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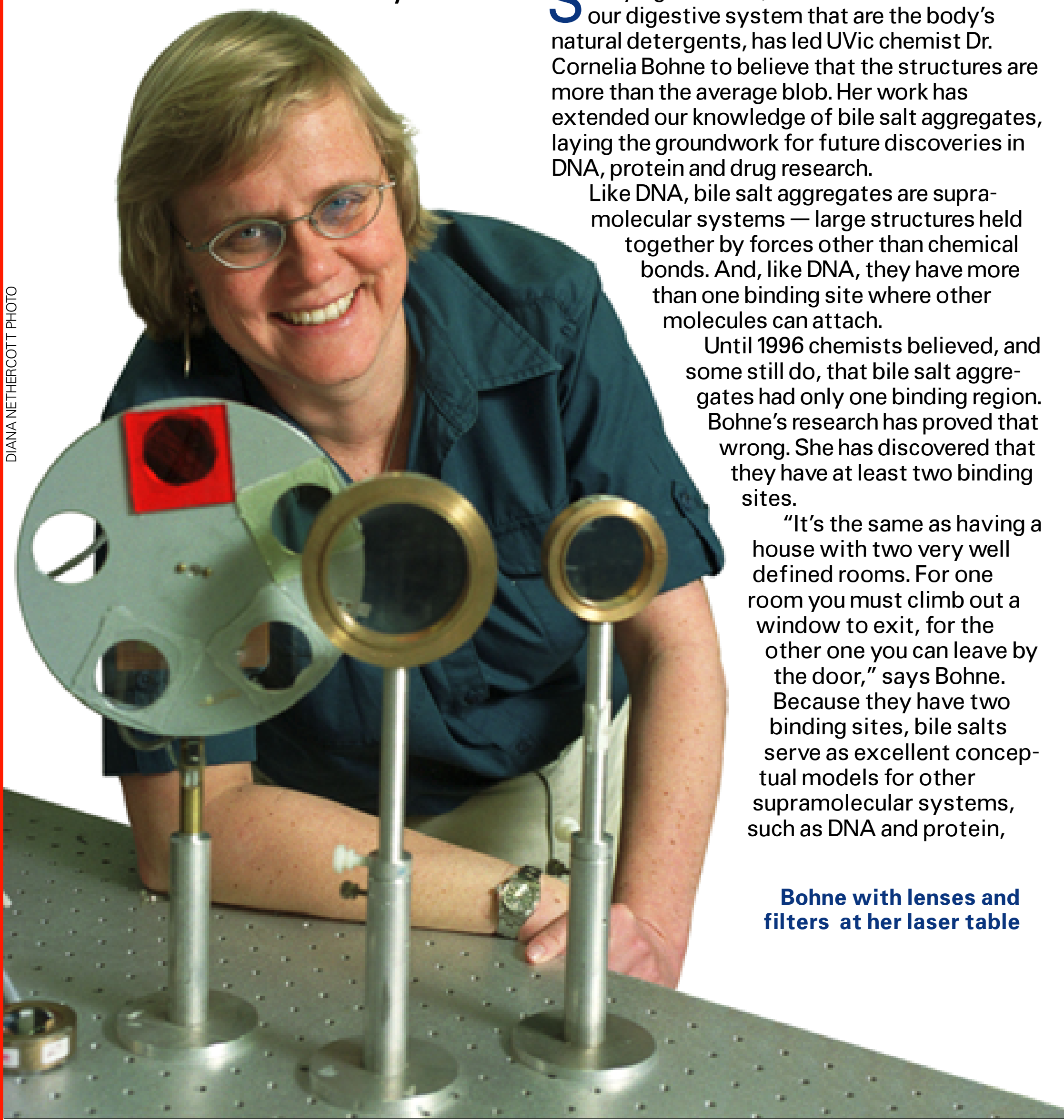
RESEARCH AND DISCOVERY AT THE UNIVERSITY OF VICTORIA

Seeing inside supramolecular systems

by Leah Pence



DIANA NETHERCOTT PHOTO

Bohne with lenses and filters at her laser table

Studying bile salts, essential substances in our digestive system that are the body's natural detergents, has led UVic chemist Dr. Cornelia Bohne to believe that the structures are more than the average blob. Her work has extended our knowledge of bile salt aggregates, laying the groundwork for future discoveries in DNA, protein and drug research.

Like DNA, bile salt aggregates are supramolecular systems — large structures held together by forces other than chemical bonds. And, like DNA, they have more than one binding site where other molecules can attach.

Until 1996 chemists believed, and some still do, that bile salt aggregates had only one binding region. Bohne's research has proved that wrong. She has discovered that they have at least two binding sites.

"It's the same as having a house with two very well defined rooms. For one room you must climb out a window to exit, for the other one you can leave by the door," says Bohne. Because they have two binding sites, bile salts serve as excellent conceptual models for other supramolecular systems, such as DNA and protein, that also have multiple binding sites.

