

ICATS News

Autumn 2020

ICATS
Education for the aroma and flavour trades



Editor's Notes Deirdre Makepeace

As the ICATS team travelled back from FlavourTalk in Amsterdam March 2020, the implications of COVID-19 lockdown were just becoming apparent. Delegates from across Europe and beyond rushed home before borders closed and, once home, found that every aspect of life was to change. Six months on I don't believe many of us could have guessed the dramatic and enduring implications of this global pandemic on our working lives, our leisure time, our communities and our links with friends and family.

The flavour and aroma trades have been affected as supply chains and consumer habits have been disrupted. Over the summer, Perfumer & Flavourist magazine reported the results of global giant, Firmenich, showing positive growth despite COVID-19 challenges. The negative impacts on fine fragrance and food service markets had been more than offset by strong performance in savoury, sugar reduction, plant-based proteins, personal care and home care. UK's Vogue suggested that 'perfume came

into its own in lockdown. Scent was suddenly so much more than just a finishing touch to an outfit. It served as a talisman-like reminder of our loved ones... and an imaginary ticket to a location far beyond our four walls.' Even in lockdown it seems that the world of scent continues to reach the upper tiers of Maslow's often-cited hierarchy of needs. I agree completely; life is challenging but with a spritz of my favourite perfume I am ready for my day of virtual meetings.

Welcome to ICATS

ICATS has been providing world class distance learning for nearly 30 years. Its foundations were in the aroma trades but in 2012 the course was developed to incorporate a flavour pathway, recognising the increasing integration between the two sectors. The courses are accredited by the International Federation of Essential oils and Aroma Trades (IFEAT). From its base in Plymouth UK, ICATS runs a virtual network of academics, industry professionals and tutors supporting students around the globe as they develop their technical and managerial skills to succeed in the specialist and complex aroma and flavour industry.

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ICATS team

The ICATS headquarters is in the University of Plymouth Campus in the UK from where a core team of staff is supported by a wider virtual team that delivers the full portfolio of educational services including the Diploma Programme, workshops, and other educational initiatives.

- Dr Ali Green**
Director of Studies
- Dr Tony Curtis**
Founder and Principal Tutor
- Sharon Shand (née Heard)**
Student Experience, Finance and Administration
- Peter Whippy**
Tutor and Past President BSP
- John Forbes**
Tutor
- Professor Dave Harwood**
IFEAT / ICATS External Examiner

- Deirdre Makepeace**
Chartered Institute of Marketing
Examiner, Author and Tutor
- John Wright**
ICATS Author and Industry Expert
- Dr Brian Lawrence**
ICATS Author and Industry Expert
- John Ayres**
ICATS Author and Past President BSP
- Penny Williams**
ICATS Author and Industry Expert

IFEAT ICATS Diploma and Certificate



The core qualification is the masters level Diploma but increasingly, students are opting to study for the more concise Certificate or completing a selection of modules to meet individual CPD requirements.

To date nearly 150 delegates have enrolled on the current Diploma programme and ICATS students come from a wide range of roles within the sector including producers, brokers, processors, compounders, manufacturers or retailers. They also come from the four corners of the world. The programme is delivered through distance learning with a network of professional tutors supporting students on a one-

to-one basis and to an individually agreed timetable. Students receive a study pack that includes relevant module workbooks and copies of core text books to support their studies. There are 13 modules in total in the full Diploma and each one is assessed by a work-related assignment. There are specialist modules for the flavour and the fragrance pathways but the majority of the modules are common to both pathways. The one-to-one teaching approach allows students' professional roles to be reflected in the assignments, generating a portfolio of professional work that is clearly contextualised to the workplace.



ICATS Deirdre Makepeace and Sharon Shand

Global units:

- 1 Foundation science and mathematics
- 2 Odour and flavour language
- 3 Aroma materials of natural and synthetic origin
- 6 Safety, regulatory and environmental issues
- 7 Operations, logistics and QA
- 8 Marketing and business environment
- 9 New Product Development
- 10 Project management
- 12 Financial and management issues
- 12 Research methods and dissertation proposal
- 13 Dissertation

Fragrance pathway:

- 4 Fragrance creation and evaluation
- 5 Application of aroma materials

Flavour pathway:

- 4 Flavour creation and evaluation
- 5 Application of flavouring materials

IN THE NEWS

Where have all the flowers gone?

Dr Tony Curtis

ICATS Founder and Principal Tutor



As I write this article registration is in progress for the 2020 IFEAT [virtual] conference. The biggest story in the World is COVID-19: some counties are going into lock-down, some are coming out of lock-down and some are re-entering lock-down. It will be a few years before a dispassionate forensic analysis of the present situation will emerge. I will comment with only two generalisations here: it is not unprecedented and it was not unpredictable. The airwaves and TV on-demand channels have been replete with documentaries on The Black Death, Spanish Flu [which originated from the USA], SARS etc. The scientific press was awash with warnings; largely unheeded by politicians around the world [does global warming also come to mind?].

It was my Birthday in May and I was planning a party at my favourite Italian restaurant. This of course did not happen! However, I used the money to buy a new hi-fi system and used lockdown time to sort out some of my CDs. As I was listening to the latest news reports on the ammonium nitrate explosion I came across an old Springfield CD [the folk group that was part of Dusty Springfield's early career] with a 1950s legionary protest song.

*Where have all the flowers
gone, long time passing*

.....
*Oh, when will they ever learn,
oh when will they ever learn*
Pete Seeger [1955]



Top: Spanish Flu 1918-19. US school gymnasium converted into a flu ward

Left: White mineral fertiliser, ammonium nitrate

There have been numerous ammonium nitrate explosions in this century alone, let alone in the 20th Century.

- Toulouse, France, 2001
- Ryongchon, North Korea, 2004
- Tianjin, China, 2015
- Beirut, Lebanon, 2020
- Next one – *Oh when will they ever learn?*

I return to a past theme in this column about the excellent work done by the whole industry to ensure people may enjoy our industries' products with confidence. ICATS is deeply grateful to Penny Williams who has rewritten the ICATS module *Regulation*. Academic authors will be suitably impressed by the great skill with which she has made a dense and impenetrable topic comprehensible

to non-specialists. The current IFRA Guidelines are evidence of the proactive and transparent approach of the industry.

I have spent 20 years teaching MBA. I was also asked to teach Management Studies to final year M.Eng students as I had a PhD in a Physical Science subject and might have better rapport with them than a Lecturer with no Science or Engineering background. The syllabus was rubbish, it was written as a dilution of a normal business course with lots of emphasis on balance sheets [accountants look after these] and nothing on the Management of Safety [a crucial aspect of the role of all professional Engineers]. I was fortunate that I had an understanding External Examiner and we adjusted

the syllabus a bit to make it more meaningful to an Engineering career. I was also very lucky that I could draw upon a superb short publication from the Engineering Council 'Guidelines on Risk Issues'.

continued over page >

Penny Williams, author of the revised ICATS module on regulatory matters, is featured on pages 8-9 of this edition.



Lebanon port before the August 2020 explosion

One of the interesting features of this publication is that the words 'safe' and 'safety' do not appear in the glossary and appear in the index as 'See Health & Safety'. Back to 'Oh when will they ever learn', there is no such thing as safe. The title of the publication gives the clue – not 'Management of Safety' but 'Guide Lines on Risk Issues' [i.e. the management of risk]. As soon as you hear a person (often a politician) 'We [some course of action]...ensure... totally safe', you know they are making a false statement [it is impolite to call them liars and we will ascribe this to simple ignorance]. As I am typing this there is a thunderstorm in Plymouth, I remember to lookup Table 3 'Levels of Fatal Risk in the UK (average, approximate figures':

1 in 10,000

General risk of death in a road traffic accident

1 in 10,000,000

Risk of death by lightning.

All the people concerned with regulatory issues in our industry know there is no such 'This is totally safe'. There is only acceptable level of risk. Often people within the population at large want simple answers to complex questions. Difficult as it is, it is incumbent on all professionals to engage with public education as appropriate behaviours [observance of social distancing!?] depend on individuals accepting their own responsibility and behaving in an accountable fashion. This is not just an issue of regulation but also of recognition by every individual of their social duty.

