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## USE OF NATURAL AROMAS AS AN ARCHITECTURAL DESIGN ELEMENT IN LUNAR HABITATS

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### **Abstract**

Among the many aspects of environmental control in a lunar habitat is that of regulating the atmospheric chemical composition. After meeting acceptable standards of safety, health and personal acceptance for long stays, the question arises as to how the atmosphere could be made an aesthetic, architectural component of the total living experience. In the vast history of the global fragrances industry it is clear that the well-known physiological and psychological connection between smells and memories can be exploited in many ways. Here, we intend to discuss the advantages of enabling habitat dwellers to enjoy their own individual choices of atmospheric trace components, with a likely preference for familiar and pleasant natural plant aromas. When the paper is presented, an example of the iconic shrub of the Californian desert, the creosote bush, *Larrea tridentata*, will be passed around for an olfactory treat.

### BACKGROUND

The architectural design of lunar habitats offers many opportunities for ingenious and unconventional solutions to the problem of making people feel at home. Constrained by the need for protection from the lunar environment and by likely limits on habitat size (at least in the early stages of lunar settlement) the architect must seek every way to provide surroundings that positively support the inhabitants, not only for the minimum vital functions of safety, physical and psychological health and productivity but also for a varied and stimulating aesthetic experience.

Here we discuss the possibility of making the habitat experience more enjoyable through aromas. Obviously it is not sufficient, indeed it would be harmful, to introduce fragrances into the whole interior atmosphere, if only because different people have different aroma preferences. Ways to provide an individual and changeable olfactory adventure are essential.

### PHYSIOLOGY AND PSYCHOLOGY

The easily-observed connection among smells, memories and emotions has been the subject of much research, and its physiological basis is clear: olfactory sensors in the nose communicate directly with the related regions in the brain (Refs. 1 and 2). Experiments confirm that aroma memories formed early in life persist strongly and evoke emotions even into old age.

From the point of view of a lunar-habitat architect these physiological and psychological findings enable the designer to take advantage of an established human trait, adding one more way to provide a supporting aesthetic experience.

### TECHNICAL CONSIDERATIONS

Astronaut experience suggests that providing individually-selectable natural plant aromas could be a useful addition to the measures already known for enhancing sensory experience in long-duration habitat stays (Personal communication with R. Thirsk, July 2010). The supply of smell choices, however, must be done in such a way as not to introduce significant volatiles into the general habitat atmosphere.

One way to meet this constraint and still give the desired availability and flexibility of choice would be to package the scent sources in small sachets, delivered in sealed containers to be opened on demand, perhaps in private spaces or within small and convenient face masks.

Whether or not this constrained means of delivery, requiring voluntary action as distinct from just giving a momentary aroma experience, would diminish the resulting pleasure is a question that could be answered by experiments.

The idea of carrying scents in sachets to enhance life and productivity in an alien world, enclosed in an unforgiving and hard technology environment seems very useful, especially during the primary stages of infrastructure development, when there is a dearth of natural flora and fauna.

Such surroundings, that we take for granted here on Earth, are absent in small and tight spaces, designed for primary life support of crew during tours of duty ranging from a few weeks to a few months.

John Young commented on the smell of lunar dust as comparable to that of gunpowder inside the Lunar Excursion Module as he removed his helmet after EVA. The dust that the crew had tracked in from the lunar surface contributed to this memory.

Scents bring up memories, both pleasant and unpleasant. Olfactory mechanisms impact appetite, not to mention that they also warn occupants of dangerous situations such as fires.

Aroma therapy is a form of treatment that appears to have some effect on patients suffering from migraine and other stress-related mental conditions and might be exploited to adjust crew productivity and temperament.

Here we do not advocate aroma therapy in lunar habitats, simply because not enough is yet known about the interrelations among crew needs and habitat architecture. What we do suggest is that a voluntary, individual, selectable aroma experience could be beneficial, and we advocate Earth-based experiments to evaluate that possibility.

The fragrances industry boasts a very mature and established tradition and could provide insight into technologies that can be used for highly selective dispensation of scents to crew. Advances in microencapsulation and nanotechnology also may offer some very useful products.

The electronic on-demand mixing of molecules to form a variety of aromatic hydrocarbons may also offer a venue to explore in the production of simulated scents, thereby reducing or eliminating the need to carry a variety of vials for the expedition.

A forceful demonstration of the links among scent, memory and emotion can be provided with the aid of the ubiquitous shrub of the California deserts, *Larrea Tridentata*. The common names of this plant are greasewood and creosote bush, the latter being somewhat of a misnomer as its fragrance has no resemblance to that of the tar-derived industrial wood preservative used for utility poles and railroad ties.

Anyone who has lived or camped in or otherwise enjoyed these deserts will acknowledge a strong surge of pleasurable emotion upon perceiving the familiar and unmistakable scent, even many years after the experience.

This is but one example of what could be done in a lunar habitat to evoke feelings of being at home. Tests with a variety of human subjects and a variety of natural plant aromas could be an interesting and rewarding prelude to the architectural design of living spaces for the Moon.

#### REFERENCES

1. Angier, N. (2008), The Nose: An Emotional Time Machine. New York Times, 8 August
2. International Symposium on Olfaction and Taste (2008), San Francisco, 21-26 July