MYTHICAL CLYTIE'S GYRATIONS STILL SPIN AT THE TOP OF THE WORLD

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It is almost magical that some flowers, which we expect to stay put, move as the sun moves across the sky. Plants around the world, which include a surprising number from the Arctic, have a habit of tracking the sun.

Scientists seek reasons for such sun-wise plant behaviour, but the first attempts to explain it come from ancient myth. Consider the story of Clytie. She appears in Metamorphoses, a collection of mythical tales written in about 8 AD by the classical Roman poet, Ovid (Publius Ovidius Naso, 8; Golding and Forey 2002). Ovid's characters often transform into plants and animals, thanks to capriciousness, fate and the whims of Titans, gods and their offspring. Lovestruck Clytie is no exception. Clytie pined after the sun god (Figure 1), Helios, a.k.a. Sol, whose amorous attentions were for Leucothoe. Clytie became a flower that followed Helios' every move. It is a timeless tale of fixed and unquestioning love, feminine jealousy, and masculine indifference [1].

Scholars often assume that flower Clytie became is the heliotrope (*Heliotropium europaeum*). The first part of the Latin name, *Heliotropium*, literally means, 'turning with the sun'. 'Diaheliotropism', the term used by botanists to describe plants that clock the sun's motions, also shares those same linguistic roots. However, despite its name, the five-petalled heliotrope flower

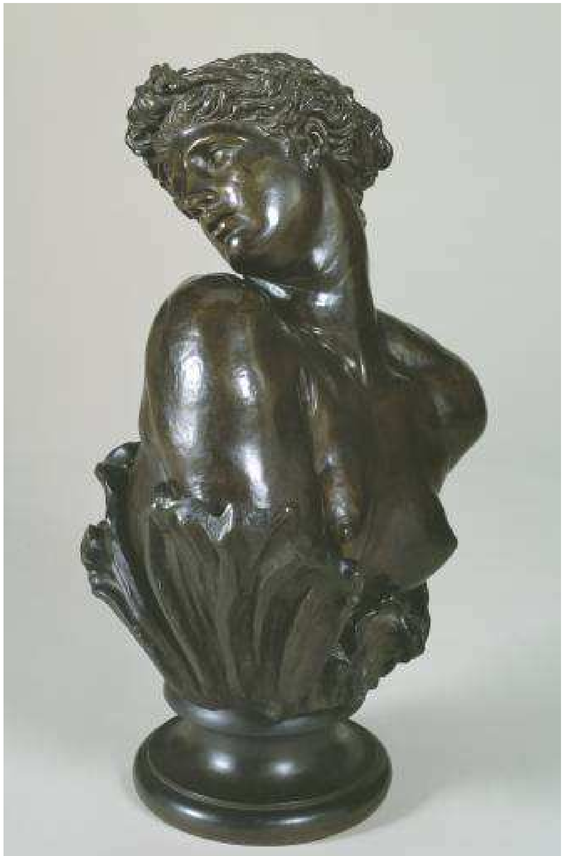

Figure 1. Bust of Clytie, head craning round and surrounded by sepals. Sculpture by George Frederick Watts (ca. 1878) (Tate Gallery, London, UK)

may not deserve its reputation for faithfully moving with the sun.

Another candidate might be the starburst-like meadow salsify, or Shepherd's clock (*Tragopogon dubius*). Its pale yellow heads trace the sun's passage for only half the day then close: "Johnny-go-to-bed-at-noon". Long known in Europe, salsify is now a common North American weed. Despite its sun-following habits, the common sunflower (*Helianthus annuus*) ('girasol' in Spanish, 'tournesol' in French) is not in the running: it is a North American plant, unknown in ancient Europe.

[1] Ovid in Metmorphoses (IV:204, 234 – 256) describes Clytie as rooted to the ground, having greenish, bloodless, but partially red hands adhering to the ground, and her face hidden in a flower similar to that of a violet and that gyrated to face the sun for nine days.
Reports that the leaves of *Heliotropium* turn to the sun and that it flowers at the summer solstice are equally suspect.

*Figure 2. Arctic aven (*Dryas integrifolia*) flowers seeking the sun*

Much farther north than Ovid's Italy, the Arctic is home to a number of Clytie-esque plants that know the sun's daily movements very well (Figures 2 – 5). They provide clues as to how wise these plants are in their use of the sun's movements. Two plants, iconic of the Canadian north, have flowers that gyrate to track the sun. They are the Arctic aven (*Dryas integrifolia*) (Figure 2, 3), floral emblem of the Northwest Territories, and the Arctic poppy (*Papaver radicatum*) (Figure 4), emblematic of Nunavut. Dryas, too, may be named for a mythological woodland nymph (one of the Dryades). The word, which means 'oak' applies to several mythic characters.

