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Reverse of cover page.

The Journal

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Note to our readers: The third part of The Gallenkamp Story will be continued in the summer edition.

Editorial

Welcome

My thanks go to all the contributors to this, the IST Winter Journal 2009. Their articles, letters and musings have contributed to an edition which I feel has a good mix of interesting topics. I would also like to extend a special thanks to Paul Durkin for his endeavour in putting together his very first published article "Noise at the Hop". I really would encourage members and readers to have a go at producing their 'first'.

Well, I'm being told daily by the media that we are in the depths of a recession. They back up this statement excitedly through a variety of colourful graphs, historical statistics, forward looking trends, and of course, the ever increasing public debt figures. It's very worrying for us all, as only a very few are not affected by it. Many companies are finding it hard to stay in business and have to reduce their operations and staff. The public sector is also under severe pressure to cut back, and the HE sector is in the midst of "heavy trimming" to reduce its staff costs. If you want the management speak it goes something like; "we are re-aligning our capability to reflect current needs, whilst also positioning ourselves in preparation for a predicted up-turn". Or perhaps more simply put; "we need to cut back and ride it out"! Government assure us that in a few years time the economy will get back on track, so patience and a long term outlook is what's needed. And that reminds me of a story I read a little while ago.

The story concerned a small local council who at the time were faced with replacing a long stretch of old street lights on their main road. They decided to enlist consultant engineers, who they asked to look at reducing energy and maintenance costs through the use of new technology. The solution offered was to use solid state semiconductor Power LED lighting which, while proving expensive initially, would pay for itself in 5-10 years time based on savings in both energy and maintenance costs. The alternative being standard old lamp technology, which would be cheaper but carried a heavy and likely increasing energy and maintenance cost. The council, in their wisdom, went for the cheap short term option, justifying its decision by virtue that it could only commit its current budget within its term of office, which remained at just over 3 years.

My point is that the long term benefits of applying new technology were lost because of short term thinking. And this I fear is the knee-jerk reaction we are seeing in the present financial climate. Investment and planning in science and technology has to be long term. Let us hope that whoever forms the next government will recognise this as an essential part of our recovery.

However, I don't think we should bank on it (forgive the pun)!

Ian Moulson
Editor

The Valery Chapman Award

Philippa Nobbs

Valery Chapman (nee Cobb) was an extraordinary person. On the surface she was a lab technician in a secondary school in Lincolnshire. Underneath the surface, she recognised a problem and thought of a solution. Then she did something that few of us manage to do. ***She did something about it!***

School lab technicians encounter various, well-documented difficulties when doing their job. Some arise because they work in isolation, some arise from curriculum changes, some arise from teaching staff changes and so the list goes on. While there are local groups of school technicians that meet perhaps once a term, this is not sufficient to provide on-going support. To address this, Valery, working with Dr Peter Robinson at the University of Central Lancashire, set up SCITECH-L, an e-mail discussion list for school and college laboratory technicians. This began to operate in 2000 and immediately became a hit with users. There are currently about 800 registered users, both in the UK and overseas, and it is not unusual to receive 50-60 messages per day, especially when a specific topic touches a nerve. Valery moderated the messages and would 'rap the table' when contributors began to stray from work-related issues. She continued to do this until a few weeks before her death in May this year. The shockwaves that the news of her death set up within the group could be felt physically. Most technicians hadn't met her face-to-face but all appreciated what she had made possible. Many comments were posted in the days after her death and a few extracts are given below:

I was always grateful for her help and wisdom. So very sad to lose her at such a young age. The group made me feel part of an extended family with Val as the matriarch. I will miss her.

I, like so many of us, never actually met Val in person. But she was a friend - a joy to talk to, a great personality, a brilliant communicator and, as she was to so many of us, a great email buddy. Val's role in setting up the Scitech forum was awe-inspiring and truly inspirational.

I now feel very lucky and privileged that I did get to speak to Val when I first joined up; even in a couple of brief conversations, her obvious good humour came out.

Such very sad news about Val. She was very highly regarded and has left a tremendous legacy in SCITECH. Many of us work alone and this group gives us a sense of belonging and is a tremendous resource. There is always someone prepared to help you out especially Val. Although I never met her I shall miss Val's presence on the forum.

I, like many of you, never had the honour to meet Valery, but I feel proud and privileged to have known her as not just a fellow professional colleague but as a friend. Val was an inspiration to us all and will never be forgotten. It was her advice that got me fighting the battle for science technicians locally and nationally. I cannot express how honoured, proud and privileged I feel to have known Valery Chapman.

