

ICATS NEWS

WINTER 2017

EDITOR'S NOTES

Ali Green

This edition of ICATS News should have something for everyone. From a rather rainy Plymouth, many of these articles take me on a very pleasant trip to far more pleasant climates and more exotic locations. We will take you on a journey through some of the latest research in the world of aromas and their application in medical science as well as a tour through some of the rich history of our fragrant world.

The latter part of 2016 was full of amazing and colourful fragrant journeys for two of the ICATS team members, Sharon Heard and me. Whilst Sharon was in Dubai for the fabulous IFEAT conference, I was a delegate on the IFEAT study tour to the USA with a special focus on mint oil production. Closer to home, the entire ICATS team travelled to London for the 2016 IFRA Fragrance Forum at the Royal Society: this was a real treasure trove of knowledge delivered in highly prestigious surroundings and it is my pleasure to report on some of the fascinating presentations from the day.

There will also be a feature on our prize-winning student Zohra Kaliq and a piece on one of the biggest names in British perfumery, John Bailey, who presented the keynote lecture in Dubai on the subject of oud. Tony Curtis has been scouring the press to report stories in the news as well as reviewing a publication that will be of interest to many of the readers.

As ever, please let me know if you would like us to write a feature on anything that you are working on, issues that interest you or events you would like us to publicise to our readers. Until next time, kind regards, Ali



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IFEAT STUDY TOUR TO THE USA, AUGUST 2016

ALI GREEN

Now this is going to be a difficult article to write. Not because I have nothing to say. Rather, there is so much to say that I could actually fill the pages of several ICATS Newsletters with details of this one fantastic experience. Now – where to begin...

Our tour began in San Antonio, Texas; not an area that would necessarily spring to mind as a producer of essential oils. The day I arrived, the whole of Texas was subject to unseasonable downpours, so the tour of the city for those who arrived early took place under umbrellas with people ducking for shelter in monsoon-like conditions. Our guide was rather thrown by the rain as Texas had endured a drought for quite some time, but nevertheless showed us the State's most famous site, just in front of our hotel, the Alamo. This gave us an excellent introduction to the fascinating history of the *Lone Star State*, its multicultural heritage and independent outlook. That evening (after we had dried out) all the delegates gathered for a *Texas-style Welcome Reception* at the hotel, sponsored by Eucaforest

Ltd. a locally run company that operates in Southern Africa to produce sustainable essential oils that impacts beneficially on the local community. Catherine Crowley, the Director, arranged a fabulous spread of Texan food and some great musical entertainment which really made us feel welcome.

The following day, we were up early to look at cedarwood felling and oil production at Texarome Inc. Leakey, run by the Boucard family. Although called cedarwood by the Texans, this is not wood from the true cedar tree, rather it is from the juniper family (*Juniperus ashei* and *Juniperus mexicana*). The oil production is actually a by-product of the fence post industry. As you can see from the image, the shrub does not have many thick branches suitable for this use, so all the thinner twigs and branches are used for oil production. The felling is a local environmental necessity as the shrubs are very thirsty trees and will drain the local water table if not controlled by sequential felling. In addition to the cedarwood, the company also distills



Cedarwood production



Labbeemint inside the facility

Haitian vetiver and Dominican amyris. The processing involves firstly shredding the wood which is then distilled. Texarome use continuous distillation, a system that uses "a pneumatic conveying system using dry super-heated steam instead of air to move the oil-laden solids from one part of the plant to another. While it is transported (only 25 seconds), the oil is completely stripped from the finely ground solid material, passed through a 5µm baghouse filter, condensed and separated in a continuous decanter.¹" The setup at Texarome is clearly very effective as a consequence of their origins as an R and D company; they also manufacture similar distillation plants in-house, which they sell across the world. The Boucard family provided an excellent lunch at the nearby Frio Pecan Farm. We were treated to a fabulous barbeque (despite the weather, which was still rather rainy) and some excellent Texan country music courtesy of two great characters. We then travelled by air to the Pacific Northwest and Seattle, luckily leaving just before the airport was closed due to the torrential rain.

We had to leave the hotel extremely early the following day for a drive south through the stunning scenery of Washington state, which provided a total contrast to Texas with the forests and snow-topped peaks of the Cascade Mountain range. After a scenic place to stop on the way, we continued into the higher desert and to *Norwest Ingredients*, the first of many mint growers and oil producers that we were scheduled to visit on the trip. After a fascinating visit to *Norwest's* facility, we were entertained at the residence of Terry and Stacey Cochran, the President and Global Account Manager of this family run firm. Before a guided smelling exercise, we had some excellent talks from Steve Salisbury of the *Mint Industry Research Council* and Jason Stromme, *Director of Norwest Ingredients*². It was lovely to be welcomed to



Winnie Yeung and Hussein Fakhry with some impressive farm machinery



Shinn Family Farm tractor tour



Norwest Ingredients reception

¹ Texarome notes provided as part of the Study Tour booklet.



Callisons applications laboratory

the private home of the proprietors and to enjoy such a fabulous spread of American food. After lunch, we moved up to the Yakima Valley and the evening's entertainment at the tranquil *Apple Tree Golf Resort*. As we arrived slightly early there was an impromptu exercise class on the lawn for the delegates which limbered everyone up for the later celebrations for Indian Independence Day after dinner.

The following day comprised of another morning of mint. We were hosted by *Labbeemint*, who guided us through their facility and provided a very professional, comprehensive smelling exercise. The facility afforded the opportunity to see traditional distillery equipment alongside a state-of-the-art bespoke distillation plant using pioneering new technology commissioned by Tyler Labbee to accommodate the specific needs of their mint processing facility. The Labbee family provided a fabulous lunch on the lawn, after which we visited a nearby in-field distillation plant.

The afternoon saw a brief interlude from the mint industry and we visited Shinn Family Farm, who are a specialist hop producer. We were taken on a tour around the hop fields on specially adapted trailers where we were also given the opportunity to sample a number of local craft beers that make use of some of the specialist hops grown on the farm. We were guided around the harvesting and drying facility, which was a far cry from the traditional hop drying oast houses I grew up with in the South East of England. Hops are increasingly being processed now as a flavour ingredient that is far more easily transported than sacks of the dried hops; this is ideal for some smaller craft breweries, offering a wider range of speciality hops than would be practical with the raw crop. This visit was excellent fun and it was great to be pulled around a farm by a tractor gaining a real insight into hop farming in the USA today.

2 As we visited so many mint facilities, please see the separate article on the mint industry in the USA for details of these lectures.



Studebaker Museum

The evening entertainment was another treat, with a wonderful wine tasting and dinner at the Silver Lake Winery provided by Citrus and Allied Essences Ltd. The view over the vineyards as we enjoyed an excellent dinner and sampled local wines was superb and was the perfect end to a really enjoyable day.

The following morning was another early start; this was a bit of a struggle for some of the party, who had enjoyed the remainder of the wine from the tasting late into the night! We were warmly welcomed at Green Acre Farms, who grow a diverse range of agricultural produce, including apples, nectarines, hops and mint. As well as working closely with the local Native American reservation, the farm is deeply involved with many initiatives to improve sustainability and to pioneer farming methods that are environmentally friendly including Salmon Safe and USDA Organic. They have also looked at alternative energy solutions (including going diesel-free and solar panels) to reduce pollution as the local area as it is a unique high desert location with herds of wild horses and other wildlife running free nearby as well as a unique eco-system supporting many species of flora and fauna that would be adversely affected by reckless pesticide and fertiliser usage and over-consumption of natural water reserves. It was heartening to hear that sustainability and the preservation of the environment was so important to Green Acre Farms; a great antidote to the scare stories that we hear in the media concerning irresponsible farming methods. After this fascinating visit and tour of their facility, we boarded the coach for the long drive through some fabulous scenery to the Columbia River Gorge.

