

ERGONOMICS, WORK AND HEALTH

This book is dedicated to my students: past, present and future

“The reasonable man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man.”

Man and Superman, George Bernard Shaw

“We are all in the gutter, but some of us are looking at the stars.”

Lady Windermere's Fan, Oscar Wilde

ERGONOMICS, WORK AND HEALTH

Stephen Pheasant

Consulting Ergonomist

palgrave
macmillan



© S. T. Pheasant 1991

All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission.

No paragraph of this publication may be reproduced, copied or transmitted save with written permission or in accordance with the provisions of the Copyright, Designs and Patents Act 1988, or under the terms of any licence permitting limited copying issued by the Copyright Licensing Agency, 90 Tottenham Court Road, London W1T 4LP.

Any person who does any unauthorised act in relation to this publication may be liable to criminal prosecution and civil claims for damages.

The author has asserted his right to be identified as the author of this work in accordance with the Copyright, Designs and Patents Act 1988.

Published by

PALGRAVE MACMILLAN

Houndmills, Basingstoke, Hampshire RG21 6XS and

175 Fifth Avenue, New York, N. Y. 10010

Companies and representatives throughout the world

PALGRAVE MACMILLAN is the global academic imprint of the Palgrave Macmillan division of St. Martin's Press, LLC and of Palgrave Macmillan Ltd. Macmillan® is a registered trademark in the United States, United Kingdom and other countries. Palgrave is a registered trademark in the European Union and other countries.

ISBN 978-0-333-48998-7 ISBN 978-1-349-21671-0 (eBook)

DOI 10.1007/978-1-349-21671-0

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources.

A catalogue record for this book is available from the British Library.

Contents

Foreword	viii
Acknowledgements	x
Prologue	1
Chapter 1 Introduction	3
What is Ergonomics?	3
Ergonomics, Work and Health	5
Ergonomics and Design	13
Ergonomics and Economics	15
Chapter 2 The Physiology of Work	24
Bioenergetics of Exercise	24
Static and Dynamic Work	32
Physical Workload: Cardiovascular Demands	33
Biomechanics of Muscle	38
Strength	43
Muscle Pain and Dysfunction	48
Appendix: Anatomical Terminology	54
Chapter 3 Back Pain at Work	57
Epidemiology: Some Definitions	57
Low Back Pain	58
Work-related Risk Factors	65
Personal Risk Factors	72
Summary	75
Chapter 4 Repetitive Strain Injuries	77
RSI: The Australian Epidemic	79
Neck and Shoulder Pain	81
Disorders of the Elbow, Forearm, Wrist and Hand	88
Some Other Conditions	96

Chapter 5 Posture	98
Standing	100
Sitting	104
Lying	106
Squatting	107
Working Posture	107
Chapter 6 Work Design	116
The Systems Approach	116
Task Demands and Working Capacity	118
Anthropometrics	122
Working Efficiency	127
Job Design: The Broader Issues	134
Chapter 7 Stress, Fatigue and the Working Environment	139
The Semantics of Stress	140
A Taxonomy of Stress	141
Stress, Arousal and Performance	142
Work Stress	148
Mental Workload	153
Fatigue	156
Working Hours	161
Chapter 8 Shiftwork	165
Circadian Rhythms	166
The Effects of Shiftwork on Health and Well-being	169
The Design of Shiftwork	173
Chapter 9 Accidents, Errors and Interfaces	176
Accident Proneness	177
Human Error	181
Error Ergonomics	185
Chapter 10 Visual Work	196
Light and Vision	196
Visual Displays	201
The Visual Environment	204
Eyestrain	210

