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EDITORIAL

Naming, Remembering and Recalling Things

Collection, classification, organization, storage and retrieval of information are the central occupations of the new age information scientists. The vast, chaotic and unorganized material on the world wide web miraculously organizes itself under the spell of key words and the power of Internet search engines. The tasks of classification, naming and recall seem almost too trivial to discuss in a journal of science. My attention was sharply drawn to this subject by an attractively titled column, 'Reviving the Lost Art of Naming the World' (Carol K. Yoon, *The New York Times*, 11 August 2009). The author, a regular writer on biology and biologists, begins recalling student days when she was 'tutored in the ordering and naming of life – the science of taxonomy'. Yoon notes, in sentences that have a familiar ring: 'Despite the field's now blatant modernity, with practitioners using DNA sequences, sophisticated evolutionary theory and supercomputers to order and name all of life, jobs for taxonomists continue to be in steady decline. The natural history collections crucial to the work are closeted or tossed.' Taxonomy, whose origins can be traced back to the seminal work of Carl Linnaeus (1707–1778), is now a term used not only in botany and zoology, but has permeated many other disciplines, where classification of objects becomes necessary. For example, the many diverse folding patterns of protein molecules require a 'taxonomic' classification of shapes. Yoon provides anecdotal evidence for the feeling that naming objects may be a skill that is intrinsic and independent of culture. The example that she provides in defence of her argument for the 'deep-seatedness of taxonomy' comes from the case of a patient, who lost the ability to recognize living things but continued to identify non-living objects, following a swelling of the brain as a result of a herpes attack. Although the *New York Times* column does not cite a reference, the energy and enthusiasm of a colleague, together with the power of search engines, led me to the original report. The selective impairment of semantic memory was first described by Elizabeth Warrington (*Quart. J. Expt. Psychol.*, 1975, **27**, 635) in a study which showed that cerebral lesions correlate with the 'failure to recognize or identify common objects'. In a subsequent report, years later, she described the case of J.B.R., a university student, whose memory deficits followed viral infection induced brain swelling (Warrington, E. K. and Shallice, T., *Brain*, 1984, **110**, 1273). In subsequent years many such examples have been described, including the formidably titled report 'Questioning the living/nonliving dichotomy: Evidence from a patient with an unusual semantic dissociation' (Siri, S. *et al.*, *Neuropsychology*, 2003, **17**, 630). The authors report the case of a patient J.P. who had undergone a lobectomy, following a viral attack, who also showed a severe impairment in his ability to name and identify fruits, vegetables and musical instruments. There appears to be evidence that the living–nonliving distinction may be blurred and that 'semantic knowledge is organized in the brain on the basis of object properties'. The increasingly sophisticated technologies of neuroscience, particularly magnetic resonance imaging, will undoubtedly be brought to bear on the problem of semantic memory deficits.

I would not have been drawn to this topic if Yoon in her *NY Times* column had not asked with some eloquence: 'How to tell the carrot from the cat – which to grate and which to pet?'. Her statement of the problem is compelling: 'As curious as they are, these patients and their woes would be of little relevance to our own lives, if they had merely lost some dispensable librarianlike ability to classify living things. As it turns out, their situation is much worse. These are people completely at sea. Without the power to order and name life, a person simply does not know how to live in the world, how to understand it . . . . They are utterly lost, anchorless in a strange and confusing world. Because to order and name life is to have a sense of the world around, and, as a result, what one's place is in it.' A developing hypothesis, that Yoon draws attention to, is 'that there might be a specific part of the brain that is devoted to the doing of taxonomy'. Yoon's lament about the decline of taxonomy is not new; indeed, as far back as the 1920s the alarm bells, announcing the impending demise of the field, have been rung. A couple of years ago the 300th anniversary of Linnaeus' birth provided an opportunity for biologists and essayists to celebrate taxonomy's importance in furthering our

