

**The
Birmingham
Botanical
Gardens
Study Centre**

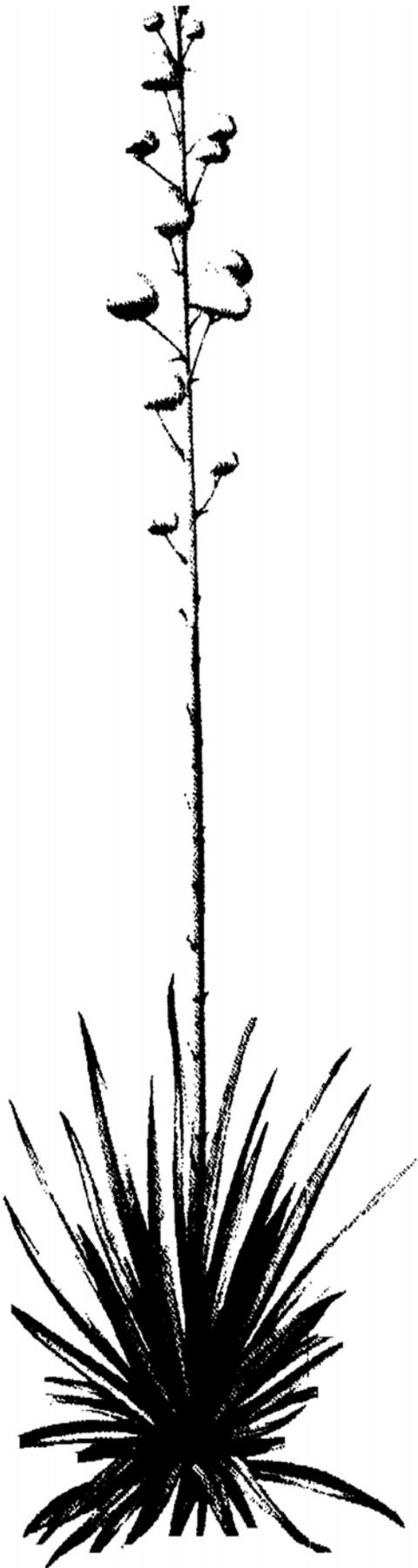
**Desert
Trail**

**(Plant adaptations to
an arid environment)**



The Birmingham
Botanical Gardens
& Glasshouses

 **Birmingham City Council**
Learning and Culture



Setting the Scene

This glasshouse simulates a hot desert, however at night, temperatures do drop and may have seasons which sometimes can be divided into cool winters and hot summers. Desert soil is rocky, gravelly, sandy or a combination of these.

Desert plants are structured to survive harsh conditions. Shown in this glasshouse are common adaptations of desert plants to help with:

- **Water conservation.**
- **Protection from solar radiation.**
- **Protection from animals.**

Plants usually have more than one of these features.

The main form of plant in this glasshouse is the succulent. This is divided into two types:

- **Stem succulent**
- **Leaf succulent**

Deserts

- Deserts are areas with less than 25cm of rain per year, with little or no vegetation.

- The overall temperature of deserts varies depending on where they are found in the world.

- Temperatures can range from 50 degrees Centigrade with intense light and heat by day, to zero degrees or below at night.

- The sky is often cloudless by day giving a low humidity of 15% becoming high to saturated at night.

- Soils are mainly coarse minerals with little or no organic content (humus) and poor water retention. Some deserts have underground water accessible to very deep tree roots.

- Deserts cover 1/5th of the world's land mass and surprisingly; produce 1/5th of the world's food.



Protection From Animals

Succulents are plants that store water; these are very attractive to animals, so they need to protect themselves.

