Introduction to Virology

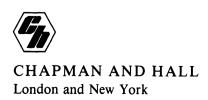
Introduction to Virology

K. M. SMITH C.B.E., D.Sc., Ph.D., F.R.S.

Formerly Director, Virus Research Unit, Agricultural Council, Cambridge

Chapter 9, The replication of viruses and Chapter 10, Virus genetics contributed by D.A. RITCHIE Ph.D.

Professor of Genetics, University of Liverpool



First published 1980 by Chapman and Hall Ltd 11 New Fetter Lane, London EC4P 4EE

Published in the USA by Chapman and Hall in association with Methuen. Inc. 733 Third Avenue. New York NY 10017

© 1980 K.M. Smith and D.A. Ritchie

Photoset in English Times by Red Lion Setters, London and printed in Great Britain by J.W. Arrowsmith Ltd., Bristol

This title is available in both hardbound and paperback editions. The paperback edition 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 of 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.

All rights reserved. No part of this book may be reprinted, or reproduced or utilized in any form or by any electronic, mechanical or other means, now known or hereafter invented, including photocopying and recording, or in any information storage and retrieval system, without permission in writing from the Publisher.

British Library Cataloguing in Publication Data

Smith, Kenneth Manley

Introduction to virology.

1. Virus diseases

I. Title II. Ritchie, Donald Andrew

616.01'94 RC114.5 79-41116

ISBN-13: 978-0-412-21970-2 e-ISBN-13: 978-94-009-5876-0

DOI: 10.1007/ 978-94-009-5876-0

Contents

Pref	Preface	
1.	Introduction	1
1.1	Virus characteristics	3
1.2	Some virus definitions	3
2.	Some representative viruses – size, morphology, ultrastructure	_
	and replication	5
	Size	5
	Morphology	6
	Ultrastructure	10
2.4	Replication	32
3.	Purification of viruses	38
3.1	Plant viruses	39
3.2	Insect viruses	42
3.3	Viruses affecting the higher animals	44
4.	Classification and nomenclature	46
4.1	Introduction	46
4.2	Viruses of invertebrates	50
4.3	Viruses of bacteria	53
5.	Some virus diseases in man and other animals	54
5.1	Man and the higher animals	54
5.2	Insects and other invertebrates	64
6.	Some virus diseases in plants and micro-organisms	73
	Plants	73
	6.1.1 The higher plants	73
	6.1.2 Fungi	80
6.2	Micro-organisms	83
0.2	6.2.1 Protozoal viruses	83
	6.2.2 Algal viruses	83

vi Introduction to Virology

6.2.3 Bacterial viruses, bacteriophages, phages	85
6.2.4 Mycoplasma viruses	87
6.2.5 Spiroplasma viruses	88
7. The spread of viruses from host to host	89
7.1 Methods of virus dissemination	89
7.1.1 Higher animals	89
7.1.2 Insects	90
7.1.3 Plants	91
7.2 Viruses and vectors	93
7.2.1 Plant viruses	93
7.2.2 Animal viruses	98
8. Latency, satellite and incomplete	
viruses, viroids and virus-like particles	104
8.1 Latency	104
8.2 Satellite viruses and incomplete viruses	109
8.3 Viroids	111
8.4 Virus-like particles	112
9. The replication of viruses	115
9.1 The virus-host relationship	115
9.2 Adsorption and entry	116
9.3 The eclipse	117
9.3.1 Transcription of virus genomes	118
9.3.2 Translation of virus DNA	118
9.3.3 Regulation of gene expression	119
9.3.4 Replication of virus genomes	119
9.4 Maturation	120
9.5 Release of progeny virus	121
9.6 Replication of bacterial viruses	121
9.6.1 Single-stranded DNA phages	121
9.6.2 Double-stranded DNA phages	124
9.6.3 RNA phages	129
9.6.4 Lysogeny	130
9.7 Replication of animal viruses	132
9.7.1 DNA animal viruses	132
9.7.2 RNA animal viruses	137
9.7.3 DNA-RNA animal viruses	140
9.8 Replication of plant viruses	141
10. Virus genetics	143
10.1 The role of genetics in virology	143

		Contents	vii
10.2	Variation among viruses	143	
	Genetic analysis of viral functions	146	
	10.3.1 Complementation analysis	146	
	10.3.2 Biochemical characterization of mutants	147	
10.4	Recombination and mapping virus genomes	149	
	10.4.1 Recombination	149	
	10.4.2 Mapping virus genomes	152	
11.	Tumour viruses	157	
12.	Tissue and cell culture of viruses	170	
12.1	Plant viruses	171	
	12.1.1 Protoplast culture of plant viruses	173	
12.2	Animal viruses	173	
13.	Virus assay	180	
13.1	Plaque assay	180	
13.2	Plant virus assay	181	
	13.2.1 Serological methods of plant virus assay	181	
	Counting virus particles	183	
13.4	Mixed virus infections	184	
14.	Control of virus diseases	188	
14.1	Animal viruses	188	
	14.1.1 Avoiding infection	188	
	14.1.2 Immunization procedures	189	
	14.1.3 Chemotherapy	190	
14.2	Plant viruses	191	
14.3	Viruses as agents of biological control	193	
References		197	
Subi	ect index	208	

Preface

The study of viruses, or virology as it is now called, had its origin in 1892 when a Russian botanist, Iwanawsky, showed that sap from a tobacco plant with an infectious disease was still highly infectious after passage through a filter capable of retaining bacterial cells. From such humble beginnings the study of these 'filter-passing agents', or viruses, has developed into a separate science which rivals, if it does not excel, in importance the whole of bacteriology.

The importance of viruses lies not only in the diseases they cause in every type of living organism, but also because of their intimate relationship with the living cell, in which alone they can reproduce. Their study has influenced the whole of biology by greatly increasing our knowledge of the gene, genetics, and molecular structure; there is also the possible connexion of viruses with human cancer, in view of the occurrence of many viral cancers in other animals.

The book attempts to give a comprehensive but necessarily superficial survey of the subject as a whole and should help senior undergraduates and postgraduate students who wish to gain some knowledge of virology. Further information is available from the extensive bibliography.

Grateful acknowledgement is due to Council of the Royal Society from one of us (K.M.S.) for a grant of money towards the expenses of writing this book. We are also indebted to many friends and collagues who lent us photographic prints or sent us reprints; the names of these authors are given under each borrowed illustration.

Acknowledgement is also due to the publishers Chapman and Hall and the Longman Group for permission to reproduce certain passages and illustrations from previous writings.

Kenneth M. Smith Donald A. Ritchie