We were treated to another fine spread for lunch at the Hood River Inn overlooking the Columbia River sponsored by *RCB International, Albany Oil*. After this we enjoyed a beautiful coach tour of the River Gorge, guided by a



Night cruise on Lake Michigan

real character called Thelma. We stopped off at the jaw-dropping Booneville Dam and its salmon ladder, where you could view the salmon and lamprey eels on their journey upstream as well as a nearby fishery that had a small lake of sturgeon (a rare opportunity to see these giants up close). We moved on to Multnomah Falls, a stunning waterfall that we climbed up to and then onto a great view point for a photo opportunity with the whole Columbia River Gorge spread out below us. The afternoon break from industry visits was fabulous as it gave us a taste of the amazing scenery near to the farms and facilities we were visiting. The evening was spent in Vancouver WA with more great food laid on at Warehouse 23 by *Callisons, Inc.*

The following day saw a very early start again and the two-hour trip to *Callisons* facilities. We were treated to an excellent and informative tour of the facilities there including their analytical services, the applications lab, the logistics, processing and warehousing plant and finally, a talk on the marketing initiatives and industry placement of *Callisons*. The whole morning ran incredibly smoothly and was very instructive, particularly learning about the novel applications that were being pioneered by *Callisons* including the tasting of various items of confectionary. We had a really enjoyable lunch at *Callisons* before moving onto the airport to fly to Chicago for the third leg of our tour. We eventually arrived at our hotel up in St Joseph, Michigan in the early hours of the morning rather tired, but keen to see how the Midwest differed from the industry we had explored on the Pacific coast.

There was definitely a change in the weather from the Yakima Valley once we arrived at Kalamazoo, Michigan to visit *Kalsec, Inc.*, with cloudy skies and rain showers. It made rather a contrast to the heat of the high desert and the cloudless skies of Washington State. *Kalsec* provided an excellent tour of their facility, including their research and development laboratories and production facilities

3 Kalsec Company Profile in the Study Tour Booklet

where they devise and produce innovative "herb extracts, natural flavours, colours and antioxidants, modified hop extracts and nutritional ingredients."³ This provided the next step in the story begun in Shinn Family Farms, as we saw a large hop processing plant at *Kalsec*, where the hop extracts are distilled and processed from the raw ingredients. Our visit to *Kalsec's* laboratories took us on a culinary tour as every room we visited smelled of a different foodstuff or seasoning. The pioneering nature of their work, to transform natural raw plant ingredients into versatile and convenient products for the food and drinks industry was impressive. After the tour of the facility, we were all rather hungry, as our appetites had been stimulated by the delicious smells throughout the facility and *Kalsec* treated us to a smashing lunch next to a lake in their extensive grounds. The family-run firm has a strong tradition of caring for the local wildlife while the whole facility is run as sustainably as possible, with beautiful planting and conservation in action across the site. Unfortunately, our lunch was amidst some rather heavy rain showers, but it made a welcome change from the incessant dry heat of Washington State.

The afternoon saw us visit the Lebermuth new facility in South Bend, Indiana. Alan Brown, the Chief Operating Officer at Lebermuth was also the Chair of the IFEAT USA Study Tour and so it seemed fitting that we visited his family firm on the last full day of industry visits. After a great welcome from Lebermuth President Robert Brown, we were split into groups to tour various parts of the new premises that Lebermuth had recently moved to, including a really high-tech, formulation facility that can precisely measure aroma materials for both small and large quantity formulations (using Fricke Concordia I robotic dosing equipment). Although Lebermuth's core business has always been peppermint and spearmint, it has now expanded to include other aroma ingredients (natural and synthetic) and services such as bespoke



In-field Mint Lecture by Alan Brown

in-house fragrance and flavour creation catering for a range of customers across the industry. Clearly Lebermuth have wisely invested a great deal into these fantastic laboratories and production facilities: truly a forward-looking and highly competitive facility set for the challenges of at least the next twenty years.

Alan Brown organised a really special night for us in South Bend, where we were hosted for evening entertainment at the local museum featuring a fascinating collection of vintage Studebaker cars. We were also guided around the 38-room Oliver Mansion, a nearby stately home owned by the nineteenth century wealthy industrialist J.D. Oliver. All in all, the evening provided a fascinating journey back in time, which was then countered by a DJ set and dancing. It was a truly memorable evening and provided an insight into an American history we had not witnessed anywhere else on the tour.

The following day was our final industry visit in the morning: a tour of Shady Lane Farms. We visited the peppermint and spearmint fields and were given an in-field talk by Alan Brown, explaining the farming methods used locally. It was great to also chat to the owner's family and hear about the day-to-day challenges of running a profitable farm in the Midwest. We enjoyed wonderful hospitality on our visit there, including a look at a selection of vintage tractors kept on the farm and the in-house distillation facility. After some splendid food provided by Lebermuth, we made our way to Chicago for our final night in the US.

I took a quick trip around the Chicago Museum of Modern Art before we all headed down to Lake Michigan for a farewell dinner cruise. It was sad to be seeing the other delegates for the last meal together on such a splendid tour, but it was a once-in-a-lifetime experience to watch the iconic Chicago skyline from the lake listening to live music and enjoying great food and wine. I would highly recommend the IFEAT study tour to any IFEAT members across the aroma trades industry, whatever your role. I thoroughly enjoyed the visits to such a comprehensive selection of farms and companies so ably-selected by Alan Brown and Peter Greenhalgh. We were all shown such a welcome everywhere we went and given open access to so many businesses that took a great deal of time and trouble to prepare wide-ranging and interesting tours and lectures for us. I would like to extend my sincere thanks to Alan and Peter for creating such a great programme for us and to all the companies that hosted us or provided corporate entertainment. The whole experience was one that I am sure never to forget and has been immensely useful to me in my position as ICATS Director of Studies. **Thank you IFEAT!**

THE MINT INDUSTRY IN THE USA

ALI GREEN

Having visited so many mint producers and processors in the USA last summer, I learnt an awful lot about the industry from farm to end products⁴.

Growing Mint in the USA

There are two main crops: peppermint and spearmint. Although there are numerous hybrids of both each one possesses varying amounts of certain aroma chemicals desirable for different applications. The environment in which they are grown (climate and geology) also has an impact on the oil content and manufacturers will often specify which region of the US the plants originate from as each locality produces a unique balance of aroma chemicals. The main production areas are the Pacific Northwest (Washington State, Oregon, Northern California, Nevada and Idaho) and the Midwest region (Michigan, Indiana, Illinois and South Dakota). We spent a lot of time in the Yakima Valley in Washington State, which is the largest producer of peppermint and spearmint oils in the USA with 150 growers and 33,000 acres under cultivation for the both crops.

Growing mint provides unique challenges one of which is that commercially grown plants have no viable seeds, so root stock and rhizomes are dug from established plants and hybrids and grown on in sterile green houses. These are then planted out in a highly mechanised operation. For most peppermint, there is one harvest a year in September, but for Yakima peppermint and spearmint there are two (July and September) with these oils being described as 'first cut' and 'second cut' respectively. There is a noticeable difference in concentration of the aroma chemicals present in the first harvest and second, due to the different environmental factors impacting on the plant (such as longer exposure to the sun). Before processing, the mint is harvested to form 'mint hay', which is allowed to dry for two to three days prior to distillation.

Distillation and further processing of mint oil

Nearly all distillation of mint oil has a number of stages. The first uses specially-designed trucks which chop and

transfer the mint hay from the field to a distillation plant where live steam is passed directly through the truck and the crude oil collected after about two to three hours. Further refining is needed to remove smoky residues and excess water, but this is not usually done in the field. Rather the crude oil is transferred to processing plants, such as the one at Labbeemint, where analytical tests like GCMS can ensure the oil is free of contaminants and cuts can be taken in order to separate the desirable aroma chemicals. One issue with mint oil is that it can be very viscous and volatile; thus in processing, the oil drums can only be recycled for mint storage a finite number of times. The mint industry has a number of schemes in place to recycle these drums for other usages and to pioneer new tank/drum



Mint field

⁴ Given that there was so much information, it is presented here in a brief form, but I would be more than happy to forward more detailed notes to any of our students.



