and Cycadeæ. The view of their affinities, which we suggest, is that they are derivatives of an ancient generalised race of ferns, from which they have already diverged considerably in the cycadean direction. Of the two genera, *Heterangium* appears to be geologically the more ancient, and certainly stands nearer to the filicinean stock. *Lyginodendron*, while retaining conspicuous fern-like characters, has advanced much further on cycadean lines. This view by no means involves the improbable assumption that these plants were the actual ancestors of existing Cycadeæ. How far their divergence from the fern stock had proceeded cannot be determined until we are acquainted with their organs of reproduction.

The existence of a fossil group on the border-land of ferns and Cycads seems now to be well established. Count Solms-Laubach places his *Protopitys* in this position, which is probably shared by *Myeloxylon* and *Poroxylon*. Messrs. Bertrand and Renault have indeed endeavoured to derive the last-named genus from Lycopodiaceæ, and have extended the same view to *Lyginodendron* and *Heterangium*. In the latter cases their theory is completely negatived by the organisation of the leaves, and by many structural details.

The relation of the genera which we have described to those ancient gymnosperms, the *Cordaiteæ*, will form one of the most interesting palæobotanical problems of the future.

The paper is illustrated by micro-photographs and by camera-lucida drawings.

IV. "On the Origin of the Triradiate Spicules of *Leucosolenia*." By E. A. Minchin. Communicated by Professor Lankester, F.R.S. Received April 30, 1895.

(Abstract.)

In *Leucosolenia coriacea* the youngest spicules are found to be surrounded by six cells, which are similar in all their characters to the cells of the external flat epithelium of the sponge, and undoubtedly derived from this layer. It appears that three cells of the external epithelium wander inwards, and give rise to six by division of each cell into two, the six cells being arranged in such a way, that three are placed more internally, *i.e.*, towards the gastral surface of the body wall, and three more externally, towards the dermal surface. Each of these sets of three cells has a form which might be compared to a trefoil, and the whole mass may be described as two such trefoils superposed, the cells of one trefoil exactly corresponding to those of the other.

The spicule is formed by the three inner cells, a ray being formed

by each cell. In many instances it appears as if the three rays were formed quite separately and afterwards fused at the centre.

The three outer cells soon lose their rounded form, and by throwing out processes, assume an amœboid appearance. After the spicule rays have attained a length of 10 or 15 μ, the three outer cells are no more to be found, having apparently rejoined the flat epithelium from whence they came. The three inner cells alone secrete the rays and continue to do so until the spicule is full grown.

The spicule rays soon appear to project beyond their formative cells, but are in reality covered by a thin layer of protoplasm. At the same time, the spicule sheath makes its appearance as a denser layer of substance between the protoplasm of the formative cell and the calcareous spicule, and it is by continued calcification of the sheath that the spicule grows.

The spicule rays attain their full thickness at their bases before they have reached their full length. The formative cells remain at the bases of the rays until this portion is built up to its full thickness. Each formative cell then migrates along its ray towards the tip, building up the ray to its full thickness as it goes. In the fully formed ray the formative cell is found adherent to the extreme tip.

Theoretical considerations.

(1.) The origin of the spicule-forming cells—that is to say, of the whole connective tissue system in these sponges—from the external flat epithelium, is another nail in the coffin of the so-called mesoderm in these forms. Sponges are to be regarded as two-layered animals, composed of a dermal and a gastral layer. The dermal layer is differentiated into (1) an external flat contractile epithelium, the neuro-muscular system, and (2) an internal connective tissue layer. The gastral layer consists of the collar cells. The amœboid wandering cells are perhaps also to be reckoned with the gastral layer.

(2.) The fact that each ray of a triradiate spicule is formed by a single cell, shows that each triradiate spicule must be regarded as derived from the fusion of three originally separate monactinal spicules. This supports Schulze's theory, namely, that the triradiates of the more primitive Ascons have arisen as an adaptation to the structure of the sponge, and goes against Dreyer's theory that the primitive spicule of all sponges is a tetraxon, a form explained by him as the direct mechanical outcome of the vesicular structure of living bodies.