Morphological Notes.

BY

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With Plates VIII and IX.

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V. ABNORMAL FRUITS.—PRECOCIOUS GERMINATION IN A MELON.

THE melon figured in Plate VIII was kindly sent to me in July, 1898, by General, the Right Honourable Sir Dighton Probyn. It had been grown at Sandringham in the gardens of H.R.H. the Prince of Wales, now H.M. the King, and when cut open on the table at Marlborough House, the interior was seen to be filled with well-developed seedlings, as shown in the figure.

The specimen was so striking that it was eventually preserved in spirit and placed in the Kew Museums. Sir Dighton Probyn, however, kindly supplied me with two other examples from the same source, and exhibiting the same condition; these were submitted to careful examination by Mr. Horace Brown, F.R.S., who was working in the Jodrell Laboratory.

The whole interior of the melon when received at Kew was filled with well-developed young plants. Some of these were removed with the section of the fruit which had been cut away. The first point was to ascertain whether the young plants originated from intra-ovarian buds or from seeds. As

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will be seen, it was conclusively shown by the cases represented in Pl. IX, Figs. 1-3, that the young plants were the result of precocious germination.

Mr. Horace Brown kindly allows me to make use of the following notes which he drew up at the time:—

‘The cotyledonary leaves of several plantlets measured $1\frac{1}{2}$ in. long and $1\frac{1}{4}$ in. across, and were of a light-green colour. The hypocotyls were about 2 in. long and $\frac{1}{4}$ in. in diameter. The roots were well developed, with secondary root-fibres up to $\frac{1}{2}$ in. in length.

‘The plants had undoubtedly been produced from seeds, since in some cases the two halves of the testa were still attached to the cotyledons, and a few seeds were found in the early stages of germination. In one instance a tap-root was found to have actually penetrated the solid parenchyma of the pericarp to a depth of about $\frac{1}{2}$ in., considerable force being required to withdraw it. This root is shown in Pl. IX, Fig. 2, the point to which it had penetrated being indicated by a dotted line. Penetration of the pericarp by the roots seemed to have occurred only in exceptional cases: for the most part they ramified amid the placentas and the broken-down ovarian tissue, from which they seem to have derived their nourishment.

‘The dry weight of the plantlets far exceeded that of the seeds from which they were produced. Sixteen perfect seeds, after washing and drying, were found to weigh 0.1560 gram., or an average of .0097 gram. for each seed, including the testa.

‘The dry weight of one of the plantlets was 0.1929 gram., or about *twenty times* the weight of the seed from which it sprang. Hence there can be no doubt that the plant had availed itself of a large amount of nutriment which could only have been derived from the fruit.’

It is obvious that the physiological problem is one of considerable interest. The seedlings would speedily have exhausted the nutriment stored up in the seed, and their further development would have been arrested if there had

been no external supply available. It is well known that the placental tissues in the melon break down into a copious sugary juice as the fruit ripens, and upon this it is perfectly clear that the young seedlings fed. This is not surprising in view of the well-known research of E. Hamilton Acton¹. What is, however, more remarkable is that they were able to plunge their roots into the fairly resistant and less dis-integrated tissues of the pericarp itself. This penetration is clearly shown in the lower part of the section on Plate VIII.

The cotyledons of the seedlings were, as stated by Mr. Horace Brown, distinctly green. He wrote to me:—

‘I think the amount of chlorophyll present must be very small. It does not give a strong coloration to the alcohol in which the plants are immersed, and what little green there is fades rapidly on exposure to light.’

Subsequently he wrote to me further:—

‘I amused myself by scooping the seeds out of a melon and testing the translucency of the walls of the pericarp. I was quite surprised to find how much light would pass through fully $1\frac{1}{2}$ in. of the walls. In full sunshine there must be quite a respectable twilight in the neighbourhood of the seeds, and as I see Van Tieghem states that the formation of chlorophyll in etiolated seedlings commences in a diffused light which will barely permit small print to be read by the eye, we need not wonder that the ovarian seedlings contained a small amount of chlorophyll.’

Chlorophyll is formed in the cotyledons of Conifers in complete darkness² as well as in the precocious germination of seeds of the orange, which occasionally occurs. Such cases are, however, quite exceptional.

Whether the small amount of chlorophyll present in the melon seedlings was effective functionally to an appreciable extent may be doubted. The chemical changes which took place in the interior of the fruit would be accompanied by the evolution of carbonic acid, which would probably be present

¹ Proc. R. S., Vol. xlvii, pp. 150-175.

² Sachs, Textbook, second ed., p. 743.

in any part of the internal cavity not occupied by fluid, in a greater proportion than in atmospheric air. But the illumination of the seedlings would be too feeble to allow of its being fixed and decomposed.

On the whole the nutrition of the seedlings closely approached that of a saprophyte. What is, however, noteworthy is that it must have been practically anaerobic. At any rate, it is evident that the working up of the disintegrated tissues of the parent melon into new living tissue required a minimum amount of oxygen.

