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978-0-521-11267-3 - Machina Carnis: The Biochemistry of Muscular Contraction in its
Historical Development

Dorothy M. Needham

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MACHINA CARNIS

THE BIOCHEMISTRY OF
MUSCULAR CONTRACTION
IN ITS HISTORICAL
DEVELOPMENT

by

DOROTHY M. NEEDHAM

F.R.S.

*Fellow Emeritus of Lucy Cavendish
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Fig. 85 is reproduced by courtesy of H. Fernández-Morán, The University of Chicago

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MEMORIAE
FREDERICI GOWLAND HOPKINS
PRAECEPTORIS OLIM ET AMICI
CONIVGI QVOQVE
IOSEPHO NEEDHAM
FAVTORI MONITORI ADIVTORI
PER ANNOS COMPLVRES
CONSTANTISSIMO
QVO SINE NIL PROFECISSET
HOC PIETATIS PIGNVS
D·M·N

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Corporis membra in unam machinam ad usas vitales
aptantur.

Asclepius, 27 (ca. 1st. cent. AD) in *Corpus Hermeticum*, II, p. 333

Iam vero quattuor elementorum diversitates contrari-
asque potentias nisi quaedam armonia coniungeret, qui
fieri potest, ut in unum corpus ac machinam conveni-
rent?

Boethius (d. AD 524), *De Institutione Musica*, I, 1

Partibus his constat humanae machina carnis,
sed multipliciter quae numerentur habes:
portio prima caput, collus ac brachia, truncus,
intera, sensus iners, femora, crura, pedes.

Eugenius of Toledo (d. AD 657), *Carmen XLIII*

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PREFACE

Looking back on the years spent in writing this book, I feel sometimes that it was done primarily for my own enjoyment. I wanted to visualise in a single perspective the path of man's knowledge about the function of muscles, progressing so slowly for so many centuries but then during the last seventy years reaching speedily towards the goal in a rush of great discoveries. Professor A. V. Hill, whose fundamental work constantly appears in these pages, tells me that he never took theories of contraction seriously; but perhaps he would not disagree with Dr William Croone who in the seventeenth century reckoned 'such speculations amongst the best entertainments of our mind'. Be this as it may, I hope that, in spite of its defects and omissions, this book will be useful to some of those for whom the fearful and wonderful phenomena of muscular movement retain all their fascination. We can respond to the words of Sir Thomas Browne (*Religio Medici* I. 13):

Search while thou wilt, and let thy Reason go,
To ransom Truth, even to th'Abyss below;
Rally the scattered Causes; and that line
Which Nature twists, be able to untwine...

DOROTHY M. NEEDHAM

*The Master's Lodge
Gonville and Caius College
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I must express my gratitude to the trustees of the Leverhulme Foundation for an award made in 1963 towards the expenses of preparing this book.

Warm thanks are also due to Miss Margaret Webb and Mrs Diana Brodie for their most expert secretarial assistance.

Finally, I should like to place on record the inspiration that I derived from working in the Cambridge Biochemical Laboratory from 1919 to 1963.

D.M.N.

ABBREVIATIONS

ADP	Adenosine-5-diphosphate	GTP	Guanosine-5-triphosphate
AMP	Adenosine-5-mono-phosphate	HMM	Heavy meromyosin
ATP	Adenosine-5-triphosphate	IAA	Iodoacetic acid
CTP	Cytidine-5-triphosphate	IANH ₂	Iodoacetamide
CoA	Co-enzyme A	IDP	Inosine-5-diphosphate
Co-Q	Co-enzyme Q	IMP	Inosine-5-monophosphate
DEAE-cellulose	Diethylamino-ethyl-cellulose	ITP	Inosine-5-triphosphate
DNA	Deoxyribonucleic acid	LMM	Light meromyosin
DSEM	Disulphide-exchanged myosin	NAD	Nicotinamide-adenine dinucleotide (cozymase)
EDTA	Ethylenediaminetetracetate	NADP	Nicotinamide-adenine dinucleotide phosphate
EGTA	Ethyleneglycol-bis-β-amino-ethylether- <i>N,N'</i> -tetracetate	NEM	<i>N</i> -ethylmaleimide
ESF	EGTA sensitising factor	NTP	<i>p</i> -nitrothiophenol
FAD	Flavin-adenine dinucleotide	PCMB	<i>p</i> -chlormercuribenzoate
FDNB	1-fluoro-2,4-dinitrobenzene	Q, Q ₂₇₅ , CoQ	Co-enzyme Q
FeNH	Non-haem iron	RNA	Ribonucleic acid
flpr	flavoprotein	RPS	Relaxing protein system
FMN	Flavin mononucleotide	TNP	Trinitrophenol
		TPP	Thiamine-pyrophosphate
		UDP	Uridine-5-diphosphate
		UDPG	Uridine diphosphate glucose
		UTP	Uridine-5-triphosphate

NOTE. All units of temperature in the text are °C