This is done by various means:

- Prickles e.g. *Ferrocactus*
- Thorns e.g. *Yucca*
- Bitter or poisonous sap e.g. *Aloe*
- Camouflage e.g. *Lithops* (flowering stones)



Water Conservation

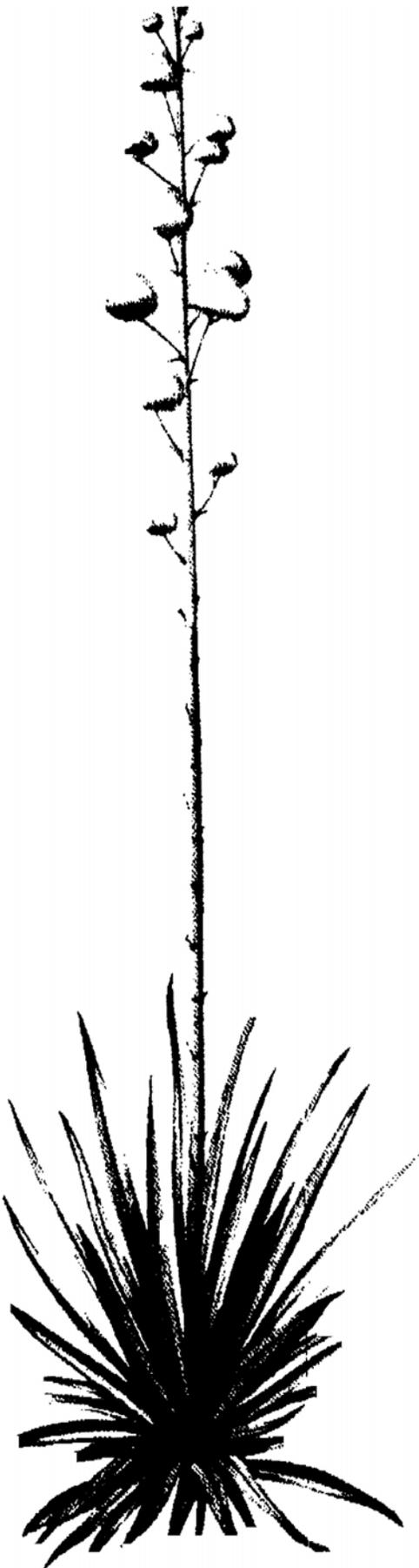
Succulents store water in two forms:

- **Stem Succulents**

Here the stem is swollen with water inside a thick rubbery skin to prevent it being lost. To reduce the surface area from which water can be lost, there are no leaves. Therefore the stem is green to allow the plant to carry out photosynthesis. The barrel-shaped cacti often use their ridges to change shape, expanding and contracting as they store and use water e.g. *Trichocereus*.

- **Leaf Succulents**

Here the water is stored in thick, fleshy leaves with a rubbery skin. Some plants have no stem but gain height by adding leaves on top of each other. After a while the lower leaves fall off leaving the bases to become woody e.g. *Agave*.



Solar Radiation

Deserts are usually very hot, especially during the day, so the plants need protection from this heat.

There are three major adaptations:

- **Vertical orientation**

A stem pointing upwards reduces surface area of the plant being exposed to the sun e.g. *Opuntia* (Prickly pear), *Euphorbia*.

- **Presence of hairs**

Hairs reflect sunlight and help keep the plant cool. Plants from higher altitudes also need the protection of hairs due to dangerously high levels of ultra violet light e.g. *Cleistocactus*. Some plants have 'sunhats', extra hairs on the vulnerable top of the plant e.g. *Euphorbia*.

- **Ridges**

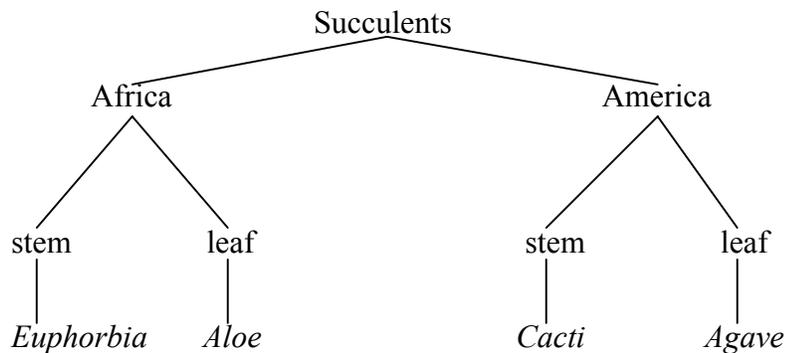
These cause shadows around the plant helping to keep it cool e.g. *Astrophytum*.



