Symbiosis, fertilizer and a molecular farm
The microbe-bean connection

NSERC

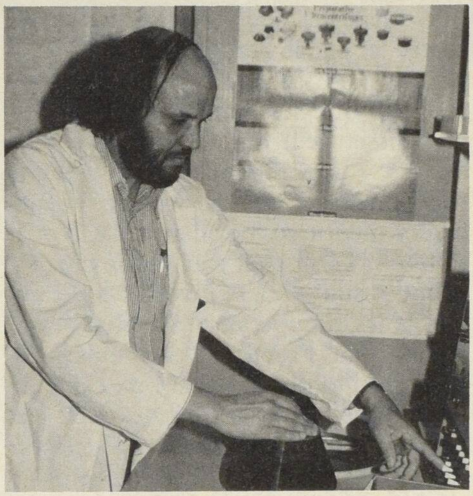
While it may just be another acronym to most people, NSERC, or the Natural Sciences and Engineering Research Council, has special meaning for scientists like Desh Verma and his colleagues in the university scientific community. Besides awarding fellowships and scholarships that allow science and engineering graduates to continue their studies (a vital role, given the projected shortages of trained scientists in Canada) the Council is a major source of funds to keep university labs running and equipped with the highly specialized (and very expensive) tools needed to do scientific research. As Canada's principal federal agency funding basic research in science and engineering, NSERC will disburse upwards of $197 million this year (1981-82) in support of university science across Canada. To encourage excellence, the Council identifies four outstanding university scientists annually and awards them its prestigious E.W.R. Steacie Memorial Fellowship, created in memory of a former president of the National Research Council. For scientists like Dr. Verma, one of this year's winners, the Fellowship frees him up from teaching duties for two years, allowing him to concentrate on his research. Because the McGill researcher works in a field related to food and agriculture, one of the areas of science judged vital to our national interest by NSERC (the others are energy, communications, oceans and environmental toxicology) he also receives what is known as a Strategic Grant to further support his research. Such a Grant could hardly be more appropriate for a project aimed at understanding and ultimately exploiting the biological process responsible for supplying living systems with nitrogen, an essential element in protein building.

Thus, NSERC is more than mere acronym to researchers like Desh Verma, and to ensure that it has meaning beyond the university community, Science Dimension begins with this issue to feature science supported by the Council on a regular basis.

Desh Pal Verma, a biologist at McGill University, has received one of the 1980-82 E.W.R. Steacie Fellowships from the Natural Sciences and Engineering Research Council (NSERC). The award allows Dr. Verma to concentrate on his research into the genetics of a fertile, rare symbiosis between plant and microbe. The study could, ultimately, improve the world's supply of food.

On the door of a biology laboratory at McGill University in Montreal a student has taped this sign: *Molecular Farm*. It's a witty and accurate label. Here, for the past eight years, Dr. Desh Pal Verma and many co-workers have been digging up facts about the unique partnership between legumes (beans, peas and other plants with seed pods) and the microbes which dwell in nodules in their roots. In exchange for home and sustenance, the minute guests provide their plant hosts with fertilizer which they make out of nitrogen drawn directly from the air.

To make the multitude of proteins essential to life, plants must have nitrogen. Their roots can draw this vital nutrient from soil in the form of decaying organic matter or chemically bound to oxygen as nitrate, but when plants grow rapidly as food plants do, this natural source is soon exhausted. The prime factor setting limits on the productivity of farm crops and forest lands is the availability of nitrogen.



McGill University's Desh Verma. Untangling the mysteries of an ancient relationship.

Le Dr Desh Verma, de l'Université McGill, essaie d'élucider les mystères d'une association de longue date.

Yet nitrogen is abundant. Seventy-nine per cent of the earth's atmosphere is nitrogen, in the form of the inert gas N_2. But the nitrogen in the winds blowing through their leaves and branches cannot be used by plants until it has been "fixed", that is, incorporated into a chemical form that allows cells to utilize it in protein building.

After World War I and the invention of the Haber process for fixing atmospheric nitrogen (in effect reducing it to ammonia, or NH_3, which can be used by life), artificial fertilizers came onto the market and led to a dramatic upsurge in food productivity. These fertilizers have come into widespread use in the interim, and in 1981 it is expected that farmers on this planet will spread some 40 million tons of nitrogenous fertilizer on their fields; this tonnage should quadruple by the end of the century.

But, there are serious drawbacks to this trend. The cost, for instance, is staggering. Building the new fertilizer plants to feed the world's burgeoning population will require billions of dollars in capital. Too, fossil fuels are consumed in the process, a drain on non-renewable energy supplies. Finally, fertilizing is inefficient, with rarely more than a third of the fertilizer actually being taken up by plants; the remainder is washed away, often nourishing strangulating blooms of algae in rivers.

Against this bleak background, the significance of biological nitrogen fixation is evident. Though only a few microorganisms — certain bacteria, certain algae — have mastered the trick, nevertheless the quantity of atmospheric nitrogen which they fix is at least three times greater than the total fixed industrially. Some biological nitrogen fixers live independently in