understanding of nature. In an engaging commentary H. C. J. Godfray reflected on 'Linnaeus in the information age' (*Nature*, 2007, **446**, 259). He argues that 'Linnaeus's brilliance was that he initiated the solution to the first bioinformatics crisis: how to organize knowledge about the increasingly large number of species that were being discovered during the age of exploration'. Godfray suggests if Linnaeus had begun his work today, 'he would have been a "techie", exploiting the Internet and other modern means of sharing and coordinating data'. The Linnaean approach does indeed lie at the basis of the growing number of databases that collect, curate, organize and share the exploding information on gene sequences and expression data, protein structures, biochemical pathways, molecular structures and dozens of other bodies of data that have spawned the information revolution in biology and chemistry. A new breed of librarians is emerging schooled in the new taxonomy of scientific publications; classifying, organizing and retrieving information acquires new dimensions as the fields of science begin to merge at broad and porous boundaries. In the area of molecular bioinformatics an understanding of biological classification and the evolutionary underpinning of biological phenomena is valuable, but is almost always absent in most discussions. As the public perception on the importance of recognizing and maintaining biodiversity increases, so will the demands on taxonomy and taxonomists. There is a technological solution that is being persistently advanced which may soon dominate the field, consigning Linnaeus' descendants to an obscure corner of the discipline. The use of 'DNA barcodes' and 'hand held readers', connected by wireless technologies to gigantic computerized databases may one day enable 'bar coding' of every organism on the planet. In a curious way, 'bar coding life' (*Science*, 2005, **307**, 1037) appears conceptually related, in a taxonomic sense, to the recently launched effort in India to provide a 'unique identification number' to over a billion people. Identifying individual members of a species is an interesting task; one which 'Linnaeus the techie' might have approved of. In keeping with the generally pessimistic view of the future of classical taxonomy, the *Science* feature was entitled, 'Will DNA bar codes breathe life into classification?'. Since all plants and animals have a gene coding for the protein cytochrome oxidase I, which shows significant interspecies variation in sequence and much smaller difference within a species, an ideal identification tag appears to have been found. The estimates of named species range between 1.5 and 2 million, while the total number of organisms on earth may range between 10 and 20 million. This would catapult the 'unique bar code' project into the league of 'big science' projects with cost estimates of about $1 billion. Efforts are already underway for specific classes of organisms, with other short DNA pieces being advanced as unique identifying tags. With DNA sequencing costs falling, any effort to use DNA coded information seems to appear feasible. As high technology invades and overruns taxonomy, there are those who watch, with some discomfort, the slow extinction of the practice of careful collection, observation, annotation and classification that characterized the Linnaean approach. However, the tools of the information age are central to modern taxonomy. A commentary published during the Linnaeus tercentenary year emphasized the case for the importance of keeping track of species names, the rules governing naming and the need to encourage web-based approaches, bringing the field firmly into the electronic age (Knapp, S. *et al.*, 2007, **446**, 261). In reflecting on 'the legacy of Linnaeus' a *Nature* editorial (2007, **446**, 231) suggests that 'the realization that the second edition of his dreamed-of universal catalog would be slimmer than the first would surely strike him as a melancholy one'. A major problem for modern taxonomy is to impose and maintain codes for naming, as the number of identifiable species increases. Amateurs coexist uneasily with professionals in taxonomy; a characteristic of a field which flowered in the Linnaean era, when exploration of the planet provided the basis for new discoveries.

While technology may catalyse a revival of taxonomy, the current awareness of the importance of biodiversity and the rise of the conservation movement may provide the foundation on which modern taxonomy builds a secure future. In an editorial published in *Science* over five years ago, three leaders in biology argue that 'the great biological challenge of our age is to create a legacy of knowledge for a planet that is soon to be biologically decimated' (Wheeler, Q. D., Raven, P. H. and Wilson, E. O., *Science*, 2004, **303**, 285). But to emphasize the beauty and importance of naming, I must return to Carol Yoon and her column: 'Because once you start noticing organisms, once you have a name for particular beasts, birds and flowers, you can't help seeing life and the order in it, just where it has always been, all around you.'

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