Curriculum Vitae: Paul-Michael Agapow

- **Address:** Dept. Biology, Imperial College at Silwood Park, Ascot, Berks SL5 7PY, United Kingdom
- **Phone:** +44 (0) 207 594 2267
- **Fax:** +44 (0) 207 594 2339
- **Email:** p.agapow@ic.ac.uk

Summary of Skills

- **Educational background:** Wide range of computational and biological experience, including computational biology, artificial life, evolutionary science, artificial intelligence.
- **Computer programming:** Fluent in C++, C, Python, Pascal, Lisp (Common Lisp and Scheme). Experience in Java, Basic, Fortran, Mathematica.
- **Other computer skills:** Experienced in MacOS, Unix, Windows; HTML including the construction and maintainence of several substantial websites, CGI, LaTeX, common software packages (MS Word, Excel, Access, Paradox et al.).
- **Communication skills:** Substantial experience in biology and interdisciplinary teaching, technical and popular scientific writing with over a dozen papers in peer reviewed journals or volumes. Native English speaker, conversational level in French.

Experience and Employment

- **Postdoctoral Scientist (1998 to present)**
  Dept. Biology, Imperial College
  I am investigating the detection of macroevolutionary trends in evolution via computer simulation,which has resulted in a number of publications including one in *Science* and several pieces of software. During this time I have also undertaken some outside projects in computational embryology, retroviriology and population genetics. Also, I have lectured undergraduates in a range of subjects (artificial life, extinction, phylogenetics and conservation), as well as conducted several workshops for staff and graduate students (in HTML and programming).
- **Programmer (1997 to 1998)**

Dept. Genetics, La Trobe University
During this temporary position, I developed web resources for the department and Australian Biological Resources Network, including an online primer database.

- **Sessional Lecturer (1994 to 1996)**
  Dept. Computer Science, RMIT
  During this part-time position, I taught and tutored undergraduates in computing for the biology sciences, theoretical computer science and ethics. Undergraduate surveys rated my teaching extremely high.

- **Journalist (1994)**
  "Computer Age"
  Contributing weekly columns to the computer section of a major metropolitan paper, I highlighted news and developments in computer technology.

- **Tutor (1992 to 1993)**
  Dept. Computer Science and Computer Engineering, La Trobe University
  I taught and tutored undergraduates in computers and biological modelling.

- **Programmer (1991 to 1993)**
  NUDIST Project, La Trobe University
  As a programmer with a university research project and (later) startup company, I helped develop and sell scientific software. My duties included programming, technical and customer support.

Education

- **PhD (1993 to 1998)**
  Dept. Computer Science and Computer Engineering, La Trobe University
  Thesis title: "Artificial Life and Approaches to Problems in Biology" (Supervisors: T.J. Richards, R. Crozier).

- **Graduate Diploma in Advanced Computer Science (1992)**
  Dept. Computer Science and Computer Engineering, La Trobe University
  Thesis title: "Artificial Life and Approaches to Problems in Evolution" (Supervisor: T.J. Richards).

- **Graduate Diploma in Computer Science (1991)**
  Dept. Computer Science and Computer Engineering, La Trobe University
  Major areas of study included artificial intelligence, scientific and numerical computing.

- **Postgraduate study (1988 to 1990)**
  Walter and Eliza Hall Institute of Medical Research, Royal Melbourne Hospital
  Thesis title: "Development and Differentiation of B Lymphocytes" (Supervisor: J.F.A.P. Miller).

- **B.Sc. (1st class honours) (1985 to 1987)**
  Dept. Biochemistry, University of Queensland
  Thesis title: "Electrostatic Dimerization of Prothrombin Fragment 1" (Supervisor: D.J. Winzor).

Professional Affiliations & Awards

- Certification in C and C++ programming and HTML (www.brainbench.com)
- Graduate student research award, Complexity '96 conference.
- Student prize, School of Mathematical and Information Sciences, La Trobe University, 1991.
- Student prize, ACS (Australian Computing Society), 1991.
- NHMRC (National Health and Medical Research) scholarship, 1989 to 1990.
- Commonwealth Postgraduate Research Award, 1988
- Member of New York Academy of Sciences.
- Member of American Academy for the Advancement of Sciences.
- Member of the ISCB (International Society for Computational Biology)
- Member of NCEAS 2000 workshop on Phylogeny & Conservation
- Associate Fellow of the Centre for Population Biology
- Attended 2000-2001 Silwood seminar series in phylogenetics
- Attended 1999 Lipari Summer School in Bioinformatics
- Attended Imperial College workshops on small group teaching, lecturing and career development.

