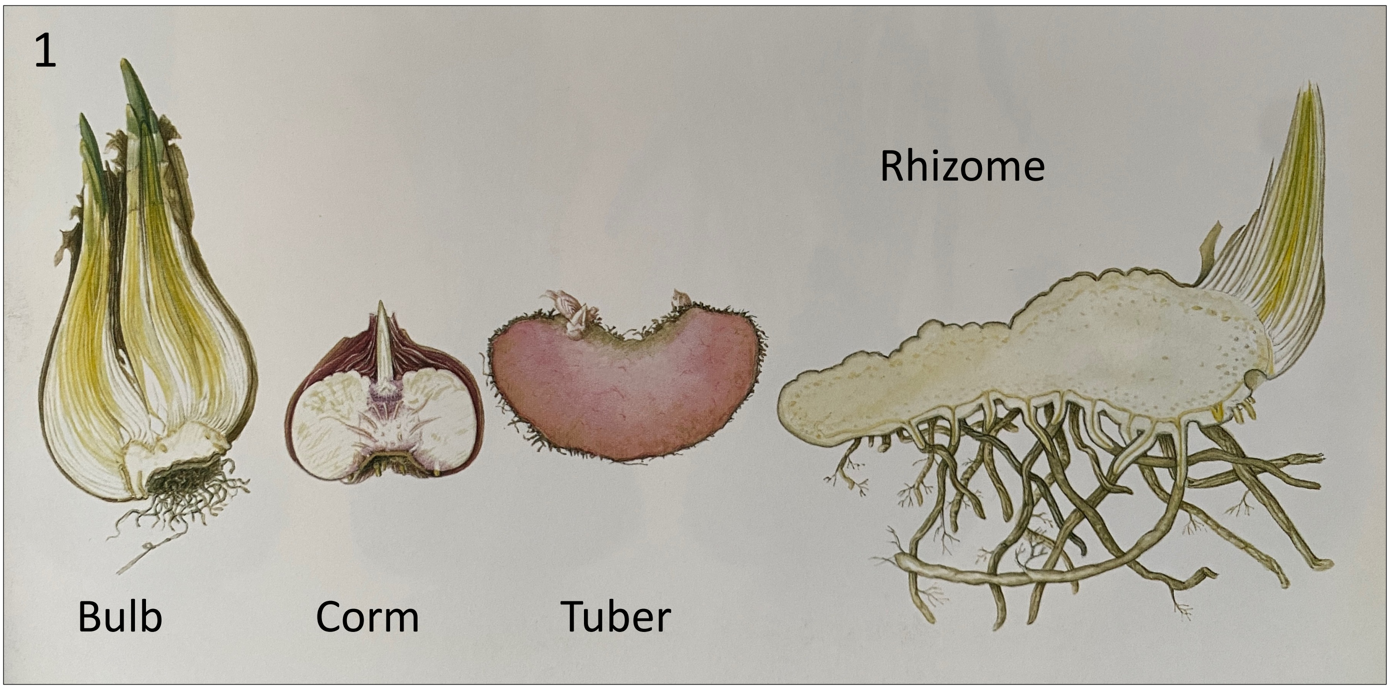
St Clement's
CAMBRIDGE

Plant Science

Geophytes: Bulbs, Corms, Tubers and Rhizomes

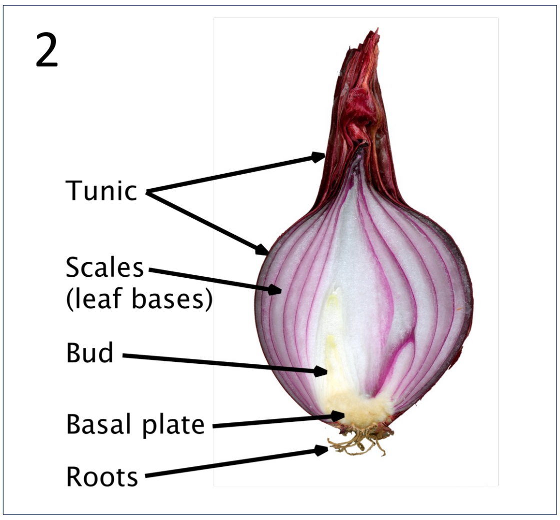
Plants that form underground bulbs, corms, tubers and rhizomes are called geophytes. They contain energy storage systems designed to navigate the low light intensities of autumn and winter, when the main method of energy production, photosynthesis, is reduced. They also provide the plant with an alternative method of reproduction - asexual vegetative reproduction – that enables it to exploit favourable local conditions by spreading rather than seeding. Geophytes have quite distinctive structures (1) which reflect the way they store energy.



