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X.—Observations on the Functions performed by the Hairs on the Sligma in Campanulaceæ, Compositæ, and other Plants

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size and opens obliquely upwards, the coronoid process is long as in *Spalax*, the lower incisor runs backwards and outwards, and the thin layer of bone covering its base forms a protuberance (*d*) on the outer side of the condyle (*e*), in this respect resembling both *Rhizomys* and *Spalax*. The descending ramus springs from the under side of the alveolus of the inferior incisor, and not from the outer side, as in the true *Bathyergidae*. The posterior part of the descending ramus is not directed outwards, as in *Spalax*; but is on the same plane as the horizontal ramus, as in *Rhizomys*. The molar teeth agree closely with those of *Spalax*, as well as with *Bathyergus*, being nearly cylindrical, of equal size, and having but one external and one internal fold of enamel; the incisors are proportionally broader than in *Spalax*.

The great difference between the skull of *Bathyergus splendens* and that of *Spalax typhlus* consists in the form of the occiput, it being vertical in the former, or very nearly so; but I very much suspect that the peculiar form of occiput which we observe in *Spalax typhlus* (which is the only species of the genus the skull of which I have seen) does not constitute a character indicative of affinity. I think it very likely to vary in the different species of the genus.

On the whole, it appears to me, that the animal called *Bathyergus splendens* by Ruppell should be removed from the genus in which he has placed it, and might be arranged either with the species of *Spalax* or perhaps between that genus and *Rhizomys*, and I think it probable Rodents may hereafter be found connecting the *Bathyergidae* with these genera.

EXPLANATION OF PLATE II.

Fig. 1. Skull of *Orycterus marilimus*.

- 1 a. Under side of do.
- 1 b. Under side of lower jaw.
- a, a. Descending ramus.
- b. Alveolus of incisor.
- 1 c. Lower jaw viewed from above.
- 1 d. Side view of do.

Fig. 2. *Bathyergus capensis*.Fig. 2 a. Lower jaw of *Bathyergus capensis*, viewed from beneath.

- 2 b. Side view of do.

Fig. 3. *Bathyergus splendens* of Ruppell.

- 3 a. Side view of skull.
- 3 b. Lower jaw, view from above.
- d. Termination of incisor.
- e. Condyle.

X.—*Observations* on the Functions performed by the Hairs on the Stigma in Campanulaceæ, Compositæ, and other Plants.* By ARTHUR HILL HASSALL, M.R.C.S.L., Corresponding Member of the Dublin Natural History Society.

I HAVE read with much interest some observations by M. Adolphe Brongniart on the 'Functions of the Hairs on the

* The principal of these observations were written during the summer of last year.

Stigma in the *Fecundation* of *Campanulaceæ*,^{*} contained in a recent Number of the 'Annals,' and translated by W. A. Leighton, Esq. 'To this subject, previously to the appearance of these remarks, I had paid some attention. I do not, however, concur in all the conclusions arrived at by that able investigator.

If the flower-bud of any of the *Campanulæ* be examined a day or two prior to the expansion of the corolla, the stamens will be observed to envelope and conceal the whole surface of the pistil. If it be again examined, about the period of the unfolding of the blossom, the anthers may be seen to open and disclose their contents. As soon as this has occurred, the stamens having performed the office allotted them, begin to wither away, in consequence of the juices destined for their nourishment being now directed into a new channel. The pistil, immediately on the dehiscence of the anthers, increases rapidly in size, carrying with it in its upward progress, (as by a brush) by means of the hairs upon its surface, the pollen granules. This increase, amounting frequently to thrice the original length of the pistil, arises, partly, from the excitation of the new action now set up in it, but mainly from the accession of the nutriment formerly sent to the stamens, but now no longer required by them.

These hairs are found in all the *Campanulaceæ*, save only the small genus *Petromarula*, extending from the base of the style to the apex of the stigma, externally, and arranged in lines, corresponding in number and position with the stamens; they are directed horizontally and slightly curved at their extremities. Their surface is lubricated by a secretion, or perhaps, I should rather say, an exudation, serving to retain the pollen in contact with them. The office performed by these hairs is undoubtedly purely mechanical, acting, first, as collectors of the pollen, and subsequently, as props, to sustain it in contact with the fecundating surface—entangled amidst the hairs it is not readily scattered or disturbed. Adolphe Brongniart's account of the anatomy of the hairs I consider to be satisfactory; although I do not deem his comparison of their retractile movements to that of certain Annelides, or the tentacula of snails, to be at all analogous, the phenomenon in the latter cases being *voluntary* and *vital*, the result of complex organization; and, in the former, merely mechanical, presenting nothing peculiar or extraordinary in its nature, but arising simply from the absorption or drying up of the fluid contained in the hair itself, and in the expansion at its base*.

