

NCYC

Behind the (long lived) acronym!

We like our acronyms. The worlds of brewing and distilling are littered with them – using the initial letters of a name. The various takeovers and mergers of companies in our industry have resulted in an ever-changing and bewildering landscape of acronyms. You know what I mean!

By **David Quain**

By way of example (if you needed it!) today's BRI (aka Brewing Research International) started life in the late 1940s as the BIRF (Brewing Industry Research Foundation) which morphed in the 80s into the BRF (Brewing Research Foundation) and



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then BRFI (Brewing Research Foundation International) before – to complete the circle – becoming BRI. Conversely over a comparable timeline the National Collection of Yeast Cultures has remained steadfastly as ... the NCYC!

A Google search for the NCYC leads off with the National Collection of Yeast Cultures but also delivers a few other interpretations such as the 'National Catholic Youth Conference', 'National Catholic Youth Choir' and best of all in my view, 'Newcastle Cruising Yacht Club'.

Norwich

Should you not know, Norwich is located in East Anglia on the eastern bulge of England, some 140 miles or so from Burton-on-Trent

and 115 miles from London. Norwich is a city of 367,035 folk and is the main town in the county of Norfolk. For me it is the home the Alan Partridge from the TV. More mainstream, the best selling cookery writer Delia Smith (called simply 'Delia' by the woman in my life) famously lives in Norwich where she is the owner of the not consistently successful Norwich City FC (NCFC), the city's football team. The other thing I know about Norwich is that it is the home of the NCYC.

Where and who

The NCYC is located at the Institute of Food Research (IFR) on the outskirts of the town in Colney Lane. As ever, my satellite navigation system delivers me to the wrong (and blocked end!) of Colney Lane. As if part of a double act, my iPod with its usual impeccable and uncanny timing, delivers up 'the long and winding road' – I eventually arrive 15 minutes late.

I am met by Dr Ian Roberts variously 'Senior Scientist', 'Exploitation Platform Leader' and, we agree best of all, 'Curator' of the NCYC. He adds to the Norwich story by adding a fascinating tit bit - there are said to be over 350 pubs and more than 50 churches. In other words a church for every week of the year and a pub for every night: if funding can be found Ian is happy to do the research!

In the lab we are joined by Chris Bond the 'Collection Manager' (and Quality Officer)



Checking plates during quality assurance.



Removing cryoboxes from storage in liquid nitrogen.



Phylogeneticist Steve James, Curator Ian Roberts and Collection Manager Chris Bond

and Dr Steve James variously ‘Molecular Biologist’, ‘Molecular Taxonomist’ or most accurately ‘Phylogeneticist’. They clearly must enjoy their work and working together as the years rack up for Ian (15 years), Chris (24 years) and Steve (16 years).

Other members of the NCYC team include Dr Georgina Pope (Business Manager), Mrs Linda Fuller (Research Assistant) and Dr Robert Davey (variously ‘software developer’, ‘computational biologist’ and ‘bioinformaticist’). Unusually – least ways to me – but impressively both Robert and Steve did their Ph.Ds with Ian Roberts.

Although not involved in the day-to-day, the NCYC can call on Linda and James Barnett as consultants. Dr Barnett is one of those ‘names’ in the yeast world, having been lead author of the taxonomic bible ‘*Yeasts: characteristics and identification*’ which is now in its third edition. James Barnett has also in recent years published a series of

papers under the banner of ‘*A history of research on yeasts*’. Paper 12 was published recently covering ‘*Medical yeasts part 1, Candida albicans*’ with previous episodes covering amongst other things ‘*the fermentation pathway*’, ‘*taxonomy*’ and ‘*regulation of sugar metabolism*’.

Other NCYC alumni include the late Professor Robert Davenport developer of yeast ‘forensics’, who received the ultimate accolade (for a yeast scientist) in having a newly-isolated yeast named after him. *Candida davenportii* was isolated from a dead wasp found in the sampling tap of a sugar storage tank in a soft drinks factory. The lead author of the paper describing *C. davenportii*, Dr Malcolm Stratford of Unilever and now at the University of Nottingham is another long-term collaborator with NCYC.