In-field distillation facility



Distillation facility at Green Acre Farms

designs that are more sustainable. For example, Callisons employ a recycling scheme for their drums and have introduced totes (large tanks) as these use less metal, hold the equivalent of ten drums and last ten to twenty years (longer than the drums). They have also re-purposed lots of the drums in a children's adventure playground.

Applications

There are a number of applications for mint oil, but there are key market sectors that use the majority of US mint oil.

- Confectionary
 - Chewing gum
 - Mint chocolate
 - Boiled sweets
 - Tablet sweets

- Oral care products
 - Toothpaste
 - Mouthwash
 - Denture cleaning products
 - Denture adhesives

- Personal care products
 - Hair care
 - Shower gel and soap

During our visit to Callisons, we were given a guided tour of their Applications Laboratory, which gave a great insight into new product developments in these product areas as well as how different mint notes were favoured for particular market sectors. For the chocolates they were working on, the blend of chocolate was just as important as the blend of mint oil. Callisons were also looking at novel ways of applying the flavour as alternatives to the simple addition of the essential oil, such as sprays and powders. The burgeoning field of encapsulation technology (so important in the renaissance of laundry care products) is also being utilised in confectionary to ensure longevity of flavour to prolong the mint 'sensation' for as long as possible.

Conclusions

Until this visit I had been completely unaware of the complexity of mint fragrance and flavour. I was incredibly impressed by the technology used in the field, in the factories and in the laboratories to harness the rich selection of aroma chemicals from peppermint and spearmint. As an end user of many products containing mint oil, I will now be contemplating, with some fascination, the choices that must have been made by industry specialists when producing my favourite toothpaste or after dinner mint. Mint is ubiquitous: it would be a rare garden that didn't contain at least one mint plant and an even rarer household in the developed world that does not contain at least one mint product. I witnessed a real celebration of this much-overlooked aromatic plant in the USA and so many people whose entire lives were consumed with passion for mint and would like to thank each and every one of those I met in the industry for sharing it with all of us from the IFEAT study tour.

IFEAT CONFERENCE DUBAI 2016

THE MIDDLE EAST – CHALLENGES AT THE HISTORICAL CROSSROAD OF THE F&F TRADE

SHARON HEARD

The journey to the IFEAT conference this year was more than a little fraught, accidents and traffic congestion along the motorways of the UK made us late for our flights, which was more than a little stressful! After rearranging the seats on the next flight out the stress levels finally settled down and we arrived in Dubai early the next morning.

Registering on the Saturday afternoon was a quick and efficient process, and it was clear that the Jumeriah hotel was not only a beautiful venue for this year's conference, but also easy to navigate. It was a pleasant surprise for ICATS to find a bespoke stand set up ready for us to unpack and set up.

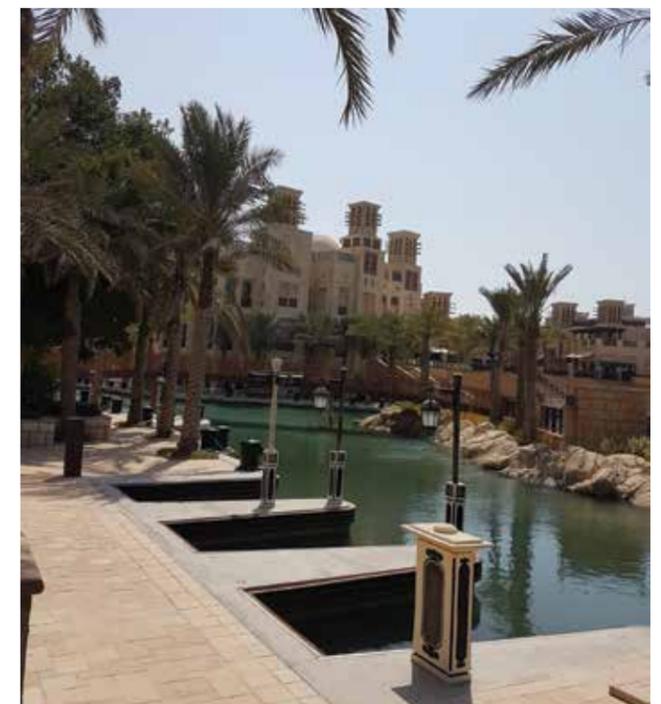
Sunday brought the welcome cocktail reception at the Medinat Jumeirah, which was a great opportunity to get settled in and meet up with everyone, including Kate Williams and John Bailey from the British Society of Perfumers.

Monday morning was hectic for us as usual, as our position near the information stand and registration desks meant that we were central to the majority of activity. The venue was positively buzzing with activity as delegates registered, met with old friends, colleagues and arranged meetings.

Throughout this busy start we had many visitors to the stand. Brian Lawrence visited to catch up on the latest from ICATS and John Bailey dropped by before final preparations for his presentation on Oud: *Liquid Gold – a global success story*. For more details see the featured article in the newsletter.



Zohra Kaliq with Sharon Heard by the ICATS stand



The Conference hotel

ZOHRA KALIQ

ON ICATS, WINNING HER IFEAT MEDAL AND FIRST IFEAT CONFERENCE

During the afternoon Zohra Khaliq from Aromatherapy Associates (this year's ICATS IFEAT medal-winning student) came to the stand to introduce herself and catch up. There were a lot of people interested in the ICATS Diploma throughout the day, including many new faces, which was a very positive start to the conference.

On Tuesday I presented the ICATS annual report during the IFEAT AGM which went well; congratulations from the committee were greatly appreciated. It was also another busy day on the stand, with delegates taking interest in the course and the array of text books and monographs we supply as part of the diploma.

The annual IFEAT dinner that evening was on the terrace of the Armani hotel at the base of the spectacular Burj Khalifa. We were treated to a fantastic light display on the Burj as we ate a superb meal - a fantastic way to finish a busy day.

Wednesday was a quieter day for ICATS as many of the delegates were busy in the exhibition space meeting with suppliers. However, this was a great opportunity for some of the IFEAT executive including Winnie Yeung and Phillippe Masse to come and look at the course material and catch up. It is always nice to see graduates of our diploma programme drop by and we were delighted to see Gurav Mittal and hear of his progress in the industry.

The calmer afternoon gave an opportunity to take a break from the stand and to go and see the exhibition space. This format was new for the Dubai conference and it was really informative to visit the labyrinth of stands featuring a variety of organisations. Numerous companies were represented, covering areas such as essential oil producers through to new technology developers. Some companies also opted for closed meeting booths in which to host clients and meetings.

The final morning was busy as the annual ICATS book sale took place and we sold off our display copies. We were pleased to be visited by Hussein Fahkry who offered his congratulations on the ICATS report presentation. As the day wore on, the conference became quieter and we retired to get ready for the evening closing banquet.

The gardens in front of the Burg al Arab were the setting for the closing banquet, where we were greeted by a group of Emiratis in traditional outfits singing and dancing a welcome; just a flavour of the entertainment on offer for the rest of the evening. The meal was fantastic as always, although we could not stay long as we had an early flight on the Friday morning. This was a fitting end to an excellent conference and we look forward to attending in Athens in 2017.

I currently work as a Development Chemist for the Aromatherapy Associates Group. The brand uses the highest quality botanicals and deep knowledge of essential oils to offer all-natural, wellness experiences steeped in the traditional practice of aromatherapy. My current responsibilities span from technical new product development (using my olfactive recognition knowledge of natural aroma materials) through to the operational delivery. I have managed the in-house quality control and quality assurance procedures for the aroma materials inventory, through to the applications of fragrance blends within the skin, body, hair categories and candles. My role involves re-formulation of fragrance blends during quality variation and fluctuating supply, due to crop shortage.

The ICATS/IFEAT programme has allowed me to combine my day-to-day work challenges with further understand standard industry practices. Working within a relatively small organisation, it has allowed me to expand my knowledge and underpin what I have learnt in industry. Although it was a highly-challenging experience, I am grateful for the expertise I have gained within this specialist field. The course allows you to gain an overall understanding of the aroma trades industry, and all elements proved to be highly valuable to me. Working

within the field requires on-going dedication to continue learning, paying special reference to both analytical and creative techniques. I feel truly privileged to work within this field, due to its unique 'two tone' outlook, combining both scientific and artistic principles in the work environment.

