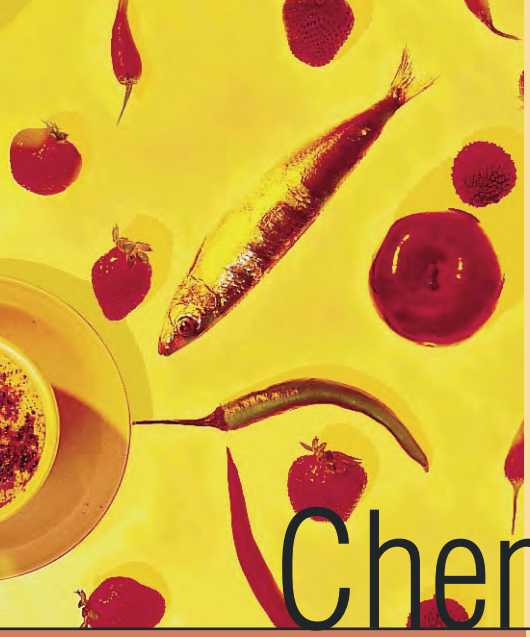
Vol. 15, No. 1 March 2013



Chemo Sense

EDITORIAL AND SWAN SONG

New Owner-Management Starts Next Issue

By Graham Bell
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This is the 57th issue of *ChemoSense*. As I write this, a new team is getting ready to take over: A younger, smarter, more energetic team, willing and able to carry forward what my group of colleagues and friends began nearly fifteen years ago. We began in December 1998 with an 8 page printed edition, edited by Karen Weisner, with contributions from Karen, myself, Don Barnett, Marilyn Styles and John Prescott. The design by Jodi Lawton was so radically arty as to dazzle the eyeballs. With a bit of tweaking the bulletin became easier on the eyes and rapidly grew to 16 pages per issue and a readership of over 4000. In June 2003, after UNSW removed financial support for printing, we "went electronic," where we remain 10 years later.

The aim of *ChemoSense* was to inform intelligent readers in a wider world beyond academia of the important discoveries that are happening in a little known area of science: the chemical senses. All articles, mini reviews and commentary, were by invitation of the editor and many a great scientist (or to be great scientist), has responded to the

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Artificial Olfaction and the "App Factor": New Efficiency, New Users

Graham Bell
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What is this "app mania" that is sweeping the developed world, and how can we make the most of it in science and technology?

In developed countries, such as Australia, conversion from "conventional cell" ("mobile") phones to so-called "smart phones" is now over 60% according to anecdotal reports. This is not a fashion fad, but part of the IT revolution the world is going through. Part of the reason for the rapid uptake of "smart phones" is their ability to deliver instant, mobile data and internet access to the owner, provided they are within telecommunication range. People now have access to their e-mails from anywhere at any time, plus all the features of the internet. In addition there is a new plethora of functions that the smart phone

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INSIDE:

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EDITORIAL CONTINUED

New Owner-Management Starts Next Issue

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invitation. The result is a legacy collection of fine mini-reviews giving the personal perspective of experts on the most important developments in the field.

Our aim to be contemporary has produced a view on the passing years and has reflected in articles, "faxes from abroad", editorials and news items, a changing world. We have watched many momentous happenings: the Asian economic crisis of 1998-9 and the Indonesian melt-down; the Millennium Bug fizzer; the Sydney 2000 Olympics; the Dot Com Bubble; the Japanese economic downturn; the horror of "9-11"; the SARS (Severe Acute Respiratory Syndrome) epidemic and lock-down in China; the rise of great New Zealand wines; the olfactory receptor Nobel Prize won by Buck and Axel; the disappearance of the wine cork; the Helicobacter pylori Nobel Prize won by Aussies Marshall and Warren; two years of devastating Australian floods and some deadly bush fires; the Japanese earthquakes, tsunamis and the Fukushima tragedy.

While these events and several nasty wars and conflicts raged on, the science reflected in *ChemoSense*, which is far more important and amazing, poured forth. So much progress has been covered in our pages that it will require a book to do it justice. Perhaps that will happen. Anyone interested?