Bohne sees her research as a starting point for future supramolecular studies. "If we can't handle two binding sites then we won't be able to handle more," she says.

Her bile salt research also focuses on the aggregate's loose structure and the way in which particles move in and out of it: the dynamics.

One element of the study of bile salt dynamics is exploring how outside molecules move within these structure and how many billionths of a second it takes them to do so.

To test this mobility Bohne places the bile salt in a vial of water and then adds another guest molecule. The guest molecule enters the bile salt structure because it prefers its environment to that of water. Using a laser pulse, Bohne changes the stable guest molecule into a highly unstable form that microscopes can see move in and out of the bile salt.

Bohne follows the movement in and out of the newly created molecule formed from the bile salt aggregates by measuring light emission or absorption using photomultipliers, fast light detectors, that can sense the change of light in a billionth of a second.

Using an oscilloscope that shows how the light intensity changes with time, she then records the guest molecule's movements and properties. She hopes to move soon from observing the guest's movements to controlling them.

If she can master the technique on bile salts, she is one step closer to understanding how a guest, such as a drug, would interact within DNA.

SPARK

Leah Pence wrote this as a participant in the SPARK program (Students Promoting Awareness of Research Knowledge), funded jointly by UVic and the Natural Sciences and Engineering Research Council of Canada.

EDGE/WISE Left-handed and right-handed molecules

Many chemical compounds occur in mirrored pairs, like a right and left hand. This handedness allows molecules to perform double duties — that can be both good and bad.

"It is now known that the handedness of a chemical compound can have disastrous effects when you develop a drug. Just look at thalidomide," says Bohne. Thalidomide, a pregnancy drug that was introduced to the market in the late 1950s, had both right-handed and left-handed forms. One form took away morning sickness and the other caused birth defects.

Since the thalidomide tragedy, chemists have gone to great lengths — at high cost — to ensure that only one mirror-variant of their product is formed in the reaction, or that its mirror-image is efficiently removed at a later stage of the production process.

Because of their own handedness, bile salts are starting to be used as an analytic tool to separate chemicals with different handedness. Chemists hope that bile salts will achieve this separation more efficiently.

FACTS FROM THE EDGE

• Bohne's discovery that bile salts have two binding sites is controversial research. There are two camps: those who think bile salts are simple blobs and those who see them as more complex structures. "We come down in one camp, but at least we come down with new information and a new approach," says Bohne. "There's nothing wrong in science in doing something that is controversial. Not everyone accepts it, but it has had impact."

• If supramolecular structures are not held together by chemical bonds, how do they stick together? Forces such as electrostatic interactions (the way in which opposite charges attract), hydrophobic effect (the way that water-hating molecules will interact with each other) and hydrogen binding (the type of binding present in DNA) hold the structures together — though only lightly.

• Bohne's work has been supported with funding from the Natural Sciences and Engineering Research Council, and she has recently received a two-year $60,000 U.S. award from the Petroleum Research Fund for her research group's work on bile salts.

SHARPEN YOUR KNOWLEDGE

• To learn more about Bohne's research, see her webpage: **www.foto.chem.uvic.ca**

• In a few years, the newsprint this story is printed on will be yellow. To address this problem, Bohne and her research group are working to develop a "sunblock" to inhibit the photoyellowing of paper and reduce reliance on potentially harmful chemicals in the papermaking process. The project is part of the national Mechanical Wood-Pulps Network of Centres of Excellence. **www.ppc. ubc.ca/wood-pulps**

• Like learning about chemistry one molecule at a time? Check out the Molecule of the Month at **www. bris.ac.uk/Depts/Chemistry/MOTM/motm.htm**

• Bohne organizes a national summer exchange program for undergraduate students. Applicants for the program, Reactive Intermediates Students Exchange (RISE) should be in the chemical/biochemical sciences and have second- or third-year standing. The research conducted through the program involves chemical or biochemical reaction mechanisms, usually involving fast reaction kinetics. **www.chemistry. uvic.ca/rise.htm**

ON THE EDGE OF YOUR SEAT

PUBLIC EVENTS AT UVIC

Guitar Recital
Bachelor of Music graduating recital by Adam Foster
April 18, 8 p.m.
MacLaurin Bldg., Phillip T. Young Recital Hall.
Free admission.
Information: (250) 721-7903

Lafayette String Quartet
Schubert — *Quartet in E flat Major, Op. post. 125 D.87*
Istvan Marta — *Doom. A Sigh*
Brahms — *Quartet in A minor, Op. 51, no. 2*
April 28, 8 p.m. & April 29, 2:30 p.m.
MacLaurin Bldg., Phillip T. Young Recital Hall.
Tickets $16/12
Information: (250) 721-7903