A potted history

NCYC formally started life at BRI (then BIRF – see above!) in about 1951 although the concept is thought to have first been mooted in 1948. Things are a bit hazy but by the 1960s the NCYC was firmly under Brian Kirsop’s departmental wing with Barbara Kirsop running it day to day. For me, as someone new to the industry in 1970, a hugely evocative image of that time at BIRF was the

warm room incubation of yeast cultures in ‘roux’ bottles jerkily aerating on a device that was clearly created and built at the BRI/Lytell Hall workshop.

After a couple of years of discussion the NCYC left leafy Surrey for its current similarly leafy Norwich home in 1980 with Barbara Kirsop becoming the first Curator. There it has remained although there was talk in the mid 90s of returning to Surrey – Egham not Nutfield. Today whilst solidly within the IFR, the talk is more about funding than location.

The NCYC is now part of the IFR registered charity and is funded primarily via the Biotechnology and Biological Sciences Research Council (BBSRC). Inevitably these days, another review is underway, this time considering whether the IFR (and in turn the NCYC) should become part of the nearby University of East Anglia within the School of Health. The jury is currently out.

In passing, Ian Roberts remarks that the CEO designate at the BBSRC is both a friend of the NCYC and the brewing world. Professor Douglas Kell late of the Universities of Aberystwyth and Manchester. He, of course, is behind the biomass probe or the Aber meter used to monitor and control viable yeast on pitching and cropping. Continuing the theme of ever-changing acronyms, the BBSRC was formerly the AFRC (Agricultural and Food Research Council) and prior to that the ARC (Agricultural Research Council)!

A very public collection

There is obvious pride within the NCYC. Ian and his team talk about preserving

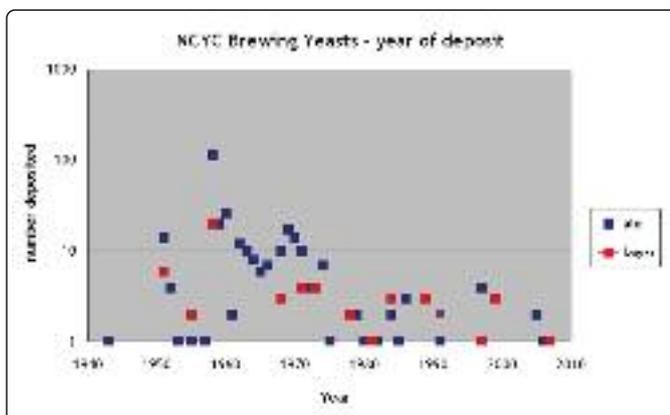


Figure 1.

“...the injection of ‘new’ brewing strains into the collection might also further encourage the commendable efforts of some brewers to recreate beers from the past as well as creating new beers...”

yeast/genetic diversity for future generations and that it is the largest public collection of yeasts in the UK. Currently the collection contains 3518 yeasts ranging from *Pichia*, *Kloeckera* and *Saccharomyces* species deposited (elsewhere) in 1920 to NCYC 3520, a human clinical isolate of *Candida albicans* deposited in August 2008.

The NCYC routines for yeast deposit and supply are captured in ‘standard operating procedures’. These in turn fit into the Institute of Food Research’s site wide ISO 9001 accreditation which in addition to the usual suspects also includes the finance function.

Given NCYC’s origins, commercial strains of *Saccharomyces cerevisiae* (and *S. pastorianus*) feature strongly with 474 strains of which 413 are brewing, 40 used in wine and cider, six in distilling and 15 in baking. Of the brewing yeasts, 334 are ale strains and 79 lager strains. Further analysis (Figure 1) shows that the majority of ale and lager strains were deposited between 1950 and the mid 1970s with 1958 being the real hotspot accounting for 136 strains in the brewing collection. Similarly the distilling strains are primarily from the 1950s with the most recent (NCYC 2945) being deposited in 2000.

More detailed analysis of the brewing collection in Figure 1 shows that, to my surprise, since the UK beer orders in 1989, only 37 brewing strains or so (10 ale, 14 lager and 13 to be characterised) have been deposited in the NCYC. With the benefit of hindsight, this is more than a little disappointing as the brewing world has undergone something of a ‘change programme’ in the last 20 years with the repositioning of the then ‘big brewers’, accompanying globalisation, and the resurgence of regional and small/craft/micro brewing businesses. Regrettably for the NCYC, at such times of change thoughts are elsewhere and saving yeast strains for posterity and use by future generations of brewers is pretty low on the list of priorities.