In the coming issues, readers will learn what the new owner-editors, James St John and Jenny Ekberg have in mind for this bulletin. All I intend to do is hang up my pencil and let them loose to make of it exactly what they wish. It comes to them with an established ISSN registration, a website for archived issues, a mailing list and lots of love. I hope you the readers will give them your support, write for them and buy advertising to help cover costs. I trust they will continue to support the Australasian Association for ChemoSensory Science (AACSS) and that that body will remember the support it receives from them and has enjoyed consistently from this bulletin's founders, these many years past.

Thanks to all our readers, authors and advertisers, and to Brian Crowley and Jodi Lawton who have supported me for so long ■

Artificial Olfaction and the "App Factor": New Efficiency, New Users

continued

user can invoke via so called "apps". Each is underpinned by a program, uploaded to the person's phone, and used to access a specific source of information, such as global positioning, via the phone network.

Young entrepreneurs are riding a wave of bright ideas both by using and inventing new apps. At the Australian Technology Park in Sydney an entrepreneurial start-up program (www.startmate.com.au) is stimulating the imagination of around thirty start-up companies. More than half of these make use of apps to give mobile usage to a product, or are developing novel apps themselves.

How can artificial olfaction benefit from app technology? Here we review some ways electronic noses are and will be used, by linking to information technology available on smart phones.

Food and Beverage

In the food and beverage industries, electronic noses can potentially replace human noses in quality control, product development, and other facets of food technology. With a device installed to sniff aspects of food production, the app allows the user to engage with the production process in real time without being tethered to a control panel, laptop or desk, or for that matter anywhere near the factory. If a sensory specification measured on the production line (or among consumers in the field) is not met or exceeded, an operator can follow the measuring process by smart-phone and immediately take corrective action. Such "live data streaming" does not require the internet. The production instrumentation can stream information directly to the receiver.

Graffiti Vandalism

A device, "graffit-e-nose" that detects the smell of spray paint used by graffiti vandals has been applied in several contexts in Sydney (www.e-nose.info). The device makes a decision as to what it is sniffing and if it is spray paint, it initiates a message to the owner of the property being defaced. However, in many cases, false alarms and timing is costly and inconvenient: the vandals, may have moved on within a minute or two, which is too soon for a physical intervention by security personnel. In other circumstances, substances with composition close to spray paint, such as other aerosols or exhaust fumes, might trigger the alarm. In both cases, there is expense in making a fruitless response. Enter the app, the e-nose and an ancillary sensing technology: data streamed vision. Present-day digital video recorders can be specified with large data storage hard-drives with capacity in the order of one terabyte or more. The recorder runs continuously for months on end and captures the outputs of between 1 and 32 cameras. It can transmit its live or recorded visual data to an app on a smart phone. Thus, when a chemical detection is made, and an

Figure 1A

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continued

operator alerted, the live vision can be retrieved immediately and the situation at the area guarded by the e-nose assessed. Then the most appropriate and cost-effective response can be initiated. The streamed video can be retrieved later as time and date-stamped evidence, as shown below.

Figure 1B

Figure 1A & B: Vandals in action in Brisbane and Sydney, apprehended by E-Nose P/L video streaming to a smart phone app.

Where graffiti vandals have previously been able to operate with impunity, this technology is changing the reward structure and bringing about behavioural change for the benefit of the public, whose funds are currently wasted on cleaning graffiti paint off walls and other surfaces. The funds can be used for better purposes. In addition, reduction in general disorder can be expected where graffiti is not present in the environment (Keizer, 2008), as well as better growth in capital value of domestic and other property (http://www.graffiti911.com/costs.php) Intrusion into privacy by these forms of electronic surveillance is the price we are paying for safer cities, where our actions will be monitored by CCTV and various forms of artificial olfaction.

technology. Big Brother's apps will be watching and sniffing you.