In 2018 the architecturally innovative and outstanding road bridge in Genoa failed. What was not fully understood, at the time of design and construction, was that the ground breaking approach was vulnerable to corrosion. When the unexpected corrosion was noticed remedial action was slow and incomplete.

In March 2019 the innovative Boeing 737 Max was taken out of service after two fatal crashes (it took not one but two fatal accidents). In the Genoa bridge disaster a single point of failure caused a total collapse. The 737 Max uses innovative software to counteract issues derived from the use of larger [more fuel efficient] engines in the new design. It is reported that the aircraft should return to service early next year. It will have taken some two years to resolve the fatal problems. It will take even longer for the full forensic reports to appear as to how such a failure could occur in such an advanced system. However, it is reported, that a single sensor provided information to the computer. Failure of this sensor, it is reported, could cause the computer to put the aircraft into a dive. It is reported that two such sensors were on board but only one provided information to the computer. If this is true, this is yet another design with a single point of failure. Moreover, it has been reported that the training manual for the new aircraft did not fully address actions in the event of the type of failure experienced.

The Kegworth M1 (UK) Air Disaster (1989): A problem developed in the no 1 engine. There was an indicator failure showing that no 2 engine was the problem. The crew mistakenly shut down the no 2 engine, not the faulty

no. 1 engine. Among the contributory causes of the accident was that fault was 'outside their [the crew] training and experience'. Does anything sound familiar?

Why all this discussion of regulatory failures from outside our industry? We do conduct potentially hazardous operations in the manufacture of aroma materials. Ammonium nitrate is a great nitrogen fertilizer [as well as an explosive!]. It is not only synthetic aroma chemicals manufacture that may involve hazard issues. Today our industry has a good record of proactive work in the development of regulation and promoting good practice throughout the industry on a global basis. Let the last line of the 1950s protest song:

*Oh when will they ever learn,
oh when will they ever learn*

apply to other industries. The utmost professional insight and competence is needed when innovation takes an industry beyond regulation (regulation by its nature is always playing catch-up). Regulation is not some inconvenience; it is there to protect individuals, society and the environment. Regulation without compliance, transparency and audit is worthless. Our industry has a good record, let us continue to learn, not only from the past, but from other industries. This is a prelude to my persistent plea to all to read widely. One of the values of the ICATS / IFEAT Diploma Programme is not simply the provision of knowledge but providing professional development to give people these wider perspectives that are vital to continued industry success.

IFEAT medal-winning ICATS student 2019/20



**ICATS IFEAT, 2019-2020
Medal-winning student
Marta Garcia Cantón
shares her aroma and
flavour-filled career
path and her reasons for
studying with ICATS.**

Since I was a little girl, I have always liked to smell everything around me and to taste all kinds of food. I remember playing a guessing game trying to name the ingredients that my mother used in her meals. As a teenager I had in mind to work in the Flavours and Fragrances sector and that's why I focused on studying chemistry. As the world of chemistry is so broad, I declined internship opportunities in the laboratories of several important companies in the pharmaceutical sector, to begin my internship at Lluch Essence, a leading company in the distribution of essential oils and aroma chemicals. At the end of my internship, I continued working in this company where I acquired extensive knowledge about the raw materials used in the Flavours and Fragrance Industry. During the eight years I worked at Lluch Essence, I carried out several tasks in the R&D and Quality Control department. Furthermore, during this period I continued to expand my studies to support the knowledge

I was acquiring. I did a Masters degree in Gas Chromatography and Mass Spectrometry at the IUCT which allowed me to learn more about how to develop and optimize chromatographic methods to achieve better and faster results in analysis. Later I did a postgrad in aromas at the UPC which gave me the necessary tools to understand the formulation and application of flavours for the food industry. And finally, Lluch Essence as member of IFEAT let me know about the Aroma Trades course at ICATS, so I decided study the Fragrances pathway,

'...it has given me the opportunity to learn with the support of great and expert professionals in the sector and I am very grateful and proud to receive this award from excellent professionals recognising my hard work.'

but in 2015, I began working as a flavourist in EFF Spain, the flavour production centre within the EFF group, so I decided to switch to the flavour pathway. The course has complemented my knowledge and know-how in the different areas of the Food Industry including Operations, Logistics, and Quality Assurance. Thanks to this, I am able to put into practice everything learned and I can

relate my acquired knowledge to the demands of the clients, always seeking to offer them the best quality and service. In addition, it has given me the opportunity to learn with the support of great and expert professionals in the sector and I am very grateful and proud to receive this award from excellent professionals recognising my hard work.

Many of the courses are face-to-face and are not compatible with working and family life. So ICATS gave me the opportunity to study through its specialized, flexible and rigorous course. Additionally, I was impressed by the expertise of the authors and tutors, as well as the accreditation of the course by IFEAT and the endorsement from IFRA UK, the British Society of Flavours and the British Flavour Association. All these facts inspired me to undertake the ICATS course, along with my desire to learn more about fragrances and the fragrance industry.

Working and studying at the same time is never easy, but it has been worth spending time expanding my knowledge of the fascinating food industry and consolidating the theoretical foundations for flavouring. I encourage everyone who is as attracted to this sector as I am to improve their talent doing this course.

PEOPLE

Industry expert **Penny Williams** has joined the ICATS academic team and is updating the *Module 6: Safety, regulatory and environmental issues*, to cover significant changes in this area over the last few years

Penny Williams



I have over 30 years of experience in the fragrance industry, including creative and technical perfumery; analytical and quality control laboratory roles; legislation and regulatory affairs management. This includes many years as a Perfumer and a position as Chief Perfumer at Belmay, an international fragrance house which was later purchased by Symrise.

I'm a full member of the British Society of Perfumers, member of SIPC – the International Society for Perfumer Creators, deputy Chairperson on the IFRA UK Technical Advisory Group, Chairperson of the IFRA UK group 'Fragrance Changes Lives', a member of the IFRA IOFI GHS Taskforce and consultant to IFRA and IOFI on the NCS taskforce, regarding natural complex substances.

My arrival into the industry was not planned, but certainly serendipitous.

I joined Belmay UK in 1989 at an ideal time in their development as a company. They were still small, ambitious and with plenty of opportunities. During my first six years I enabled the fragrance division to attain the quality management standard ISO9001; established and managed both the analytical department and the regulatory affairs department; introduced Formpak software to enable us to produce safety data sheets (a fairly new challenge for a fragrance business in 1991); obtained the ICATS-IFEAT Diploma in aroma studies and gained additional qualifications through the Open University. Eternally curious; nosey – if you pardon the pun; there was always more to learn and this is still true today. The quality control laboratory was particularly useful in building my knowledge of ingredients. Not only how they smell

and how to assess them qualitatively, but crucially smelling them within fragrances. All this smelling, coupled with reviewing GC analysis of essential oils and fragrance mixtures, was great beginnings for my internal odour map. I started to see as well as smell the scented patterns and over time, was able to relay the patterns to products and purpose.

Early in my career, when taking part in a routine internal smelling test, I scored surprisingly well – it highlighted a good memory and recall for odours. Perfumers seemed like magicians, I was suspicious but mostly intrigued. Being around them, in that odour rich environment made me want to be a perfumer. With encouragement from colleagues, I began my career as a Perfumer, alongside other responsibilities in the business.

In 1995, after developing fragrances which achieved



breakthrough wins at a key customer, I was enabled to practise perfumery on a full-time basis. In addition to creating hundreds of winning fragrances for toiletry, fragrance and homecare brands in the UK and internationally, I enjoyed managing people and positively contributed to the running of the business.

I was promoted to Chief Perfumer in 2003 and continued to create fragrances, helping Belmay break into target markets and played a major role in the management of the company including the integration processes following the acquisition of a competitor.

In July 2006 I started my own consultancy based business: Orchadia Solutions. Since then I've provided consultancy and training all over the world to diverse clients including fragrance houses, product developers, ingredient producers,

fragrance retailers and individuals. A particularly notable example is Formpak software, one of the first companies I approached. They were embarking on their own growth plans which I've been a part of ever since and am now a Director. The experience I already had proved invaluable; Formpak serves the aroma trades globally and continually adds to my own understanding and experience.

Orchadia projects often encompass commercial, creative and technical challenges. They include research projects; regulatory affairs; providing expertise to fragrance houses and their suppliers; developing perfumes for niche products; and providing fragrance advice, business support and training.

