Mothers of the genome

LIKE many others who end up working in computational biology, Cathy Ball got into it by "accident". In 1992, a week after receiving her PhD in DNA recombination from the University of California at Los Angeles, she had her first child. Ball left her postdoctoral position at the University of California at Berkeley after only six months, as she was trying to work part-time and could not be as productive as she needed to be. She had heard from a friend that geneticists David Botstein and Michael Cherry were establishing the *Saccahromyces* genome database at Stanford University and were interested in providing more biological information than was previously available on existing yeast databases. The database project started out with one curator working ten hours a week, has expanded to as many as five staff, but is currently at three. Historically, the laboratory's team of curators has been solely made up of women PhDs, all of whom have had young children. The team shares the responsibilities for the database, each working 15–30 hours a week. As the work is largely computer based, it is possible to work from the home if necessary. Like many, Ball's apprenticeship in computational biology has been mostly in the form of on-the-job training. Today, the group uses its expertise to introduce other researchers to the Stanford yeast database, as well as to the other resources to which the database is linked, such as Entrez, GenBank, the Yeast Protein Database and the Martinsried Institute for Protein Sequence (MIPS). □

who have demonstrated interdisciplinary research interests, particularly in areas such as physical and genetic mapping, biological databases, multiple sequence alignment, phylogeny construction, sequence search and analysis, simulation of control pathways, statistical methods, and discrete algorithms and combinatorial optimization in biology. (see Web site table previous page).

Ecker expects that a new masters programme in biotechnology, which is in development at the university, "will be able to take a biologist, and give them enough skills and knowledge to be useful as a bioinformatics specialist, but not necessarily a hard-core programmer". The masters programme will consist of three parallel tracks, molecular biotechnology, engineering biotechnology and computational biology/bioinformatics, the purpose being to encourage students to cross over into a complementary field that will expand their range of skills. At the same time, students will also be made aware of non-technical issues relevant to biotechnology, studying aspects of bioethical issues, government regulation, the drug-approval process and patent law.

Jordan says that at the NCHGR there is uncertainty about how best to train researchers in computational biology. She says that the Human Genome Program has been trying to facilitate cross-disciplinary training between biology and computer science, physics or engineering by encouraging people with a masters' degree in one of these non-biology areas to undertake PhD training. Some inroads have been made, Jordan says, but interdisciplinarity has not caught on as much as had been anticipated.

According to the NCHGR, most institutions have not, as yet, developed graduate and postgraduate training programmes in genomic science that would enrol students in molecular biology or one of the non-biological disciplines, yet also provide training to allow them to develop complementary expertise in another discipline. The NCHGR is offering financial support for institutional programmes that are designed to train scientists with multi-disciplinary skills (more than one institution can apply as a consortium if it can be demonstrated that a well coordinated, integrated programme can be developed). The multi-disciplinary training programme in genomic sciences is intended to expand the research capabilities of individuals with backgrounds in either molecular biology or a non-biological scientific discipline relevant to genomics, for example, physical, chemical, mathematical, computer and/or engineering sciences.

Northern lights

In Canada there is not the infrastructure to operate on the scale of, for example, the United Kingdom's Sanger centre, and so the Canadians are in the process of building on their existing strengths in research. The Canadian Genetic Diseases Network, one of ten Canadian centres of excellence, was developed to promote advances in genetic research, to train Canada's young researchers and to create a partnership involving universities, medical centres, companies and Canada's Medical Research Council. This network comprises 38 of Canada's leading geneticists who are associated with eleven universities, eight hospitals and eight core facilities across the country. The network was founded in 1990 by Michael Hayden of the University of British Columbia, Vancouver. This "network of centres", as he calls it, provides funding for research and training opportunities, as well as an outlet for graduate students and postdoctoral fellows to employment opportunities with the network's industrial partners and spin-off companies.

The initial funding for training graduate and postdoctoral students came fromthe Network/Merck Frosst award, which granted a total of CAN$280,000 (US$378,000) to graduate students and postdocs over the first four years of the programme. Hayden describes the network as a "centre without walls", where network scientists can work in other laboratories in the network, learning specialized techniques of value to their own projects and bringing these skills back to their own laboratories. Such exchanges can be subsidized by a 'visiting researcher' fund, which provides limited support for up to 50 internode training exchanges annually.

Currently, the network is providing training for 70 postdocs, 86 graduate students, 21 research associates and 75 technicians (18 per cent of network participants are non-Canadian).

Because of the network's commitment to the transfer of technology to industry, students experience aspects of research and development, including patent and commercialization issues, that they might not encounter in a solely academic setting. "What we're doing is selectively filling the commercial infrastructure" so that the growth of these new ventures will provide opportunities for network trainees to put their skills into practice, says David Shindler, the managing director of the network.

Over the past two years, CAN$300 million in early development capital has been raised for new commercial ventures from technologies stemming from research carried out within the network. Among these are the Canadian Medical Discovery Fund (CMDF), which totals CAN$200 million, and the Neuroscience Partners Fund (CAN$52.5 million), both of which are managed by MDS Health Venture Capital. As of mid-October the CMDF has made 19 investments to the tune of nearly CAN$50 million, whereas the Neuroscience Partners Fund has completed 11 investments to date, in six Canadian and five US companies.

The dividend for Canada is the development of start-up biotech companies such as NeuroVir in Toronto, which was formally launched last month with CAN$4 million of private financing. The company will focus on gene therapy for cancer and diseases of the nervous system. It hopes to raise a further CAN$10 million over the next year.

Further financial and technical partnerships are planned with pharmaceutical and biotechnology companies in the field of cancer and neuroscience research. In the area of bioinformatics, the network will be launching new research and training initiatives to work closely with new Canadian bioinformatics companies such as a Base4, which was launched recently as a subsidiary of Allelix and is the first dedicated bioinformatics company in Canada.

The network also provides money to undergraduates for summer posts in network laboratories: in 1994–95, 46 Canadian undergraduates received funding for three-month training opportunities. An annual scientific meeting brings postdocs and graduate students together to take part in plenary sessions, brainstorming and career-enhancement workshops with industry representatives. **Brendan Horton**