Reduction of the photoperiod in Antarctica

In Antarctica, the seasons are reversed in relation to North America. Meaning that, while Quebec partakes in the joys of summer, we'll be squaring off with the austral winter.

The closer you get to the poles, the more days vary in length depending on the season. In the Antarctic, as in the Arctic, winter is the season of the longest night. It's true that for us, and ever since the March 21 equinox, the nights are longer than the days. This will continue to be the case until September 21, the approximate date of the Antarctic's spring equinox.

Here are a few definitions worth mentioning:

. ➓ **Equinox**: either of the two times each year when the sun crosses the equator and day and night are everywhere of equal length, in other words, approximately March 21 and September 21.
. ➓ **Solstice**: longest or shortest day of the year, in other words, approximately June 21 and December 21.
. ➓ **Polar circle**: place where, at winter solstice, the day is so short that the sun does not even rise above the horizon. Corresponds to about latitude 66°33'.
. ➓ **Photoperiod**: day length period.

Effects of light deprivation

Because the *Sedna* is currently moored near the polar circle, day length will shrink considerably until the solstice, only to slowly increase afterwards. We will therefore have to deal with substantial light deprivation for about four months straight. We know that light plays a major role in the equilibrium of mammals in general and human beings in particular. Day-night alternation synchronises the body's internal clock to a 24-hour period, a cyclical phenomenon called the circadian rhythm. Research on the subject has shown the importance of day and night cycles on a neuro-hormonal level; a stable circadian rhythm is therefore essential to physical and mental health.

Everyone has a genetic base rhythm, which can change according to habit and environment. Actual synchronisation of the circadian rhythm takes place in the brain, in the suprachiasmatic nuclei, just behind the eyes; these nuclei receive light information from the retina and reset the daily oscillator each day.

The blind often have problems maintaining a circadian rhythm of 24 hours due to a lack of suprachiasmatic nuclei stimulation. Another common example illustrating the circadian cycle is jet lag, which is experienced by many travelers every day around the world and characterised by daytime sleepiness and temporary insomnia in the new time zone. Fortunately, this only lasts for a few days after which the traveler adapts his/her cycle according to the daily rhythm of the new location.

Melatonin is a neuro-hormone involved in the jet lag syndrome as well as in the behaviour of hibernating animals. Bright light inhibits the secretion of melatonin. Produced in the brain by the pineal gland, it plays a major role in regulating the sleep-wake cycle.

Several other hormones are secreted cyclically, **serotonin,** for example, is connected to such mood disorders as depression. It is quite interesting to note that while serotonin possesses a cycle based on sunlight, in other words, it's production peaks every 24 hours and variations are based on seasonal change, other hormones, such as the ones that affect the menstrual cycle, seem to be based on the lunar cycle, which is roughly 28 days. Obviously, our biological equilibrium is heavily influenced by our environment.

To feel good and remain healthy, we therefore need restorative sleep. Did you know that even your memory and immune system need quality sleep to function properly? Of course, needs in terms of sleep vary from one person to the next. But it's a known fact that for sleep to be restorative, the body's internal clock cycle must be stable. When day length decreases dramatically, the human body clock can become misaligned. As a result, sleep quality is affected and the person could suffer from various symptoms:

- chronic fatigue
- loss of concentration
- memory disorders
- irritability, depressed mood
- dysfunction of the immune system
- hormonal imbalance, changes in the menstrual cycle
- weight loss or weight gain
- chronic sleep disorders
- increased risk of accident

This last point clearly illustrates the risk of a vicious circle settling in, one in which a person doesn't get quality sleep due to a misalignment of the human body clock and yet, ironically, has problems falling asleep in spite of fatigue! In some cases, it's quite difficult to reverse this downhill spiral.