I've always been involved in developing people and love training. In August 2013, I launched The

International Perfume Academy: dedicated to professional training and development in perfumery art, communication, science and legislation. The ethos is simple: to explain complex topics clearly and provide engaging and thought-provoking content with the goal of building real understanding with practical applications. I hope this translates into my contribution to the ICATS course.

To anyone wishing to work within the aroma trades, be reassured there are great opportunities for a fascinating career. You can explore so many aspects of life; science, psychology, fashion, business, farming, maths, law, people, politics, environment and so much more! You will also join a global network of dedicated and brilliant professionals who you may know for decades.

PEOPLE



A multi-faceted career in the
flavour and fragrance industry

Dr Peter Greenhalgh

Peter Greenhalgh at IFEAT Athens closing
banquet 2017. Credit Kate Parkinson for IFEAT

My direct involvement in the fascinating flavour and fragrance (F&F) industry came somewhat late in life when in my 30th year I joined the Tropical Products Institute (TPI) in London. The previous decade had been spent studying economics and history at the London School of Economics (LSE), the School of Oriental and African Studies (SOAS), Birmingham and Princeton Universities and lecturing in Ghana, as well as completing a Ph.D. on the West African diamond industry – all a long way from the world of flavours, fragrance and essential oils!

TPI was a UK Government scientific research institute with over 400 employees working on post-harvest issues relating to a wide range of products predominantly from Third World countries. It had a large essential oils and spices section headed by Dr Clinton Green, who was closely involved in the development of the trade association IFEAT (International Federation of Essential Oils and Aroma Trades), formed in 1977 to represent the interests of those trading and using F&F ingredients. In the late 20th century the UK still had an important role in the F&F industry and supplying these ingredients. Some of IFEAT's early executive meetings were held at TPI and Clinton for many years was an IFEAT technical advisor, as well as Conference Programme Coordinator, a role I later took over from him.

At the time of my arrival, TPI was a leading global centre for information on essential oils, spices, extracts and related products. Dr Green led a department of approximately 10 people, with hundreds of years of accumulated experience in the sector. Alongside Clinton, other colleagues during my time included Stan Mathews, Tony Dann, David Baker, Mike Milchard and John Coppen, each of whom had researched and provided advice on the production, processing, analysis and marketing of these products to a large number of countries, sometimes on long term overseas assignments to countries including Brazil, Grenada, Indonesia and Paraguay. We benefited from a marvellous library and set of records dating back to the creation of TPI's predecessor, the Imperial Institute, by Queen Victoria in 1894 (now part of Imperial College, London),

established specifically to support the development of production and trade within the British Empire and Colonies. Data were scrupulously recorded in the *Bulletin of the Imperial Institute* (BII), including the results of every sample evaluation, and later *Tropical Science*. Over the decades, TPI worked on a wide range of aromatic materials in numerous countries.

My first project was undertaking market studies on identifying potential products to replace opium production in the Golden Triangle of northern Thailand. Following extensive market research, several very detailed studies were prepared and published by HMSO (Her Majesty's Stationery Office) in the late 1970s early 1980s and circulated free to developing countries as part of the UK Aid Programme. These included market studies on mint oils, culinary herbs and herbaceous essential oils. While their impact on opium production was probably negligible, the law of unintended consequences led to their being of use to other countries and companies. I was told some years later by several Indian companies, that the mint oil market study had proved very useful. In the early 1980s India produced very small quantities of mint oils – today it is the world's largest producer with an annual estimated production of *M.arvensis* oil of some 40,000 - 50,000 MT, *M.piperita* oil 400 MT and spearmint oil 200 MT. The mint oil sector alone employs well over one million people in India.

Other areas of research included detailed published analyses of the "naval stores" industry, now commonly referred to as "pine chemicals" i.e. products obtained from the oleoresin of pine trees. The term "naval stores" started to be used several centuries ago when tar and pine pitch were used in the caulking and weather-proofing of the timbers and rigging of wooden sailing ships. Pine oleoresin products include gum rosin, wood rosin, tall oil rosin, turpentine, pine oil and a whole range of chemicals obtained from turpentine including alpha- and beta- pinenes, which are now such vital ingredients for the perfumer. Remarkable to remember that turpentine in those days was best known as a paint thinner!

TPI colleagues, including myself, also made substantial contributions to other comprehensive published

studies, containing detailed analysis of essential oils and other extracts, including

(i) Purseglove, J W, Brown, E G, Green, C L and Robbins, S R J (1981). *Spices*. Vols. 1 and 2. London: pp. 813, Longmans,

(ii) ITC (1986) *Essential oils and oleoresins: a study of selected producers and major markets*, Geneva; pp. 208

(iii) ITC (1982) *Spices; a survey of world markets*, Vols 1 and 2 Geneva pp. 584

Many of the projects I was involved with did not relate only to the F&F sector but covered a very wide range of renewable resources. The commodities on which I undertook research and published studies and articles included silk, vegetables, fruit and other horticultural products, coconuts, fibres (including sea island cotton, jute, ramie, sisal) and edible nuts. All of which gave me the opportunity to visit many countries on five continents. This included a visit to Beijing, China in 1988 to make a presentation at IFEAT's annual conference on market trends and information sources on essential oils. An issue analysed in the presentation was the decline of natural essential oils, particularly in the fragrance sector, in the face of intense competition from synthetic substitutes. The latter, being cheaper, of more consistent quality and with greater regularity of supply, were leading to a decline in "naturals". How times have changed over the past few decades as "naturals" have made an impressive fight back! Also in 2006, prior to my taking over from Clinton Green as IFEAT Programme Coordinator, I made the opening presentation at IFEAT's Cape Town conference, on "*An historical overview of the industry in sub-Saharan Africa*".

Following the re-location of TPI in the late 1980s I moved to work for LMC International, a privately owned commodity consultancy company in Oxford, where I worked for eight years analysing soft commodities, particularly coffee and cocoa, followed by two years at the Institute of Energy Studies in Oxford, where I worked on a range of energy related issues. In 1999 I returned to work at TPI's successor, the Natural Resources Institute (NRI) now based at the University of Greenwich.



IFEAT study tours, an education success story

Since 2007 I have had the great pleasure of working for IFEAT in several roles. The two main ones being the organisation of the annual Conference lecture and workshop programme and the annual study tours. Organising and editing some 25 – 30 presentations at each conference and editing the conference proceedings put me in direct contact each year with dozens of diverse people, companies, countries, topics and issues in the industry. The annual conference proceedings, available to members on the IFEAT website (www.ifeat.org), provide an invaluable source of detailed information and analysis on development and changes in the F&F sector throughout the world.

Since my first involvement in the F&F sector in 1976 enormous changes have taken place, reflecting in part the monumental economic, political, climatic and regulatory changes that have taken place throughout the world. These changes include the global expansion of the sector, the unprecedented growth of

legislation and regulations, industry consolidation and the technological revolution. These trends in the F&F sector are summarised in *Celebrating IFEAT Around the World 1977 – 2017*, the book I prepared to celebrate IFEAT's 40th Anniversary in 2017. Copies of the book are available from the IFEAT Secretariat. Against the background of the dramatic changes in the F&F industry the book traces IFEAT's growth including details of the annual conferences, study tours and its support of scientific research and educational programmes, including ICATS/Plymouth and Reading Universities.

A very successful feature of IFEAT's educational activities has been the organisation of study tours for members. Started in 2005, IFEAT study tours have gone from strength to strength. They have proved to be a great learning experience – in the company of other industry specialists, who might be competitors but become good friends. This has facilitated the growth of the international IFEAT family. While

IFEAT



CELEBRATING IFEAT AROUND THE WORLD 1977 - 2017



each study tour follows a similar format, they remain very different, predominantly because of the country and companies visited as well as different participants. This diversity of people, expertise, aromatic ingredients, products, processing techniques and range of end uses have all contributed to making the F&F sector such a fascinating and beautiful sector to be involved with. In part, this is reflected in books I have prepared after each annual study tour, which profile the essential oil sectors and companies visited in such diverse countries as Indonesia, Brazil, Paraguay, India, China, France, USA, Bulgaria and Spain.