In 2016 I was awarded the ICATS/IFEAT Student of the Year; I was truly privileged to receive an invitation along with an opportunity to attend the IFEAT Conference in Dubai. During my trip I was able to network with many potential and existing essential oil suppliers, listen to presentations from industry experts within the aroma trades, and finally being awarded my medal by IFEAT, presented to me by the current President, Raul Amigo.

The Conference was my first opportunity to be immersed in the industry at an international level, and I am very grateful to the ICATS and IFEAT team. Now that my ICATS learning has been completed, I am inspired to continue learning in both the creative and scientific fields. My passion for perfumery and natural ingredients continues every day in my work environment, and I will certainly look back and cherish my medal for years to come.



The conference display stands



Zohra Kalik receiving her prize from Raul Amigo President of IFEAT

REVIEW OF THE CONFERENCE PROCEEDINGS FROM DUBAI 2016

A RICH HERITAGE OF NATURAL GUMS AND RESINS

ALI GREEN

I was very disappointed to miss the Dubai Conference this year as it was clearly a highly memorable occasion with an excellent selection of the very best research presented in the lectures. Reading the Proceedings (very ably compiled by Romina Garay) has been thoroughly enjoyable giving a real feel for the aromatic traditions of the region as well as engaging with developments in industry over the last year and looking forward to how they might be best addressed in the coming decades.

The theme of local resins and oils featured strongly in the Conference, as one would expect in a region with these beautiful aromas at its heart. The IFEAT Medal Lecture from Abdulla Ajmal (presented by Dr Kanwal Deep) focused on agarwood (oud) from its formation, harvesting and processing to its usage, and finally dealing with serious threats to the entire industry from over-harvesting and regulation. Agarwood is an aromatic resinous wood that forms due to a fungal infection that affects injured Aquilaria trees that are native to South East Asia – each cultivation area will give a unique aroma chemical balance. Generally, the best quality wood is separated to burn as incense, while the lower quality is used for oil distillation. The oil yields are extremely low with 1kg of agarwood leading to 1-2ml of the oil which is why it is very expensive in its pure form. Ajmal have pioneered several production methods to broaden the appeal of oud and show its applications in a number of new products, such as spray-dried oud oil (Dahn Al Oudh) and new formulations (a mukhallat range) focusing on aromatic ingredients popular in the Middle East such as rose and sandalwood. Ajmal established a Research and Development Centre in Hojal, Assam in order to research the “Commercial cultivation of medicinal and aromatic plants in the North East region of India with particular reference to Aquilaria species”. They have also set up a plantation and are pioneering new techniques for farmers to improve yield sustainably. A difficulty for the industry has arisen due to the designation of Aquilaria under C.I.T.I.E.S regulations⁵ which effectively

meant that the harvesting of agarwood from the wild would become impossible. Ajmal have now patented new techniques for artificially inducing agarwood which can be differentiated from the wild agarwood by microscopic examination and this is a valuable addition towards sustainability. The threats of inferior (sometimes artificial) wood being sold and the felling of young trees are still issues that need to be contended with. Abdulla believes that a global grading system should be adopted and that demand will increase for natural Dahn al Oudh with the burning of the wood for incense decreasing meaning that the better quality wood can be used for oil production. Obviously the only way that this increase in demand for the oil can be sustained is with vigilance for tracking plantation and felling trees. This is surely a worthwhile venture to ensure the supply of this fabulous wood so future generations can enjoy the pleasure of an oudh fragrance.

Guelleh Osman (Neo Botanika) presented a comprehensive view of Somaliland and the gum resins produced there: myrrh, frankincense and opoponax. Somaliland has been supplying these highly-prized aromatic products since the times of the pharaohs and, despite some setbacks in the late twentieth century due to political instability, is flourishing today under the stable democratic government. Somali frankincense is harvested predominantly from *Boswellia carterii* and *Boswellia frereana*, although they also harvest from *Boswellia rivae*. *Carterii* (a gum resin) is said to be the most aromatic and is used in numerous perfumes as well as being sought after for its anti-inflammatory and antiseptic properties⁶. *Frereana* (a gum) is found only in the Somali frankincense region and has high pinene, thujene and cymene content, endowing it with many medical applications; currently it is primarily exported to the Middle East, where it is used as chewing gum. Guelleh estimated that production of both *carterii* and *frereana* could be more than doubled, but there are challenges affecting all the products that

he discussed. These included lack of education and bad practice amongst inexperienced harvesters, adulteration, supply chain issues and climate change. To meet these challenges, Neo Botanika work with local producers to encourage sustainable practices as well as pioneering strategies for the regeneration of the forests to avert desertification including a tree nursery. Guelleh hopes that with this focus on sustainability and a more straightforward supply chain, that the traditional Somali products of frankincense, myrrh and opoponax will provide a means to a better livelihood for rural communities.

The historic nature of the frankincense trade was discussed at length by Trygve Harris (Enfleurage), who has opened a frankincense distillery in Salalah in the south of the Sultanate of Oman. She gave not only a highly evocative account of the local ecology of the beautiful Dhofar region, but also a thorough description of the harvesting techniques from this remote region. The sad truth of the matter is that the harvesting itself is not only dangerous, but commands a very poor wage and is now undertaken by Somalis. It was fascinating to read of the rich history of the frankincense trade from this region as far back as the Mesopotamian era in 5000 BCE and the extent to which it flourished in the Roman period, when an army of 12,000 men was stationed to police Dhofar and the frankincense trees there. The frankincense from Oman (from *Boswellia sacra*) is not widely harvested now, yet has a distinct aroma that differs from the Somali varieties in chemistry and odour qualities. Trygve is looking to the future as new plantations of *Boswellia sacra*, sponsored by the Omani government, are created in Dhofar and is hoping for continued supply of this unique aromatic.

Concern about sustainable production and maintenance of the supply of *Boswellia sacra* from Dhofar were issues that were addressed by Ashad Chaudry (Ashad Botanix) in his fascinating presentation: *Can Frankincense Oil be Produced Sustainably?*. He cites recent research from Ethiopia concerning another species of frankincense (*Boswellia papyrifera*) which was seriously under threat of

extinction due to over-tapping (up to twenty-three rather than the sustainable nine), which leads to less resin and poor pollination (due to fewer flowers as a result of stress to the tree), which in turn leads to the trees being cleared to make way for more profitable crops like cotton. Since the *Boswellia* trees acts as barriers to the expansion of deserts, their felling will inevitably lead to desertification of this farming land; since the 1970s, 200,000 hectares of forest have been lost. A similar issue with over-tapping had been occurring in the Dhofar region of Oman, but when oil was discovered in Oman in the 1970s, many moved to the lucrative oil industry and away from frankincense. Today there are less than 100 migrant Somali harvesters compared to 2,000 Omanis in 1970 but the trees were still under threat from a number of factors: grazing of livestock (camels will strip anything less than two metres high), over-harvesting of luban (frankincense resin) and land conversion (gravel mining) which had affected the soil through erosion and depletion of nutrients and water in the soil. However, the Sultan of Oman has responded by creating the Jabel Samhan Nature Reserve and developing a propagation programme using cuttings and seeds in protected sites away from foraging livestock. Ashad is hopeful that this will protect the viability of *Boswellia sacra* as a key aroma producing tree in Oman, but also points out that the cooperation of harvesters, sorters and suppliers all working together according to a centralised system of good practice is another necessary element for sustainability. He notes that there is great opportunity for long term prosperity from these forests, but we must ensure that this is not at the expense of the very trees that provide this aromatic treasure.

I have only selected a few of the excellent papers from Dubai to review here as space is limited. If you are an IFEAT Member, then you can access the Dubai Conference Proceedings on the IFEAT Website. All ICATS students are also entitled to free access to this and past conference proceedings; please contact aroma@plymouth.ac.uk if you would any sent to you via web transfer.



