BIO/TECHNOLOGY

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THE FIRST WORD/

IMPURE INFORMATION

It was about four years ago, now, that Sidney Brenner proclaimed the passing of the age of chemistry-as-information (the early years of molecular genetics A.D.—after DNA) and the ascendency of chemistry-as-organization (the machinery of cell-to-cell interaction)*.

After a week spent ridding our in-house computers of a digital 'flu, and a few hours spent writing a program for comparing character sequences, we're not so sure. The deeper we delve into the relationships between life science and information science, the more light they seem to cast on one another.

Computer viruses, though man-made, uncannily resemble their DNA namesakes in their survival strategies, disruption of the more organized system, and tenacity. Our own informational infestation was known (completely without affection) as Stoned. Every now and then, Stoned would taunt us and urge the legalization of marijuana, and once in a while we would lose a file or two. Stoned is what's known as a boot-sector virus (roughly equivalent to a herpesvirus that lies doggo along the dendrites, invisible and almost impossible to eradicate as it waits to erupt into shingles). It is a snippet of malignant machine language that shoulders aside the disk's basic operating-system and bookkeeping code, addling its memory. Stoned is like a bad cold: Your eyes burn and you may miss a little bit of work, but you'll survive. Some computer viruses can be fatal, destroying every bit of data they touch.

Unlike a cold, though, Stoned could be cured. We finally managed to eradicate the pest using a commercial anti-virus program: It keeps a template of the virus code in memory and scans through the disk until it finds a matching pattern, which it then splices out and destroys. Interestingly, this is a just approach proposed for the generation of RNA-based anti-virals now in development.

The sequence-comparison routine we were working on is nothing special—a simple multi-color dot-matrix homology display. Researchers like Cary Queen and David Mount and Temple Smith—not to mention the programming pros at Intelligenetics and other companies—were doing the same sort of thing much better a decade ago.

We did want to extend the notion a bit, though, so that we could go beyond ACGT to compare any two texts. Such a tool would be useful (we ratiocinated) not only for browsing through gene sequences, but also for checking a manuscript against itself for redundancy, or in cross-checking one manuscript against another for (ahem) unintentional duplication.

So, because we are still far behind Brenner on the learning curve, still climbing the steep face on pitons and a safety line, we remain astounded by molecular genetics' information-like aspect. Indeed, biology sometimes seems to have an information/chemistry duality as profound and mysterious as physics' particle/wave duality. Both can be as hard to pin down as a Zen koan. The effort requires rare and special training.

We can't help wondering, though. We use an old communications program called CrossTalk XVI. Of the program's 61,000 bytes (the equivalent of about 240 kilobases), only about 25 percent are "expressed" as messages to screen, printer, or modem. A biologist might call the rest "junk" as opposed to genes. A programmer would call it "logic" as opposed to input and output. I/O is how the program interacts with the outside world, how it produces measurable effects. But the invisible logic dictates what is expressed, and when, and where.

The California Institute of Technology has for some time encouraged biochemistry grad students to cross-train in information science and other disciplines to meet the challenge of the chemistry/information duality. Other researchers are announcing new disciplines whose names are redolent of bits and bytes—genomics, bio-informatics, even bio-linguistics. Maybe they will see past the "junk" epithet to discover whether the logic lies within the genome, but beyond the gene.

And now, back to wet-lab chemistry, already in progress. Tune in next month for the first reports on new bioreactors producing up to 200 grams of soluble recombinant protein daily from a 50-liter vessel, using inputs costing at most a few dollars.

—Douglas McCormick

*See "The King in a Golden Chariot," *Bio/Technology* 5:1107, 1987.