What of the future? This has become even more difficult to predict in the light of the COVID-19 pandemic. Many things will be very different from 2020 onwards – the economy, health and welfare, travel, security and levels of trust. However, it is likely that the enormous changes over the past four decades in the F&F sector outlined above will continue and probably accelerate. Topics of growing

importance will include:

- supply side issues, particularly in relation to naturals and their sustainability and traceability;
- scientific and technological research and innovation into a wide range of issues: pesticides, adulteration, carbon footprint, medicinal and therapeutic benefits, artificial intelligence, robotics, computing, new product development and biotechnology;
- high-level educational programmes for both company employees and owners in the diverse areas the industry covers e.g. naturals, synthetics, production, processing, commerce, regulatory and quality assurance and control.

Whatever, your particular interests and expertise, there will always be something in this fascinating industry to attract you!

IFEAT 40: Celebrating IFEAT Around the World 1977 – 2017, researched and written by Peter Greenhalgh

'This diversity of people, expertise, aromatic ingredients, products, processing techniques and range of end uses have all contributed to making the F&F sector such a fascinating and beautiful sector to be involved with.'

MEET THE STUDENT

As the sector copes with the global challenges of Covid-19, some ICATS students are finding it the perfect time to push on with their studies. Meet **Sascha Schreiber**, stranded in California in spring.

Sascha Schreiber

Before I began the Diploma program, I had been learning about the perfume industry by seeking out seminars and listening in on lectures, using press passes to gain access to industry events, which were generally not open to the public. Trying to understand the industry in this way - what it is comprised of and what drives it - was challenging, partly because I was limited to events held in Europe and to the subject matter these touched upon. Two years into my journey, I discovered the ICATS/IFEAT course, a program designed specifically to build a thorough foundation in a practical and cogent manner by, for example, teaching about techniques used in fragrance and aroma molecule creation while simultaneously considering relevant aspects like intellectual property protection.

Unexpectedly, only weeks into my studies I found myself stranded in California as the Covid-19 crisis



prompted worldwide lockdowns and stay-at-home orders became widespread in the United States. What was initially planned as a three-week stay quickly turned into three months. Thankfully, I had most of my course materials with me digitally and I had brought a few of my books as well. My Tutor, Dr. Curtis, kindly emailed me any materials I was missing (including entire modules) and fully supported the sudden change in submission

schedules. Ultimately, as unusual as this time has been, it has allowed me to focus on the studies and shortened my self-set deadlines significantly. That is not to say that I

wished to accelerate the process, but to demonstrate the flexibility of the program and show that it is possible to pursue it whether on a full-time basis or while working nine to five. I believe that taking this course, with its breadth, depth and scope provides an invaluable foundation for anyone looking to work in the industry as well as for professionals to further expand their knowledge; the learning never ends.'

their knowledge; the learning never ends.

Here at ICATS we wish Sascha every success in her continuing studies and her career in the industry.

EVENT REPORT



Flavourtalk 2020 Natural Flavours: Innovations, Technologies and Authenticity

Deirdre Makepeace and Mandy Burns

This firm fixture on the flavour industry's calendar was sadly impacted by the emerging COVID-19 crisis. The exhibition and conference started a matter of days before the USA and many European countries announced travel restrictions and varying degrees of lockdown. Some delegates and exhibitors had taken the difficult decision to pull out and others left early, unsure if their return home would be hampered by restrictions. However, the reduced number of exhibitors and delegates

were able to make the most of some excellent product demonstrations and specialist presentations. The event, run by Flavour Horizons, focused on key emerging themes such as defining 'natural', clean labelling, sourcing, purity, health and of course cost.

As in the past the event ran on a two-day format with the first day consisting of table-top exhibitions.

Advance Biotech's presentation stated that 'derived herbal and botanical extracts will experience some of the fastest growth this

year.' Thyme, rosemary, ginger, basil and habanero extracts were demonstrated with a range of uses across both food and cosmetics from baked goods to beverages and confectionery with all products being both Kosher certified and organic. The company also announced a number of new products under development including Strawberry Glycidate 2, Pyrazine Mixture IX, with a nutty, coffee chocolate odour, and Cocoa Hexenal.

Merck (Sigma Aldrich) demonstrated seven scent samples,



Above: Flavour Talk Amsterdam (hall) The Barbizon Palace's 15th century chapel, Olof's with day 2 presentations set to begin

Above Right: Lionel Hitchin Ltd, ingredient demonstrations underway

The Flavour Raw Materials Exhibition and FlavourTalk conference are presented by Flavour Horizons in association with the British Society of Flavourists.

three of which were also available in tasting formats. Delegates were invited to smell, think and interpret the aromas and flavours, checking against the catalogued aroma and taste notes. As always, a full table of developers and buyers will often pick up on different nuances across the samples and discussions around potential uses was evidence of the shared innovation that these sessions can offer.

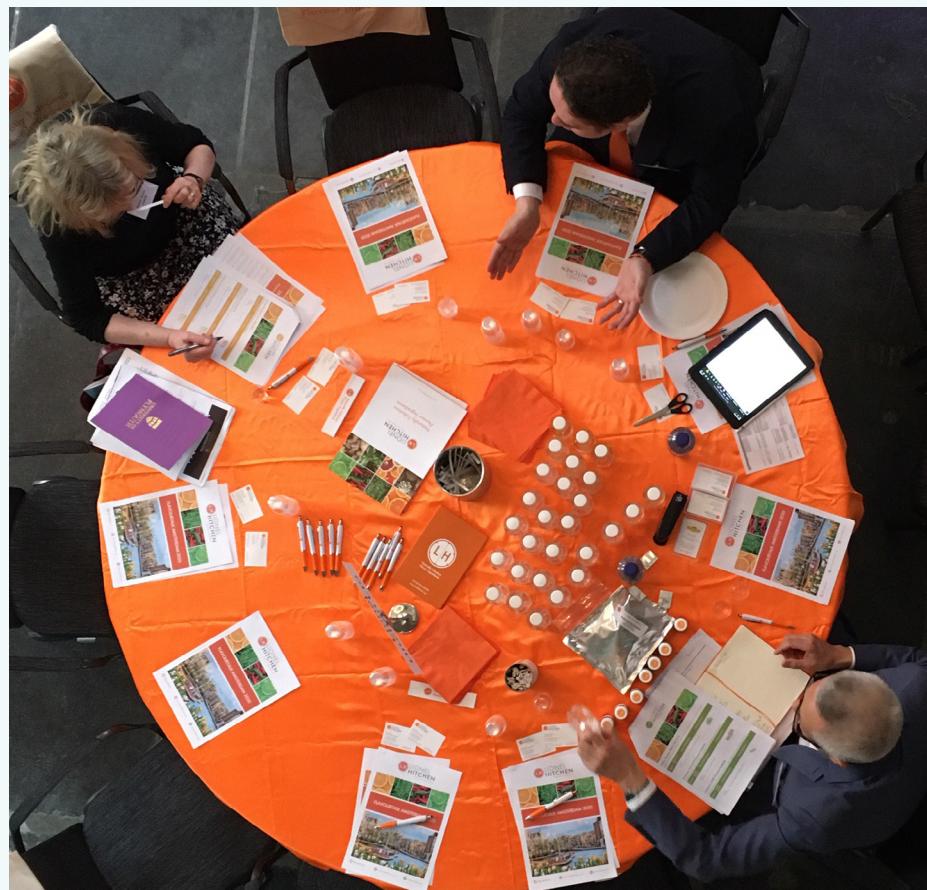
Omega demonstrated their kiiNote® natural extracts in a delicious non-alcoholic Bloody Mary recipe, re-imagined as a 'Bloody Shame'. Carrot flavours added a fresh vegetable depth, beetroot a more earthy depth, unmani a complex and slightly smoked savoury note and tomato essence, created unusually from English grown tomatoes, those that don't quite make the grade for supermarket display. The final kick of Sancho Pepper kiiNote® and Capiscum filled the alcohol gap. They had replaced celery salt, a known allergen, with watercress. The 'Bloody Shame' was an entertaining showcase of Omega's drive for pure and natural ingredients.

Lionel Hitchin showcased a range of taste and aroma samples from both their citrus ranges and their herb and spice ranges, including some more unusual extracts such as Bourbon Oak

Soft Extract. Obtained by aqueous ethanol extraction and distillation of untoasted bourbon oak powder, the aroma presents a rich and woody vanilla scent.