Dr Kanwal Deep presenting the Gold Medal Lecture on behalf of Abdulla Ajmal



Frankincense

⁵ The Convention on International Trade in Endangered Species of Wild Fauna and Flora.

⁶ Please see the article on the IFRA Fragrance Forum for details of Dr Mark Evans' research into the medical usage of frankincense in treating cancer.



John Bailey presenting in Dubai

WHO'S WHO IN THE INDUSTRY?

JOHN BAILEY AND HIS PASSION FOR OUD: DUBAI 2016

ALI GREEN

After detailing some background information on John outlined six of his favourites at Dubai:

- *Gucci Oud*, a woody oriental fragrance which he believes is one of the best oud unisex fine fragrances on the market
- *Atkinsons Oud Save the Queen*, a woody fragrance with crisp white flower notes which has a splendid golden bottle thereby encapsulating the idea of 'liquid gold perfectly'
- *Floris Honey Oud*, a woody oriental fragrance which includes amongst its creators a 9th generation member of the founding family
- *Grossmith Amber Rose*, a dry woody fragrance from a London company with a fascinating heritage
- *Arabian Oud Kashmir*, a woody oriental fragrance that combines the citrus notes Japanese yuzu with a classic heart of oud
- *Perfumers Guild Queen of Sheba*, John finished with one of his own creations inspired by the book *Frankincense and Myrrh* by Nigel St John Groom OBE. A scented bookmark was included with the book launch and this also coincided with the British Museum's major exhibition *Queen of Sheba: Treasures from the Ancient Yemen*. John's fragrance was shortlisted for a FiFi award in 2002 from the Fragrance Foundation UK, and was a great success for him.

John's great knowledge of the use of this "liquid gold" ingredient was apparent throughout his paper along with his familiarity and love for all aspects of our fabulous industry. Thank you John for being such a great friend to us all in ICATS Plymouth and for all you give to our wonderful fragrant world.

It gives me great pleasure to write a feature about a good friend to ICATS, the ever-youthful John Bailey who presented a paper at the Dubai Conference on Oud. As well as running his own Perfumer's Guild, an artisan perfumery and independent consultancy, John is also an Ambassador for the British Society of Perfumers, approaching all that he undertakes with great passion and enthusiasm (along with a strong sense of style and panache)!

John has seven decades of experience in the industry, with his early years spent as an apprentice in a company of manufacturing chemists, druggists and distillers studying botanical and aromatic raw materials, after which he continued as a trainee apothecary. Working as an expert with essential oils and perfumery, he spent time with Stafford Allen, Bush Boake Allen, Naarden International and Treatt (where he worked with talented perfumer and chemist Charlie Beck). He then decided to found his own consultancy business The Perfumers' Guild Ltd., which has gone from strength to strength ever since creating bespoke perfumes from the finest of ingredients.

John was one of the project managers for the excellent British Society of Perfumers 50th Anniversary book, which is a "must have" for anyone with an interest in the industry. He also has many other accolades, including being a Freeman of the City of London, a Liveryman in the Worshipful Company of Gardeners and a Fellow of the Royal Society of Arts. He is a self-confessed bibliophile, an avid collector of perfume bottles and has a broad-reaching fascination with all aspects of modern and ancient perfumery.

This love for the heritage of our industry as well as an encyclopaedic knowledge of the market today made him well-placed to speak about oud fragrances in Dubai. He was appointed the English ambassador for the Arabian Oud Group by Sheikh Al Jasser more than ten years ago and showcased his excellent knowledge of oud-oriented fragrances. He noted that 875 were listed in *Fragrances of the World 2016*, but since publication, 75 had been added reflecting the popularity of this prestige ingredient today.

IFRA FRAGRANCE FORUM: "DO YOU SMELL WELL"

ALI GREEN

Last October a full complement of ICATS staff travelled from Plymouth to The Royal Society for the 2016 Fragrance Forum. We had a fabulous location for our display table underneath the portraits of eminent philosophers and scientists.

It was great to see many old friends from the industry along with IFRA and the BSP and have the opportunity to listen to so many fascinating speakers on a wealth of subjects pertaining to the sense of smell. The lectures ranged from the historical to the medical and even to the philosophical, including an olfactory exploration of wine (with tasting) thanks to the brilliant Prof. Barry C. Smith of the Institute of Philosophy's Centre for the Study of the Senses.

I have selected four of the lectures to focus on here, but all of the presentations were excellent and it was a really difficult choice and I would recommend further reading of the work of all speakers at the Forum.

John J. Johnston of University College London was a great opening act, transporting us from 21st century London back in time to ancient Egypt, providing an insight in how fragrance would have been employed in a society in which unpleasant aromas were ubiquitous. As with many cultures, fragrance was the preserve of the upper echelons of society (around 5% of the populace) and we have the most information about the ruling classes. John first introduced the audience to Hatshepsut (a rare female pharaoh), who sent an expedition to Punt (probably modern day Somalia) in order to source various luxury

items, including myrrh trees. Her mortuary temple at Deir El Bahari was a key vehicle for propagating her public image and the roots of myrrh trees have been found here. We do not know precisely how the myrrh would have been employed here, but an incense burner in the shape of a hand has been excavated, which indicates that it was likely to have been burned in a ritual context. Other information about Egyptian perfumes and incense comes from texts, artefacts and images in tombs. We read of the complex recipes for perfumes containing honey, mastic, sweet flag, cypress leaves, cinnamon, frankincense, pine resin, mint and juniper berries and artefacts give some idea of how these substances were applied or used. John showed images of cosmetic spoons in the form of dancing girls and ducks and images of what have been described as incense cones on the heads of ladies in Egyptian paintings, which he feel merely indicate that the wig was perfumed rather than indicating an actual cone of perfume was worn on the head. One of the key usages for perfumed oil was as part of mortuary ritual (as in Ancient Greece described in last year's Newsletter). In Egypt there are seven sacred oils said to be used in this context although we do not have recipes for them and their formula largely remains unknown. So far the analysis completed by Bonn University on the pot residue from a small bottle marked with the cartouche of Hatshepsut has indicated that it was full of carcinogens and thus rather unhealthy to use today!

After this trip back in time, Dr Benoist Schaal gave a fascinating lecture on his research into the aroma chemicals in breast milk where he wanted to explore the



Sharon Heard and Kate Smith on the ICATS Stand

role of smell in a new born's desire to suckle. He analysed the aromatic elements of breast milk using headspace analysis and also undertook tests with cling film over breast to eliminate the role of sight in the act of breast feeding and then went onto testing the smell preference of bottle fed babies. Here, there was a clear preference for breast milk, even though the babies had not had it previously. Dr Schaal wanted to see to what extent this was down to smell and eventually isolated excretions from the Montgomery glands (near to the nipple) which he added to his complex preference testing. What he found was that the gland excretions had a stronger response than the milk alone thereby seemingly being a strong mechanism to focus the child's attention to the breast area and feeding necessary for its development. Finally he looked at gaze patterns of new-borns (tracking where their eyes focused) with and without the odour of the breast secretions and there was a clear correlation between exposure to the odour and focus on the mother's face, with babies looking at it more frequently and for a longer duration. His research clearly demonstrates what a key role smell has in the urge to feed and bond with the mother in humans and was truly fascinating.

Dr Mark D Evans, a lecturer in Biomedical and Medical Science at De Montfort University, Leicester has been researching the medical role of frankincense for many years in collaboration with The Sultanate of Oman and The University of Leicester. Firstly he outlined some basic information about Boswellia; the top grade only being used for oil. It has been used in traditional medicine for hundreds of years, with a particular focus on inflammatory conditions like arthritis; in particular Boswellia serrata in ayurvedic medicine. Clinical investigation shows that the boswellic acids dissolve in fat, are water soluble and can be extracted

using steam distillation but there are 340 other compounds in the oil that are not boswellic acids. It has been found that one of them incensole acetate has antidepressant and anxiolytic (reduces anxiety) effects while boswellic acid is shown to have an action like steroids such as prednisolone, causing similar cell changes but has few if any side effects so is very safe. In tests Boswellia sacra has been found to be more effective than Boswellia serrata. An extracted chemical called AKBA (acetyl-11-keto-beta-boswellic acid) has been found to dampen the immune system so could be really helpful in treating cancer and other inflammatory conditions. An initial test on cancer cells in the laboratory has had really promising results, so we look forward to further research on this amazing resin with bated breath.

