

Ari van Tienhoven

Reproductive Physiology of Vertebrates

Second Edition

Reproductive Physiology of Vertebrates

Reproductive

SECOND EDITION

COMSTOCK PUBLISHING ASSOCIATES, a division of

Physiology of Vertebrates

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CORNELL UNIVERSITY PRESS Ithaca and London
USA.

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First published 1983 by Cornell University Press.
Published in the United Kingdom by Cornell University Press Ltd.,
Ely House, 37 Dover Street, London W1X 4HQ.

International Standard Book Number 0-8014-1281-1
Library of Congress Catalog Card Number 82-71595

Printed in the United States of America

*Librarians: Library of Congress cataloging information appears
on the last page of the book.*

*The paper in this book is acid-free and meets the guidelines
for permanence and durability of the Committee on Production
Guidelines for Book Longevity of the Council on Library Resources.*

To Ans

Je m'excuserais d'abord d'écrire cette préface,
si déjà je n'écrivais cette préface pour
m'excuser d'avoir écrit la pièce:

—André Gide, *Préface du Théâtre*

Preface

The second edition of this book, like the first, is based on lectures given in a course on reproductive physiology of vertebrates. It was originally written to fill the need for a textbook that compared the reproductive physiology of different classes of vertebrates, from cyclostomes to humans, and it continues to serve that purpose. It is intended both as a textbook for advanced students familiar with concepts of neuroendocrinology and reproductive physiology, and as a reference book for researchers.

About ten years after the first edition was published, two of my colleagues, Dr. Neena B. Schwartz and Dr. Terry G. Baker, stated that they wished a newer edition were available. Their encouragement led me to undertake the writing of this second edition, in which I incorporated much of the new information about hormonal fluctuations gained through radioimmunoassay techniques. I rearranged the chapters so that Chapter 1, "Sex and Its Determination," is now followed by a chapter on sexual development through the prenatal period. A chapter on intersexes is included because of its importance, especially in teleost fishes. A new chapter, "Puberty," precedes "Anatomy of the Reproductive System." The chapters on the physiology of the testis and the ovary lay the foundation for the understanding

of the reproductive cycles. The chapter on insemination and fertilization, followed by those on care of the embryo and fetus and the expulsion of the oocyte, embryo, or fetus, give a chronological and logical sequence of events. Chapter 12, "Reproduction and Immunology," and especially Chapters 13 and 14, "Endocrinology of Reproductive Behavior" and "Environment and Reproduction," integrate the information given in previous chapters.

In the revision, the chapters "The Nongonadal Endocrine Glands," "The Hypothalamus," and "Effects of Nutrition on Reproduction" are omitted, partly because the readers of this book are assumed to be familiar with the neuroendocrinology of reproduction and partly because the information is incorporated in other chapters to provide a better and more logical sequence. The choice of topics and their treatment reflect the bias of my education and interests. The reader will find little in the present edition about the biochemical or molecular biological aspects of reproductive physiology.

Even in a much-studied species such as the laboratory rat, much basic information is lacking, and information about nonlaboratory animals is often fragmentary. I hope that in bringing some diverse information together I will encourage oth-

ers to do some much-needed research and provide the context that will aid in the interpretation of this information.

It is a pleasure to acknowledge the help and cooperation of many people. First and foremost I thank my wife, Ans, for her continuous confidence, her patience, and her contributions in prodding me to rewrite and rethink. She also proofread the final version of the manuscript and the page proofs. Thanks are due to Dr. Neena B. Schwartz and Dr. Terry G. Baker for their encouragement to rewrite this book. The typists of the Department of Poultry and Avian Sciences at Cornell University, Olympia McFall, Mary Ellen McParland, Theresa Rinkcas, Barbara Smagner, Diane Wittner, and Helen DeGraf were most helpful and patient; Teresa Ferrara retyped the entire final version of the manuscript. The personnel of Cornell University's Mann Library Reference and Loan departments have given frequent and valuable help and were always willing to go an extra mile.

My friend, critic, and delightful devil's advocate, Dr. Howard E. Evans, has contributed in

many more ways than he knows to this book, and I will always be in debt for many kindnesses he has extended to me.

The editor of the manuscript, Antoinette M. Wilkinson, deserves a special acknowledgment of my gratitude for her many questions, for her patient explanations, and for ignoring my sometimes caustic comments; she has improved the book substantially. I am also indebted to Allison Dodge of Cornell University Press for her patience and for letting me argue my case.

I gratefully acknowledge authors and publishers who gave their permission to use tables, graphs, and figures from their publications. In these tables and legends small changes made by me are placed in brackets.