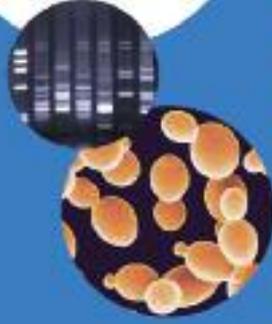
Perhaps it is now timely to consider making amends? Those brewing strains in company collections which have long ceased to be used in commercial brewing could be donated to the NCYC, anonymised (or not) and made available once again for fermentation. Not only would this enhance the diversity of the brewing collection of the NCYC but would release the current ‘curators’ of these yeasts from the need to maintain these ‘historical’ collections.

From a personal perspective, the injection of ‘new’ brewing strains into the collection might also further encourage the commendable efforts of some brewers to recreate beers from the past as well as creating new beers with different yeast specific flavours and aromas.

Whilst the brewing collection has had little growth, the NCYC has diversified into clinical and opportunistic yeasts, food spoilage yeasts and environmental isolates (including new species isolated in the Ecuadorian rain forest). Also yeasts from the Netherland’s Centraalbureau voor Schimmelcultures (CBS) Fungal Biodiversity Centre are backed-up at the NCYC. For culture collections, storage elsewhere is best practice in case of disaster, although very wisely the CBS is located in Utrecht which unlike much of the Netherlands is above sea level! In the case of the NCYC, the collection is backed up elsewhere in a remote location.



Yeast Security



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Dedicated liquid nitrogen storage facility



Remote site back-up of freeze-dried strains



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500 brewing strains available for purchase



DNA Fingerprinting

DNA Fingerprinting detects genetic changes that can affect product quality. Safe-deposited strains can be re-supplied in pristine condition should mutations or contamination have occurred.



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Table 1: The top ten yeasts

	NCYC Strain Number	Description	Background
1	1187	Ale	Deposited in 1960 from a British brewery, <i>S. cerevisiae</i>
2	240	Ale	Deposited in 1951 by B.M. Brown. Whitbread Taylor Walker Yeast SC12 – <i>S. cerevisiae</i>
3	1245	Ale	Deposited in 1965 from a British brewery – <i>S. cerevisiae</i>
4	1324	Lager	Deposited in 1973 from a Scottish brewery – <i>S. bayanus</i>
5	203	Lager	Deposited in 1951 by L.S. Walters, South Australian Brewing Co, West End Strain – <i>S. pastorianus</i>
6	450	Lager	Deposited in 1955 by R.S.W. Thorne, Bottom yeast no. 785 – <i>S. pastorianus</i>
7	680	Lager	Deposited in 1966 by O. Bendova, Holesovice B strain – <i>S. pastorianus</i>
8	1026	Ale	Deposited in 1958 from a British brewery, Whitbread B equivalent – <i>S. cerevisiae</i>
9	479	Sake	Deposited in 1956 by K. Sakaguchi, Kyokai 7 strain – <i>S. cerevisiae</i>
10	452	Lager	Deposited in 1955 by R.S.W. Thorne, Bottom yeast strain No. 1118 – <i>S. pastorianus</i>

NCYC commercial

Inevitably these days the NCYC needs to 'balance the books' and grow its commercial activities whilst delivering impactful research. For most of us, the supply of yeast cultures is what we associate with the NCYC. In terms of sales the 'top ten' yeasts makes interesting reading (Table 1 overleaf). The top ten yeasts feature six strains deposited in the 1950s, three from the 1960s and the remaining yeast from 1973. The upside is that these 'heritage' strains are still working for a living and to my knowledge producing great beers. Reflecting the times, further analysis shows that lager strains predominate with five, four (including the top three) strains are ale yeasts, and a sake strain completing the top 10.

Of the 413 strains in the brewing collection, 334 strains were characterized in terms of fermentation performance by criteria such as head, deposit, attenuation, fermentation rate, clarity and flocculence. Whilst dating back to the NCYC/BRI connection and using worts of 1.040 in two-litre EBC tall tubes, these results provide clues about the performance of these brewing strains in sales (and directionally) higher gravity fermentations.

