

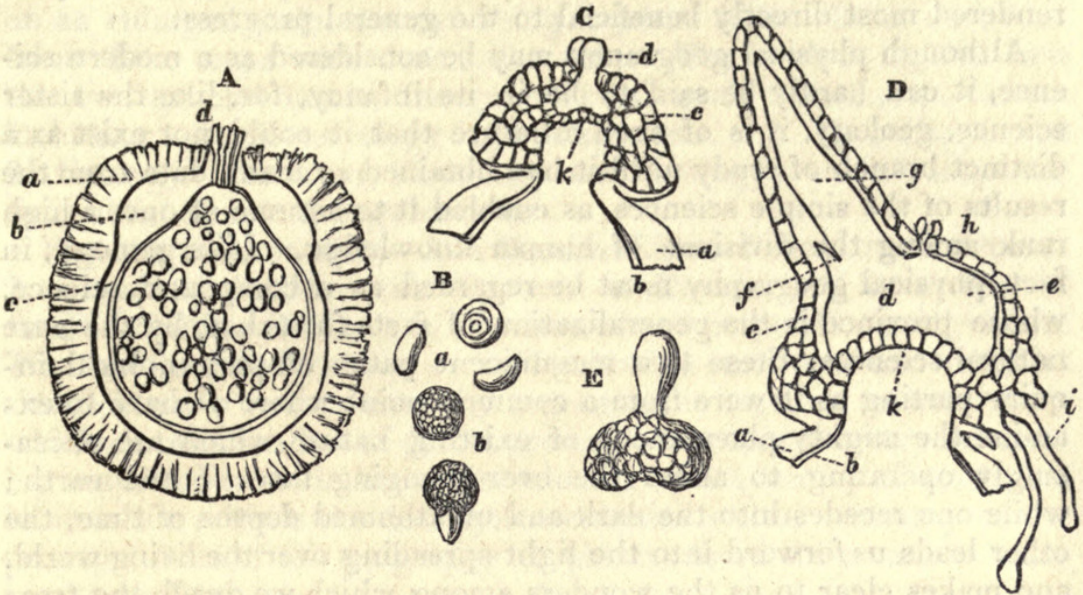
XLV.—On the Fructification of the Rhizocarpeæ.

By M. J. SCHLEIDEN *.

FOR the development of a new individual in *Rhizocarpeæ*, two very distinct parts separate from the old plant, namely pollen grains and ovules. The former have the usual structure, consisting of a cell (the pollen-cell) and the outer pollen membrane. The ovules exhibit the following structure: a very large, firm-walled cell, containing very large starch granules, mucilage and oil (the embryo-sac), is inclosed in a white coriaceous membrane, which is formed of cells so very small as to be almost indistinguishable; this membrane forms a papilla (the nucleus) at one end, which is sometimes clothed either by three lobes of the same membrane as in *Salvinia*, or by an envelope composed of these three lobes united together so as to leave an orifice at the apex as in *Marsilea*; this is called the simple coat of the ovule (*integumentum simplex*). The whole is inclosed in a cellular sac (*sacculus*) as in *Salvinia*, or surrounded by a layer of quite gelatinous and almost confluent cells, as in *Pilularia* and *Marsilea*. The cell of the pollen grain extends itself into a longer (*Salvinia*) or shorter (*Pilularia*) tube. Simultaneously the cells of the nucleus develope toward the apex of the embryo-sac, become clearly distinguishable and more lax, filled with chlorophylle, &c., and break through the nucleus so that they project free (*mammilla nuclei*). If a pollen tube now comes in contact with these cells it penetrates deeply between them and reaches a layer of smaller green cells, immediately clothing the embryo-sac (*Pilularia* and *Salvinia*), and then expands as a vesicle; it thus displaces the surrounding cellular tissue, which however continues to develope and protrudes from the ovule as a larger or smaller green body; in *Salvinia* it elongates into two lateral, connected processes, while in *Pilularia* a portion of the cells of the upper surface extend themselves into long, hair-like fibres. In the utricular end of the pollen tube cellular tissue is developed, which, becoming the embryo, finally breaks through, with one end, the *mammilla nuclei* of the ovule, which now exhibits the appearance of a thin-walled sac; the latter on the occurrence of this process assumes the form of a round sheath (*Pilularia*), or a flat, bilabiate body (*Salvinia*). In *Salvinia* the protruding embryo forms a stem which spreads out above into a flat disc, floating on the water (*primary leaf, cotyledon*); from its point of attachment, at the lower part of a vertical fissure in it, a bud already somewhat developed produces into a little stem, bearing leaves on both sides and sending out radicles below. In *Pilu-*

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laria the protruded end of the embryo develops into an upright green filament (*primary leaf, cotyledon*), at the base of which a bud, already formed, produces a stem with long filiform leaves. The opposite end of the embryo becomes a root and breaks through, somewhat later, the green *mammilla nuclei* of the ovule, which here also appears as a sheath.



Pilularia globulifera. *A*, Transverse section of an ovule at the commencement of development; *a*, gelatinous envelope; *b*, coriaceous coat; *c*, embryo-sac filled with starch and drops of oil; *d*, mammilla of the nucleus. *B*, Pollen grains; *a*, fresh from the pollen sac; *b*, swollen in water and at the commencement of the formation of the tube. *C*, Upper part of the ovule after the penetration of the pollen tube *d*; *a*, coriaceous coat; *b*, embryo-sac; *c*, nucleus and its mammilla; *k*, layer of cells which separate the pollen tube from the embryo-sac. *E*, Pollen tube from *C* prepared free; above it shows the still uncovered portion which was inclosed in the outer pollen membrane, in the middle the more slender special tube, and below the broad expanded part already filled with cellular tissue, which develops into the embryo. *D*, Upper end of the ovule in a further advanced stage of development; *a*, coriaceous coat; *b*, embryo-sac; *c*, nucleus and its mammilla, expanded by the development of the embryo into a sac; *d*, stem-end of the embryo (*e*); *g*, primary leaf (cotyledon); *h*, pollen tube; *f*, first axillary bud; *i*, capillary, outstretched external cells of the nucleus; *k*, layer of cells which separates the embryo from the embryo-sac.

BIBLIOGRAPHICAL NOTICES.

The Physical Atlas; a series of Maps illustrating the Geographical distribution of Natural Phenomena. By H. BERGHAUS, LL.D., F.R.G.S. &c., and A. K. JOHNSTON, F.R.G.S. &c.

It is with no small pleasure that we find ourselves called upon to notice this important undertaking, especially in the improved form under which it is here presented to the British world; the comprehensiveness of the design and the care which is bestowed upon its



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