

Cambridge University Press
978-1-108-00360-5 - The Power of Movement in Plants
Charles Darwin
Frontmatter
[More information](#)

CAMBRIDGE LIBRARY COLLECTION

Books of enduring scholarly value

Darwin

Two hundred years after his birth and 150 years after the publication of 'On the Origin of Species', Charles Darwin and his theories are still the focus of worldwide attention. This series offers not only works by Darwin, but also the writings of his mentors in Cambridge and elsewhere, and a survey of the impassioned scientific, philosophical and theological debates sparked by his 'dangerous idea'.

The Power of Movement in Plants

Written in collaboration with his son Francis, a notable botanist, this 1880 book builds on Darwin's earlier investigations into climbing plants, orchids, insectivorous plants, flower variety, and the processes of fertilisation. This detailed study of many species from seed to mature plant further develops Darwin's work on adaptation and evolution, with the aim of collating the results of individual studies into common factors applicable to plants in general. Particular emphasis is given to analysis and investigation of the process here termed circumnutation, the movement of the stem of the plant in order to direct the head in certain directions. This is seen as of paramount importance, with the conclusion that it is modification of this feature that has enabled plants to adapt and evolve so diversely. The authors also note similarities between plants and animals, such as sensitivity to touch and habit of action at certain times, in this influential publication from late in Darwin's career.

Cambridge University Press
978-1-108-00360-5 - The Power of Movement in Plants
Charles Darwin
Frontmatter
[More information](#)

Cambridge University Press has long been a pioneer in the reissuing of out-of-print titles from its own backlist, producing digital reprints of books that are still sought after by scholars and students but could not be reprinted economically using traditional technology. The Cambridge Library Collection extends this activity to a wider range of books which are still of importance to researchers and professionals, either for the source material they contain, or as landmarks in the history of their academic discipline.

Drawing from the world-renowned collections in the Cambridge University Library, and guided by the advice of experts in each subject area, Cambridge University Press is using state-of-the-art scanning machines in its own Printing House to capture the content of each book selected for inclusion. The files are processed to give a consistently clear, crisp image, and the books finished to the high quality standard for which the Press is recognised around the world. The latest print-on-demand technology ensures that the books will remain available indefinitely, and that orders for single or multiple copies can quickly be supplied.

The Cambridge Library Collection will bring back to life books of enduring scholarly value across a wide range of disciplines in the humanities and social sciences and in science and technology.

Cambridge University Press

978-1-108-00360-5 - The Power of Movement in Plants

Charles Darwin

Frontmatter

[More information](#)

The Power of Movement in Plants

CHARLES DARWIN
EDITED BY FRANCIS DARWIN



Cambridge University Press
978-1-108-00360-5 - The Power of Movement in Plants
Charles Darwin
Frontmatter
[More information](#)

CAMBRIDGE UNIVERSITY PRESS

Cambridge New York Melbourne Madrid Cape Town Singapore São Paulo Delhi

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9781108003605

© in this compilation Cambridge University Press 2009

This edition first published 1880

This digitally printed version 2009

ISBN 978-1-108-00360-5

This book reproduces the text of the original edition. The content and language reflect the beliefs, practices and terminology of their time, and have not been updated.

Cambridge University Press
978-1-108-00360-5 - The Power of Movement in Plants
Charles Darwin
Frontmatter
[More information](#)

THE
POWER OF MOVEMENT
IN
PLANTS.

THE
POWER OF MOVEMENT
IN
PLANTS.

BY CHARLES DARWIN, LL.D., F.R.S.

ASSISTED BY

FRANCIS DARWIN.

WITH ILLUSTRATIONS.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1880.

The right of Translation is reserved.

Cambridge University Press

978-1-108-00360-5 - The Power of Movement in Plants

Charles Darwin

Frontmatter

[More information](#)

LONDON :

PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

CONTENTS.



INTRODUCTION Page 1-9

CHAPTER I.

THE CIRCUMNUTATING MOVEMENTS OF SEEDLING PLANTS.

Brassica oleracea, circumnutating of the radicle, of the arched hypocotyl whilst still buried beneath the ground, whilst rising above the ground and straightening itself, and when erect—Circumnutation of the cotyledons—Rate of movement—Analogous observations on various organs in species of *Githago*, *Gossypium*, *Oxalis*, *Tropæolum*, *Citrus*, *Æsculus*, of several Leguminous and Cucurbitaceous genera, *Opuntia*, *Helianthus*, *Primula*, *Cyclamen*, *Stapelia*, *Cerinthe*, *Nolana*, *Solanum*, *Beta*, *Ricinus*, *Quercus*, *Corylus*, *Pinus*, *Cycas*, *Canna*, *Allium*, *Asparagus*, *Phalaris*, *Zea*, *Avena*, *Nephrodium*, and *Selaginella* 10-66

CHAPTER II.

GENERAL CONSIDERATIONS ON THE MOVEMENTS AND GROWTH OF SEEDLING PLANTS.