Air Pollution

Artificial olfaction is now well-integrated into the air monitoring field, through the development of robust devices that can survive in the outdoors. A number of different chemical sensing devices are used to audit smelly and chemically dirty sites, including oil and fuel depots, petrol and mineral refineries, landfills, paper manufacturers, fish and meat processing plants, and sewage treatment plants. Data transmission from these sites by wireless telecommunications means that the site can be managed more remotely and efficiently. The app now provides full mobility for site management. Early detection of leaks and other dangerous events can be made and communicated through an app to one or several appropriate people. Risk mitigation follows if more than one person can be alerted immediately.

Figure 2: E-Nose applied to six industrial air quality problems:

Fig 2A, Continuous monitoring at a waste treatment site, Melbourne, Vic

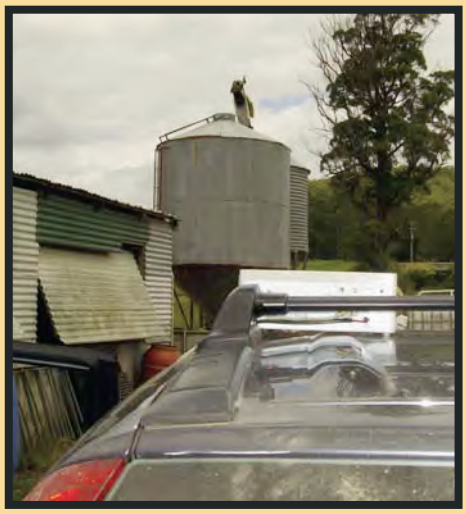

Fig 2B, Sampling air near an intensive piggery in Nambucca Shire NSW

Fig 2C, Smell audit at solid waste recyclers, Sydney, NSW

Fig 2D, Sampling from down a sewage well, Brisbane, Qld

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continued

Fig 2E, Monitoring fugitive odour from a sewer water mining plant, Sydney, NSW

Fig 2F, Monitoring vapours from a waste water pond at an abattoir in NSW.

Figure 3: Odour was measured at varying depths in two experimental biofilters (Bioaction Pty Ltd). Ports for air sampling at varying depths can be seen on each filter vessel. The E-Noses were located inside the trailer at left. Odour was piped to the filters from a fertilizer plant at right (Bell and Botham 2011).

Applied Science

While e-noses have also found use in chemical laboratories, they have been progressively finding applications in allied technologies, such as air filtration. In a recent study (Bell and Botham 2011) the efficacy of various filtration materials was measured with an e-nose at varying depths in the filter beds. By this means it was shown where and when the filtration was effective as calibrated with human detection of industrial odour passing through the filter. This study points to the future use of artificial olfaction, communicated through an app, in alerting an operator to a filtration failure or to the end-life of the filter having been reached. Industrial sites will in future be monitored by several tailored forms of chemical sensor array.

Medicine

In the medical field the combination of e-nose and app is likely to progress the delivery of medical data and treatment outcomes. Data from a peripheral device, such as breath-diagnostic e-nose can be transmitted to a central database and the results retrieved by app. The role of the medical practitioner will be changed by the

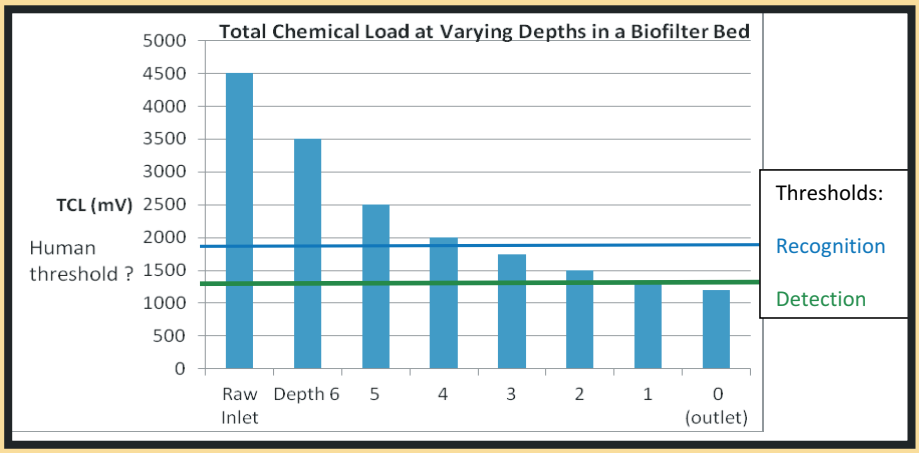

Figure 4: Superimposition of E-Nose chemical load measurements from air samples at different depths in one of the experimental biofilters (TCL,mV) and human thresholds found from duplicate air sample bags taken at the same depths. After level 4, odour fumes passing through the filter have been reduced to below human recognition threshold and by level 1 they no longer can be detected at all by 50% of normal adults (Bell and Botham 2011).