Although yeast storage and supply remains core, other services have been developed by the NCYC. The confidential 'safe deposit' service provides a back up for key strains with a couple of slopes returned 'home' every year. The 'premium' package includes a DNA fingerprint check, to my mind an invaluable add on. For those without laboratory scale-up, bulk pitching yeast of your strain of choice is a further option. Furthermore – reflecting NCYC's capability with molecular techniques – yeast strains can be identified or, in the case of brewing strains, cultures can be authenticated, checked for purity and genetic drift.

Other activities include screening for traits of commercial interest (e.g. for use in biofuels or pharmaceuticals) and troubleshooting yeast related problems using forensics.

NCYC research

In terms of research, the NCYC's laudable ambition is to 'learn as much as we can about yeast'. As reflected in today's NCYC, research is by no means *Saccharomyces* – centric. In the noughties, a number of publications in high-impact journals have described new yeasts such as *Candida sorbosivorans* (a contaminant of vitamin C production), *C. braccarensis* (clinical isolate) and the aforementioned *C. davenportii*. Not surprisingly, the NCYC have explored the *Zygosaccharomyces*, a genus important to the food industry as these yeasts tend to be resistant to preservatives (sorbate, benzoate and sulphur dioxide) and are tolerant to high levels of ethanol and sugar resistant. Publications include a study of sorbic acid resistance in populations of *Z. bailli*, characterisation of *Z. kombuchaensis* (from tea fungus used in fermented tea) and a report on natural genetic hybrids of *Zygosaccharomyces*.

The *Saccharomyces* genus has not been ignored, with publications on the phylogenetics of the (family) *Saccharomycetaceae* and study of the evolutionary relationships in the *Saccharomyces sensu stricto* complex. This group consists of four closely related and familiar species *S. cerevisiae* (ale yeast), *S. pastorianus* (lager yeast), *S. bayanus* (wine yeast) and the undomesticated *S. paradoxus*. Building on this, the NCYC was also involved in the isolation of three new species of the *Saccharomyces sensu stricto* complex, *S. cariocanus*, *S. kudriavzevii* and *S. mikatea*.

More recently the NCYC led a group evaluating the application of metabolomics in the differentiation of brewing yeasts – for more details see 'Coming 'ome – the return of brewing yeast genetics' in the June 2008 issue of *The Brewer and Distiller International*.

The NCYC is also involved in the *Saccharomyces* Genome Resequencing Project (SGRP), led by the Wellcome Trust Sanger Institute in Cambridge and the Institute of Genetics, University of Nottingham. In all 36 *Saccharomyces cerevisiae* strains and 35 *Saccharomyces paradoxus* strains are being sequenced with a view to better understand genomic variation and evolution. All the strains in the SGRP are available from the NCYC.

Returning to the NCYC's bread and butter, Collection Manager Chris Bond has recently contributed to *Methods in Molecular Biology* with articles on freeze drying and cryopreservation of yeast cultures. Although both approaches have in the past been used at the NCYC, the emphasis is moving to cryopreservation and the supply of yeast slopes (as opposed to freeze dried ampoules) to customers.

Collaborators

Leading edge research in yeast invariably involves networking and collaboration, an approach massively facilitated by the internet and information technology. Importantly the NCYC collaborates with many of the leading players in yeast research. For example the above metabolomics paper involved contributions from Roy Goodacre (University of Manchester), Douglas Kell (Manchester/BBSRC), Ed Louis (Nottingham) and their respective co-workers. NCYC also have also collaborated over the years with Steve Oliver (now Cambridge) especially in the work on speciation and the evolution of *Saccharomyces sensu stricto* complex.

The future

The NCYC appears well placed to ride out whatever further changes the future may bring. To a degree the NCYC has reinvented itself, moving away from its brewing origins to a broad based collection of non-pathogenic yeasts that meets a global need. Perhaps it is now timely for the NCYC and greater brewing industry to re-engage with each other to the benefit of both parties. ■

■ For more information on the NCYC contact Ian Roberts at ian.roberts@bbsrc.ac.uk.

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