* The retraction of the hairs does not take place until some days after the application of the pollen, the greater part of which then falls off in con-

M. Brongniart states, "that the pollen grains undergo no modification either during their application to the hairs or when drawn along with them in their retractile movement, and consequently no connexion exists between them and the interior of the style." From this it follows, that fertilization can only take place through the medium of what are considered to be true stigmas, viz. the internal surfaces of the three (occasionally four) diverging rays on the top of the style. This statement is wholly opposed to the result of my investigations. The outer of the mass of pollen grains adherent to the hairs certainly suffer no material change; but if those in contact with the style be examined, a single pollen tube of considerable length may be observed to pass from the greater number of the granules, apparently losing itself in the tissue of the style, which I believe it to penetrate through the interspaces between the hairs. This view of the matter is further supported by the following corroborative evidence. 1st. The great mass of pollen collected on these hairs, contrasted with the small quantity, or even occasional *absence* of it, on what is called the true stigmatic surface. 2ndly. The structure of the surface itself—it being covered with papillæ resembling the hairs themselves in all save length. 3rdly. That this surface sometimes does not expand, and when it does, frequently but to a small extent, and this only when the process of fertilization is evidently far advanced, and the flower itself sometimes even beginning to fade.

From the observation of these facts, I have come to the conclusion, that not only the surface of the true stigma, but more particularly of that portion of the style itself which is covered with hairs, is essentially concerned in the fecundation of *Campanulacæ*.

These collecting hairs are by no means peculiar to the *Campanulæ*, but exist in the whole of the family *Compositæ*, and in many genera of other orders. I have observed them in *Colomia grandiflora*, *Veronica chamædrys*, *Hyacinthus orientalis*, *Ixia maculata*, *Haworthia radula*, *Godetia rubicunda*, and *Epilobium hirsutum*. In the *Compositæ* they are admirably adapted to the office they are destined to perform, viz. that of harrowing up the pollen grains, being all sloped upwards and terminating in a sharp point. These hairs in *Haworthia radula* cover the true stigmatic surface, are longest near the circumference, and become mere papillæ towards the centre of the stigma. In *Veronica chamædrys* they also cover the stigmatic surface, but a depression is to be observed in the middle free

sequence of the loss of their support.—Adolphe Brongniart speaks of this retraction of the hairs as presenting a phenomenon unexampled in the vegetable kingdom.

from hairs, while in *Ixia* they are arranged along the edges of the stigmata. It is however to the structure of the stigmata of *Epilobium hirsutum* and *Godetia rubicunda* that I would particularly call attention, conceiving them to confirm in the strongest manner my opinion that the stigmatic function in the Campanulaceæ is not limited to that part which is usually considered to constitute the proper stigma. These are quadripartite, and each division of their true stigmatic surface is covered with hairs precisely resembling those of the Campanulaceæ.

I am about to try an experiment, the issue of which will determine the truth or fallacy of my deductions, as far as the Campanulaceæ are concerned. As each flower of *Campanula pyramidalis* comes into blossom, I intend to cut away the whole of the true stigmatic branches, leaving only the lower portion of the style covered with hairs and pollen. Should perfect seeds ripen upon this plant, the question will, I think, be satisfactorily decided.

August 1811.

XI.—On some species of *European Pines*. By Capt. S. E. WIDDRINGTON*, R.N.

IN a paper which was read before the British Association at Newcastle (Ann. Nat. Hist., vol. ii. p. 163), the two species of *P. austriaca* and *P. pumilio* were not fully described, nor their places in the system as to elevation assigned. This deficiency, which was caused by my not having seen these species growing in their natural sites, a recent tour in Austria and Upper Germany has enabled me to supply.

The *Pinus austriaca* of the English, *P. nigrescens* of the German botanists, partly covers, as it no doubt once did entirely, the plain of Austria to the south and east of Vienna. There is an extensive remnant of it between Neustadt and the foot of the Semering range, which divides Austria and Styria. It also partly clothes the hills near Baden; but in ascending the range it soon disappears, and is replaced by the spruce and Scotch firs. I am not aware of its being seen to the north of the localities I have mentioned, nor in the northern prolongation of the range, there called the Wiener Wald. In Styria I never saw it to the north of the river Muhr; but it ranges to the south of Styria, forming a sort of link between the European pine series and that of the Caucasus and of Asia. On considering the elevation and geography of these ha-

* Late Cook. Read in the Section of Zoology and Botany at the meeting of the British Association, Plymouth, and communicated by the Author. See his paper on *Pinus* and *Abies*, Ann. Nat. Hist., vol. iii. p. 296.