Teaching experience

- **Imperial College (1998 to 2000):** Occasional lecturer in artificial life, extinction, phylogenetics and conservation. Conducted several small workshops for staff and graduate students in programming and HTML.
- **Royal Melbourne Institute of Technology (1994 to 1996):** Sessional lecturer in computing for biological sciences, theoretical computer sciences, and ethics.
- **La Trobe University (1993-1994):** tutor in computers and biological modeling.
- **Queens and Ormond College, University of Melbourne (1988-1990):** tutor in

biochemistry and microbiology.

Publications

- Agapow, Paul-Michael and Burt, Austin (in press); "Indices of multilocus linkage disequilibrium", *Molecular Ecology Notes*.
- Purvis, Andy; Webster, Andrea; Agapow, Paul-Michael; Jones, Kate E. and Isaac, Nick J.B. (in press); "Primate phylogeny and life history", in PM Kappeler (ed), *The Role of Life Histories and Socio-Ecology*, Cambridge: Cambridge University Press.
- Agapow, Paul-Michael and Isaac, Nick J.B. (submitted); "MacroCAIC: correlates of species richness", *Bioinformatics.*
- Agapow, Paul-Michael; Gittleman, John; Crandall, Keith L.; Mace; Gorgina; and Purvis, Andy (in prep); "Species concept and conservation", *Conservation Biology*.
- Isaac, Nick J.B. and Agapow, Paul-Michael (submitted); "Testing the tests of macroevolutionary hypotheses: Performance of a new method and sensitivity to departures from ideal model conditions", *Systematic Biology*.
- Purvis, Andy; Agapow, Paul-Michael; Gittleman, John L. and Mace, Georgina M. (2000); "Non-random extinction increases the loss of evolutionary history", *Science*, **288**, pp328-330.
- Crozier, Ross H.; Pederson, Karsten and Agapow, Paul-Michael (1999); "Phylogenetic assessment of total biodiversity", in Winston Ponder & Daniel Tunney (ed), *The Other 99%: The Conservation and Biodiversity of Invertebrates*, Royal Zoological Society of New South Wales, Mossman (Australia), pp30-33.
- Crozier, Ross H.; Agapow, Paul-Michael and Pederson, Karsten (1999); "Towards complete biodiversity assessment: an evaluation of the subterranean bacterial communities in the Oklo region of the sole surviving natural nuclear reactor", *FEMS Microbial Ecology*, **28**, pp325-334.
- Agapow, Paul-Michael and McGalliard, Joan E. (1997),"An introduction to Objective-C", in George Michaelson (ed), *Proceedings of the AUUG'97 Conference*, AUUG, pp237-242.
- McGalliard, Joan E. and Agapow, Paul-Michael (1996); "Smalltalk as a commercial development environment: An examination" in *AUUG 96 and Asia-Pacific World Wide Web Joint Conference*.
- Agapow, Paul-Michael (1996); "Computational brittleness and the evolution of computer viruses", in Hans-Michael Voigt, Werner Ebeling, Ingo Rechenberg and Hans-Paul Schwefel (ed), *Parallel Problem Solving from Nature - PPSN IV*, Springer-Verlag,

Berlin, pp2-11.

- Agapow, Paul-Michael (1996); "Computational brittleness and evolution in machine language", in Rob Stocker, Herbert Jelinek, Bohdan Durnota and Terry Bossomaier (ed), *Complex Systems 96: from local interactions to global phenomena*, Ios Press, Amsterdam, pp299-308.
- Agapow, Paul-Michael (1996); "Extinction, self-organised criticality and evolution", in *Proceedings of Mendel `96*, Technical University of Brno, pp5-10.
- McGalliard, Joan E. and Agapow, Paul-Michael (1996); "Surviving C++: Tips and tricks", in David Purdue (ed), *Proceedings of AUUG Summer Conference*, AUUG-NSW, pp50-59.
- McGalliard, Joan E. and Agapow, Paul-Michael (1996); "Surviving C++: Tips and tricks", in Enno Davids (ed), *AUUG-Vic Summer 96 Proceedings*, AUUG-Vic, pp12-22. (Revised version of above paper.)
- Agapow, Paul-Michael (1996); "The Galileo II computational ecosystem", La Trobe University technical report.
- Agapow, Paul-Michael (1994); "Alternatives to C++", in Arnold Pears (ed), *Australian Unix User Group Summer Conference*, AUUG-Vic, pp31-38.
- Agapow, Paul-Michael (1994); "Bootstrapping evolution with extra-somatic information", in Russell Stonier and Xing Huo Yu (ed), *Complex Systems: mechanisms of adaptation*, Ios Press, Amsterdam, pp29-36.
- Agapow, Paul-Michael (1993); "Computer viruses - the inevitability of evolution?", in David Green and Terry Bossomaier (ed), *Complex Systems: from biology to computation*, Ios Press, Amsterdam, pp46-54.
- Agapow, Paul-Michael (1993); "Computer viruses - the inevitability of evolution?", in Michael Paddon (ed), *Australian Unix User Group Summer Conference 1993*, AUUG-Vic. (Revised version of above paper.)
- Agapow, Paul-Michael (1994); "Does God play yahtzee?", *Arena*, **9**, pp25-27.
- Agapow, Paul-Michael (1993); "Malicious logic", *Arena*, **12**, pp45-48.
- Winzor, Don J.; Agapow, Paul-Michael and Jackson, Craig M. (1991); "Preferential ligand binding to multi-state acceptor systems: comparisions of the calcium binding and dimerization characteristics of prothrombin and fragment 1", *Journal of Theor. Biol.*, **153**, pp385-400.
- Agapow, Paul-Michael (1989); "Science noir - Ethics, law and the new biology", *Ormond Papers*, **6**, pp123-130.
- Agapow, Paul-Michael and Winzor, Don J. (1988); "Allowance for effects of

