ 53 .5	1 53 .5
186	29°	6	6 .16	7 .16
	30	6	6 .39	7 .39
189	15	7	57 59 .38	56 59 .38
191	36 30	10	49 30 .35	49 50 .35
192	47 0	6	39 23 .35	39 33 .35
	50	4	35 50 .77	35 59 .77
193	50	4	35 50 .77	35 59 .77
	51 50	6	35 58 .47	35 50 .47
194	63 50	4	24 51 .71	24 41 .71
	65 50	7	24 9 .65	24 9 .25
	67 50	2	20 32 .46	20 22 .46
	74 50	3	14 23 .67	14 23 .37
	84 0	7	6 10 .07	6 10 .03
	89 10	8	0 52 .30	0 52 .36
204	8 0	5	2° 25 18 .14	2 25 18 .74
	9 50	8	2 32 53 .87	1 32 53 .87
205	10 20	5	2 27 15 .88	2 27 15 .86
	10 30	9	89 .64	39 .64
	10 40	8	1 29 16 .33	1 29 36 .53
	10 50	8	1 28 57 .56	1 28 56 .56
	12 30	5	2 8 11 .29	2 28 11 .29
	13 10	9	42 .28	42 .27
	13 20			
	14 50	8	1 12 11 .42	1 12 11 .43
	18 20	2	1 31 42 .14	1 31 42 .15
206	20 0	4	15 .86	14 .86
	20 10	4	15 .96	14 .96
207	Table 2.	head	"head or foot"	"head" only.
228	220°	6	23° 50′ 53″	28 50 53
	221	6	38 27 11	28 27 11
	226	2	198 11 37	193 11 37
232	11 20′	5	18 2 27 .89	18 2 27 .99
	16 40	5	16 34 36 .97	16 34 36 .95
	18 40	2	22 28 26 .00	22 20 26 .00
238	Table 13.	head	Appoximate	Approximate
	27°	11	4′ 33″.80	4 43 .80
	44	4	2 8 .88	2 10 .88
239	25	11	8 43 .36	8 40 .36
	31	2	5 33 .79	5 53 .79
	37	8	10 13 .43	10 53 .43
	39	2	7 11 .29	7 12 .29
240	22	11	10 14 .29	11 14 .29
	51	10	22 26 .37	22 36 .37
	52	4	18 23 .44	18 28 .44
	61	4	20 20 .27	20 30 .27
241	30	9	28 28 .19	18 28 .19
	45	5	23 23 .47	23 43 .47
242	22	3	15 2 .58	15 2 .38
	28	2	13 28 .30	18 28 .80
	35	3	22 1 .67	23 1 .67
	35	11	26 41 .79	26 21 .79
243	57	8	42 12 .15	42 12 .12
244	17	11	16 39 .06	16 29 .06
	18	11	17 35 .37	17 25 .37
	19	11	18 31 .36	18 21 .36
	21	8	19 42 .57	19 47 .57
245	11	11	10 16 .47	11 16 .47
	16	6	15 48 .48	15 58 .48
	21	9	21 11 .93	21 1 .93
	23	5	22 33 .14	22 32 .14
	32	7	31 51 .04	30 51 .04
	33	7	32 42 .46	31 42 .46
	45	11	41 26 .91	41 46 .91
246	15	7	15 29 .40	15 29 .48
	16	5	16 23 .86	16 26 .86
	33	3	32 81 .61	32 21 .61
	48	3	44 49 .29	44 9 .29
	48	6	41 27 .14	44 25 .14
	49	3	45 30 .51	44 50 .51
250	bottom	.....	☾'s co-latitude	the co-latitude
251	bottom			
252	bottom 9′	8	☾'s co-latitude 16′ 6″.06	the co-latitude 10 6 .06

Page	Argument.	Column.	Instead of	Insert
253	bottom	98	her latitude	the reduced lat.
	bottom	.....	☾'s co-lat.	the co-lat.
254	8′	11	3′ 44″.17	2 44 .17
255	38	6	15 3 .57	16 3 .57
257	8	17°	2 26 .42	2 26 .49
259	84°	65	53 54 .83	54 4 .83
260	77	84	58 8 .42	58 8 .52
263	39	20″	16 .54	15 .54
268	.0039	2	0 1 .99	0 1 .90
	.0040	2	0 1 .99	0 1 .95
270	bottom	.....	Latitude	co-latitude
	bottom	after	0 .02 M. add.....	"and 0 .03 N'.
278	24 Pisc. Aust.	4	$22^h\ 46^m\ 43^s.53$	22 46 34.53
288	Table 2.	head	Diameter	Breadth
330	.....	.....	Lampton	Lambton
331				
336	Tab. XV. 07	N. P. D.	2	19
	True N P. D.	.....	82° 38′ 1″.44	82 38 1.52
337	from bottom	four lines	Mr. Bates	Mr. Bate
338	from bottom	five lines	dele "except in one solitary instance of α Tauri."	
343	α Pisc. Aust.	Column 5	0 .37	0 .27
347	Example 1.	Table 1.	−0 .92	+0 .08
		Table 2.	+0 .09	+1 .09
			+0 .002	+2 .07
			−0 .012	−0 .014
	App. R. A.		$5^h\ 45^m\ 40^s.007$	5 45 40 .210
	from bottom	twelve lines	one-third	one-tenth
376	Table 7.	Title	Latitude	Altitude
389	first line		latter	reduced paral.
	second line		= hor. par.	= reduced paral.
397	Az. 1° 40	Lat. 50° 0′	10′ 48″.85	10 48 .55
	Az. 11 40	Lat. 56 40	9 4 .24	9 9 .24
	Az. 85 0	Lat. 58 20	0 46 .90	0 46 .60
398	Az. 33 20	Lat. 38 20	1.2948	1.2947
401	from bottom	line ten	45° to 90°	45° to 60°

TABLES

FOR FACILITATING

THE REDUCTION OF CELESTIAL OBSERVATIONS.