air, germination is said to be epigeal ("above the earth"). Bean and pumpkin are examples. When the hypocotyl

does not elongate greatly and the cotyledons remain under ground, the germination is hypogeal ("beneath the earth"). Pea and scarlet runner bean are examples (Fig. 48). When the germinating seed lies on a hard surface, as on closely compacted soil, the hypocotyl

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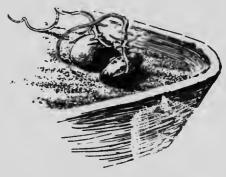


FIG. 17. — PEA. Grotesque forms assumed when the roots cannot gain entrance to the soil.

and rootlets may not be able to secure a foothold and they assume grotesque forms. (Fig. 17.) Try this with peas and beans.

The first internode ("between nodes") above the cotyledons is the **epicotyl**. It elevates the plumule into the air, and the plumule-leaves expand into the first true leaves of the plant. These first true leaves, however, may be very unlike the later leaves in shape.

Germination of Bean. — The common bean, as we have seen (Fig. 15), has cotyledons that occupy all the space



FIG. 18.— COTYLEDONS
OF GERMINATING
BEAN SPREAD APART
TO SHOW ELONGATING CAULICLE AND
PLUMULE.

inside the seed-coats. When the hypocotyl, or elongated caulicle, emerges, the plumule-leaves have begun to enlarge, and to unfold (Fig. 18). The hypocotyl elongates rapidly. One end of it is held by the roots. The other is held by the seed-coats in the soil. It therefore takes the form of a loop,

and the central part of the loop "comes up" first (a, Fig. 19). Presently the cotyledons come out of the seed-coats,