Generality of the circumnutating movement—Radicles, their circumnutating of service—Manner in which they penetrate the ground—Manner in which hypocotyls and other organs break through the ground by being arched—Singular manner of germination in *Megarrhiza*, &c.—Abortion of cotyledons—Circumnutation of hypocotyls and epicotyls whilst still buried and arched—Their power of straightening themselves—Bursting of the seed-coats—Inherited effect of the arching process in hypo-

gean hypocotyls—Circumnutation of hypocotyls and epicotyls when erect—Circumnutation of cotyledons—Pulvini or joints of cotyledons, duration of their activity, rudimentary in *Oxalis corniculata*, their development—Sensitiveness of cotyledons to light and consequent disturbance of their periodic movements—Sensitiveness of cotyledons to contact Page 67–128

CHAPTER III.

SENSITIVENESS OF THE APEX OF THE RADICLE TO CONTACT AND TO OTHER IRRITANTS.

Manner in which radicles bend when they encounter an obstacle in the soil—*Vicia faba*, tips of radicles highly sensitive to contact and other irritants—Effects of too high a temperature—Power of discriminating between objects attached on opposite sides—Tips of secondary radicles sensitive—*Pisum*, tips of radicles sensitive—Effects of such sensitiveness in overcoming geotropism—Secondary radicles—*Phaseolus*, tips of radicles hardly sensitive to contact, but highly sensitive to caustic and to the removal of a slice—*Tropæolum*—*Gossypium*—*Cucurbita*—*Raphanus*—*Æsculus*, tip not sensitive to slight contact, highly sensitive to caustic—*Quercus*, tip highly sensitive to contact—Power of discrimination—*Zea*, tip highly sensitive, secondary radicles—Sensitiveness of radicles to moist air—Summary of chapter 129–200

CHAPTER IV.

THE CIRCUMNUTATING MOVEMENTS OF THE SEVERAL PARTS OF MATURE PLANTS.

Circumnutation of stems: concluding remarks on—Circumnutation of stolons: aid thus afforded in winding amongst the stems of surrounding plants—Circumnutation of flower-stems—Circumnutation of Dicotyledonous leaves—Singular oscillatory movement of leaves of *Dionæa*—Leaves of *Cannabis* sink at night—Leaves of *Gymnosperms*—Of *Monocotyledons*—*Cryptogams*—Concluding remarks on the circumnutation of leaves: generally rise in the evening and sink in the morning 201–262

CONTENTS.

vii

CHAPTER V.

MODIFIED CIRCUMNUTATION: CLIMBING PLANTS; EPINASTIC AND
 HYPONASTIC MOVEMENTS.

Circumnutation modified through innate causes or through the action of external conditions—Innate causes—Climbing plants; similarity of their movements with those of ordinary plants; increased amplitude; occasional points of difference—Epinastic growth of young leaves—Hyponastic growth of the hypocotyls and epicotyls of seedlings—Hooked tips of climbing and other plants due to modified circumnutation—*Ampelopsis tricuspidata*—*Smithia Pfundii*—Straightening of the tip due to hyponasty—Epinastic growth and circumnutation of the flower-peduncles of *Trifolium repens* and *Oxalis carnosa*.. .. Page 263–279

CHAPTER VI.

MODIFIED CIRCUMNUTATION: SLEEP OR NYCTITROPIC MOVEMENTS,
 THEIR USE: SLEEP OF COTYLEDONS.

Preliminary sketch of the sleep or nyctitropic movements of leaves—Presence of pulvini—The lessening of radiation the final cause of nyctitropic movements—Manner of trying experiments on leaves of *Oxalis*, *Arachis*, *Cassia*, *Melilotus*, *Lotus* and *Marsilea*, and on the cotyledons of *Mimosa*—Concluding remarks on radiation from leaves—Small differences in the conditions make a great difference in the result—Description of the nyctitropic position and movements of the cotyledons of various plants—List of species—Concluding remarks—Independence of the nyctitropic movements of the leaves and cotyledons of the same species—Reasons for believing that the movements have been acquired for a special purpose 280–316

CHAPTER VII.

MODIFIED CIRCUMNUTATION: NYCTITROPIC OR SLEEP MOVEMENTS
 OF LEAVES.

Conditions necessary for these movements—List of Genera and Families, which include sleeping plants—Description of the movements in the several Genera—*Oxalis*: leaflets folded at

night—*Averrhoa*: rapid movements of the leaflets—*Porlieria*: leaflets close when plant kept very dry—*Tropæolum*: leaves do not sleep unless well illuminated during day—*Lupinus*: various modes of sleeping—*Melilotus*: singular movements of terminal leaflet—*Trifolium*—*Desmodium*: rudimentary lateral leaflets, movements of, not developed on young plants, state of their pulvini—*Cassia*: complex movements of the leaflets—*Bauhinia*: leaves folded at night—*Mimosa pudica*: compounded movements of leaves, effect of darkness—*Mimosa albida*, reduced leaflets of—*Schrankia*: downward movement of the pinnae—*Marsilea*: the only cryptogam known to sleep—Concluding remarks and summary—*Nyctitropism* consists of modified circumnutation, regulated by the alternations of light and darkness—Shape of first true leaves: Page 317-417

CHAPTER VIII.