The presentation by Essential Oils of Tasmania was a measure of the global opportunities that this event offers. Boronia, native to Australia, where 12 million yellow flower heads are used to create one kilo of absolute, is used in tobacco, spirits, juices and also fragrance. The leaves of the Tasmanian native pepper, known as the mountain pepper, used to create diverse products, has an exotic scent and spicy top notes. Tasmanian peppermint is harvested from paddocks that have been established for over 30 years and the oil has a strong fresh flavour and aroma with a clean, rich complex background. The state of Tasmania is non-GMO and has one of the lowest air pollution ratings on the planet. Year to year product consistency was discussed, particularly in the light of Australia and Tasmania's recent climatic challenges.

Robertet, one of the oldest businesses in the sector, used a historic theme to demonstrate the journey to today's world of natural products. Robertet presented as *The Botanist* with five healthy concepts combining taste, active ingredients



and clean labelling. There was an emphasis on certified organic and with Gumcommunity, EFSA approval for labelling as having benefits for relaxation and respiratory disorders.

Besmoke highlighted one of the latest trends in food flavouring with significant growth in demand for smoky flavours in products such as barbecue flavoured crisps. PureTech, the company's revolutionary patented smoke filtration technology, is being used to create the 'next generation' of safe and clean smoky flavours for e.g. rice pouches and crisps. Besmoke's Pure Tech processes enable the reduction of carcinogens and the use of Puremani reduces sugars.

Finally delegates were invited back into the seventies for a colourfully themed presentation by Mane, evoking the 'limitless happiness' of the decade with its vintage themed table.

Although travel and working restrictions are changing working and conference habits the benefits of bringing product innovations and creative flavourists together for practical flavour and aroma session cannot be underestimated.

On day two the usual conference health and safety briefing had the, now familiar, instructions on using biocide wipes and a reminder of the

'no-handshakes' rule. The conference programme had been amended somewhat with some speakers joining remotely and others unable to join. The programme was nonetheless excellent with a range of technical and regulatory presentations of enormous value to the assembled delegates. This year's focus was on the regulatory landscape, the consumer landscape and the ongoing challenges of authenticating natural ingredients.

After welcoming remarks from David Baines of Flavour Horizons, Jan Verhoeven of the European Flavour Association (EFFA) Working Group on Natural Processes, discussed the complex definitions of what is meant by 'natural flavours', whether those flavours come from food or non-food sources. The starting point for the discussion is that consumers regard 'natural' as 'good, desirable and safe' and that this is not necessarily always true. 'The industry cannot follow the (undefined) consumers' opinion but is bound by the regulations, primarily EC 1334/2008'. The EU definitions state that a natural flavouring substance is one that is identified in nature i.e. identified in materials of plant, animal, microbial or mineral origin. It also states that such substances can be processed by appropriate physical, enzymatic or microbial processes to

create a 'natural flavouring substance'. Traditional food preparation processes include for example cooling, cutting, drying, pressing, distillation, mixing and macerating. The presentation formed the perfect introduction to the very complex field of definitions surrounding the narrative of 'natural'.

David Baines continued with a comparison between EU and US legislation on the subject summarising the EU criteria that a natural flavour must therefore be 1. made from natural source materials 2. prepared using traditional processes and 3. found in nature. The UK will be adopting EU regulations post-Brexit. In the US natural flavourings must be derived from natural starting materials and must also be Generally Recognised As Safe (GRAS) listed. The FDA (Food and Drug Administration) in fact discourages the food industry from using the word 'natural' on labels because of its ambiguity. They gave up on attempts to formally define the term 'natural' in 1993. The IOFI guidelines determine that natural flavouring substances are derived from natural materials using permissible processes. There are many oxymorons surrounding the use of 'natural' as a description that can be confusing to the consumer and Baines called for clearer definitions.



In summary the simple concept of 'natural' in the mind of the consumer, is far from simple from the perspective of regulators and therefore producers.

Delegates were then introduced to the area of authentication of natural products with three detailed presentations covering specific research projects. Christina Ramos, European Operations Manager for Beta Analytic, presented by live video, having returned to Spain after day one of the event. Her research has focused on identifying the mis-labelling of products and detecting (economically motivated) adulteration using carbon 14 analysis. Sandrine Bodin a Flavourist for Solvay, discussed her research into the authentication of natural vanillin. Sophie Lavoine-Hanneguelle, R&I Manager for Robertet, presented research into the authentication of the Zanthoxylum genera of peppers with cryomilling and DNA analysis as two methods trialled.

Lewis Jones, Innovation, Analytical & Sensory Manager for Sensient continued the natural labelling theme and the topic of clean labelling, stressing the market appeal and consumer demand for more complex

and well defined labelling. In a Sentient survey of 5,000 Americans, 61% strongly agreed that 'when buying new products, ingredient labels impact my food and beverage purchasing decisions'. For example the terms 'natural ginger extract', 'natural ginger flavour', 'ginger extract', 'ginger flavour' and 'artificial ginger flavour' were compared for their 'clean label' perception with the results clearly demonstrating the weight placed on the words 'natural' and 'extract'. There was some variance across generations with Boomers being the most likely to pay a premium for foods that contain extracts instead of flavours.

Nick Eskins of Taste Connections Ltd, stepping in with just 14 hours notice, presented further research into complex consumer taste drivers with geographic provenance as part of the story and introduced delegates to the concept of 'small but perfectly farmed'. Taste Connection's research has identified a number of contemporary trends:

- Food production revolution – changing attitudes to farming and animal welfare – 'it's cool to be kind'

- Veganism – the rise of *PLNT PWR*, now a lifestyle cornerstone
- Under the sea – sustainability vs. plastic
- Question everything – trust and traceability – it's all part of the story
- Traditional 'good and proper'
- 'Hyperlocal'

Eskins contrasted that historically, savoury snacks primarily involved two key flavours - salt and MSG but today's market is far more complex with people vociferously demanding traceability, healthier options and redefined food. The company has observed a number of new food concepts emerging from changing tastes and buying behaviour including savoury twists in Danish pastries and yoghurts, conversely combining fruit and sweet flavours with things that are traditionally savoury and vegetables being cooked like meats e.g. vegetable terrines and ragout. Delegates were introduced to a relatively new product, Salmon Crisps, made from the often-wasted but nutrient-rich by-product of fish skin and asked to ponder the future concept of edible jelly fish – a massive potential food source.



The focus returned to authenticity as John Points of John Points Consulting explored the role of analytical testing in ensuring authenticity. Around 20% of global food scares related to food fraud, representing around 2000 cases in 2019, but only eight of these related to flavouring. 'Should everything be subject to analytical testing? If so, where in the food chain should testing take place?' The reality is that analytical testing is very expensive and is therefore likely to be used as a small element of a range of sources of intelligence that can combine

to strengthen integrity through the supply chain. Analytical testing should be more about building a case, sharing intelligence and data in a collaborative, non-competitive way to mitigate risk of false claims and interpretation.

So from Salmon crisps to savoury yoghurts – the 12th annual FlavourTalk exhibition and conference did indeed offer food for thought on both adventurous consumer-driven food trends and the challenges of appropriate product labelling and authentication of those increasingly diverse food stories.



Far Left: Omega Ingredients inviting delegates to discover the flavours in their 'Bloody Shame' alcohol-free cocktail

Left: Sea Chips, the UK's first salmon skin crisps.
Credit Nick Eskins,
TasteConnection Ltd

Below: Mane Caption Mane - imaginatively evoking the 'limitless happiness' of the seventies through flavour ingredients



BOOK REVIEWS



Adam Kucharski
2020 Profile Books: Wellcome Collection
Hardcover £16.99
ISBN 978 1 78816 019 3

- Introduction
 - 1 A theory of happenings
 - 2 Panics and pandemics
 - 3 The measure of friendship
 - 4 Something in the air
 - 5 Going viral
 - 6 How to own the internet
 - 7 Tracking outbreaks
 - 8 A spot of trouble
- Notes
Further reading

The Rules of Contagion Why Things Spread – and Why They Stop

Dr Tony Curtis

I think this book ‘accidentally’ expresses the zeitgeist of 2020 as it was written before COVID-19 exploded. My experience of 2020 is continually muttering under my breath ‘*A little knowledge is dangerous*’.