Chapter 11 The Ergonomics of Seating	212
The Physiology of Comfort	212
Seat Design	214
Seating and Back Pain	222
The Office Desk	226
Office Chairs	228
Adjusting the Workstation	229
 Chapter 12 Working with Computers	 231
VDUs and Health	231
Workstation and Task Design	236
Pausgymnastik	247
 Chapter 13 Driving	 253
Driving Posture and Workstation Layout	253
Dynamic Loading	256
Vibration	257
 Chapter 14 Hand Function and Tool Design	 261
Repetitive Manipulative Tasks	261
Hand Function	263
Tools and Handles	268
Vibration Syndrome	274
 Chapter 15 Lifting and Handling	 277
Epidemiology	277
The Mechanics of Lifting	278
Selection	287
Training	289
Work Design	301
Maximum Permissible Loads	306
 Chapter 16 Clinical Ergonomics	 320
Checklist: Thirty Ergonomic Questions	321
Back Schools	323
Ageing and Disability	324
 Epilogue: Macroergonomics	 329
References	331
Index	355

Foreword

It is a brave man who rises from the trenches of his own discipline and moves to occupy the high ground of an ally as they advance on the broad front of Knowledge.

As its title implies, this book is intended to place Ergonomics firmly in the clinical setting in which it is very much needed; it will stand with a regrettably small number of other texts as requisite reading for all in Occupational Health. It follows logically from the author's recent *Bodyspace*, itself a considerable help to occupational physicians.

As an examiner in the Associateship examination of the Faculty of Occupational Medicine, one of my most important, and rewarding, tasks is to read the journals of the candidates encompassing a four-week period of their working lives. It is encouraging to see ergonomic concepts and ideas increasingly featured; to see a recognition of ergonomic problems and a need to seek precisely the solutions this book is designed to offer.

The fact that patterns of work, not just "industry", have changed world-wide in the last few decades illustrates that we have substituted one set of ergonomic problems for another, no less intractable if not scientifically analysed; the computer instead of the blast furnace; the human errors of Chernobyl, Three Mile Island and Zeebrugge instead of mining disasters.

The whole gamut of the work environment is covered and the author does not evade the Byzantine problems of back pain, the Waterloo of so many aspiring authors.

Many who are invited to contribute a foreword must cry "Why me?" As I write, the travails of the Channel Tunnel construction appear in the press and on our TV screens weekly and the giant machines which grind their way towards each other in climactic consummation are awe-inspiring to behold. Years ago I told the author of the intense rivalry between mining machinery manufacturers in the Soviet Union and Western Europe. Nowhere was this more intense than in tunnelling, where vast prototypes were claimed to advance through strata at a rate undreamt of. The acme was reached by one company, the last word, and duly demonstrated. Unfortunately the sole operator was positioned at the front of the machine and disappeared into the tunnel in a cloud of noise and dust. No, he did NOT turn up in Australia and, YES, the design was radically modified. The upshot was the development of a team of ergonomists who cast a critical eye over all prototypes offered to the British mining industry. The resultant modifications and improvements had much to do with the fact that the British coalmining industry has the

best safety record in the world, not due solely to good ergonomics, but in which our discipline has paid a vital part.

The moral is, never tell your best stories to your best friends in case you are asked to write a foreword. But bear this story in mind as you read this book. . . .

Dr Roy Archibald
October, 1990

Acknowledgements

Many of the ideas which go into a book like this surface for the first time in conversation with friends and colleagues—in ways which do not necessarily lend themselves to the normal conventions of academic citation. I have discussed the central topics of this book, at length and over the years, with David Stubbs, Peter Buckle and their colleagues at the Robens Institute—to the extent that we have probably all long since forgotten who said what first. I am particularly indebted to Sheila Lee for introducing me to the fascinating world of osteopathy. Anne-Marie Potts, Jackie Nicholls and Fiona Turner have also given me the benefits of their clinical knowledge; and conversations with John Long have helped me tighten up the nuts and bolts of my conceptual frameworks. The story of the chemical plant, with which I commence this book, was told to me originally by Mike Gray of the HSE. To all these people and to anybody else I have unconsciously plagiarized I extend my thanks.

Thanks are also due to David Sanchez and Andrew Pinder, who helped with the illustrations, and Pamela Dale, who patiently typed my endless revisions of the manuscript; and to my “other publishers”, Taylor and Francis Ltd, for generously allowing me to reproduce so many illustrations from *Bodyspace* (1986).