Val has left us all a great legacy. Scitech is one of my most valuable tools in the prep room, and I would be lost without all of my virtual friends and colleagues. Thank you Val.

What a tremendous legacy Val leaves behind. Just this one aspect of her full life has clearly touched so many of us.

I think each and every one of us would hope that our lives will make a positive difference to others in some way. Val most definitely made a difference to Science Technicians around the country - and the world – in the work she did in inspiring, setting up and supporting this most valuable resource. Long may it continue as her legacy to us all.

Like many other techs out there I owe Val great thanks, but probably my job as well. Without Val's wonderful foresight and perseverance in establishing what has become a community of like-minded individuals who are able to communicate and support each other on a daily basis, I sincerely doubt I would have stayed in this profession. After being thrown in at the deep-end six years ago (lone technician with NO experience), being introduced to this endless fount of information has saved my bacon on many an occasion. Even when actively not participating, reading other peoples queries and concerns enables me to realise that I'm not really on my own - others are out there at just the click of a few buttons.

She was responsible for setting up and running our most valuable CPD resource in the Scitech group and I am sorry I never had the chance to meet her. I for one would be far less competent in my job without having access to this excellent group.

As a way of commemorating Valery's significant contribution to the professional development of school and college technicians, the IST's Prize Fund committee has created 'the Valery Chapman Award' to enable a school or college laboratory technician to attend a conference or training event for the first time. This award will be made annually and is open to subscribers to the SCITECH-L discussion list. Applications are currently being sought for attendance at an event in 2010.

Details about SCITECH-L are available from **www.sciencetechnician.com**

Further information about the Valery Chapman Award is available from **office@istonline.org.uk**

Philippa Nobbs
Education Officer

The assessment of air-cleanliness in cleanrooms and cleanzones using optical particle counters

Tim Sandle

Introduction

In laboratories or pharmaceutical manufacturing where air-cleanliness is important or where protective measures are required to maintain asepsis the use of cleanrooms and cleanzones is commonplace. Cleanzones can refer to laminar airflow (or more accurately unidirectional airflow cabinets). This paper surveys the current standards and testing requirements for clean areas in terms of airborne particle counts and assesses the equipment used to monitor for airborne particles (particle counters). The emphasis is upon the operation and calibration of particle counters. This is a critical step in order to have a sufficient level of confidence in the results obtained.

A clean room (or 'cleanroom') or zone is, simply, a room that is clean. A more specialised meaning is as defined in ISO 14644-1:

- A room with control of particulates and set environmental parameters.
- Construction and use of the room is designed in a manner to minimise the generation and retention of particles.
- The classification is set by the cleanliness of the air.

Laminar flow cabinets are common in many laboratories where activities are undertaken which require minimal risk from contamination. Laminar airflow cabinets are carefully enclosed areas designed to prevent contamination of critical samples, such as biological or semi-conductors. The devices function by air being drawn in through a HEPA (high efficiency particulate air) filter and blown in a very smooth, laminar flow towards the user. The cabinets are usually made of stainless steel with no gaps or joints where spores might collect. Such devices exist in both horizontal and vertical configurations, and there are many different types of cabinets with a variety of airflow patterns and acceptable uses.

Figure 1: Work being undertaken in a laminar airflow cabinet (photograph courtesy of Bio Products Laboratory)

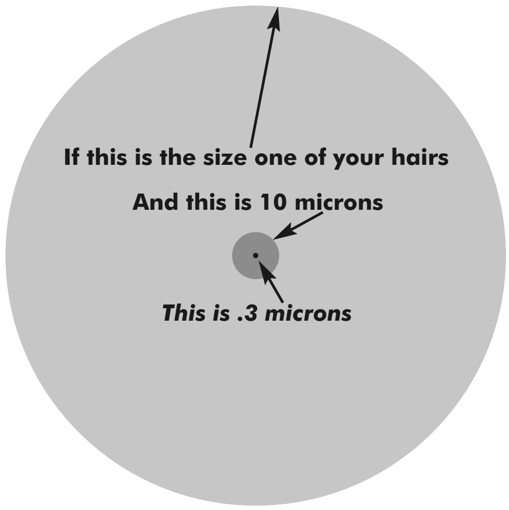
By prescribing a grade or class, the areas are regarded as controlled environments. A controlled environment is:

"Any area in an aseptic process system for which airborne particulate and microorganism levels are controlled to specific levels to the activities conducted within that environment" (Institute of Validation Technology Dictionary).