In the late summer, Plymouth is the home of the UK Firework Championship. Plymouth Hoe provides the ideal grandstand for some 100,000 people watching the spectacle sited on the breakwater. Without fail you will always be within ear shot of an ‘expert’: what they don’t know about fireworks has never been discovered! In the UK, descriptions like ‘bar room pundits’ or ‘armchair experts’ are used for people who do not let their lack of knowledge or understanding prevent them from providing [usually loudly] definitive critical assessments.

Regrettably even textbooks are not immune to this type of problem. Take the example of The Boston Matrix, a common model given in many Marketing textbooks. Sadly, I know of no such textbook (except my own!)

that has a correct representation of the model. Teachers who have never applied the model in real life will expertly say that products called ‘dogs’ are in the decline phase. However, they unfailingly have the dog represented in a quadrant above the zero-market growth line. Apparently, they are blissfully unaware of the contradiction or have a total lack of knowledge of even the most basic mathematics. In innumerable exam papers I have marked, students have blissfully commented that this is the model of choice as it is ‘simple’. Well yes, most often it is simply wrong and inappropriate. In one Marketing exam, the instruction for candidates was to draft a Boston Matrix from ‘real’ market data. A number of formal student complaints were received that the question was impossible as negative market growth did not fit into the [text book representation] of the model.

It was a chastising experience that I too had fallen into the trap of familiarity. Marketing textbooks are

replete with discussion of the ‘Diffusion of Innovation’ and its representation in the familiar innovators, early adopters, majority and laggards’ labels for buyers. This translates into the equally familiar ‘S’ shaped curve. An immense strength of this book is the meticulous referencing and use of original source material. The birth of this model is lost, for many like myself, in the mists of time. The model was apparently first developed in 1962 by Everett Rogers in his book ‘Diffusion of Innovations’. This model, as are all models, based on assumptions; in this case just how uptake is passed from one individual to another. I too had become a ‘armchair expert’, using a model without understanding the underlying theory. We need books like Kucharski’s to get us back to grounding that models use data and assumptions since in real life, there can be problems with both!

Back to our ‘armchair’ experts. Everybody appears to have an expert opinion on the value (or lack of it) of wearing a mask and with great

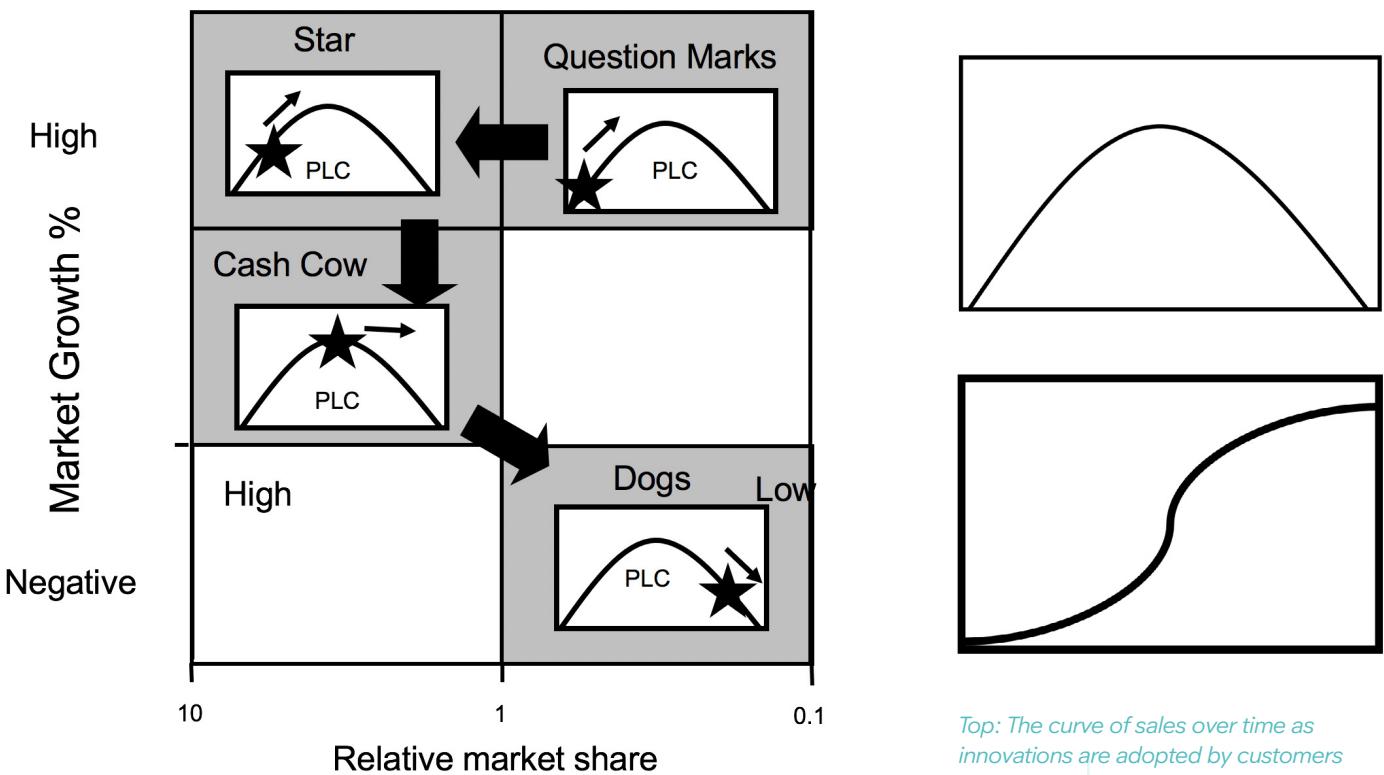


Figure 16.5 - Adapted Boston (BCG) matrix

confidence discuss the 'R' number to prove their assertions. This book is the first good discussion I have read about the DOTS model:

$$R = \text{Duration} \times \text{Opportunity} \times \text{Transmission probability} \times \text{Susceptibility}$$

Use of the 'R' number without understanding the underlying components of which it is comprised is futile. It never stops the tabloid press with its unfailing drive to keep complex problems simple!

In a few pages of enthralling reading Adam takes us from the South Sea Bubble, to the 2008 financial crash and onto the Ronald Ross's mosquito model of malaria transmission. The structure of the 'R' model gave insight into how to better devise malaria transmission control programmes. Better knowledge and understanding can help us make improved decisions.

In chapter 4 'Something in the Air', Adam takes us on another magical

pathway from the 19th century 'miasma theory' group think to the classical exposition of Snow's brilliant detective identification of the cause of the 1854 Soho cholera outbreak (not miasma). What I find truly remarkable as a Chemist, was that the cause 'bad water' was identified, but there was no germ theory at the time. For a Chemist, this is reminiscent (after the 200th anniversary of the Periodic Table) that Mendeleev had no atomic theory to anchor his inspirational ordering of the elements. They both followed the data. The fundamental understanding of the theoretical causes came later. What is truly remarkable is how, with judicious insight, models can be moved from one area of application to another. The mathematics and modelling in this book take us onto public health inspired insights into the issue of domestic violence.

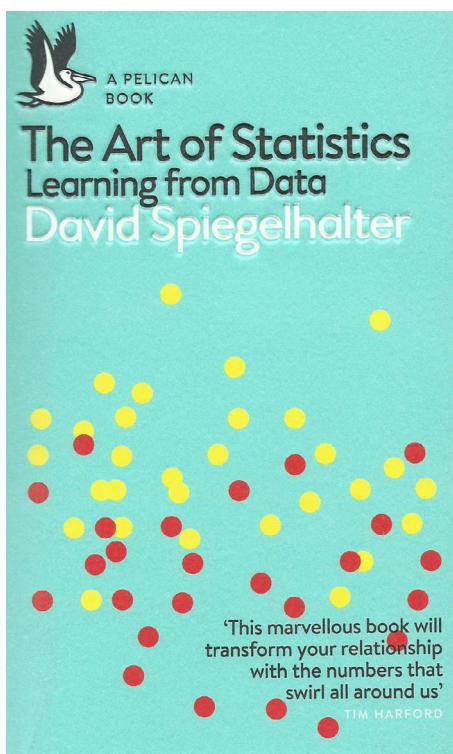
I have to confess I am on a mission to impress on our ICATS students and all our readers: it is imperative to read and discuss things widely,

Top: The curve of sales over time as innovations are adopted by customers

Above: The S-shaped curve

since concepts and ideas developed in apparently unconnected areas can yield invaluable insights. Human behaviour and motivation are core factors in numerous areas. In the 1854 Soho cholera outbreak, the beer drinking brewers did not get infected. Fake news is not just irritating when it affects individual behaviour (and hence the 'R' number) the effects can be fatal for many people. One of the weekly magazines I read has a column entitled 'Boring but important'. This book is not just good, it is exemplary! There are 51 pages of meticulous notes and references and 5 pages of recommended further reading. These references and further reading take you to the frontiers used by Adam in providing us with this invaluable insight into a diverse set of important issues all linked by one concept: contagion.

