THE CELL NUCLEUS

Chairman
Professor J. S. MITCHELL, F.R.S.

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Proceedings of an informal meeting
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PREFACE

SINCE the foundations of cytology were laid in 1838–9 by Schleiden and Schwann, the dominant role of the nucleus over cell functions has been the subject of continued investigation. The organization of this meeting and the publication of this book indicate that at the present time there is still an urgent need to obtain information about the nucleus of the living cell.

The main topics of discussion in this book may be summarized as dealing with the molecular architecture and the biochemistry of the nucleus without immediate concern for practical applications. This meeting demonstrates the value of the collaboration of workers in a wide range of scientific disciplines as a necessity for progress in a very difficult field of scientific enquiry. It is clear that a great deal has been learnt about the cell nucleus during the last few years and that there is still much more to be discovered. This book appears to me to be a useful contribution to knowledge and I hope it will prove of value to workers in most branches of biology and medicine.

This meeting and this book owe their inception and their success largely to Dr. Barbara Holmes and I wish to take this opportunity of thanking her. Finally, I wish to express my grateful thanks—and I am sure I can speak on behalf of all the participants—to the Faraday Society for their generous support and help which made this valuable and delightful meeting possible.

J. S. MITCHELL

Department of Radiotherapeutics
University of Cambridge
22nd February, 1960

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LIST OF ABBREVIATIONS

DNA	deoxyribonucleic acid
RNA	ribonucleic acid
DNase	deoxyribonuclease
RNase	ribonuclease
DNprotein	deoxyribonucleoprotein
RNprotein	ribonucleoprotein
ATP	adenosine-5′-triphosphate
GTP	guanosine-5′-triphosphate
CTP	cytidine-5′-triphosphate
UTP	uridine-5′-triphosphate
AMP, GMP, CMP, UMP	corresponding monophosphates
ADP, GDP, CDP, UDP	corresponding diphosphates
dATP, dAMP, dUMP, *etc.*	corresponding deoxy- compounds
TTP, TMP, TDP	(deoxy)thymidine tri-, mono- and diphosphates
ITP	inosine-5′-triphosphate
ATPase	adenosine triphosphatase
Tris.	tris(hydroxymethyl)aminomethane
PRPP	5′-phosphoribosyl pyrophosphate
DPN	diphosphopyridine nucleotide
BAL	British Anti-Lewisite (2,3-dimercaptopropanol)
P	phosphate
A, G, C, U	adenosine, guanosine, cytidine, uridine
dA, dG, dC, dU	corresponding deoxy- compounds
T	(deoxy)thymidine
R	ribose
PP	pyrophosphate
aa	amino acid
^{3}H-thymidine	tritiated thymidine
^{3}H-cytidine	tritiated cytidine
PCA	perchloric acid

SESSION 1

FUNCTIONS OF THE NUCLEOLUS

Chairman:

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1.1

THE ULTRASTRUCTURE OF THE MAMMALIAN NUCLEOLUS

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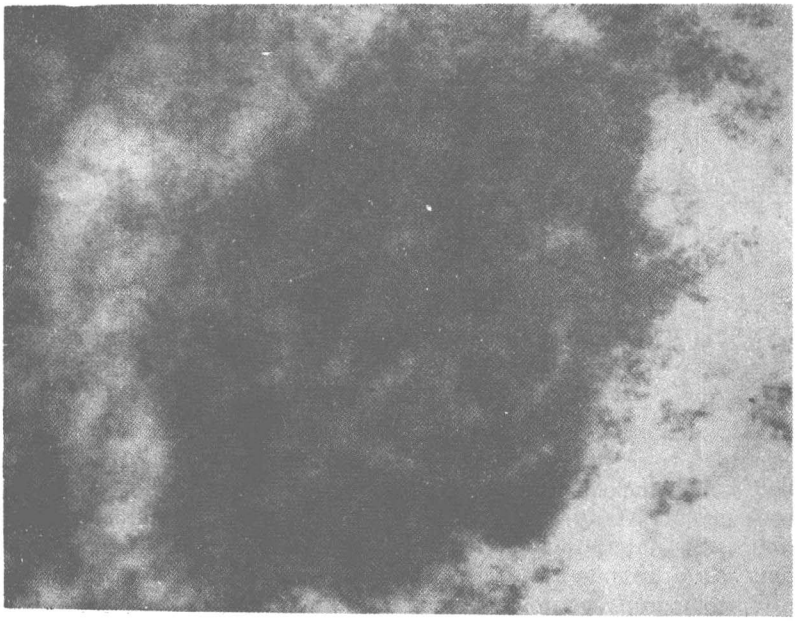
The nucleolus appears as a structureless body when studied with ordinary light microscope stains, but special techniques, for example those developed by Estable[1], were able to show that it was composed of a central filamentous network, the nucleolemma, surrounded by amorphous material called the pars amorpha. Many workers have shown that the nucleolus is formed from chromosome material after telophase, and Estable claimed that the nucleolemma fibres became attached to the chromosomes with the dissolution of the nucleolus in prophase, and could be followed throughout the mitosis.

