RESEARCH at INDIANA UNIVERSITY

Stuck on you

Yves Brun

Some of science's great discoveries happen by accident. But not all happen that way.

Indiana University Bloomington bacteriologist **Yves Brun** has been studying the tiny, kidney-bean-shaped *Caulobacter crescentus* for more than a decade, and has become a (if not the) world expert on the bacterium.

Brun has published papers on the bacterium's genetics, molecular biology, and development, the biochemistry of its components, its quirky life cycle, and most recently, the sterner stuff that helps *C. crescentus* remain affixed to rocks, pebbles, and the inside curve of water pipes.

In the April 11 issue of the *Proceedings of the National Academy of Sciences* , Professor Brun, Brown University biophysicist Jay Tang, and colleagues presented evidence that the bacterium secretes a glue-like polysaccharide that may be the strongest adhesive in nature.

The scientists found they had to apply a force of about 1 micronewton to remove a single *C. crescentus* from a glass pipette. Because *C. crescentus* is so small, the pulling force of 1 micronewton generates a huge stress -- relatively speaking, of course -- of 70 newtons per square millimeter. That stress is equivalent to five tons per square inch. In terms more familiar, that's three or four cars balanced atop a quarter. Commercial "super" glue breaks when a shear force of 18 to 28 newtons per square millimeter is applied.

"There are obvious applications since this adhesive works on wet surfaces," said IU Bloomington bacteriologist Yves Brun, who co-led the study. "One possibility would be as a biodegradable surgical adhesive."

C. crescentus affixes itself to rocks and the insides of water pipes via a long, slender stalk. At the end of the stalk is a holdfast dotted with polysaccharides (chains of sugar molecules). The scientists show in the *PNAS* paper that these sugars are the source of *C. crescentus* 's tenacity. It is presumed these sugars are attached to holdfast proteins, but this has not yet been confirmed. One thing is certain -- the polysaccharides are sticky.

"The challenge will be to produce large quantities of this glue without it sticking to everything that is used to produce it," Brun said. "Using special mutants, we can isolate the glue on glass surfaces. We tried washing the glue off. It didn't work."

Brun says the IU-Brown discovery demonstrates the importance of basic research. As opposed to applied research, where the goal is develop new technologies, basic research answers basic, mechanistic questions about a natural phenomenon. Sometimes, like the discovery of penicillin, basic research spawns important, commercializable technologies. Brun is currently consulting with intellectual property experts at the IU Research & Technology Corporation.

Many things will have to happen before *Caulobacter* -brand glue hits the shelves of your local hardware store, however.

The scientists must figure out how to clone the genes that produce the glue, so the glue itself can be mass-produced. Since the glue is so sticky, the scientists will also have to figure out a way to dissolve it. Otherwise, the glue will be impossible to remove from its storage container, let alone manipulate. And if the glue is to be used as a medical adhesive, as the scientists hope, it cannot be toxic or antigenic to human beings. A series of clinical trials would have to be conducted to study the glue's safety and efficacy when wounded human tissues are exposed to it.

For now, Brun and colleagues will briefly bask in the glow of a phenomenal discovery before extending a new line of scientific inquiry. "It's all pretty exciting to us," Brun said. "We're looking forward to the next steps."