electrostatic repulsion on protein dimerization", *Biochimica et Biophysica Acta*, **953**, pp197-200.

Press

Some of the subject's work has attracted public interest and media coverage. A sample is placed below.

- "Family Misfortunes", *New Scientist*, 00/4/22.
- "Extinction - An End to Elephants?", www.science.net.org.uk, April 2000.
- "Computer Viruses - the inevitability of evolution", *PC Week*, 93/2/10.
- "Viruses 'as alien life forms'", *ComputerWorld*, 93/12/18.
- Radio interview, 2CC, Canberra. 92/12/15.
- "Alien life form may be in bits ... and bytes", *Canberra Times*, 92/12/10.
- "Beware! Life forms in the machine", *ANU Reporter*, 92/12/9.

Research Interests

Computational and theoretical biology, extinction, complex systems (artificial life and emergence), genetic organisation, the origins of life.

Potential Projects

Research projects for the future may include:

- A point of departure between natural and synthetic evolutionary systems is the issue of alleged brittleness - the ratio of functional (valid) genotypes to all possible genotypes and therefore the probability of mutation between functional genotypes (Farmer and Belin 1992 in Langton et al., *Proceedings Artificial Life II*, p815-840; Ray 1993 in *Artificial Life*, v1, p179-210). However while this issue may still be significant, it has been mis-analysed (Agapow 1996 in Stocker et al. as above). More significant than the ratio is the actual relationship of functional genotypes to each and their possible arrangement in "sequence space". An examination of the topology of this space via homology studies would contribute not just to theory (e.g. Schuster's ideas on protein evolution), but also to evolutionary computation and the neutralism vs. selection debate.

- Retroviruses and transposable elements are being increasingly implicated as agents of evolutionary change and markers of evolutionary history (McDonald 2000, *Transposable elements and genome evolution;* Sverdlov 2000, "Retroviruses and primate evolution." *BioEssays* , 22: p161-171). At the same time, it is becoming painfully obvious how complex their lifecycle can be. Fully exploiting the mass of sequence (and thus element distribution and phylogeny) data available requires a sophisticated understanding of how evolution has acted to produce the distributions and relationships that we see today. Their intermittant activity, the state of the host genome and the interactions between elements serve to obsfucate investigation. As direct observation is difficult, this problem might be solved by developing a models within which we can simulate the evolution of retroelements under varying conditions and study the outcomes. Manipulation of the virtual experimental model will enable us to determine the relationships between observed patterns and their basis in host/parasite interactions.

- A consequence of the data explosion is an urgent need for new methods of analysis and organisation, by categorisation or theory (Fagerstrom 1996 *Science*, v274, p2039-2040). But perhaps the problem can be turned into a labour efficient solution, by data-mining the mountain of sequences. Rather than look for specific sequences, one would search for undiscovered patterns and correlations. It is hoped that this may demonstrate a fresh insight on genetic organisation and highlight the relative importance of different sequence regions, especially the neglected non-coding features. Possible methods include linguistic analysis (Pesole 1996, *Methods in Enzymology*, v266, p281-294), evolutionary computation and recent advances in analogical reasoning (Hofstadter 1995, *Fluid Concepts and Creative Analogies*).

References

- Dr. Andy Purvis; Dept. of Biology, Imperial College at Silwood Park, Ascot, Berks SL5 7PY, United Kingdom; Phone +44 20 7594 2327; mail://a.purvis@ic.ac.uk.

- Prof. Ross Crozier; School of Tropical Biology, James Cook University, Townsville Q.4811, Australia; Phone ++61 7 4781 5734; mail://Ross.Crozier@jcu.edu.au.

- Prof. John L Gittleman; Dept. of Biology, Gilmer Hall, University of Virginaia, Charlottesville, VA 22903, United States; Phone +1 804 982 5740; mail://j.gittleman@virgina.edu.

- Dr. Austin Burt; Dept. of Biology, Imperial College at Silwood Park, Ascot, Berks SL5 7PY, United Kingdom; Phone +44 1344 294 266; mail://a.burt@ic.ac.uk.