MODIFIED CIRCUMNUTATION: MOVEMENTS EXCITED BY LIGHT.

Distinction between heliotropism and the effects of light on the periodicity of the movements of leaves—Heliotropic movements of *Beta*, *Solanum*, *Zea*, and *Avena*—Heliotropic movements towards an obscure light in *Apios*, *Brassica*, *Phalaris*, *Tropæolum*, and *Cassia*—Apheliotropic movements of tendrils of *Bignonia*—Of flower-peduncles of *Cyclamen*—Burying of the pods—Heliotropism and apheliotropism modified forms of circumnutation—Steps by which one movement is converted into the other—Transversal-heliotropism or diaheliotropism influenced by epinasty, the weight of the part and apogeotropism—Apogeotropism overcome during the middle of the day by diaheliotropism—Effects of the weight of the blades of cotyledons—So-called diurnal sleep—Chlorophyll injured by intense light—Movements to avoid intense light.. .. . 418-448

CHAPTER IX.

SENSITIVENESS OF PLANTS TO LIGHT: ITS TRANSMITTED EFFECTS.

Uses of heliotropism—Insectivorous and climbing plants not heliotropic—Same organ heliotropic at one age and not at another—Extraordinary sensitiveness of some plants to light—The effects

CONTENTS.

ix

of light do not correspond with its intensity—Effects of previous illumination—Time required for the action of light—After-effects of light—Apogeotropism acts as soon as light fails—Accuracy with which plants bend to the light—This dependent on the illumination of one whole side of the part—Localised sensitiveness to light and its transmitted effects—Cotyledons of *Phalaris*, manner of bending—Results of the exclusion of light from their tips—Effects transmitted beneath the surface of the ground—Lateral illumination of the tip determines the direction of the curvature of the base—Cotyledons of *Avena*, curvature of basal part due to the illumination of upper part—Similar results with the hypocotyls of *Brassica* and *Beta*—Radicles of *Sinapis* apheliotropic, due to the sensitiveness of their tips—Concluding remarks and summary of chapter—Means by which circumnutation has been converted into heliotropism or apheliotropism Page 449–492

CHAPTER X.

MODIFIED CIRCUMNUTATION : MOVEMENTS EXCITED BY
 GRAVITATION.

Means of observation—Apogeotropism—*Cytisus*—*Verbena*—*Beta*—Gradual conversion of the movement of circumnutation into apogeotropism in *Rubus*, *Lilium*, *Phalaris*, *Avena*, and *Brassica*—Apogeotropism retarded by heliotropism—Effected by the aid of joints or pulvini—Movements of flower-peduncles of *Oxalis*—General remarks on apogeotropism—Geotropism—Movements of radicles—Burying of seed-capsules—Use of process—*Trifolium subterraneum*—*Arachis*—*Amphicarpæa*—Diageotropism—Conclusion 493–522

CHAPTER XI.

LOCALISED SENSITIVENESS TO GRAVITATION, AND ITS TRANSMITTED
 EFFECTS.

General considerations—*Vicia faba*, effects of amputating the tips of the radicles—Regeneration of the tips—Effects of a short exposure of the tips to geotropic action and their subsequent amputation—Effects of amputating the tips obliquely—Effects of cauterising the tips—Effects of grease on the tips—*Pisum*

b

sativum, tips of radicles cauterised transversely, and on their upper and lower sides—Phaseolus, cauterisation and grease on the tips—Gossypium—Cucurbita, tips cauterised transversely, and on their upper and lower sides—Zea, tips cauterised—Concluding remarks and summary of chapter—Advantages of the sensibility to geotropism being localised in the tips of the radicles Page 23-545

CHAPTER XII.

SUMMARY AND CONCLUDING REMARKS.

Nature of the circumnutating movement—History of a germinating seed—The radicle first protrudes and circumnutates—Its tip highly sensitive—Emergence of the hypocotyl or of the epicotyl from the ground under the form of an arch—Its circumnutation and that of the cotyledons—The seedling throws up a leaf-bearing stem—The circumnutation of all the parts or organs—Modified circumnutation—Epinasty and hyponasty—Movements of climbing plants—Nyctitropic movements—Movements excited by light and gravitation—Localised sensitiveness—Resemblance between the movements of plants and animals—The tip of the radicle acts like a brain 546-573

INDEX 574-593

ERRATA.

Page 3, foot-note, *for* Mr. Vine's *read* Mr. Vines'.
 ,, 452, line 7 from bottom, *for* minntes *read* minutes.