

CONTENTS

<i>Preface to the fourth edition</i>	ix
<i>Preface to the first edition</i>	x
1 The object of practical physics	1
PART 1 STATISTICAL TREATMENT OF DATA	
2 Introduction to errors	5
2.1 The importance of estimating errors	5
2.2 Systematic and random errors	6
2.3 Systematic errors	8
3 Treatment of a single variable	9
3.1 Introduction	9
3.2 Set of measurements	10
3.3 Distribution of measurements	10
3.4 Estimation of σ and σ_m	14
3.5 The Gaussian distribution	18
3.6 The integral function	19
3.7 The error in the error	22
3.8 Discussion of the Gaussian distribution	22
Summary of symbols, nomenclature, and important formulae	24
Exercises	26
4 Further topics in statistical theory	27
4.1 The treatment of functions	27
4.2 The straight line – method of least squares	30
4.3 The straight line – points in pairs	36
4.4 Weighting of results	37
Summary of equations for the best straight line by the method of least squares	39
Exercises	41

5	Common sense in errors	43
5.1	Error calculations in practice	43
5.2	Complicated functions	46
5.3	Errors and experimental procedure	48
	Summary of treatment of errors	50
	Exercises	51
PART 2 EXPERIMENTAL METHODS		
6	Some laboratory instruments and methods	55
6.1	Introduction	55
6.2	Metre rule	55
6.3	Micrometer screw gauge	57
6.4	Measurement of length – choice of method	58
6.5	Measurement of length – temperature effect	61
6.6	The beat method of measuring frequency	62
6.7	Negative feedback amplifier	64
6.8	Servo systems	67
6.9	Natural limits of measurement	69
	Exercises	71
7	Some experimental techniques	73
7.1	Rayleigh refractometer	73
7.2	Measurement of resistivity	79
7.3	Absolute measurement of the acceleration due to the Earth's gravity	86
7.4	Measurement of frequency and time	94
7.5	The Global Positioning System	98
	Exercises	101
8	Experimental logic	102
8.1	Introduction	102
8.2	Apparent symmetry in apparatus	102
8.3	Sequence of measurements	103
8.4	Intentional and unintentional changes	104
8.5	Drift	105
8.6	Systematic variations	106
8.7	Calculated and empirical corrections	109
8.8	Relative methods	111
8.9	Null methods	113
8.10	Why make precise measurements?	114

9	Common sense in experiments	117
9.1	Preliminary experiment	117
9.2	Checking the obvious	118
9.3	Personal errors	119
9.4	Repetition of measurements	119
9.5	Working out results	121
9.6	Design of apparatus	122
PART 3 RECORD AND CALCULATIONS		
10	Record of the experiment	125
10.1	Introduction	125
10.2	Bound notebook versus loose-leaf	125
10.3	Recording measurements	126
10.4	Down with copying	126
10.5	Diagrams	127
10.6	Tables	129
10.7	Aids to clarity	130
10.8	Some common faults – ambiguity and vagueness	131
11	Graphs	133
11.1	The use of graphs	133
11.2	Choice of ruling	137
11.3	Scale	137
11.4	Units	138
11.5	Some hints on drawing graphs	138
11.6	Indicating errors	141
11.7	Sensitivity	142
12	Arithmetic	144
12.1	Arithmetic is important	144
12.2	Computers	144
12.3	Calculators	145
12.4	Ways of reducing arithmetical mistakes	145
12.5	Checking algebra	148
	Exercises	150
13	Writing a paper	152
13.1	Introduction	152
13.2	Title	152
13.3	Abstract	152
13.4	Plan of paper	153

13.5	Sections of paper	153
13.6	Diagrams, graphs, and tables	155
13.7	Instructions to authors	155
13.8	Clarity	156
13.9	Good English	156
13.10	Conclusion	158

APPENDICES

A	Evaluation of some integrals connected with the Gaussian function	161
B	The variance of s^2 for a Gaussian distribution	164
C	The straight line – the standard error in the slope and intercept	166
	Comment on the dependence of m , c , and b	170
D	The binomial and Poisson distributions	171
	Binomial distribution	171
	Poisson distribution	173
E	The χ^2 distribution – test of goodness of fit	176
	Introduction	176
	Derivation of χ^2 distribution	177
	The function $P_n(\chi^2)$	180
	Degrees of freedom	181
	Test of goodness of fit	182
	Worked examples	184
	Comments	186
F	SI units	188
	Names and symbols	189
	Decimal factors	190
	Relation to c.g.s. units	190
	Definitions of the SI base units	191
G	Values of physical constants	192
H	Mathematical tables	193
	Values of the Gaussian function and the Gaussian integral function	193
	Values of χ^2 for given ν and P	194
	<i>Solutions to exercises</i>	196
	<i>Some useful books</i>	206
	<i>References</i>	207
	<i>Index</i>	209