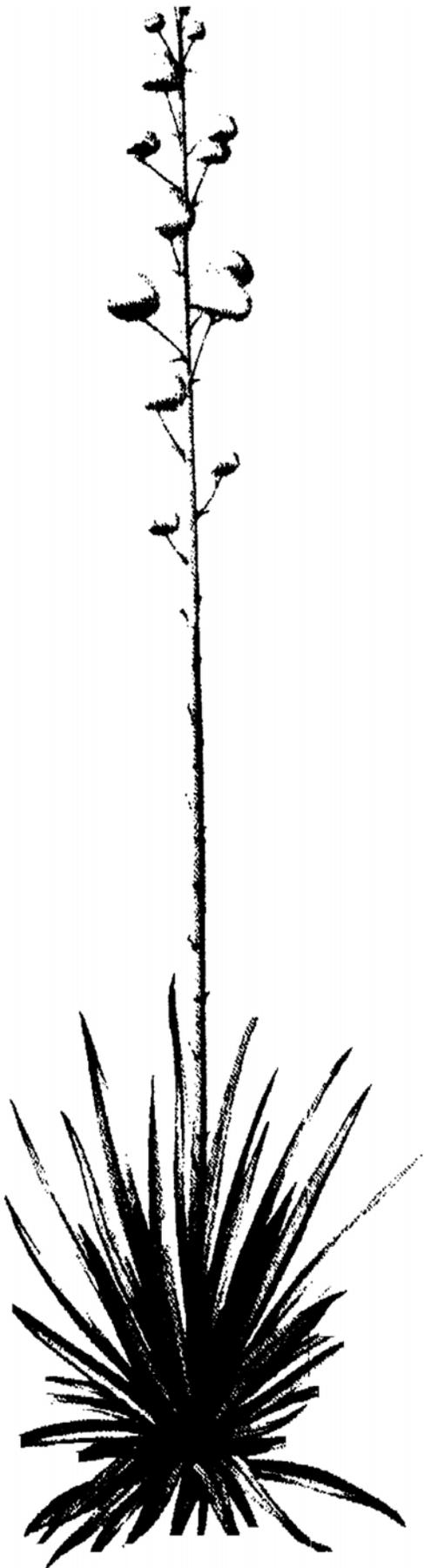
Parallel Evolution

Plants on different continents have evolved similar forms, wherever there are similar conditions. For example, some euphorbias have adapted to desert conditions in Africa and are the equivalent of the American cacti. Both are succulent, have a thick rubbery skin, ridges, prickles and green stems. Euphorbias also have white milky latex inside to heal wounds and prevent water loss.

Use the classification below to find examples of the different types of succulent from two continents. What are their similarities and differences?



Humans have moved these plants around the world so wherever dry desert conditions are found, these plants will successfully grow.



Environmental Concerns

Our influence - good or bad?

- **Desertification**

There are pressures from farming at the edges of the desert. Pastoral nomads with their overgrazing and over cultivation are also actively extending the deserts.

- **Irrigation**

For thousands of years farmers have used simple technology to supply water to their fields, having little lasting impact on the environment. Irrigation using modern technology can result in greater commercial production of economic plants. However, in the process this lowers water levels, increases salination and changes the nature of the natural vegetation.

- **Introductions**

Opuntia plants were moved from South America to Australia, but with no natural enemies it became an invasive weed. A moth was eventually introduced from its native habitat to act as a natural biological control.

- **Decoration**

Succulents are being removed from the wild to be used as garden and houseplants. Cacti collectors also pose a considerable threat if plants are removed illegally without thought to the natural environment.



Economic Plants

- **Sisal**

Leaves yield a fibre used for string and rope. Now mostly replaced by nylon.

- **Aloe vera**

Long history of folk remedies for burns and cuts of the skin. Bitter Aloes are a deterrent to children biting their fingernails. Commercially used in cosmetics such as face creams and hair products.

- **Agave**

The sap is a soothing and restorative remedy for many digestive ailments. Tequila is a Mexican drink made by distilling the fermented sap.

- **Opuntia cochenillifera**

The plant is used to breed an insect called cochineal, which is harvested for its red colour, once used to colour lipstick.

- **Prickly Pear**

Grown for its fruits that help quench a thirst.

