

**THE GROWTH OF BONE:  
OBSERVATIONS ON OSTEOGENESIS:  
AN EXPERIMENTAL INQUIRY INTO THE  
DEVELOPMENT AND REPRODUCTION  
OF DIAPHYSEAL BONE**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649213764

The growth of bone: observations on osteogenesis: an experimental inquiry into the development and reproduction of diaphyseal bone by William Macewen

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.  
Cover @ 2017

This book 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 or 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.

[www.triestepublishing.com](http://www.triestepublishing.com)

**WILLIAM MACEWEN**

**THE GROWTH OF BONE:  
OBSERVATIONS ON OSTEOGENESIS:  
AN EXPERIMENTAL INQUIRY INTO THE  
DEVELOPMENT AND REPRODUCTION  
OF DIAPHYSEAL BONE**



THE GROWTH OF BONE

PUBLISHED BY  
JAMES MACLEHOSE AND SONS, GLASGOW,  
Publishers to the University.

---

MACMILLAN AND CO., LTD., LONDON.  
*New York*, - - *The Macmillan Co.*  
*Toronto*, - - *The Macmillan Co. of Canada.*  
*London*, - - *Simpkin, Hamilton and Co.*  
*Cambridge*, - - *Bowes and Bowes.*  
*Edinburgh*, - - *Douglas and Foulis.*  
*Spincy*, - - *Angus and Robertson.*

---

MCMXII.

# THE GROWTH OF BONE

---

OBSERVATIONS ON OSTEOGENESIS

AN EXPERIMENTAL INQUIRY INTO THE DEVELOPMENT  
AND REPRODUCTION OF DIAPHYSEAL BONE

BY

WILLIAM MACEWEN, F.R.S.

GLASGOW  
JAMES MACLEHOSE AND SONS

PUBLISHERS TO THE UNIVERSITY

1912

## PREFACE.

THIS inquiry was undertaken to test by direct experiment problems connected with the growth of bone. It was necessary, as a firm belief exists that all periosteum produces bone,—such is the physiological teaching,—many believing that diaphyseal bone could not be produced without periosteum, and once produced would die were the periosteum removed. Some of the experiments most vital to the maintenance of this belief are here shown to be fallacious. Prior experience in human physiology had indicated that the periosteum was not osteogenic, but not so convincingly to the mind of others, as direct experiments have demonstrated. The evolution of the osteoblast, the exhibition of its independent vitality and proliferating power both within the diaphysis and without in the midst of the soft tissues have been here demonstrated. The great reproductive power of growing bones inherent in the diaphyseal extremities at their epiphyseal cartilages is shown in striking manner in many of the experiments. Without a full knowledge of this power the filling up of blanks in the shafts of growing bone might readily be attributed to the periosteum instead of to its true cause, the osteogenic potency of the growing shaft.

The experiments were conducted for the most part on the canine species of three varieties all in the developmental period.



Had the experiments here related been arranged chronologically the earlier ones would have been those which formed the basis of papers presented to the Royal Society, one of which is published in the *Philosophical Transactions*, Series B, Vol. 199, pp. 253-279; and they also constituted the fundamental part of the Banks Address on Surgery delivered in the University of Liverpool. The remainder of the direct experiments and observations appears now for the first time.

The author has gratefully to acknowledge the assistance of Mr. J. A. C. Macewen in the experimental work and in the revision of proofs: and the aid in carrying out the experiments received from Dr. Mort, late University Assistant, and Dr. Shaw, Research Scholar in the Surgical Department of the University. His indebtedness is also due to Sister Douglas for some of the illustrations, and to both her and Sister Saunders for help in photography.

GLASGOW,  
*December, 1911.*

## CONTENTS.

### CHAPTER I.

#### THE GENESIS OF THE OSTEOBLAST.

|  | PAGE |
|--|------|
| The Epiphyseal Cartilage, . . . . .  | 18   |
| Interstitial Growth of Bone, . . . . .   | 20   |
| The Periosteum, - - - - -  | 24   |
| The Behaviour of the Osteoblasts and the Production of Bone in<br>Acute Osteomyelitis, - - - - - | 26   |
| The Periosteum as a Limiting Membrane to the Osteoblasts, .                                      | 28   |
| The Epiphyses, - - - - -   | 30   |

### CHAPTER II.

#### HAS THE PERIOSTEUM INHERENT OSTEOGENIC POWER?

|  |    |
|--|----|
| Can a Periosteal Flap produce Bone while left still attached at one<br>end and encircling Muscle at the other? . . . . . | 38 |
| Can Heterotopic, Transplanted Periosteum produce Bone? . . . . .   | 47 |

### CHAPTER III.

#### OSTEOGENIC POWER OF BONE BEREFT OF PERIOSTEUM.

|  |    |
|--|----|
| The Periosteum as a Limiting Membrane to the Osteoblasts, .  | 49 |
| The Modifying Influence of Pressure on the Osteoblasts, . . .  | 50 |
| The Bone Cells in Normal Growing Bone control their own Increase<br>and Development apart from the Periosteum, - - - - - | 50 |

|  | PAGE |
|--|------|
| Is the production of Callus inherently greater in the lower Animals than in Man? - - - - -                                       | 54   |
| Subperiosteal Fracture in Man and Animals, - - - - -   | 54   |
| Can a Bone, deprived for the most part of its Periosteum, continue to grow? - - - - -  | 61   |
| The Periosteum removed from the entire circumference of the Diaphysis of the Right Radius, the Bone remaining <i>in situ</i> , - | 61   |
| Duhamel's Silver-Ring Experiment, . . . . .  | 62   |
| New Silver-Ring Experiments, . . . . .   | 65   |
| Second New Silver-Ring Experiment, - . . . .   | 66   |
| Third New Silver-Ring Experiment, - . . . .  | 70   |

## CHAPTER IV.

THE INHERENT REPRODUCTIVE POWER OF BONE  
MINUS THE PERIOSTEUM.

|  |     |
|--|-----|
| Bone Grafting—without Periosteum, - - - - -  | 76  |
| Transplantation of Bone—without Periosteum, <i>en masse</i> , - .  | 80  |
| Can Shavings of Nude Bone continue to grow after being placed between the Muscles, and can they unite together and form again the Continuity of the Shaft? - - - - - | 84  |
| Proliferation from Bone transplanted in form of Shavings, - .  | 84  |
| Grafting of Shavings of Nude Bone, - - - - -   | 88  |
| Heterotopic Transplantation of Bone, - . . . .   | 93  |
| Heterotopic Transplantation of Bone into Peritoneal Cavity, and also testing the value of Bone Dust as a Medium for Grafting,  | 94  |
| Bone growing in Sponge, - - - - -  | 98  |
| Bone growing in Glass Tube, - . . . .  | 102 |
| The Earliest Appearance of Bone Growth, - . . . .  | 109 |
| Osteoblasts carried by Blood Stream, - . . . .   | 116 |
| Osseous Wall formed from Osteoblasts distributed over the Sac of a False Aneurism, - . . . .   | 116 |
| Growth of Bone in Muscle, - . . . .  | 127 |
| Observations on growth of Bone in the Muscles, - . . . .   | 127 |
| Osteoblasts enveloping Muscular Fasciculi and Tendons, . . .   | 137 |
| Osseous Regeneration in Flat Bones, - . . . .  | 138 |
| Mosaic Work of Re-implanted Bone in Skull, - . . . .   | 138 |
| The Result of Human Re-implantation in one of the Flat Bones of the Skull—the Parietal—and evidence of Fresh Osseous Growth therefrom, - . . . .                     | 145 |