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Artificial Olfaction and the "App Factor": New Efficiency, New Users

technology, but made less trivial and given greater power to monitor treatment and patient conditions from a remote and mobile vantage-point.

To date, the Mk 2, 3 and 4 E-Noses (E-Nose Pty Ltd., Australia) have been developed and tested in a range of medical and veterinary applications. (Tran, et al., 2010; Cramp, et al., 2009). It is anticipated that a novel way of classifying complex data from the breath of patients (Hibbert and Bell, 2011a, 2011b) will help to accelerate uptake of this non-invasive technology, particularly in the medical and veterinary fields. The goal of timely detection of lung cancer by electronic nose is being pursued by several research groups (Blatt, et al., 2008; DiAmico, et al., 2010; Chapman, et al, 2012; Wang, et al., 2008).

A recent e-nose study, the first of its kind, focussed on identification of lung transplant rejection (Hettiarachchi, 2012) on the breath. The E-Nose was able to distinguish between transplant patients and healthy non-transplant controls but not between transplant subgroups varying in rejection status. While most sensors made a statistically non-significant contribution to the discrimination, one made a significant difference. This suggests that large arrays may produce better results in future and allow a selection of suitable sensors for such important developments in diagnosis and treatment of critical medical conditions.

Early detection of lung cancer remains a worthy goal in medical research and e-noses continue to hold promise of a non-invasive and rapid diagnostic. The list of conditions that might be detected on the breath is growing and includes liver, lung and stomach disease, metabolic conditions such as diabetes, and even breast cancer (Wysong, 2012).

The app is not an end in itself, but is the medium by which communication of measurements and results will be communicated, to a very great degree in the coming years. At the lab and clinic, the hard work will continue, to make the discoveries that will underpin future technology, just as it has always has, except that now the technology flowing from discoveries might be used anywhere, at any time thanks to this new age of smart phone communication. What we have anticipated here, is the broadening of the audience for and users of scientific discoveries in the field of chemosensory science ■

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NEWS

It's on again!

The 2013 AACSS Scientific Meeting: 16-18 August 2013 at Phillip Island, Victoria, Australia.

By Graham Bell: g.bell@e-nose.info

www.piecesofvictoria.com

Registration and abstract submission is now open for the 2013 AACSS scientific meeting to be held at Silverwater Resort on Phillip Island outside Melbourne. http://www.silverwaterresort.com.au/

The meeting will start on the evening of Friday August 16 and end after lunch on the Sunday August 18. Details are now available on the website. http://www.aacss.org/

Registrations and abstracts are **due on July 4th 2013** but if you are able register before then it would help greatly!

We are holding the meeting to dovetail with the ICEC meeting in Melbourne: see http://www.icec2013.com.au/

Please feel free to forward this information to anyone who may be interested in attending. I am also happy to answer any queries you may have about the meeting.

Alisha Anderson
AACSS treasurer and 2013 conference organiser
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Upcoming Events

17-21 April 2013	**AChemS** Huntington Beach, California, USA www.achems.org
2-5 July 2013	**ISOEN 2013: International Symposium on Olfaction and Electronic Nose** EXCO, Daegu, Korea www.isoen2013.kr
11-15 August 2013	**10th Pangborn Sensory Science Symposium** Rio de Janeiro, Brazil Abstract Deadline: 15 February 2013 www.pangborn2013.com
16-18 August 2013	**AACSS Scientific Meeting** Phillip Island, Victoria, Australia http://www.aacss.org/
8-11 September 2013	**21st International Clean Air and Environment Conference** Sydney, Australia www.casanz.org.au

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