Carl Philpott, an ENT consultant at James Paget Hospital in Norfolk and a Senior Lecturer at the University of East Anglia gave a thought-provoking talk about the reality of living without smell (anosmia). Although only 1.2% of population are anosmic, about two thirds of us will experience spells of anosmia at some time, while over 40% have problems with smell recognition (men are worse than women). There is a natural decline in the ability to smell after the age of sixty but the largest group of anosmics have sinonasal disease and for those with chronic rhinosinusitis (11% of population) the sense of smell will gradually decrease. Although olfactory disorders are more common than sight loss and deafness, far less attention is given to them despite the substantial impact it has on those dealing with anosmia. In his research, patients gave accounts of their experience of living without smell; some of what they had to say was truly heartbreaking (such as being unable to smell the odour of your children) whilst others highlighted the dangers (inability to smell a gas leak or burning). It was incredibly sad to see how this



John J Johnston

loss of a sense most of us take for granted had impacted so profoundly on the lives of these people, in particular the inability to enjoy food, do their job or worries about personal hygiene demonstrated key elements of life that caused anxiety or depression in sufferers. There is clearly a massive impact on patients but what can be done to help? Carl firstly outlined medical investigations using endoscopy or CT/MRI to look for any blockage, and then outlined a sequence of smell/taste tests to diagnose the type and severity of the problem. Smell training can be really helpful for some individuals with modified olfactory training, while some practical measures can protect individuals from dangers around the home. Dr Philpott, however, is looking to the future where more help could potentially be given to these patients through innovation in medical science, such as olfactory grafts or implants, drug therapy and the foundation of a Royal National Institute to support such research. Given the impairment that anosmics suffer to all aspects of their everyday life I really hope that such advancements will come soon to transform and enrich these lives for the better.

I would like to express my sincere thanks to IFRA UK for hosting such a fabulous event and for your continued support for the ICATS courses at Plymouth University. I am really looking forward to this year's Fragrance Forum and will continue to look for any further updates on the work of the academics who presented in 2016.



Dr Benoist Schaal



Prof. Barry C. Smith



Carl Philpott

A NEW ERA FOR ICATS

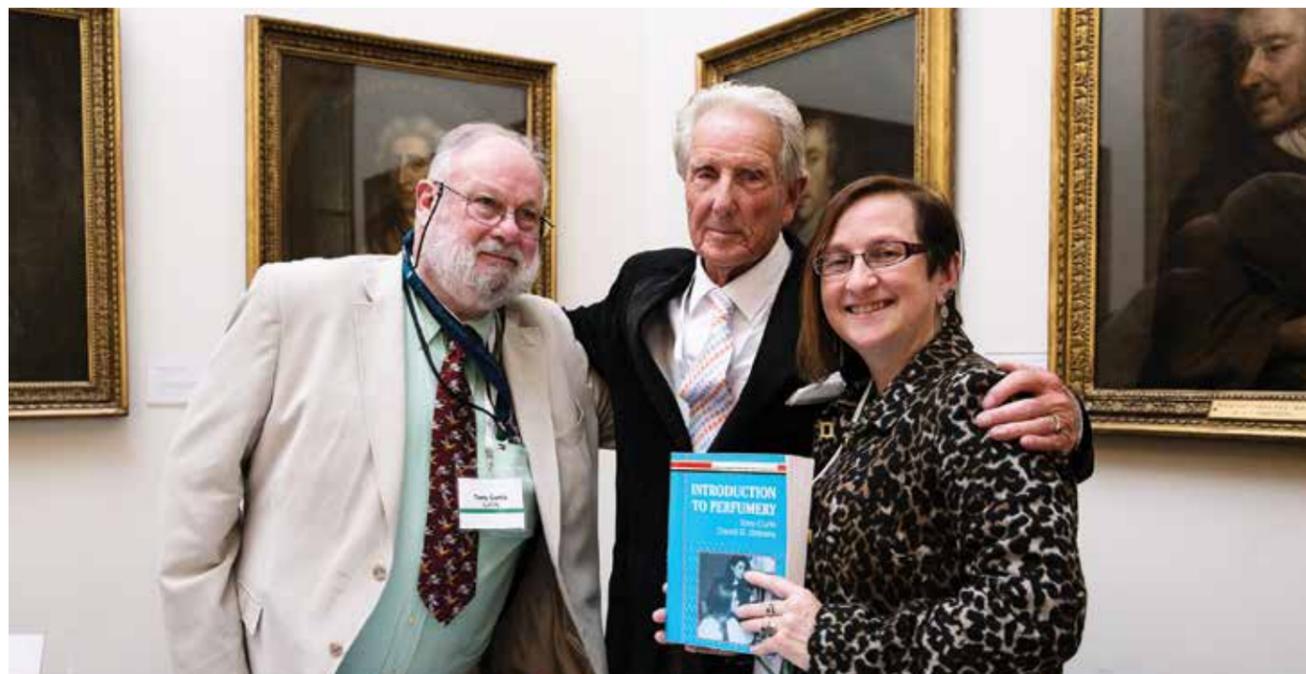
DR TONY CURTIS

As part of the ongoing development of ICATS Dr Ali Green recently became Director of Studies. To mark this, Dr Curtis and John Bailey (Ambassador for the British Society of Perfumers) presented Ali with a first edition of *Introduction to Perfumery*. This was no ordinary copy but David Williams' personal working copy complete with annotations. The Royal Society provided an appropriate setting for this presentation. ICATS has yet to celebrate its 50th anniversary but aspires to the 350 years ethos of the Royal Society of continual evolution to be in the vanguard of advancement but with continuity.

Dr Ali Green has been associated with ICATS for almost 20 of the 25 years it has been at Plymouth University. Dr Curtis said 'Ali is uniquely qualified to continue the strategic

development of ICATS. She is an experienced teacher and has the 'X' factor. Ali was awarded her PhD from Exeter University (one of the longest-established UK elite Universities) by part-time study and research. She has practical personal experience of part-time postgraduate study. This empathy for the challenge of distance learning in the Aroma Trades is a vital advantage. I wish Dr Green every success and hope she has as much excitement and enthrallment as I have enjoyed over the last 25 years'.

Tony continues with ICATS in the new role of Principal Tutor, which will ensure continuity of study for existing students. He will also still be active in writing and developing new and existing learning material.