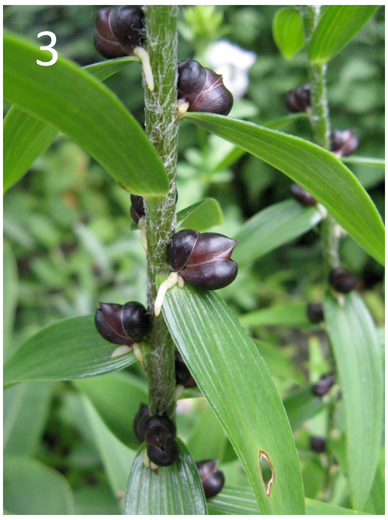
In true bulbs, such as daffodils, tulips and lilies, a short basal stem is surrounded by energy-containing fleshy **leaf scales**, emanating from a structure at the bottom of the bulb known as the basal plate from which the roots also grow (2). Buds form between the scales, and these will eventually grow into new bulbs. Onions are good examples.

Corms, which include crocuses and gladioli, resemble true bulbs, but use starchy **stem tissue** for storage rather than leaves. Similarly, tubers such as the potato, originate as swollen underground stems. Their buds, known as 'eyes', form between vestigial leaves and will eventually produce new shoots and roots.

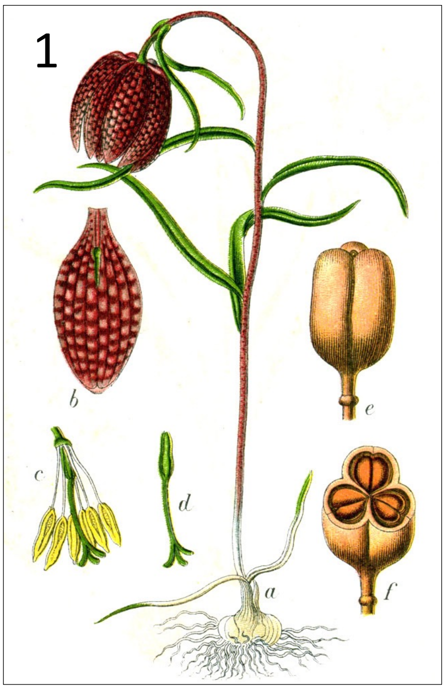
Rhizomes, such as irises, also use their stems as storage organs, but usually grow horizontally at the ground's surface.

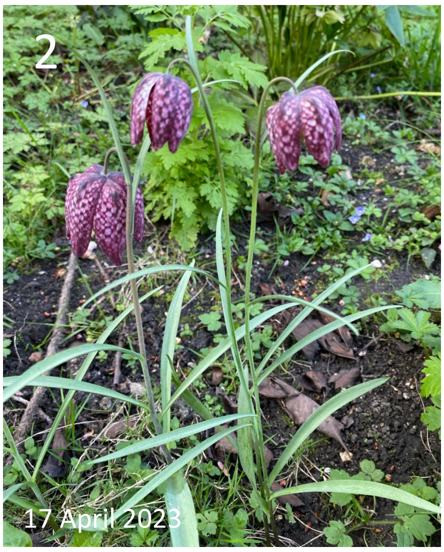


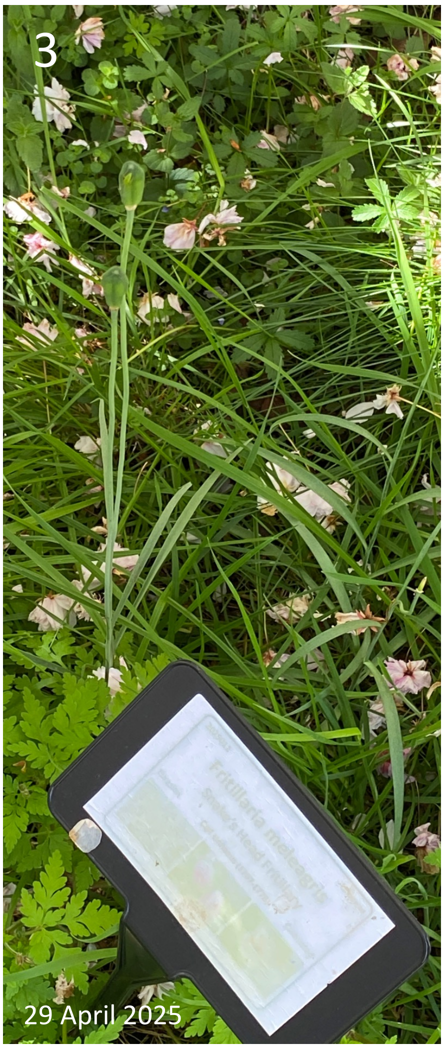
Although most of the vegetative reproduction of geophytes takes place underground, several geophytes have invested in an innovative form of aerial vegetative reproduction, producing small bulbs, referred to as 'bulbils' or 'bulblets' from their leaf axils, shown here for the tiger lily, *Lilium lancifolium* (3). Bulbils are fully equipped to hit the ground running, already bearing primordial roots! Quite frighteningly, wild garlic, *Allium vineale* (4,5), produces bulbils that start life while in the seed head itself (4). Faced with such enthusiasm, it is surprising that we are not rapidly over-run with offspring – although in the case of wild garlic we can be!