Electron microscope work has confirmed the existence of the nucleolemma and pars amorpha in many tissues, and the nucleolemma fibres have been shown to have a compound structure. Early work on the ultrastructure of the nucleolus was limited by the resolution available with methacrylate embedding media, but recently the introduction of Araldite for embedding tissues has allowed improved resolution. This medium has been used in a study of nucleolar structure in normal and regenerating rat liver.

OBSERVATIONS

In rat liver a variety of nucleolar structures are found that appear to fit into a neat series. Although it is admittedly dangerous to place isolated pictures in such a series, it is the only way in which one can hope to obtain any idea of a sequence of events at the level of the electron microscope, and for this reason the structures will be described in what appears to be a logical order. The simplest type of nucleolus that is found consists solely of a conglomeration of fibrous bundles (*Figure 1*). In what seems likely to be a later stage, the most central bundles retain their integrity, while those nearer the periphery undergo dissociation to form an irregular mass of fibres (*Figure 2*). In most nucleoli the most peripheral bundles do not undergo dissociation, and form a neat coating around the more central regions. The central dissociation appears to spread (*Figures 3, 4, 5*) until the nucleolus consists of a structureless fibrous central region, surrounded by a densely staining fibrous coating (*Figure 6*). (This last condition is quite rare in rat liver.) The diameter of the fibrous bundles is approximately 1000 to 2000 Å. They are seen to be formed of fibres 60 to 80 Å in diameter which stain densely with phosphotungstic acid, and which are surrounded by an amorphous material that stains



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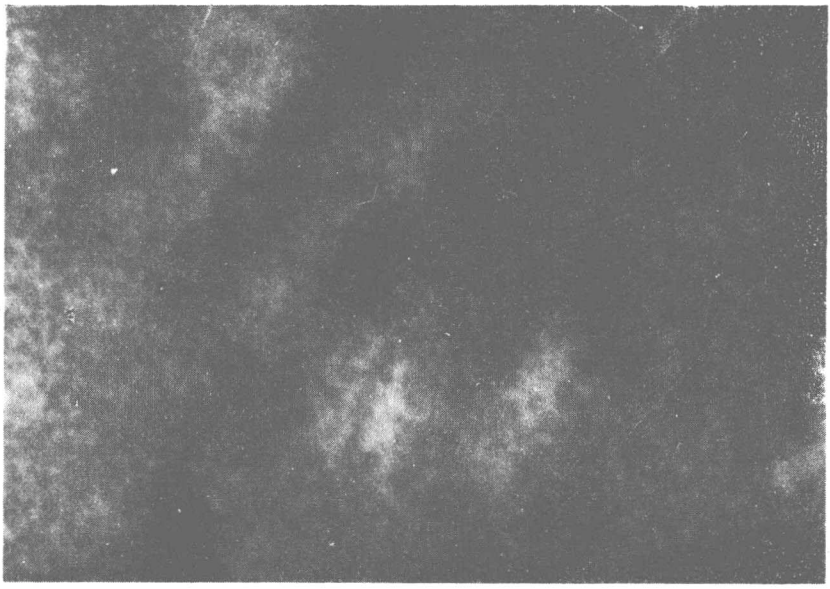

