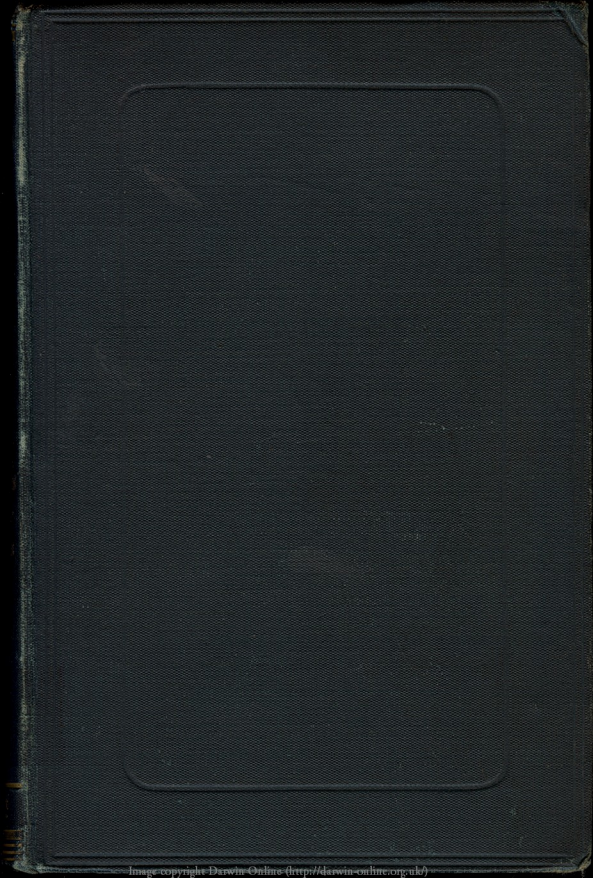

THE
FERTILISATION
OF
FLOWERS

MÜLLER

TRANSLATED BY
D'ARCY W. THOMPSON
WITH PREFACE BY
CHARLES DARWIN

MACMILLAN & CO.



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Preface by ✓
Darwin

CATALOGUED.

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FERTILISATION OF FLOWERS

BY
PROF. HERMANN MÜLLER

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WITH A PREFACE BY
CHARLES DARWIN

WITH ILLUSTRATIONS

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TRANSLATOR'S PREFACE.

IN this edition I have incorporated a large mass of Dr. Hermann Müller's recent observations, of which he sent me full notes; and I have also added further details where it seemed necessary, taken from his own and other writings. Many new figures from Dr. Hermann Müller's other works have also been inserted here.

The systematic part of the book, which is arranged on Endlicher's system in the German edition, has been re-arranged according to Bentham and Hooker's *Genera Plantarum*.

I may mention one case out of many in which I have had difficulty in choosing between equivalent words. I have throughout used *fertilisation* in preference to the ungainly word *pollination*, to imply application of pollen to the stigma without definite reference to the result of the act: that is to say, I have in ordinary cases translated *Bestäubung* and *Befruchtung* by the same word. But I have taken pains to guard against ambiguity in all cases where this rendering might lead to it.

Mr. T. H. Corry, of Caius College, Assistant-Curator of the University Herbarium, has read through the whole systematic part, giving me constant assistance.

I have been at pains to compile a list of all works relating to the subject of this book; and so far as lay in my power I have added an Index of genera to the list.

Charles Darwin's preface, full of suggestion, full of kindly appreciative feeling, is of peculiar interest as one of the very last of his writings.

D'ARCY W. THOMPSON.

TRINITY COLLEGE, April, 1888.

PREFATORY NOTICE.

THE publication of a translation of Hermann Müller's *Die Befruchtung der Blumen, &c.*, will without doubt be a great service to every English botanist or entomologist who is interested in general biological problems. The book contains an enormous mass of original observations on the fertilisation of flowers, and on the part which insects play in the work, given with much clearness and illustrated by many excellent woodcuts. It includes references to everything which has been written on the subject; and in this respect the English edition will greatly exceed in value even the original German edition of 1873, as Müller has completed the references up to the present time. No one else could have done the latter work so well, as he has kept a full account of all additions to our knowledge on this subject. Any young observer who, after reading the whole or part of the present work, will look, for instance, at the flower of a *Salvia*, or of some Papilionaceous or Fumariaceous plant, or at one of our common Orchids, will be delighted at the perfection of the adaptations by which insects are forced, unconsciously on their part, to carry pollen from the stamens of one plant to the stigma of another. Design in nature has for a long time deeply interested many men, and though the subject must now be looked at from a somewhat different point of view to what was formerly the case, it is not thus rendered the less interesting.