Pollination, Fertilisation & Embryogenesis







May is a quiet time, florally, in the garden – the early spring flowers are setting seed, while the summer flowers are yet to appear. Nevertheless, there's a lot going on, unobserved.

The flowers of the snake's head fritillary, *Fritillaria meleagris*, are a case in point. Their gently nodding flowers (1,2) have shed their tepals and are now developing the characteristic upright, 3-chambered fruit capsules (3) which will eventually contain a multitude of neatly stacked, triangular seeds (6,7). Key to this transition are the processes of pollination and fertilisation.

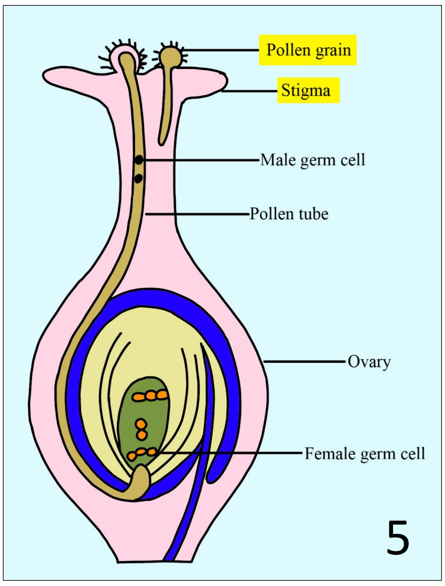
Two weeks ago, in the Newsletter, we marvelled at the great structural diversity found amongst pollen grains. The study of pollen grain structure and function is known as palynology, and is central to forensic science, linking suspects to specific crime scenes.

Pollen grains are extraordinarily resistant to environmental assaults, protected against solar radiation and desiccation by a tough sporopollenin coating: pollen grains can remain viable in the environment for many years, in some cases as long as a century. There are 390,000 species of vascular plants, each possessing its own complement of chromosomal DNA, a haploid copy of which is housed in each of their pollen grains.

In contrast to human reproduction, in which the male gametes (as spermatozoa) are motile and unicellular, in higher plants, male gametes are personally delivered to the female gametophyte (or ovum), housed within the ovule of the flower, by a pollen tube generated by germination of the pollen grain after it has alighted on a receptive flower's stigma (5). We can duplicate this process of pollen germination in the lab by suspending pollen in a sugar solution, a process which automatically induces pollen tube growth:

https://www.youtube.com/watch?v=bnu1Z49ao14

Understanding how shared biological processes such as pollination have been harnessed to create biodiversity throughout evolution is now becoming feasible using molecular biology techniques.



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ECLAS 2025

Surrounded by Miracles

This is the best time of the year for observing wildflowers in the churchyard. The cherry trees are in full bloom, early summer stalwarts such as Spanish bluebells, red campion, and ox-eye daisies, are showing promise, while the evanescent spring flowers such as primroses, hellebores and fritillaries are gradually fading from memory, all to an underlying fauxbourdon of forget-me-nots and herb Robert.

But what may not be so obvious, except to unfortunate hay-fever sufferers, are the billions of pollen grains produced by these blooms which are either floating in the air or being assiduously garnered by roving bees and other pollinators (1).

Pollen is an invisible miracle, made manifest in all its three-dimensional splendour largely by the work of Cambridge scientists such as Sir Charles Oatley (2), who worked on a magical microscope, the scanning electron microscope (SEM) in the 1950s. The development of the SEM is a fascinating story – as is the career of Oatley himself, who began his research career as an undergraduate at St Johns in the 20s, worked on radar in World War II, and ended up as a Fellow of Trinity:

http://www-g.eng.cam.ac.uk/125/achievements/oatley/cwo1.htm

Pollen from a variety of common plants is shown as a composite from Wikipedia (3): sunflower (*Helianthus annuus*, small spiky sphericals, colooured pink), morning glory (*Ipomoea purpurea*, big sphericals with hexagonal cavities, coloured mint green), hollyhock (*Sildalcea malviflora*, big spiky sphericals, coloured yellow), lily (*Lilium auratum*, bean shaped, coloured dark green), primrose (*Oenothera fruticosa*, tripod shaped, coloured red) and castor bean (*Ricinus communis*, small smooth sphericals, coloured light green). The image is magnified x500, so the bean shaped grain, bottom left, is about 50 µm. Also shown, at higher magnification, are pollen grains from the Common Daisy (*Bellis perennis,* 4) and Timothy Grass (*Phleum pratense,* 5).

Despite their inanimate appearance, pollen grains contain highly active DNA which will soon be on its way to fertilising receptive ovules in neighbouring flowers – what a miracle!