

for such a purpose. We should have welcomed a few observations on the best means of preventing fading in museum specimens, which is another crying evil, from so experienced a conservator as Mr. Rowley.

R. L.

KNUTH'S TEXT-BOOK OF FLORAL BIOLOGY.

*Handbuch der Blütenbiologie unter zugrundelegung von Hermann Müller's werk: "Die Befruchtung der Blumen durch Insekten."* Bearbeitet von Dr. Paul Knuth, i. Band, ii. Band, 1 Theil. Pp. xix + 400 and 697. (Leipzig: Wilhelm Engelmann, 1898.)

DR. KNUTH is to be congratulated on carrying out an excellent idea in a masterly manner. It is now twenty-five years since Hermann Müller's "Befruchtung der Blumen" appeared, and although the English translation of 1883 contains a good deal not to be found in the original book of 1873, yet it too is becoming antiquated. A book, therefore, like Knuth's "Handbuch," founded on Müller, and incorporating the mass of work accumulated in recent years, is very welcome. Dr. Knuth is well known as an active and successful worker in the domain of floral biology, and has therefore the chief requisite for success—a first-hand knowledge of his subject; he also makes it clear that he has gone thoroughly into the literature.

The book is to be in three volumes, of which vol. i. and the first part of vol. ii. are now published. It is summarised by its author as follows:—

I. Introduction and literature.

II. The Floral-Biology of European and Arctic plants.

Part i. Ranunculaceæ to Compositæ.

Part ii. Lobeliaceæ to Coniferæ.

III. The Floral-Biology of Extra-European Plants.

The first volume begins with the history of floral-biology, to which I shall return later. It then goes on to the different forms of reproduction occurring in flowering plants, e.g. *Xenogamy*, *Geitonogamy* and *Autogamy*, under which heading a useful list of self-fertilised and self-sterile plants is given. The author passes on to an excellent account of the biological classes into which flowers are grouped—such, for instance, as the Anemophilous and Entomophilous divisions. Among animal visitors the bird, and even the bat, are shown to be of importance: the powers of the snail in this line are respectfully discussed; while further evidence is demanded for the suggestion that the kangaroo fertilises *Dryandra*.

Next comes a good discussion of the elements that go to make up the floral machinery—protection of pollen—conspicuousness through odour or colour, nectar and nectar guides, protection against unbidden guests, &c. Then comes a fuller discussion of flowers in relation to insects, in which a well-known biological classification is adopted, flowers being grouped in an ascending series beginning with those nectarless kinds which are visited for the sake of their pollen, and then into various types of

honey-supplying species, in which the protection of the nectar increases in complexity. Next, we have an account of the specialisation of flowers for certain groups of insects, and their classification as fly-flowers, butterfly-flowers, bee-flowers, &c. Lastly, a full account of the structure of insects in relation to flowers, a subject originated and brilliantly treated by H. Müller. The author has done wisely in giving a general account of floral-biology with so much fulness. The student who proposes to go on to vol. ii. comes to the study of special mechanisms far better prepared by Dr. Knuth's vol. i. than a reader who attacks for the first time H. Müller's "Fertilisation of Flowers."

A valuable feature in Dr. Knuth's book is the excellent account of the method which Hermann Müller introduced and used with such signal success—namely, the study of an exact record of the species of insects which visit each kind of flower. This, commonly known as the statistical method, gave astonishingly interesting results in Müller's hands, supplying as it did a solid basis of incontrovertible fact to his generalisation on the reciprocal interaction of insects and flowers, the evolution of the flower in general, and other interesting points. The statistical method has been largely taken up by the modern school of floral-biologists, and especially by MacLeod, Loew, Knuth and Kirchner on the continent, and by Willis, Burkill and Scott-Elliot in this country, with results which go to swell the lists of insect visitors given for each species in vol. ii. Space does not allow me to deal with the points of general interest which occur in this section; I may, however, call the reader's attention to the clear and useful account of MacLeod's method of treating the observed facts.

The growth of floral-biology is well illustrated by the admirable list of literature given by Dr. Knuth, and for which he deserves the thanks of all serious students. D'Arcy Thompson's list (1883) contains 814 entries, which seemed to contemporary readers a sufficiently striking proof of the growth of the subject, but it is a trifle to Knuth's literary index, in which are found 2871 entries. It should be mentioned, too, that in vol. ii. the literature is carefully given under each species. This part of the work is fully illustrated with Müller's excellent drawings, as well as figures from other sources, and a certain number of original illustrations. Dr. Knuth has introduced an improvement over H. Müller's arrangement by prefacing each natural order with a general sketch of the characteristic mechanisms; this seems a better arrangement than Müller's "retrospects," which were placed at the end.

Dr. Knuth has shown so much ability in the treatment of the part of the work already published that students may look forward to his completion, with equal success, of what will be the standard treatise on the subject. The only point in which I have any adverse criticism to offer is Dr. Knuth's treatment of the Knight-Darwin law. In common with some other modern writers on floral-biology, he takes what seems to me a mistaken view of the bearing of this law. The subject does not lend itself to treatment in a brief notice; I hope, however, to deal with it at length elsewhere.

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