

Reaching outward to space

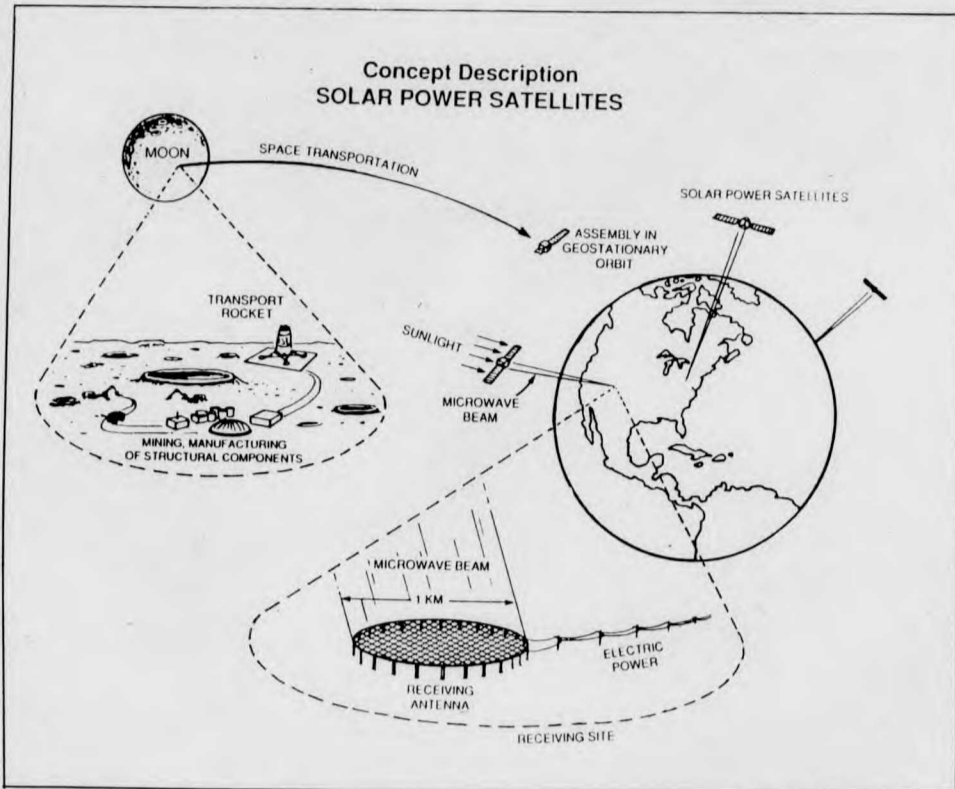
so... the climate is getting much more positive for Solar Power Satellites."

But, in 1980, the research program ground to a stop in the USA. "Effectively, the fusion power study interests in the United States see it as a threat to their fairly well-entrenched multimillion dollar studies," says Maryniak. SSI is now working on the technologies which will allow SPS to take off, but on a non-profit basis. Interest remains in France, which is about 63% nuclear (France is hosting an SPS conference in April 1991 in Paris); Germany's MBB is involved, Japan is developing a space flier which will transmit some power to earth from space, and the Soviet Union has said that it will do SPS for years.

In an attempt to overcome the high costs of putting an SPS in orbit from earth, O'Neill suggested that lunar materials could be used. In 1984, a meeting of SPS experts in Lake Tahoe initiated a study to see how 'lunar' you could make an SPS. They found that over 99% of SPS can be built from lunar materials. (copper, silver, hydrogen, and some parts of the magnetron (found in your microwave oven) would need to be imported from earth or other extraterrestrial sources.

Is all this feasible? According to Maryniak "it is only a question of when and how much money... Everybody knows, if you are going to build a SPS from lunar materials, you must design one from lunar materials." The study showed that the lunar built SPS would be about 97% cheaper, though that 97% must cover infrastructure costs; this is the cost per satellite.

With today's emphasis on the environment and the search for alternative sources of power, the idea of SPS is making a comeback. SPS represents the only real environmental energy option for a world which refuses to turn its back on technology and the future. A large fossil fuel power plant might run at 35-45 percent efficiency, versus 30-37 percent for solar power, but with



solar power this type of efficiency is less important since you are not paying for coal, oil or uranium, and not destroying the environment with mining and pollution.

Moreover, the inefficient parts are all in space, not on earth. Carbon dioxide absorption of the sun's rays (the greenhouse effect) far exceeds any other forms of waste heat, says Tillotson. "If you can get the same energy as burning a ton of coal without the greenhouse gasses, basically the earth's temperature rise will be a lot smaller." SPS is environmentally friendly and you get more power out.

