THE AFFINITIES AND ANATOMICAL CHARACTERS OF PLAGIOPTERON FRAGRANS, Griff.—In the year 1844 Griffith[1] published an account of a new genus of flowering plants, to which he gave the name *Plagiopteron*, this genus only including a single species, *Pl. fragrans* (= *suaveolens*). Griffith did not attempt to assign any definite systematic position to this curious plant, although he considered it to be related to Malpighiaceae and Sapindaceae. Walpers[2] describes it amongst the Sapindaceae, whilst in a foot-note he states his belief that it would be better placed amongst Malpighiaceae[3]. The first to place it amongst Tiliaceae were Bentham and Hooker[4], who include it in the tribe Prockieae. Their example is followed to some extent by Warburg[5], who however refers it to the order Elaeocarpaceae[6] of Schumann. The plant, that Griffith described, was growing in the gardens at Calcutta, but has since disappeared. The Kew Herbarium contains several specimens, collected by Griffith in Mergui, probably at some time after the date of the above-mentioned publication[1].

The resemblance in habit between *Plagiopteron* and certain species of *Hiptage* at the time of fruiting is certainly very striking, but the arrangement of the ovules in the former genus is not at all like that of Malpighiaceae. The Sapindaceae can scarcely come into consideration, for not alone have we the absence of any correspondence in number between the stamens and the floral envelopes, but most representatives of this order are characterized by the presence of short multicellular glands on the leaves, whereas *Plagiopteron* has no glandular hairs of any kind.

In my opinion *Plagiopteron* is certainly a Tiliaceous plant, and inasmuch as all parts are covered with stellate hairs, it should certainly be included in one of the tribes of the holopetalous Tiliaceae, which alone possess these hairs. Almost all the heteropetalous Tiliaceae (including the tribes Prockieae, Sloaneae and Elaeocarpeae)

[1] Calcutta Journal of Natural History, vol. iv, p. 244, Plate XIII.
[2] Repertorium Botanices Systematicae, v, p. 370.
[3] Cf. Kurz, Forest Fl. Brit. Burm. i, p. 172.
[4] Genera Plantarum, vol. i, p. 238.
[5] Engler-Prantl, Natürl. Pflanzenfamilien, iii. 6a, pp. 53, 55.
[6] Including the tribes Elaeocarpeae and Sloaneae of Bentham and Hooker; the Prockieae were added later.

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have simple hairs[1], and I agree with Schumann[2] in placing them together in a separate order, the Elaeocarpaceae, characterized chiefly anatomically[3] by the absence of mucilage-receptacles (which occur abundantly in almost all holopetalous Tiliaceae) and of stellate hairs.

The ovary of *Plagiopteron* is trilocular and contains two basal collateral ovules. This arrangement of the ovules is to be found in *Brownlowia*, a member of Bentham and Hooker's first tribe, Brownlowieae, in which the ovules are always limited in number. Further the resemblance between the buds of *Plagiopteron* and Brownlowieae is most striking, especially with regard to those of *Berrya* and *Brownlowia*. All have a valvate, slightly gamosepalous calyx, which is small in comparison with the valvate corolla, differing in these points considerably from the buds of Elaeocarpaceae. The stamens of *Plagiopteron* are curious in that they open by four apical pores, and it is partly owing to this mode of dehiscence of the anthers that Warburg (loc. cit.) refers *Plagiopteron* to the Elaeocarpaceae. It seems to me, however, that we can hardly compare the short, globular anthers of our genus with the greatly elongated ones of Elaeocarpaceae. On the contrary, I think that we could more readily compare them with the anthers of Brownlowieae, although I do not attach very much importance to this point at all. The anthers in the latter tribe dehisce by two lateral valves, which are frequently confluent at the apex. If we imagine these lateral valves to become gradually more apical, we should finally arrive at a dehiscence by two broad apical pores, as is sometimes found in *Plagiopteron*.

On the whole, I think that *Plagiopteron* would be best placed amongst the Brownlowieae. It has already been mentioned that practically all holopetalous Tiliaceae are provided with mucilage-receptacles (Schleimbehälter) in mesophyll and cortex. One genus (*Pityranthe*) of the Brownlowieae makes an exception to this rule, so that the fact that they are also wanting in *Plagiopteron* need not disconcert us. Finally, with regard to the opposite leaves of this genus it may be pointed out that they often show a marked tendency to

[1] Stellate hairs are said to occur in certain species of Sloanea, although I have not come across them as yet.