John Bailey officially hands over the Director of Studies position from Dr Tony Curtis to Dr Alison Green

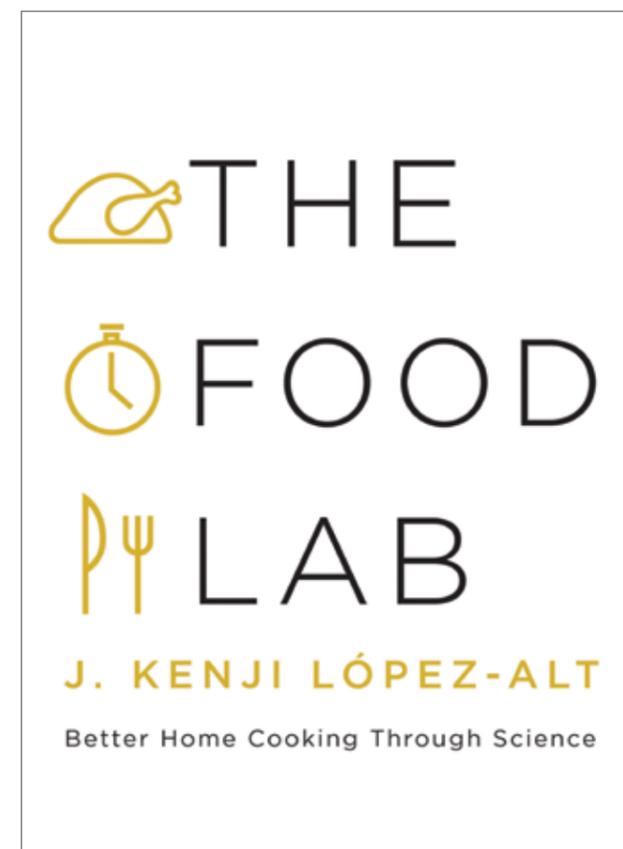
BOOK REVIEW

DR TONY CURTIS

The Food Lab: Better Home Cooking Through Science

J. Kenji López-Alt

Illustrated by the Author
2015 W.W Norton & Company, New York
ISBN 978 0 393 08108 4
£49.95



Contents

- 1 EGGS, DAIRY, and the Science of Breakfast
- 2 SOUPS, STEWS, and the Science of Stock
- 3 STEAKS, CHOPS, CHICKEN, FISH, and the Science of Fast-Cooking Foods
- 4 BLANCHING, SEARING, BRAISING, GLAZING, ROASTING and the Science of Vegetables
- 5 BALLS, LOAVES, LINKS, BERGERS, and the Science of Ground Meat
- 6 CHICKENS, TURKEYS, PRIME RIB, and the Science of Roasts
- 7 TOMATO SAUCE, MACARONI, and the Science of Pasta
- 8 GREENS, EMULSIONS, and the Science of Salads
- 9 Batter, Breadings, and the Science of Frying

This is a wonderful book but not a light read - make arrangements to strengthen your kitchen bookshelf when you order *The Food Lab*. Just for amusement I got out my kitchen scales and attempted to weigh the tome - ERROR - my kitchen scales only go up to 2 Kilograms. Upstairs to the bathroom scales and on this it weighs in at 2.9 Kg. On a \$ per gram basis this must be one of the best value books on sale! 958 pages for a measly \$49.95 - a bargain!

This is a witty and accessible book while covering the issues in some depth, more of this later. Page 3, the title page for the Introduction, is headed 'A NERD in the KITCHEN' and delightfully subtitled 'I am a nerd and I'm proud of it'. On page 19 he goes on to say in *Why the book?*

That's where this book comes in. It represents the culmination of not just a decade and a half of cooking and studying the science of everyday foods, but years of learning how to apply this science in ways that can help home cooks cook everyday food in better, tastier ways.

What you won't find are fancy-pants recipes calling for exotic ingredients or difficult techniques or chemicals or even special equipment beyond, say, a food processor or a beer cooler.

The illustrations are not of super, unreal, food conjured up in a studio. The pictures on *Poached eggs* (page 104-105) are not with a pristine pan on a cooker just out of the Ideal Home Exhibition and located in a kitchen from a 'Location, Location' TV dream house programme. Both the hob and the pan look well used and I suspect are well-loved old friends. Unlike some of the UK celebrity chefs' book offerings it is not an invitation to buy designer cookware where you need to take out a second mortgage.

Having said, in the author's own words 'There are no fancy-pants cookware suggestions' is not to say that the book is not going to cost me money. In a splendid 15 pages he presents, in exquisite detail, what knives you should have and as always within this book it goes the extra yard. We have a comprehensive guide to care, maintenance and most important of all sharpening of knives. I have a fair standard set of knives but I think I will add a Japanese style one. The recommendation is for the 7-inch Misono UX10 Santoku, in the USA about \$180. Where the investment is appropriate e.g. a good wok, good value for money suggestions are given. However, he also waxes lyrical about some of the more humble tools of the kitchen. On wooden spoons he writes:

Blood runs deep between a good spoon and his cook. I nearly cried the day I cracked the handle on the spoon that had lasted nine years. It was so well used that the handle had conformed to the shape of my hand.

Cast iron pans are not that expensive but do need care to get the best out of them. As always Kenji comes up with the goods with a splendid three pages on *How to season and maintain cast-iron cookware*. Our chemist readers will appreciate the detail e.g. why unsaturated oils such as corn are better than saturated fats such as lard.

As you might expect, after taking so much care in discussing the tools, equal attention is given to guidance on their use. Throughout the book there are *Knife Skills* panels. One page 127 there is a wonderful illustrated instruction panel on the proper way to cut a bell pepper. This approach is maintained with other ingredients in similar sections. The eight pages of The FOOD LAB's Complete Guide to Buying and Storing Eggs are fascinating.

I can guess what you may be thinking. Where are the recipes? They are there but meticulous attention is given not just to a laundry list of ingredients but detailed and painstakingly detailed instructions. There is no recipe but it takes a further eight pages, after the *How to buy* section, to outline the science and process to achieve *Foolproof soft-boiled eggs*.

I also appreciated the international dimension, this book having been essentially aimed at a North American readership. I must try the *Gooney stovetop mac 'n' cheese* and its relative *Baked mac 'n' cheese*.

Do get your own copy and do make certain there is a reference copy around the laboratory; perfumers as well as flavourists will enjoy and find value in this book. The Guide to Good Tasting translates just as well into some golden rules for successful fragrance evaluation:

The FOOD LAB's guide to a good tasting:

1. Eliminate bias
2. Introduce a control [OK evaluators may call this an action standard]
3. Know what you are asking (isolate variables)
4. Stay organised
5. Watch out for palate fatigue
6. Taste [the key point is tasting is different to eating]
7. Analyse
8. The Tony Curtis addition - record

I hope you get as much pleasure and insight from this book as I am. I have only had the book to review for a month and already some of the 958 pages have started to become dog-eared!



IN THE NEWS

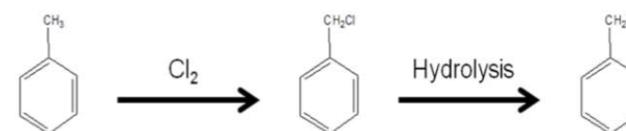
DR TONY CURTIS

As usual, I have been spoilt for choice. Aspects of the Aroma Trades have become of interest to the mainstream academic and technical press. I have selected three completely different threads for this edition of the ICATS Newsletter: synthetic organic chemistry, the contribution

of analytical chemistry to understanding the sensory structure of natural aroma materials and, as I am writing this over the Christmas/New Year festive season, some turkey food technology.

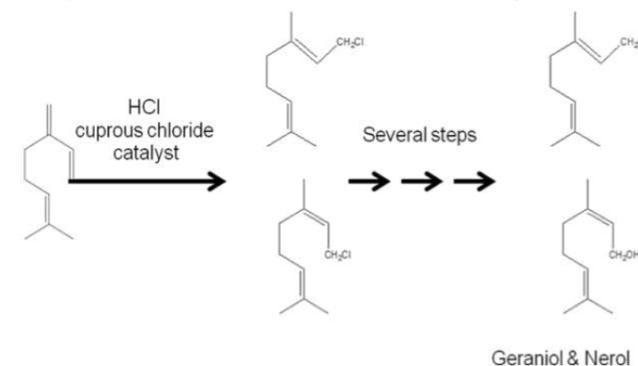
Synthetic Organic Chemistry

For two centuries chemists have been finding ways to convert convenient aromatic (in the benzenoid chemical sense not the perfumery sense) hydrocarbons, such as toluene, to aroma materials, such as benzyl alcohol. In the 19th century a key route was the chlorination of toluene and the subsequent conversion of the chloride to the alcohol.



Manufacture of benzyl alcohol with benzyl chloride intermediate

The 20th century added freely available terpene hydrocarbons such as myrcene. This could be converted to myrcene chlorides and thence to nerol and geraniol.