Precocious germination in the melon had not previously been unknown, though it is apparently uncommon. Mr. Harry J. Veitch, a well-known authority, wrote that he had 'met with such occasionally before, but not often, but cannot offer any explanation for the occurrence.' The question then arose as to whether it was to be regarded as a case of physiological variation. This point seems disposed of by the following note from Mr. A. Mackellar, who grew the melons at Sandringham, for which I am indebted to Sir Dighton Probyn:—

'I have to-day cut open two melons in which the seeds have germinated and developed into nice-sized seedlings with broad green leaves. Each melon was grown on different plants, but the same variety, and was cut for a fortnight and kept on a shelf in the fruit room; previous to being cut they were kept on the plants for quite a fortnight after being quite ripe.

'No doubt the cause of the seeds germinating and growing in the melons is the unusual length of time the melons have kept fresh. I have seen seeds germinated in a melon before, but not so far developed as in this case. The melon in which the seeds germinated is called "Osberton." Along with it I grew "Hero of Lockinge," but no seeds in this variety germinated, neither did the melons keep quite so long. My reason for keeping the melons so long is that I had two houses in which the melons were ripe almost at the same time, forty in each house. There were no germinated seeds in any of the melons that were cut when first ripe.'

I may add that I subsequently heard of cases occurring elsewhere than at Sandringham in 1898. It is possible, therefore, that there were some conditions in the season of that year that were favourable to their happening.

Precocious germination occasionally happens in the orange and other species of *Citrus*, and appears to be not infrequent in the papaw (*Carica Papaya*); an instance is figured in the 'Gardeners' Chronicle' for December 10, 1887, p. 717. But in the vast majority of cases seeds remain in a dormant condition for a considerable time after maturity. This is no doubt an adaptive character which has been acquired in order to facilitate their dispersion to considerable distances. It might be expected, therefore, that in the case of gregarious plants whose seeds grow where they fall precocious germination might occur. It is actually met with amongst the *Dipterocarpeae*; Blume figures a case in *Dipterocarpus retusus*¹. It is especially characteristic of the mangroves (*Rhizophoreae*). In the case of *Rhizophora* itself I quote the following from Brandis's 'Forest Flora,' p. 217:—

'Germination takes place in the fruit on the tree, the radicle protrudes soon after flowering as a long cylindrical body, thicker near the end, attains a length of 12 in. or more, and at length roots in the mud when the fruit falls.'

In *Bertholletia excelsa*, which has been described by Mr. Watson², the woody pericarp makes it impossible for the seeds to be dispersed before germination. This, therefore, takes place *in situ*, and the surviving seedlings are liberated by the final disruption of the decayed pericarp.

Something of the same kind would probably happen in the case of the melon. Its feral form would have a pericarp less succulent than that developed in cultivation; this would be penetrated by the roots, which would thence reach the soil, and the pressure exerted on the pericarp by the growing seedlings would eventually set them free by its disruption.

¹ Flora Javae: Dipterocarpeae, tab. ii; reproduced in Engler and Prantl, Pflanzenfamilien, vol. iii. 6, p. 256.

² Annals of Botany, vol. xv. pp. 99-102.

VI. ABNORMAL FRUITS.—PLEIOTAXY OF GYNÆCEUM
IN ORANGE.

I was indebted to a correspondent for the abnormal orange figured in Plate IX. As is well known, the fruit of the orange ordinarily consists of a single row of carpels enclosed in a fleshy rind. In this case the axis has been prolonged and has given rise to another series of carpels forming a smaller fruit, which is entirely immersed in the external one. Although various abnormalities in the fruit of the orange have been figured, I have been unable to find any illustration of a similar one. Masters (*Teratology*, p. 75) figures a case in which the outer united whorl surrounds a confused mass of free carpels. A similar case is better figured by Risso and Poiteau (*Histoire et Culture des Orangers*, tab. 56).

A similar state of things to that now described is said to be characteristic of the so-called 'Californian Navel Orange.' This apparently originated as an isolated sport, as the trees in California are said to have been all propagated from one which is still preserved at Washington.

A. P. de Candolle regarded the 'rind' of the orange as developed from the torus or receptacle, which is usually regarded as an axial structure (*Organographie*, vol. ii. p. 41), and Masters (*Teratology*, p. 75) favours this view.

In the case now figured (Fig. 4) the external rind had been removed before it came into my hands. The carpels are united below to the prolonged axis, but are separated above to leave an open pit, at the bottom of which is the secondary fruit. The ventral surface of the carpels is clothed with the characteristic glandular 'rind.' This is shown in section in Fig. 5, where the glands are unusually prominent, and crowded together in groups with little intervening tissue. In such a position the 'rind' could hardly be an axial structure. The secondary fruit is shown in section in Fig. 6; except that

the number of carpels is fewer than ordinary, there is no deviation from the normal structure.

Fruits with one series of carpels may be regarded as reductions from a more generalized multiseriate type. The interest of a case such as I have described is the proof that a tendency to revert to the more generalized type may still be latent.

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