[2] Cf. Engler-Prantl, Natürl. Pflanzenfamilien; Nachträge zu iii. 6, 1897, p. 230.

[3] The writer is occupied with an investigation of the anatomy of this order, of which one or two general results have just been mentioned.

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become alternate. In some points *Plagiopteron* seems to form a connecting link between Elaeocarpaceae and holopetalous Tiliaceae, but in others it appears to stand quite alone.

One of these, which is at the same time the most interesting feature of the plant, is the occurrence of caoutchouc-cells throughout its tissues. If any part of a dried specimen be broken into two halves and these carefully drawn apart from one another, large numbers of elastic threads of a whitish colour are seen to stretch between the two pieces, breaking off when they have been separated to a certain extent. Griffith mentions this phenomenon, saying (loc. cit. p. 246) that the plant 'abounds with spiral vessels.' The true nature of these threads was first determined by Radlkofer[1], who mentions their occurrence in *Plagiopteron*, whilst describing *Wimmeria cyclocarpa*, which is provided with similar caoutchouc-cells. They also closely resemble the caoutchouc-containing elements of certain Hippocrateaceae[2]. In view of the fact that the caoutchouc-cells of *Plagiopteron*, together with those of Hippocrateaceae, &c., will form the subject of a paper 'On Caoutchouc-containing Plants' in a subsequent number of the Annals, I can limit my remarks here to a few general statements.

These cells occur abundantly at the periphery of the pith around the groups of primary xylem and not so commonly in the secondary phloem. They are particularly abundant in the phloem of the petiole, in fact more so than in any other part of the plant. In the leaves they are chiefly found round about the vascular bundles, replacing part of the accompanying sclerenchyma; but they also send slender branches into the mesophyll, which are best seen in surface view. The caoutchouc-cells are further abundant in all parts of the flower[3] and fruit, but, since *Plagiopteron* has never formed seeds in any of the herbarium materials at my disposal, I was unable to determine whether they are also present in the embryo, which I however think very probable. Finally, it is worthy of note that the cells of the mesophyll contain large numbers of small irregular lumps of caout-

[1] Botanical Gazette, vol. xviii, 1893, p. 199; cf. also Solereder, Systemat. Anat. d. Dicotyl., pp. 176, 178.

[2] See Fritsch, Untersuchungen über das Vorkommen von Kautschuk bei den Hippocrateaceen. Bot. Centralbl. 1902, Beihefte, Band XI, Heft v, p. 292.

[3] I found them abundant in petals and sepals and in the walls of the ovary. Several run along to the tip of the style; only a few are to be found in the filaments of the stamens, and these terminate at the point where the anthers commence.

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chouc, which in their physical and chemical properties absolutely resemble the contents of the caoutchouc-cells (and are similar to the caoutchouc of Hippocrateaceae).

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ON LIGNIFICATION IN THE PHLOEM OF HELIANTHUS ANNUUS.—An examination of the structure of two plants of the common sunflower grown at Kew last year has yielded one or two results, which do not appear to have been previously recorded, viz. the occurrence in this plant of: (1) sieve-tubes and companion-cells, whose walls ultimately become lignified; and (2) sieve-tubes and companion-cells, whose *contents* give reactions resembling those of lignin.

One of the plants was cut down and put into spirit in August, when it was already forming fruit; the other plant was allowed to grow until early in October. In the thicker parts of the stem of the first plant, patches of the medullary-ray-cells in the phloem were lignified. A few sieve-tubes with slightly lignified walls were found. In the second plant the stem had attained a diameter of an inch and a half near the base and for some distance upwards. In parts of this thick region, lignification of the walls had taken place in the whole of the pericycle, in the larger and many of the smaller medullary rays in the phloem, as well as in several of the small strands of sieve-tubes and companion-cells occurring in the outer region of the secondary phloem between the primary bundles, and in a fairly large block of sieve-tube-containing phloem on the inner side of each primary sclerenchyma-strand. The small strands were examined in transverse, radial, and tangential sections, and it was found that fairly frequently some, and occasionally all the sieve-tubes and companion-cells composing them possessed lignified vertical walls. In some cases the sieve-plates were covered with callus, and not lignified; in others they were destitute of callus, and lignified. Lignification of the walls was frequently seen in the single or paired sieve-tubes with companion-cells, which run horizontally or obliquely through the medullary rays, and form tangential connexions between the vertical strands of sieve-tubes, as in *Vitis vinifera*, &c. Lignification of elements (sieve-tubes, companion-cells, and parenchyma) bordering the large, still unlignified phloem-masses, corresponding to the primary bundles, suggested a

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