BIO-STRUCTURAL ANALOGUES IN ARCHITECTURE

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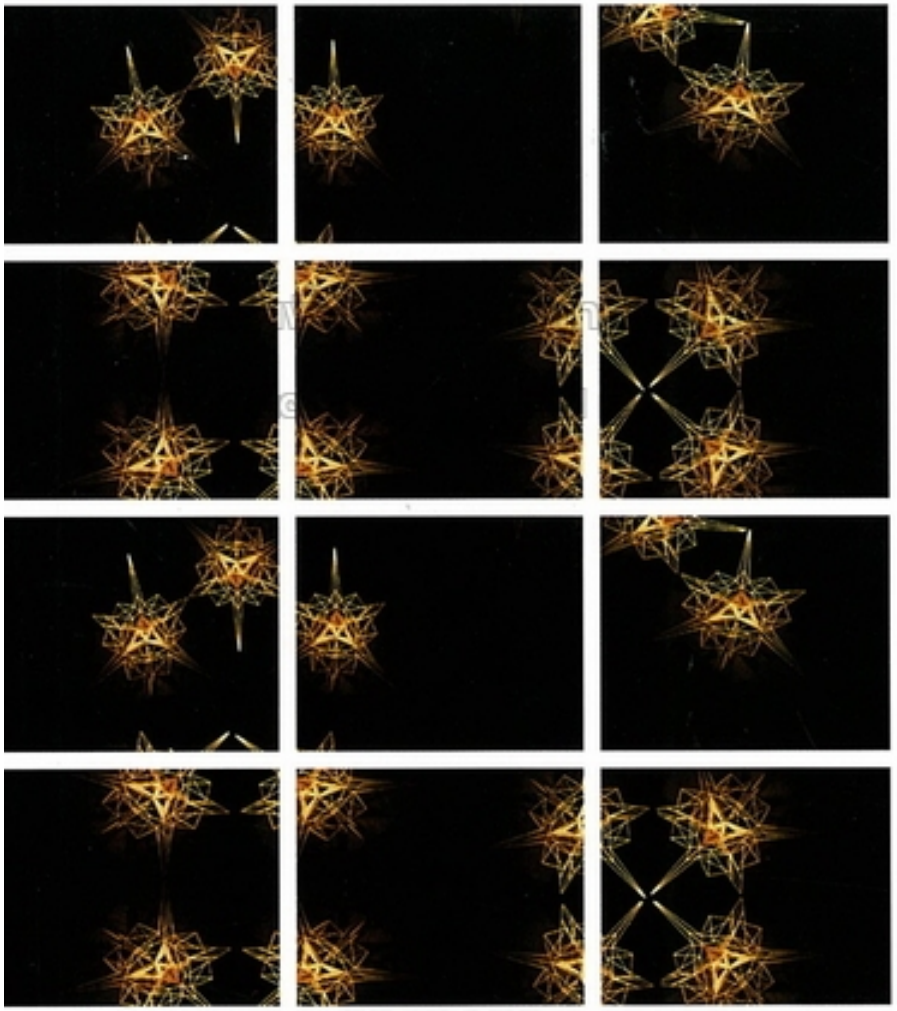

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FAMILY *PONTEDERIACEAE*
Genus Eichhornia crassipes (Water Hyacinth)

Water hyacinths, otherwise known as *Eichhornia*, are floating aquatic plants. The petiole has an air-filled structure enabling it to float on water. Its roots are feathery and grow underwater. Air sacs are joined together as a group of floats to hold up the water hyacinth leaves for photosynthesis. A single air sac is unable to hold the leaf as it overturns in water.