Manufacture of nerol and geraniol with myrcene chlorides as intermediate

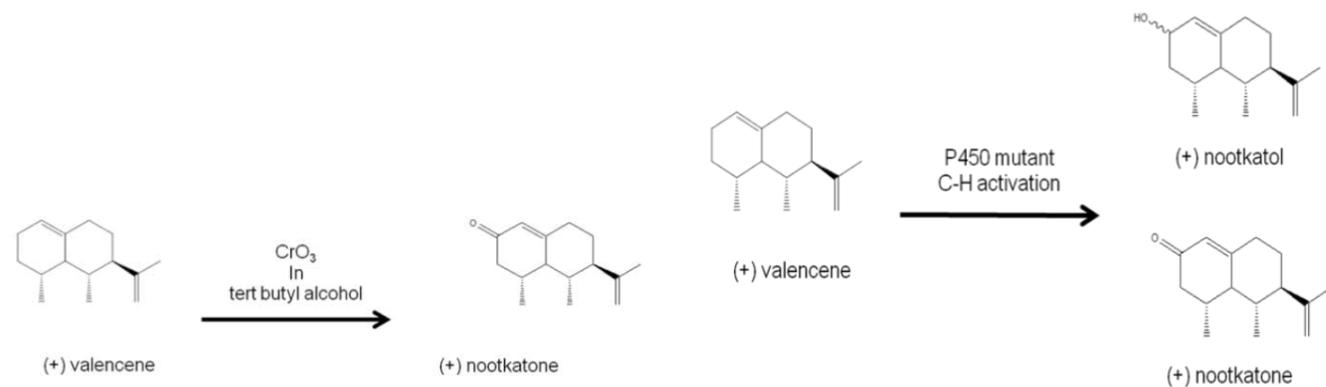
However, there are disadvantages to this type of approach:

- The need to use an intermediate involves several stages and some loss of yield.
- Once the chlorine was in you had to get it all out. The chlorinated impurities were detrimental to the odour quality of the product and could also cause stability and discolouration issues.

One chemist I knew found a very effective way in the laboratory to do this. He distilled the product away from a small amount of liquid sodium under high vacuum. Needless to say, do not do this at home! I said it was effective, I did not say it was safe!

Oddly good approaches inherently involve potentially very hazardous routes such as air oxidation and 90% hydrogen peroxide. Just as with the nitration process to make aroma materials such as musk xylene, very skilful chemical engineering is essential to control these processes.

One generic process stage was of great interest. This is the so called 'allylic' oxidation of an unsaturated hydrocarbon. This preserves the unsaturation to produce the unsaturated ketone. A key molecule of interest was valencene. This sesquiterpene hydrocarbon can be obtained from natural sources such as orange oil. Allylic oxidation then yields the very valuable nootkatone. One effective way to do this is to use tertiary butyl chromate. It is not too difficult to make. You 'just' (!) dissolve chromium trioxide in anhydrous tertiary butyl alcohol. Again needless to say, do not do this at home! Moreover, you have to use stoichiometric amounts of the reagent with a horrendous effluent issue.



Oxidation of valence with tertiary butyl chromate

We looked enviously at those "silly little plants", such as lavender, that could make all these wondrous aroma materials without a pressure vessel or an effluent plant in sight. Just to add insult to injury these trivial plants would product optically pure, more highly-prized products, such as l citronellol, not the d,l citronellol we got from the hydrogenation of nerol. In Bush Boake Allen, a working group was set up around 1970 to evaluate the use of biotechnology. They were ahead of the curve then but the technology is in place now.

The lead feature in the November 2016 edition of the Royal Society of Chemistry's CHEMISTRY WORLD was Smarter Smells:

After years of research, the flavour and fragrance industry is increasingly turning to biotechnology for commercial production.

Emma Davies

In the section *Collecting your P450*⁷ they have it cracked. There is a bonus. All of the 'nasty' chemical transformations I have discussed above would result in a product which, under regulatory compliance rules, would have to be declared as 'synthetic'. Oxford Biotrans technology is based genetically engineered cytochrome P450 enzyme. The product is declared natural under current regulations. Emma Davies explains:

.... Cytochrome P450 enzymes help metabolize toxic compounds in the liver. In plants, many of the enzymes are involved in creating defence chemicals.

We should have known if you can't beat these trivial plants, have a go at copying their processes.

Enzymic conversion of valencene to nootkatol and nootkatone

Another example given in the article is Firminich's patchouli material Clearwood. There are not enough suitable hydrocarbons to satisfy industry needs (e.g. β pinene). With mono terpenes it is economic to synthesise aroma chemicals from petrochemical feedstocks e.g. linalool. This is not so for the more complex molecules such as the sesquiterpenes. Biotechnology provides a new pathway to these valuable more complex aroma molecules. The industry is truly entering a new age.

CHEMISTRY WORLD continued its interesting run of 2016 articles with the January 2017 edition. One sometimes overhears people saying that a problem can be 'simply' solved by GC / MS. You do not hear analytical chemists involved in the process say this. Over the dark winter nights, I have been working my way through a box collection of *Poirot* (Agatha Christie's legionary sleuth). All the key facts are there but as the great detective says you have to pick them out from the 'red herrings'. These are the pieces of information and facts that do not have any contribution to the solution of the problem.

This article gives this particular approach to the analytical red herring dilemma a name 'molecular sensory science concept' and Aroma Extract Dilution Process (AEDA). As always, to get the right answer, you have to ask the right question. The question is not just what molecules a natural aroma material contains but which of these contribute to the sensory properties.

Care must be taken in this process. A common approach is to fractionate an essential oil using a high efficiency fractionation column under high vacuum. This is not good enough. You need to double check. After this process, you need to see if anything had been lost in the procedure. Appropriate samples from each fraction should be bulked to reconstitute the original material charged to the fractional distillation unit. In some cases, the resulting bulk has lost something. To protect the high vacuum pump, it is customary to use a cold trap (cooled in solid CO₂ or liquid nitrogen) from 'impurities' and residual water (dissolved in the essential oil) that could contaminate the oil and reduce



GCMS analytical chemistry equipment

the efficiency of the vacuum pump. In some cases, it can be found that surprisingly light molecules contribute to the sensory profile and the cold trap, which could be easily ignored, is a key part of the overall characteristics of the oil. This is the check that information has not been lost.

The other part of the skilled process is to rule out the red herrings. These are molecules that occur in the aroma material but do not significantly contribute to the organoleptic profile. This interesting short article *Secret of liquorice smell unravelled* is a charming example of the art. The team identified 50 potential aroma active compounds. They then assigned an Odour Activity Value (OAV) for each of the compounds. Their final conclusion is that 39 compounds, in their naturally occurring concentrations could be re-constituted, to get a product with a high similarity profile to natural raw liquorice.

I am reminded, just as with detective novels, in natural product analysis you need to be able to identify the trees but to get the big picture (identify the criminal or the profile) you need to put together the relevant trees, in context, to see the whole forest.

After all this reading I was hungry and was drawn to another feature in January 2017 CHEMISTRY WORLD. Of course, this is Chemistry not celebrity TV chef time. Thus,

the recipe page is written by a 'Culinary Scientist' Chris Loss. Unlike the renowned 19th century cookbook by Mrs Beeton (*Mrs Beeton's Book of Household Management*, a snip at £950 for a 1st edition) which reputedly starts the procedure for cooking a hare with 'First catch you hare!', Chris starts his article *Turkey delights: Why brine unlocks the flavour hidden in roast white meat* with:

Fowl play

First, let us look at the composition of a turkey. A raw whole bird is around 72.7% water, 21.6% protein 5.6% lipids and 0.13% carbohydrate. Perhaps it goes without saying, but raw turkey is insipid and inedible.

Then we are into the culinary business and explanation with *Time to brine, brined turkey for beginners: more interesting chemistry* and a link between this article and our reviewed book *FoodLab* on not only how to cook but why the process works. The final key instruction is 'Remove from the oven, allow the meat to rest at room temperature for 20 minutes then enjoy!' Back to *FoodLab* and more chemistry to eat and relish. Happy reading, experimenting (OK cooking) and eating. Ours is a sensory science!



⁷ In the UK, you get a P45 when you change your job.

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