

ferently. "Only in *Lycopodium*," says De Bary (*Comparative Anatomy*, p. 60), "can special hair-cells be distinguished from the other epidermal cells of the root."

Special hair-cells are, however, to be found in a considerable range of plants, in which they form a rather striking anatomical character of the epiblema. In all the cases which I have studied, root-hairs arise from cells differentiated for the purpose at a very early stage of the epiblema, and *from no other cells*. The hair-cells are short, often very short, sometimes wedge-shaped, possess peculiarly dense and deep-staining cell contents, and are distributed in a manner determined by the mode of origin. They originate from the division of cells near the root apex. Of each cell pair formed, one becomes a hair-cell and very shortly shows distinctive characters; while the other either becomes a single ordinary, much elongated surface cell, or divides to form several such (hairless) cells. In most cases the cutting off of hair-cells seems to be a matter of stimulus. At times the roots are wholly devoid of hairs and hair mother-cells; at other times the growing conditions—as it would seem—call out these structures.

I find such special hair-cells in *Azolla*, *Isoetes*, *Selaginella*, *Equisetum*, certain Alismales and certain Nymphaeaceæ.

In *Azolla pinnata* (the only species examined by me) the root shows several points of interest. The root-cap (as we may call the structure derived from the original segment cut from the outer face of the apical cell) consists of two cell layers, except at the apex, where the inner layer finally undergoes an extra periclinal division. The inner layer for a time coheres closely to the root-trunk, which is thus clothed with a true epidermis. At the same time the outer layer is separated from the inner except at the apex, and forms a distinct root-cap proper. The inner layer is finally pushed away from the root-trunk by the growth of hairs arising from the outer layer of the cortex, so that at maturity, and even before, the main body of the root is quite destitute of an epidermal covering.

The hairs arise in close proximity to the apex. Exterior cortical cells divide by a wall oblique

to the external surface. The lower of the two cells so formed in each case almost immediately gives rise to a hair, while the other divides transversely to form two, four or eight hairless cells. At first the hairs stand in regular zones, but ultimately these zones often become more or less broken by the unequal multiplication of the intervening cells in the different vertical rows.

In several species of *Nymphaea* examined the hair mother-cells or the hairs themselves were found as apparently constant characters of the epiblema, alternating very regularly with ordinary cells. In *Nymphaea*, it will be recalled, the root is without epidermis (except root-cap), the epiblema being merely the outermost layer of cortex, the Nymphaeaceæ in this respect agreeing with Monocotyledons and certain Pteridophytes. The hair-cells may develop in such a way as to give root-hairs, or they may be—under most conditions they commonly are—suppressed by the closing together, above them, of the ordinary elongated cells. Whenever hairs are found they proceed from short, specialized cells, early distinguishable not far from the growing point. An essentially similar condition is found in *Brasenia*, *Cabomba*, and *Nuphar*.

In some Alismales—*Sagittaria*, *Limncharis*, *Aponogeton*—essentially the same phenomenon, the production of root-hairs solely from predetermined hair-cells, obtains. This is interesting in view of the recent discovery of the monocotyledonous character of one of the Nymphaeaceæ.

I purpose in the near future to describe at length these and other like cases of root-hair formation.

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QUOTATIONS.

SCIENCE AT A WESLEYAN UNIVERSITY.

THE dismissal of Professor Frank D. Tubbs from the chair of natural sciences in Wesleyan University, at Salina, Kansas, throws an interesting light upon the standards of orthodoxy in that State. Professor Tubbs is laboring under the grave charge of believing in evolu-

tion, a theory which the people described as 'the older and more orthodox Methodist ministers' so abominate that they will not even give Professor Tubbs a hearing. Apparently the general issue of academic freedom is not involved here, for the school professes to be a sectarian institution; that is, it subordinates the independent investigation of the truth to the propagation of certain doctrines. Professor Tubbs himself admits that his standing as a scientist, his success as a teacher and administrator, and his character as a man were not the only things considered in his appointment, for he says: "Bishop Vincent fully questioned my beliefs, approved them, and appointed me to the seminary." The only question is whether an evolutionist can be an orthodox Methodist in central Kansas. The trustees of the school say no. The decision may cause Professor Tubbs temporary inconvenience; but if belief in evolution is his only fault, he can comfort himself with the reflection that he is far better off than the 'university' at Salina.—The N. Y. *Evening Post*.

MR. CARNEGIE'S GIFT TO SCOTTISH UNIVERSITIES.

AT the time when Mr. Carnegie's gift was first announced, and when nothing had been made known except its magnitude and the fact that it was intended to defray the cost of University education for Scottish students, we felt it necessary to point out, while cordially expressing our admiration of the munificence of the donor, that the very magnitude of the fund would render its wise administration a matter of some difficulty, and to call attention to circumstances which might interfere with the practical realization of the intended benefits. The conditions of the trust, as now disclosed, appear to meet, in almost every particular, the considerations which we mentioned. The application of half the income for the purpose of improving the apparatus of education and for establishing what can hardly fail to become world-renowned laboratories in every department of science which falls within the province of a university will at once lift those of Scotland to the very highest level of academic importance, and will be likely to place the coun-

try in the very forefront of practical scientific teaching and investigation. Medical science is specially mentioned in the trust, and, to take only a single example, it will be within the power of the trustees to enable any Scottish University to equip an expedition for inquiring into the life histories of fever-carrying mosquitoes or other insects, and thus to accomplish, perhaps in the course of a few months, more than could be accomplished by private enterprise, aided only by small and laboriously collected donations, even in the course of years. The problems of organic chemistry, again, are daily becoming of more and more importance in relation to health and to disease; as are those of inorganic chemistry in relation to a large number of manufacturing processes or industries. In respect of these and many kindred matters the great hindrance to scientific work in Great Britain has been simply want of means; and this want once removed, a very important step will have been taken towards assisting us to hold our own in the great industrial contests which the future can hardly fail to have in store for us, and in which scientific knowledge will certainly be one of the most important elements of success. We cannot but think that this section of the trust is likely, as time goes on, to prove itself infinitely the more important of the two, and that in the future, under the elastic terms and liberal powers of the deed, it may even come to swallow up or to supersede the general payment of fees which, after all, are not so large as to place a serious impediment in the way of any young man who is not absolutely destitute, and who is determined to push his way to the front of any calling in which it may be his purpose to engage.—The London *Times*.

CURRENT NOTES ON PHYSIOGRAPHY.

THE SOUTH COAST OF ENGLAND.

THE mid-southern coast of England is bordered by a narrow anticline of mesozoic strata, greatly eroded. The largest remnant of the anticline is the Isle of Wight, while further west a nearly isolated portion is called by the anticipatory name of the Isle of Purbeck. The physical features of the latter, with those of