Last but not least, I thank Cornell University and the head of my department, Robert Baker, for letting me write without questioning or interfering.

ARI VAN TIENHOVEN

Ithaca, New York

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Abbreviations

The following abbreviations have been used in the text of this book. Abbreviations used in tables and figures are given in their legends.

ABP	Androgen-binding protein	DNA	Deoxyribonucleic acid
A-Ca	Activator calcium	E ₁	Estrone
ACTH	Adrenocorticotrophic hormone	E ₂	Estradiol
ADP	Androstenediol propionate	E ₃	Estriol
AFP	Alpha feto-protein	EB	Estradiol benzoate
AH	Anterior hypothalamus	FGP	First growth phase
AH-POA	Anterior hypothalamic preoptic area	FM	Fluoxymesterone
AP	Anterior pituitary	FMP _s	Forward-mobility protein
AP	Hypophysectomy	FSH	Follicle-stimulating hormone
ATD	1,4,6-androstradien-3,17-dione	FTP	6 α -fluoro-testosterone propionate
ATP	Adenosinetriphosphate	GSI	Gonadosomatic index
AVT	Arginine vasotocin	GTH	Gonadotrophic hormone
CA ²⁺	Calcium ion	GVBD	Germinal vesicle breakdown
cAMP	Cyclic 3',5'-adenosine monophosphate	h	Hour
°C	Degrees Celsius	hCG	Human chorionic gonadotrophic hormone
C	Corticosterone	HPL	Human placental lactogen
CG	Chorionic gonadotrophin	3 β -HSD	3 β -hydroxysteroid dehydrogenase
CL	Corpus luteum or corpora lutea	HVc	Hyperstriatum ventralis
COMT	Catechol-O-methyl-transferase	I	Iodine
d	Days	IC	Infundibular complex
DAS	Delayed anovulatory syndrome	ICo	Nucleus intercollicularis
DD	Continuous darkness	irLH	Immunoreactive LH
DES	Diethylstilbestrol	K ⁺	Potassium ion
DF	Decapacitation factor	kHz	Kilohertz
DHA	Dehydroepiandrosterone	L:D	Light:dark, e.g., 12L:12D = 12 hours light:12 hours dark
DHT	Dihydrotestosterone		
DHTP	Dihydrotestosterone propionate		

LDH	Lactate dehydrogenase	PG	Prostaglandin
LH	Luteinizing hormone	PGC	Primordial germ cell
LH-RH	Luteinizing hormone-releasing hormone	PGE	Prostaglandin E
LL	Continuous light	PGF	Prostaglandin F
LQ	Lordosis quotient	PGH ₂	Prostaglandin H ₂
lx	Lux	PGI ₂	Prostaglandin I ₂ = Prostacyclin
MAN	Magnocellular nucleus of the anterior neostriatum	PINX	Pinealectomized
6-MBOA	6-methoxy-benzoxazolinone	PMSG	Pregnant mare's serum gonadotrophin
MEE	Methoxyethynylestradiol	POA	Preoptic area of the brain
MPO	Medial preoptic area	PRL	Prolactin
MT	17 α -methyltestosterone	RA	Nucleus robustus archistriatalis
MUA	Multiunit activity	Rh	Rhesus factor
Na ⁺	Sodium ion	RIA	Radioimmunoassay
nXII	Nucleus of the hypoglossal nerve	RNA	Ribonucleic acid
nXXIts	Tracheosyringeal portion of the hypoglossal motor nucleus	SCA	Sperm-coating antigen
oFSH	Ovine follicle-stimulating hormone	SCGX	Superior cervical ganglionectomy
2-OH-E ₂	2 hydroxyestradiol	SCN	Suprachiasmatic nucleus
20 α -OHP	20 α -hydroxypregn-4-en-3-one (<i>also abbreviated</i> 20 α -ol)	SDH	Sorbitol dehydrogenase
OIH	Ovulation-inducing hormone	SGP	Second growth phase
oLH	Ovine luteinizing hormone	T	Testosterone
oPRL	Ovine prolactin	TC	Testosterone cypionate
P ₄	Progesterone	Tfm	Testicular feminization syndrome
pACTH	Porcine adrenocorticotrophic hormone	TP	Testosterone propionate
PFF	Porcine follicular fluid	TRH	Thyrotrophin-releasing hormone
		TSH	Thyrotrophin (thyroid-stimulating hormone)
		VMH	Ventromedial hypothalamus
		ZP	Zona pellucida