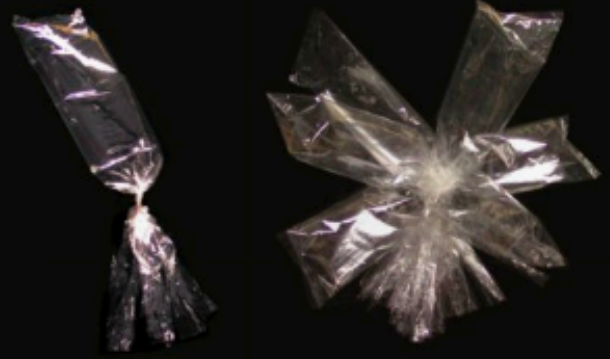
Initial studies to establish a stable configuration for the air sacs involved filling up long plastic bags and balloons with air. The ends of the plastic bags were cut into strips to act as roots. When several plastic bags were tied together and placed on water, they were able to float. But when loaded, they became unstable, were easily displaced and toppled. A second study to arrange the bags in a pattern that could float and support load followed. The water hyacinth stays afloat with air sacs distributed throughout the plant attached to the base of the petiole, in a radiating pattern on plan.

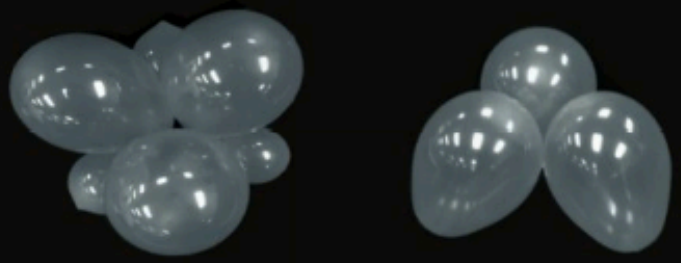
In another study, balloons were used as hyacinth air sacs and arranged in various geometric configurations on water. It was discovered that triangular patterns were the minimum necessary to prevent overturning on load application. To simulate pneumatic floats, balloons were glued together standing on their ends as an optional stable configuration. The extent of the balloon below the water line would determine the usability and positioning of space beneath the water.

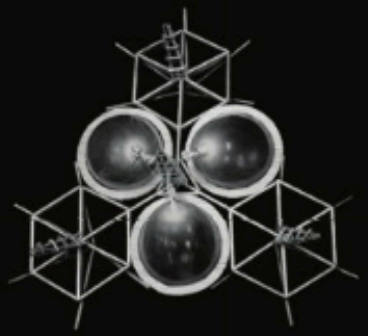
After discovering a stable arrangement for the balloons to stay afloat whilst under load, floor decks with which to create usable floor area were configured to create a form of pontoon structure. A rigid hexagonal frame defined a platform with which to extend the usable area of the floats themselves.

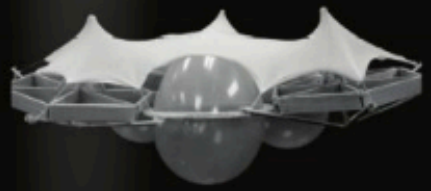
The abstract analogue of the hyacinth was thus a series of three hexagonal platforms cantilevered from three inflated hulls, acting as primary floatation devices. The inflated hull could be made in PVC as a pneumatic structure and cable tied to ring beams acting as "collars" connecting hull to deck. A tensile roof fabric was selected as an appropriate structural form with which to define space over the hexagonal decks and curvilinear hull forms. The fabric was stretched over the masts and tensile forces were transferred via cable to hexagonal floor frames that connected back to three main ring beams each supported by a pneumatic hull.

Roof configurations were studied to provide enough cover and headroom over the hexagonal decks and the connecting sections in the centre of the three inflated hulls. The final roof form freed sufficient space required for movement between decks and maximised water views.

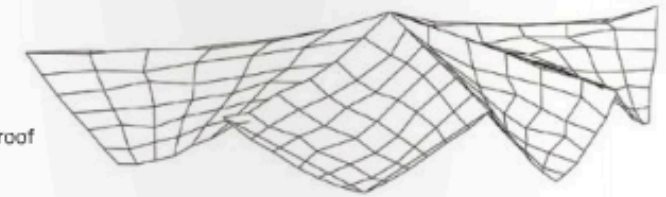








membrane roof



viewing decks

deck structure

twin layered inflatable structure