BOOK REVIEWS



David Spiegelhalter
2020 Pelican Books
Paperback £9.99
ISBN 978 0 241 – 25876 - 7

- Introduction
- 1 Getting Things in Proportion: Categorical Data and Percentages
 - 2 Summarizing and Communicating Numbers, Lots of Numbers
 - 3 Why Are We Looking at Data Anyway? Populations and Measurement
 - 4 What Causes What?
 - 5 Modelling Relationships Using Regression
 - 6 Algorithms, Analytics and Prediction
 - 7 How Sure Can We Be About What is Going On? Estimates and Intervals
 - 8 Probability – the Language of Uncertainty and Variability
 - 9 Putting Probability and Statistics Together
 - 10 Answering Questions and Claiming Discoveries
 - 11 Learning from Experience the Bayesian Way
 - 12 How Things Go Wrong?
 - 13 How We Can Do Statistics Better?
 - 14 In Conclusion

The Art of Statistics: Learning from Data

Dr Tony Curtis

I ordered my copy of this book after reading David's feature article in the *New Scientist*. What particularly caught my eye was a quotation from a response he gave to an audience question 'How do you avoid being blinded by numbers?' asked at one of the *New Scientist* events. He calls it '*Sniffing the number [the dodgy stats.]*'. Here is my summary of his rules:

- Why am I hearing this number? Be sceptical of the motivation of the person giving the number.
- Are they trying to make it big or small?
- Are they trying to persuade me rather than inform me? (Too often it is the former!)

The subsidiary questions are:

- Can I believe this number?
- Where does it come from?
- Does it actually represent what I think it represents?

His explanation is '*It is a bit like judging [sniffing out!] fake news*'. I learned a new term '*horizontal searching*': always evaluate the context of the figure

since a number without context is meaningless. I have the key points from the above pinned up over my desk.

Many years ago I was asked to review Continuing Professional Development (CPD) of technical staff in their first five years in the company and I identified a gap in provision: people were not well-versed in the range of mathematical tools that were useful to technical management. My job title at the time was Process Development Coordinator and there were two aspects to the role: the first (which was there by design) to take new aroma chemicals from the laboratory into full scale production; the second evolved by accident. One of the aspects of process development for new materials is process optimisation. I then found that the insights developed in NPD could also be applied to existing processes.

This is not the place to expand on the challenges of optimisation; we simply note that testing the effect of each variable (e.g. temperature

and concentration) one at a time does not cut it. It will not take you to the optimal process conditions. There are interaction effects (in this case possibly between temperature and concentration). I thus got very interested in experimental designs and process optimisation mathematical techniques, so I was then introduced to the Company Statistics Consultant, Professor Derek Ray at Birkbeck College, London University.

The first two meetings to discuss the major project in hand were career changing (in retrospect my first small steps into academic university teaching). We did not launch into the detail of efficient factorial experimental designs to evaluate the effect of interaction effects. This is what I expected. Not a bit! We donned hard hats etc. and walked the plant to see the gauges and equipment that collected the data. We then discussed what we **thought** we understood about the process. Again this is not the place for detailed discussion but we also

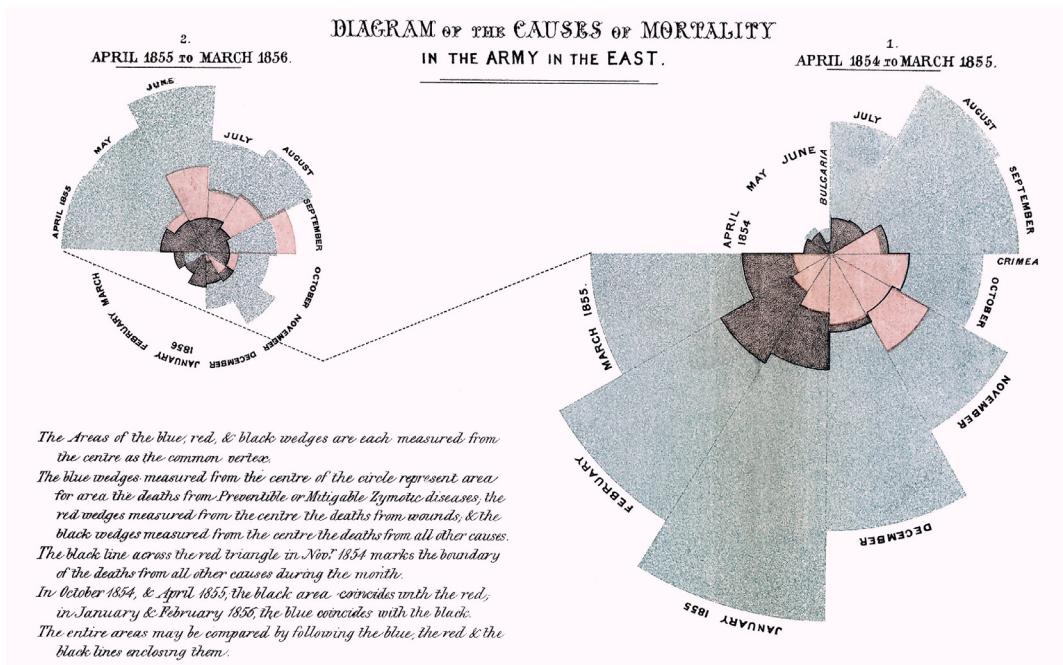


Diagram by Florence Nightingale of the 'causes of mortality in the army in the East' was published in Notes on Matters Affecting the Health, Efficiency, and Hospital Administration of the British Army and sent to Queen Victoria in 1858.

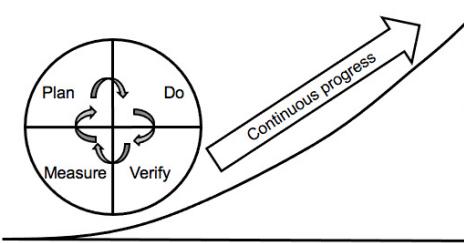
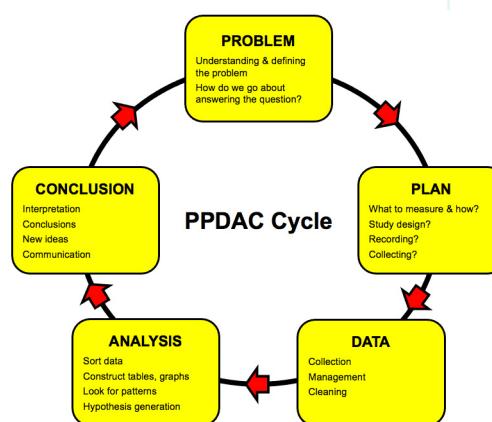
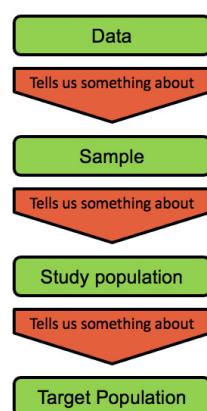
had a lengthy discussion as to just what we wanted from optimisation. In academic research papers on chemical synthesis, optimisation may be simply considered to be the percentage yield. In full scale production there may be a range of other factors such as space yield, reaction time etc. that feed into the optimisation equation.

A mantra in investment circles is '*If you do not understand the investment, do not invest!*' My lesson for life: '*Do not dash into statistical analysis until you really, really understand the data!*' I spent a happy and productive couple of years developing (as a part-time role) a full programme of in-house training on relevant mathematical & statistical techniques. We gave each participant two textbooks. One was a standard 'normal' statistics textbook, the second was the more important one: Darrell Huff's *How to Lie with Statistics*. This was first published in 1954 and is still in print.