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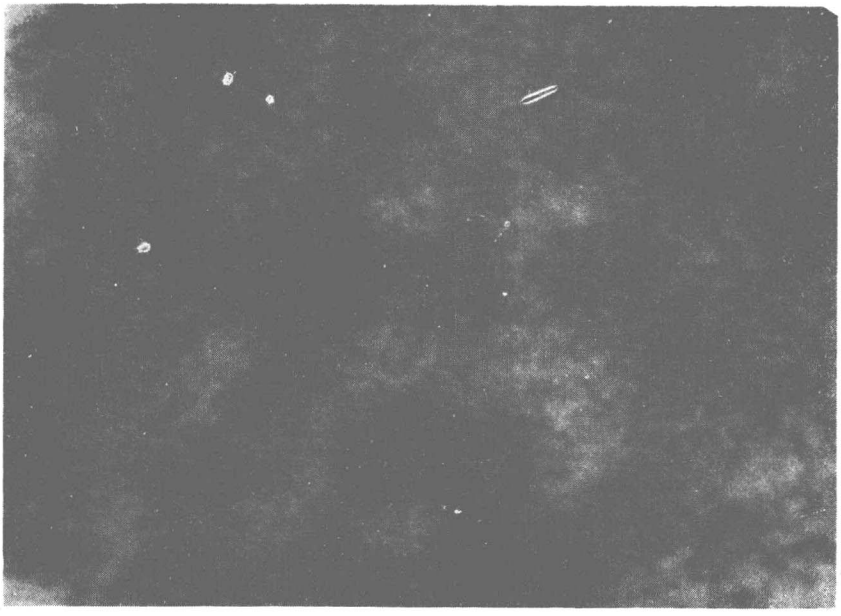

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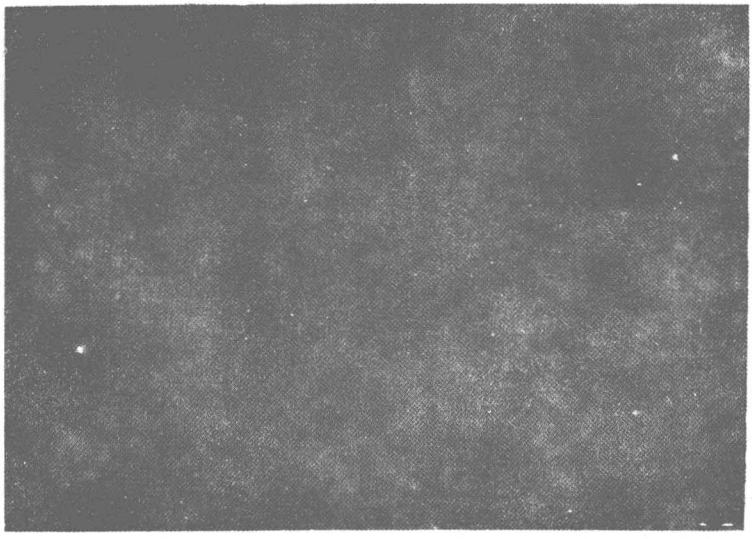

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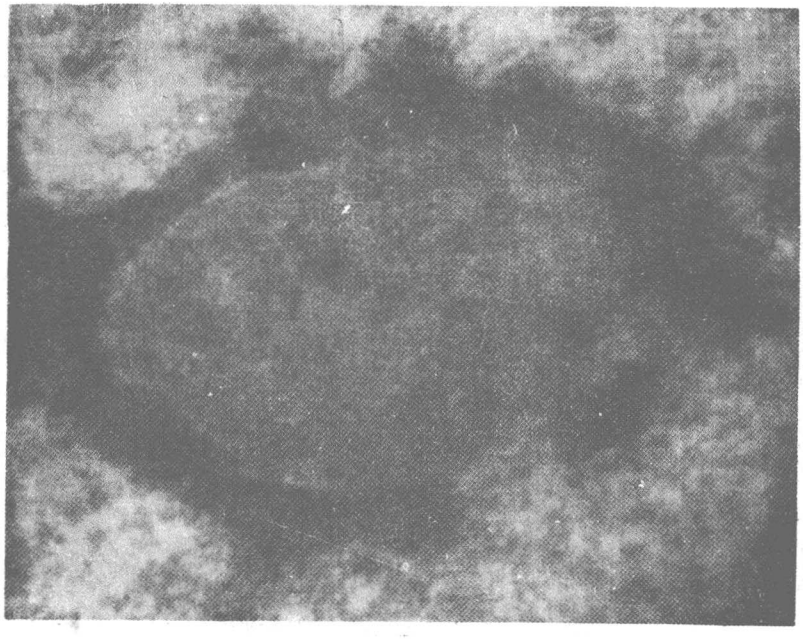