Central to all talk concerning the utilization of space and SPS is a concern for the environment, and there is no indication that this is mere posturing. As O'Neill wrote 15

years ago, the benefits of their vision of expanding human experience is ultimately "the preservation of the Earth, and its fragile biosphere, as a place of great beauty, deserving our care and our nurturing, as it has nurtured us through our evolution." Tillotson feels that the environmentally negative power generating technologies have given all technology a bad name. "An awful lot of people interested in the environment have an automatic negative response to technology. Here we have a technology which can help the environment, but there are very few

environmentalists who think that you can use technology to help you improve it," said Tillotson. But, these are the same people who rely on computers, water purifiers, and

modern communications networks.

Most people see solar power as one of the exotic forms of power generation along with geothermal, hydro, and wind power. For the average Canadian, solar power is represented by the solar cover used to heat the swimming pool or a solar battery used to run a calculator. But, for most of the third world, it represents the only hope of gaining a standard of living even remotely resembling ours. Solar power may be the only alternative to living in a world without electricity.

There are over five billion people living on our planet. Of that number, some 40 percent live without electricity, and they use coal or wood for heat and cooking. Do we want to condemn them to such a state for all time because we have wasted all the available fuel?

North Americans use 10,500 kwh of electricity per person annually, and we demand over 2.6 percent more each year. Third world demand is growing at 7 percent every year. So to just keep even, we must drastically curtail our energy use and, by the year 2030, build the equivalent of 5000 new nuclear power stations. This is not a good idea by any one's standards.

To replace the existing power generating ability with terrestrial solar power in the USA would require eight per cent of the country to be covered with solar cells. This would have a negative environmental impact as great as an other option available.

So, while Iraq battles with the Arab nations over oil rights, causing a doubling of the price of oil after the annexation of Kuwait; Canada and the USA finally start to talk about an agreement to control the acid rain caused by the combustion of fossil fuels; nuclear power is still a naughty word because of Chernobyl; and, commercial nuclear fusion is still a physicist's wet dream, breakthroughs in collecting power directly from the sun's rays goes largely unnoticed.

Motion sickness is York grad's forte

ISU (Insufficient Sleep University) passes on information and forms friendships

by Suzanne Crnic

Dr. Bob Cheung hopes to go into space in the near future. In 1983 he was one of 4500 applicants who were interviewed by the Canadian Astronaut Program. He was not chosen, but he did last to the second round of interviews, being among the sixty candidates left. When Canada decides to participate in the next space program, Cheung hopes to be on that voyage.

The dynamic thirty-five year-old is a York graduate student who is presently taking the intensive ten week course held by the International Space University (ISU) and hosted by the Institute of Space and Terrestrial Science at York University this summer.

Cheung, who moved from Hong Kong to Toronto as a teenager, has always been interested in space. "My interest in space originated from my study of the Ves-

tibular System (the organ of balance) whose function is altered in weightlessness, so I guess you could say that I was naturally drawn to study space physiology from my academic interest."

After receiving a BSc degree in Physiology and then in Education at U of T, Cheung transferred to York to obtain a Masters degree in Science in 1987. He completed his PhD in Visual-Vestibular Interaction and is presently researching motion sickness and spatial disorientation at the Defence and Civil Institute of Environmental Medicine.

Physiology, Cheung says, is a crucial branch in Space Life Sciences as it deals with physical deconditioning under microgravity. Some physiological changes can be a hazard to the health of an astronaut. For instance, the loss of calcium produces brittle bones. Astronauts can lose, on average, 0.3% of total body calcium per



Dr. Bob Cheung during a stable moment outside York campus.

month during space flight; this loss is believed to come from weight-bearing bones. Scientists such as Cheung try to find countermeasures to such dangerous changes.

Cheung is especially interested in the organ of balance which is embedded in the temporal bone, and how it is affected in space. Weightlessness, he says, rearranges the relationships among

several sensory systems. Eventually, the lack of congruence between signals leads to sensory conflict; this appears to be the basic cause of space motion sickness.

Motion sickness is Cheung's forte. In his current research, he has tried to elucidate the central nervous mechanism of motion sickness. Some information has been compiled, but the neural

pathway and neurotransmitters involved have not been discovered.

"In the last fifty years we have learned more about motion sickness, but not all there is to know. Once we understand the mechanism of motion sickness and the sensory rearrangement, then astronauts can freely operate in space craft without getting sick. Unfortunately, there is no ultimate cure for it. For instance, Gravol pills taken by people on earth can prevent motion sickness. However, the pills benefit one person, but not the other, and the side effects of these drugs can affect crew performance."

In cooperation with other scientists, Cheung is investigating new types of anti-motion sickness drugs that will have the least side effects while remaining effective.

This is Cheung's first participation with ISU. "ISU is a good concept, where a bunch of people from various backgrounds come to share their expertise and to learn from each other. I knew very little about rocket propulsion until this summer. And others who knew nothing or little of physiological deconditioning in weightlessness now know more."

A 10 week course cannot provide the opportunity for students to learn everything. Cheung and his peers say that ISU stands for "Insufficient Sleep University." But what ISU can provide, according to Cheung, is the opportunity for them to interact with others, to form friendships and to pass on information.

Suzanne Crnic photo