What a lengthy introduction for a book review! On page 16 of David's wonderful book he acknowledges the formative inspiration of Darrell Huff's seminal work. David uses real-life examples. We do not launch into big data in the first pages of the book. There are no intricate mathematical formulas. We do start (on page 1!) on a sobering exploration of the most prolific mass murder case in the UK, the Harold Shipman matter. For non-UK readers, he was a medical doctor and over a period of years had murdered 215 confirmed victims (and was suspected of possibly many more). Key data questions were what kind of people did he murder and when did they die? Moving onto, why did it take so long (and so many murders) for him to be detected? David Spiegelhalter's key exhibit is not a spreadsheet from a 'super computer' using big data, it is a scatter plot. Last week I was writing up my review of *The Rules of Contagion*

by Adam Kucharski. As soon as I saw this scatter diagram I was reminded of the occurrence map for the 1854 Soho cholera outbreak reproduced in that book. I then lost two hours!

There are dangers of working on a computer with Google access: you can follow new trains of thought. Mine was 'The analysis and communication of data: the launch of the PowerPoint pie chart!' Google and off to read up again on the Florence Nightingale's ground breaking Rose diagram. If you have the time and have internet access to the BBC archive there is a wonderful TV programme on this in the documentary series 'The Beauty of Diagrams'. Her investigation of the shameful death rate of the wounded in the Crimean war of 1853 to 1856 and its dramatic control by professional nursing were (and still are) communicated by these diagrams. In the UK the COVID 19 emergency hospitals are called 'Nightingale Hospitals'. It is a pity that



BOOK REVIEWS

today's politicians only remember her clinical work and not her contribution to rigorous, insightful statistical data analysis and communication!

The PPDAC (**P**roblem, **P**lan, **D**ata, **A**nalysis & **C**onclusion) cycle advanced in this book provides a positive structure for investigation and analysis of a problem. ICATS students will be reminded of the Deming Cycle used in TQM (Total Quality Management) theory. The implications are total rigour at every step (take nothing for granted) and one can strive for perfection but one only asymptotically approaches true understanding by continuous enhancement. Astute readers will already be asking '*Just what is true understanding?*' Here we are back to '*Sniffing the number!*' I used to upset some of my full-time Marketing Students in the lecture on International Market Research. Getting interactive with the group I would ask '*What is the greatest problem in Market Research?*' I would get lots of fairly reasonable points about representative sampling etc., but I never got the **real** answer:

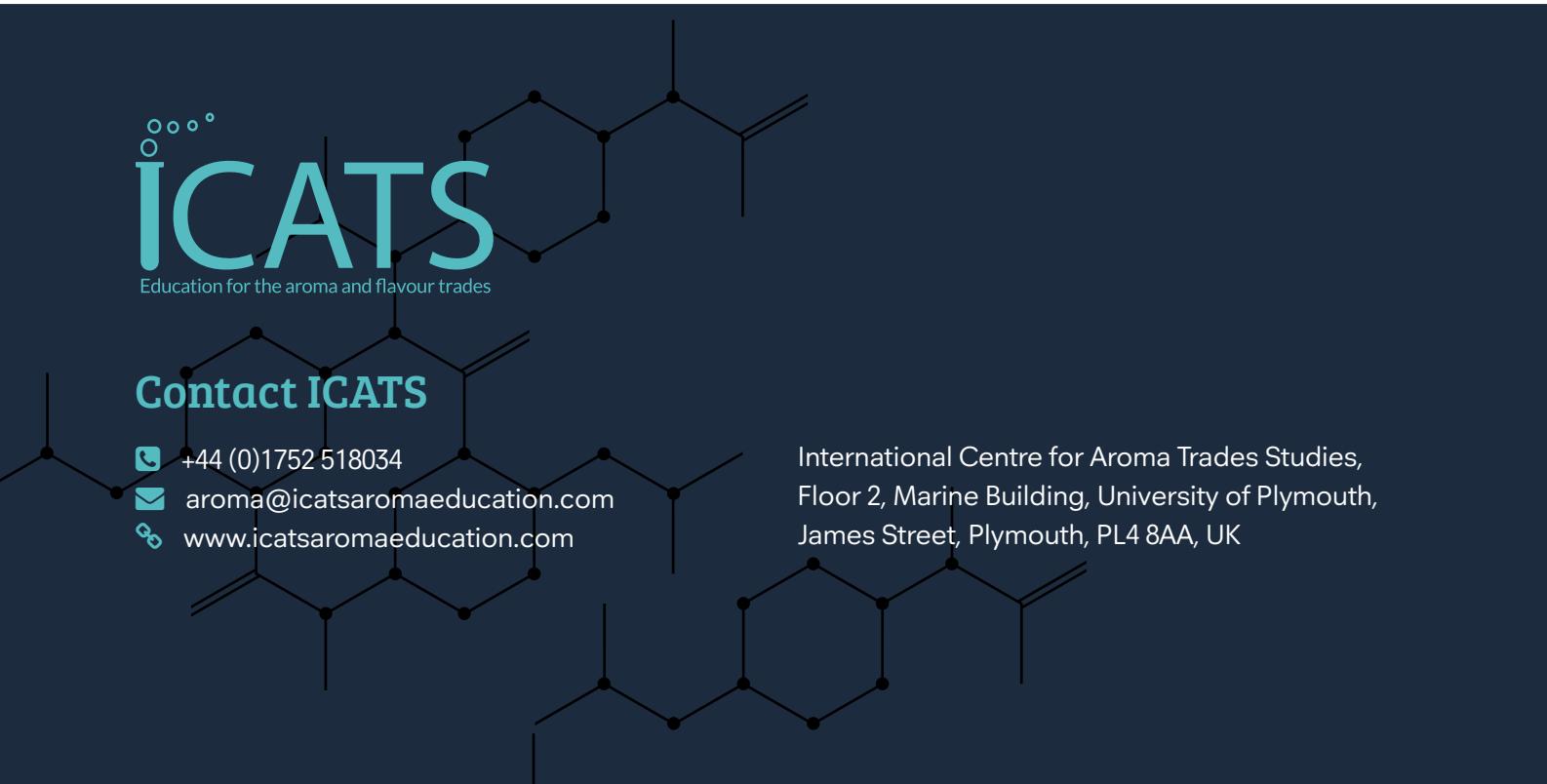
asking the right question in the first place. Too often people assume they know the 'answer'. I then used an old cartoon which showed a very drunken man hanging onto a lamppost. The caption read '*More for support than for illumination!*'

Cherry-picking data to support a preconceived assumption does not provide insight – the numbers may smell unpleasant. Numbers are being used (probability a better word would be abused!) just for support, not for insight. Possibly just to do the reverse, people are simply using selected data to justify a predetermined fixed view. This provides distortion, not insight. The PPDAC cycle and the Process of inductive inference keep us on track, continually sniffing the numbers of course!

This summer the ICATS module on Regulatory Affairs has been completely rewritten by Penny Williams to reflect ongoing developments. However, the foundations have never changed in some senses. The PPDAC cycle still applies. There is an added

complication. Much data is pre-existing and needs collection and collation. This is not a mechanical process. For example, RIFM (Research Institute for Fragrance Materials) not only collects data but evaluates it. The basics never change: to regulate you have to control, to control you have to measure, to measure you have to define. Yet this is only the start. What is great is that the PPDAC model has the critical component Communication in the Conclusion phase of the cycle.

This may turn out to be the most important book published in this decade, even though it is only months old. No person who produces, uses, interprets or communicates data should be without their personal copy. At less than £10 this is possibly the best investment you will ever make in improving your understanding of data and how to interpret it into actionable information. It should be mandatory reading for all journalists and politicians. Possibly, just possibly, they might then remember that '*Correlation does not mean causation!*'



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Education for the aroma and flavour trades

Contact ICATS

+44 (0)1752 518034
aroma@icatsaromaeducation.com
www.icatsaromaeducation.com

International Centre for Aroma Trades Studies,
Floor 2, Marine Building, University of Plymouth,
James Street, Plymouth, PL4 8AA, UK