The Arctic poppy epitomizes Clytie's plight better than any plant. It can turn its pale yellow flowers even to face the midnight sun (Kevan 1972, 1975, Corbett et al. 1992, Molgaard 1989). The aven, meanwhile, can track only for 8 to 12 hours while the sun is in the south (Kevan 1972, 1975). Other northern flowers also fit the bill (Kevan 1972). The Arctic anenome's (*Anenome parviflorum*) delicate white head follows the sun for at least part of the day. The mastodon flower (*Senecio congestus*) (Figure 5) can also bend its shaggy, multiple daisy heads towards the sun when the sun is high.

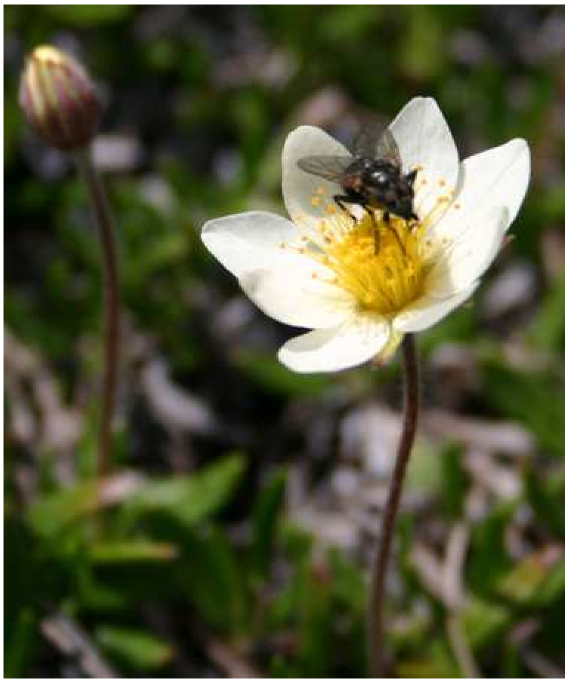

Figure 3. A fly feeding and pollinating on a sun-wise blossom of Dryas integrifolia

*Figure 4. Rain-soaked Arctic poppies (*Papaver radicatum*) with flowers transfixed, pointing to the most recent sighting of the sun*.

Why is the North home to so many of Clyte's disciples and why do they show such remarkable devotion to the sun?

In the short, cool summers of the north, heat is at a premium. Heat speeds growth and maturation. For flowers, the prime directive is in procreation. Pollen must be transferred. Plants have egg cells, called "ovules", which, when fertilized, become embryos with storage tissues of the seeds. The seeds mature and are released for propagation and colonization of new sites. Facing the sun is naturally warming. So the longer a flower faces the sun the more heat it captures. Clytie's desires were not consummated, but sun-tracking flowers can fare much better.

Even more remarkable is the shapes of the flowers of poppies, avens and anenomes. They are not simply bowl-shaped, but form cups that resemble headlight reflectors, flashlights, dish antennas, and radio telescopes. And, they work in the same way! The sun's rays stream into the flowers' parabolic bowls, whose petals reflect the energy onto the central focus of the flower. That focus contains the flowers' complex female organs, the pistils, with sticky terminal stigmas, that stand ready to accept pollen and be fertilized.

Pollen is supplied by male organs, 'anthers', of the same or another flower, depending on the plants' reproductive needs. Pollen grains germinate on the sun-warmed stigmas, grow down through the style to release sperm-like cells that penetrate the floral ovary at the flower's base where fertilization occurs! For the avens, insects bring the pollen to the stigmas from other flowers, cross-pollinating them. Arctic poppies are self-contained, though insects sometimes sit within the flowers.

Solar heating continues as long as the flowers turn to face the sun. So long as the weather is sunny and calm, flowers benefit hugely. Arctic avens and Arctic poppies elevate their internal floral temperatures by 6 to 8 C for about half to one-sixth of their short flowering lives (Kevan 1975, Kjelberg et al. 1982). That means the flowers gain 25% and 8% (respectively) more heat-units (called growing degree days) to grow in the short, cool summer (Kevan 1975).