Hermann Müller has by no means confined his attention to the manner in which pollen is carried by insects or other animals from plant to plant, for wind-fertilised flowers have been carefully described by him; and several curious transitions from the one state to the other are noticed. He has also attended more closely than any one else to the many contrivances for self-fertilisation, which sometimes co-exist with adaptations for cross-fertilisation. For instance, he has discovered the singular fact that with certain species two kinds of plants are regularly produced, one bearing inconspicuous flowers fitted for self-fertilisation, and the other kind with much more conspicuous flowers fitted for cross-fertilisation. The flowers on the first-mentioned plants serve the same end as the curious little closed cleistogamic flowers which are borne by a considerable number of plants, as described and enumerated in the present work.

There is another interesting feature in the *Befruchtung*, by which it differs from all other works on the same subject; for it includes not only an account of the adaptation of flowers to insects, but of different insects to differently constructed flowers for the sake of obtaining their nectar and pollen.

Any one who will carefully study the present work and then observe for himself, will be sure to make some interesting discoveries; and as the references to all that has been observed are so complete, he will be saved the disappointment of finding that which he thought was new was an already well-known fact. I may perhaps be permitted here to mention a few points which seem to me worthy of further investigation. There are many inconspicuous flowers which during the day are rarely or never visited by insects, and the natural inference seems to be that they must be invariably self-fertilised; for instance, this is the case with some species of *Trifolium* and *Fumaria* which bear very small flowers, with some species of *Galium*, *Linum catharticum*, &c. Many other such flowers are enumerated by Müller. Now it is highly desirable that it should be ascertained whether or not these flowers are

visited at night by any of the innumerable individuals of the many species of minute moths. A lepidopterist while collecting at night, if endowed with only a small portion of the indomitable patience displayed by Müller, could ascertain this fact. The question possesses a considerable degree of theoretical interest; for if these inconspicuous flowers are never visited by insects, why, it may be asked, do they expand, and why is not the pollen protected by the petals remaining closed, as in the case of cleistogamic flowers? It would perhaps be possible to smear such small flowers with some viscid matter, and an examination of the petals would probably reveal nocturnal visits by moths by the presence of their scales; but it would be necessary to prove that the matter employed was not in itself attractive to insects. H. Müller gives long lists of the several kinds of insects which he has seen visiting various flowers in Germany; and it would be interesting to learn whether the same insects and the same proportional number of insects belonging to the different orders, visit the same plants in England as in Germany.

There are many other subjects which it is desirable that some one should investigate, for instance, by what steps heterostylism (of which an account will be found in the present work) originated: and with trimorphic heterostyled plants we meet with a more extraordinary and complicated arrangement of the reproductive system than can be found in any other organic beings. In order to investigate this subject and several others, experiments in fertilisation would have to be tried; but these are not difficult and would soon be found interesting. For instance, there are some plants, the pistils and stamens of which vary much in length, and we may suspect that we here have the first step towards heterostylism; but to make this out, it would be necessary to test in many ways the power of the pollen and of the stigma in the several varieties. There exist also some few plants the flowers of which include two sets of stamens, differing in the shape of the anthers and in the colour of the pollen; and at present no one

knows whether this difference has any functional signification, and this is a point which ought to be determined. Again, there are other plants, for instance, the common *Rhododendron*, in which the shorter stamens are more or less rudimentary, and it has been asserted that seedlings raised from pollen taken from the short and from the full-sized stamens differ in appearance; and it would be of importance to know whether they differ in their fertility or power of yielding seeds. It would also be interesting to learn whether in the plants, already alluded to, which produce two forms, one adapted for self-fertilisation and the other for cross-fertilisation, the reproductive organs have become in any degree differentiated, so that their action would not be perfect if the two forms were reciprocally crossed. Would a flower adapted for self-fertilisation yield a full complement of seed if fertilised by pollen from one adapted for cross-fertilisation; and *vice-versâ* with the other form?

But it would be superfluous to make any further suggestions. These will occur in abundance to any young and ardent observer who will study Müller's work and then observe for himself, giving full play to his imagination, but rigidly checking it by testing each notion experimentally. If he will act in this manner, he will, if I may judge by my own experience, receive so much pleasure from his work, that he will ever afterwards feel grateful to the author and translator of the *Befruchtung der Blumen*.

CHARLES DARWIN.

Down; February 6, 1882.