Circadian rhythm disorders and light therapy

In most cases, when the biological clock is "off course", the best way to "reset" it consists of exposing yourself to bright light every morning at the same time, no matter what. Most neurotransmitters and hormones will subsequently return to a regular cycle and the body will return to its homeostasis, it's state of equilibrium. Studies show that exposure to 10 000 Lux* of light every morning for 30 minutes can reset the circadian oscillator in just a few days. There's no need to look directly into the light; you simply need to recreate the "outdoors" effect, which is what we all need to do for our well-being and what our ancestors, who gave us this genetic trait, did naturally. Special full spectrum lights equipped with UVA and UVB filters actually imitate sunlight and can prove useful in a context such as ours where the light of day is simply not

available. Lights such as these were kindly donated by Monique Paré of Northern Light Technologies, www.alpha-lite.com

Dr. Cook, the physician aboard the *Belgica*, the first boat to have ever wintered over in the Antarctic, in 1898, was the first to have documented the devastating effects of prolonged light deprivation. The medical world now recognises that cases of seasonal depression respond well to light therapy alone. Light therapy has also been used in conjunction with anti-depressants in cases of severe depression; one study showed symptoms were more likely to disappear faster and for longer with a combination treatment. This new and promising therapeutic avenue will no doubt be the subject of more in-depth studies in the years to come: we're only at the dawn in this field of research!

*Lux: unit of illuminance used to measure the intensity of light. One Lux corresponds to the illuminance cast on a surface by a one-candela source one meter away. On a sunny day in a snow-covered environment, the amount of light we receive exceeds 100 000 Lux, whereas on entering a building, whether it's a house with incandescent bulbs or an office with neon lights, we'll be lucky to receive even 500 Lux.

Research aboard the *Sedna*

The *Sedna* crew agreed to participate in a study to evaluate the psychological impact of wintering in the Antarctic. Dr Peter Suedfeld, head of research in psychology at the University of British Columbia, heads up one of the few studies conducted on the positive aspects of human adaptation to conditions of isolation, such as those that exist when wintering-over in the Antarctic.

There are two principal objectives to this ongoing study:

1. To gain further insight into the coping strategies used by individuals confined to conditions of isolation in an extreme environment in order to better understand the effects of these conditions on individuals and on the dynamics of a work group.

2. To improve the candidate selection process for future missions involving prolonged periods of isolation. These would include, for example, astronauts on space missions lasting several months, conditions that are, at least partially, quite similar to those that prevail on the *Sedna*.

One of the most important aspects of this kind of selection process consists of identifying the characteristics that make it possible for individuals to better cope with difficult situations, not only thanks to their professional skills but to their social skills as well, thus optimising relationships between crewmembers and consequently overall group dynamics.

The amount of stress handled by an individual involved in this type of project is not only linked

to difficult environmental conditions but to human situations as well: internal conflicts, communication deficits, inappropriate reactions, the hardship of isolated living, promiscuity, being away from family and friends. Special attention will be paid to the coping mechanisms that could surface during difficult situations.

Another important variable will be the photoperiod, which will go from 20/24-h in December to 4/24-h in June over the course of the study. This extreme variability will be considered during data analysis.

As for the methodology, data will be analysed after it has been collected from the questionnaires and log books crewmembers have been voluntarily filling out and compiling on a weekly basis ever since their arrival onboard. This data collection will continue on for four weeks following mission return.

Only one study has ever been published based on facts taken directly from crew log entries (Stuster, Bechaler, and Suedfeld, 2000). The opportunity of obtaining log books containing frequent and consistent entries is therefore a very precious and practically unique tool indeed.

Each log book, with its weekly and monthly entries, and questionnaire will be used by the researcher and his team to analyse the behaviour, level of activity, coping mechanisms, reaction to isolation, psychological signs, and symptoms of each crewmember according to time and events.

Dr. Suedfeld was, for many years, head of the Canadian Antarctic Research Program. He is currently working closely with the Canadian Space Agency and the NASA. To learn more about his impressive background and view a summary of his research, click here.

Throughout the entire Antarctic winter, we will therefore be focusing on the resilience of our crew. What could be more motivating for the health team?