Not only is floral maturation and seed production accelerated, flowers facing the sun receive more attention from pollinating insects, including mosquitoes. The insects too, basking in the flowers, gain from the heat (Hocking and Sharplin 1965, Kevan 1975). They may become almost twice as warm as the air surrounding the flowers while feeding on rich sugary nectar or protein-rich pollen, or just even sun-bathing.

Why doesn't Clytie's head simply twist itself off as the stiff floral stem spins around?

As diaheliotropic flowers grow, it turns out, their stems elongate. Plants bend towards light, phototropism, by growing faster on the shaded side. Clytie's head, while following the sun, always lags slightly behind it, making a tiny difference in illumination, lighter to the clockwise side and shaded to the counter-clockwise side. The floral stem on the shadier side grows slightly faster, tilting its flower sunward. Clytie's neck elongates, but does not twist, as her whistful gaze traces its spiral path,

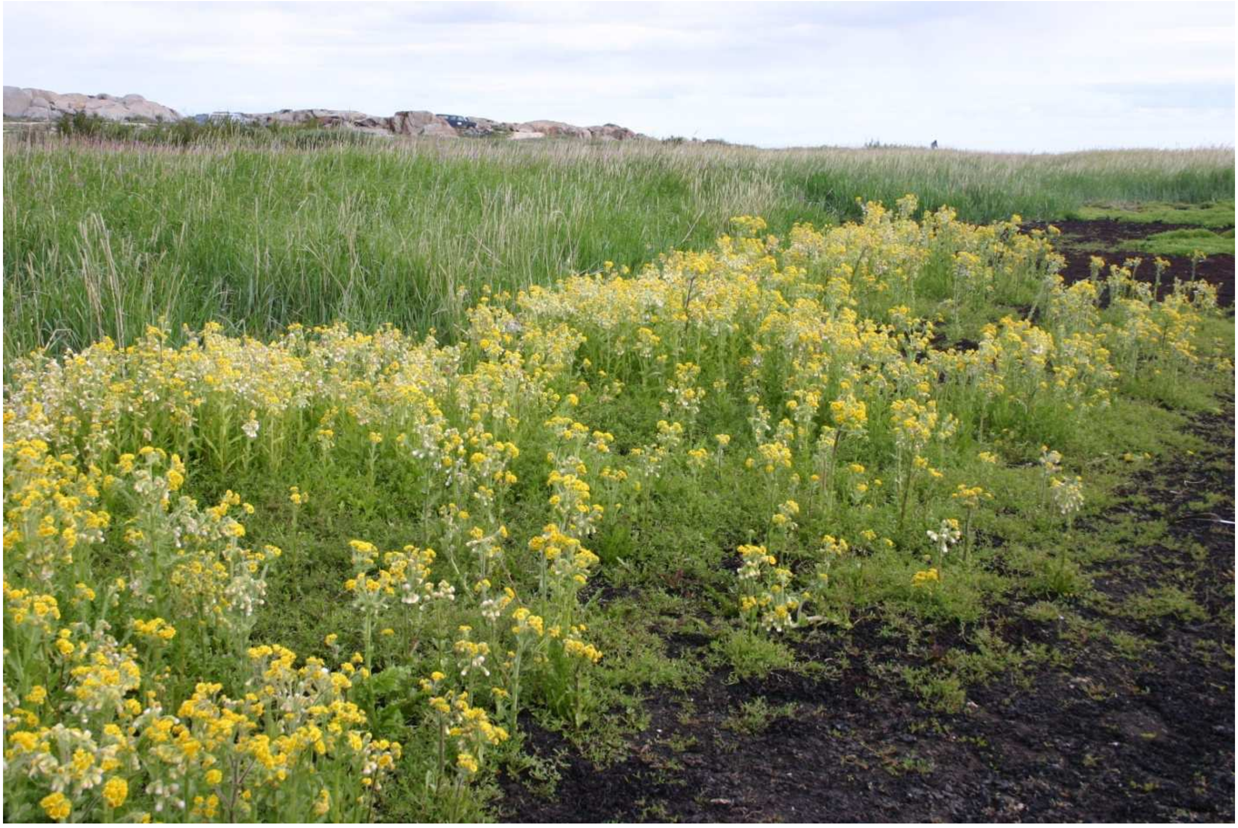

*Figure 6. Herds of Mastodon flowers (*Senecio congestus*) on the shore of Hudson Bay. Their hollow stems become warmed in the sun and the heat accumulation probably allows for very rapid growth and flowering.*

warming the cockles of her desires, while she remains indifferent to the science that explains her behaviour.

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