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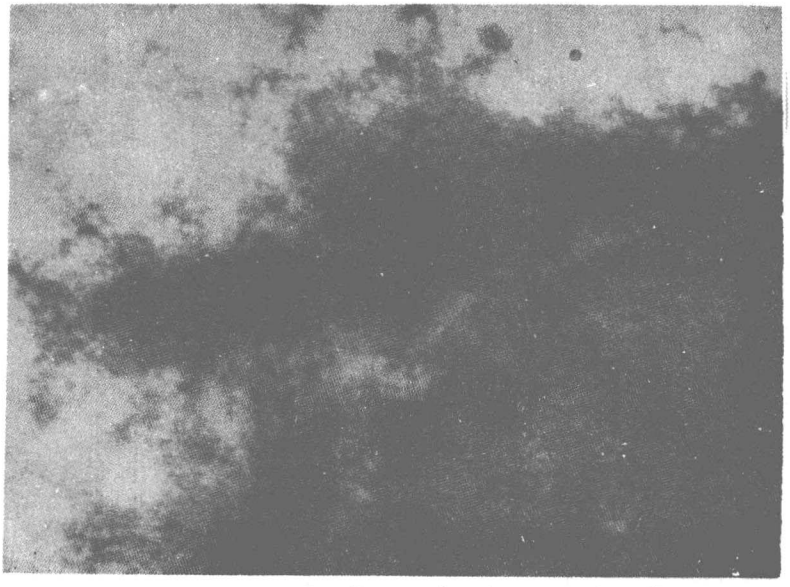
Figure 7. × 290 000 (reduced 9/20 when reproduced)



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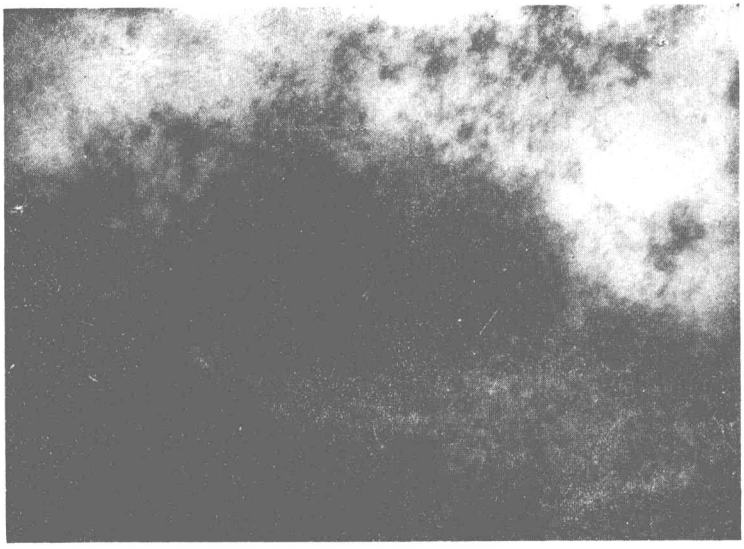

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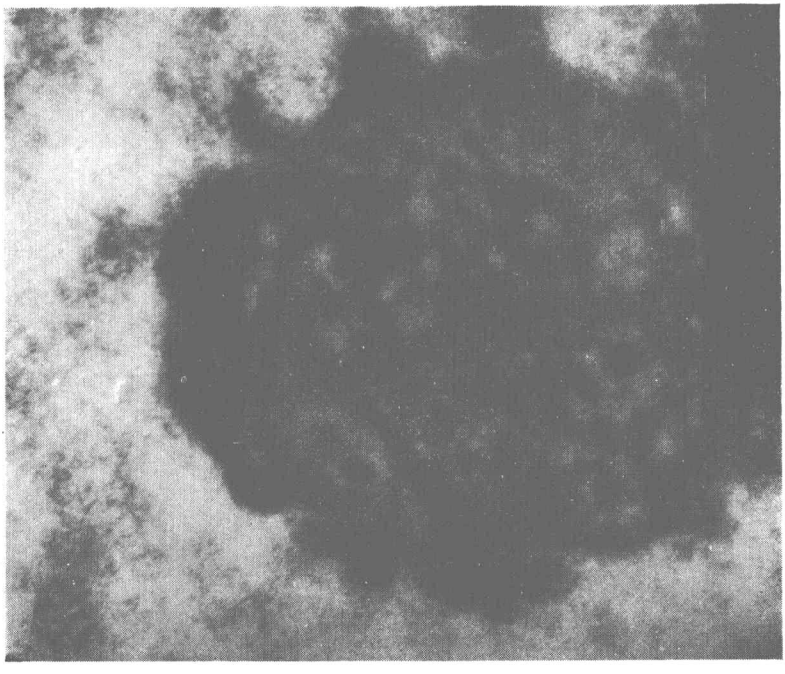

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