To give this a different perspective, the ambient air outside in a typical urban environment might contain as many as 35,000,000 particles per cubic meter, 0.5 μm and larger in diameter, corresponding to an ISO 14644-1 cleanroom class of 9.

The measurement of airborne particle counts is a key part of environmental control. Particles are measured using optical particle counters and the regulatory requirement is for two sizes of particle to be counted. These are 0.5 μm (which is close to the size of a micro-organism) and 5.0 μm (which is close to the size of a skin cell, which may carry bacteria). These particles are very small and are not visible to the human eye, as the Figure 2 below indicates:

Figure 2: relative particle sizes



Thus the particles measured may be non-viable or viable, but because of the association with micro-organisms and the assumption that some particles will be micro-organisms designing facilities to minimise the number of particles and then monitoring of particulate levels is an important part of contamination control.

These levels of cleanliness are established through the design and construction of the cleanroom, particularly:

- The air entering a cleanroom from outside is filtered to exclude dust, and the air inside is constantly re-circulated through HEPA filters. This is controlled through a HVAC (Heating, Ventilation and Air Conditioning) system. The most important part of this is with air-filtration through a HEPA (High Efficiency Particulate Air) filter, or higher grade ULPA (Ultra Low Penetration Air) filters.

- Staff enter and leave through airlocks (sometimes including an air shower stage), and wear protective clothing such as hats, face masks, gloves, boots and cover-alls.
- Equipment inside the cleanroom is designed to generate minimal air contamination. There are even specialised mops and buckets. Cleanroom furniture is also designed to produce a low amount of particles and to be easy to clean.
- Common materials such as paper, pencils, and fabrics made from natural fibres are often excluded, however alternatives are available. Low-level cleanrooms are often not sterile (i.e., free of uncontrolled microbes) and more attention is given to airborne particles. As indicated above, particle levels are usually tested using a Laser particle counter.
- Some cleanrooms are kept at a higher air pressure to adjacent (less clean) areas so that if there are any leaks, air leaks out of the chamber instead of unfiltered air coming in.
- Cleanroom HVAC systems also control the humidity to low levels, such that extra precautions are necessary to prevent electrostatic discharges.

Therefore, cleanrooms are designed to minimise and to control contamination. There are many sources of contamination. The atmosphere contains dusts, micro-organisms, condensates, and gases. People, in clean environments, are the greatest contributors to contamination emitting body vapours, dead skin, micro-organisms, skin oils, and so on. Manufacturing processes will produce a range of contaminants. Wherever there is a process which grinds, corrodes, fumes, heats, sprays, turns, etc., particles and fumes are emitted and will contaminate their surroundings. Another key contamination source is water.

In order to ascertain that such areas are functioning correctly they are typically subject to an environmental monitoring programme. Environmental monitoring is a programme which evaluates the cleanliness of the manufacturing environment; the effectiveness of cleaning and disinfection programmes and the operational performance of environmental controls. An important aspect of environmental monitoring is the assessment of the cleanliness of the air. This assessment may include viable counts (which are not covered in this paper) and particle counts (which are generally considered to be 'non-viable', although there is sometimes an association with bacteria carried in the air-stream).

Air cleanliness Standards

In order to assess cleanroom or clean device air cleanliness reference to a recognised standard is required. The most commonly adopted standard is ISO14644, which relates to a series of standards which outline the requirements for cleanroom construction and design. These standards were first issued in 1999. The ISO14644 standard replaced Federal Standard 209 series, which was in place and widely quoted for many years. The Federal Standard defined controlled environments based on the maximum concentration of 0.5 micrometre particles permitted (for example, class 100, class 1000 and so on). This now out-dated terminology is still referred to in several quarters. The ISO14644 standard uses different 'classes' of cleanrooms and this is used internationally, with the exception of Europe, for organisations which fall under Good Manufacturing Practice (GMP) regulations, where 'Grade' (A, B. C and D) remains in use. These standards assess: design, performance and testing criteria.

The tables below attempt to compare the different current (and recently superseded standards) in relation to cleanroom classification. The classification of cleanrooms is explored below.

Comparisons have been divided into two cleanroom operational states. These are static and dynamic (or, 'at rest' and 'operational').

For **static** conditions, these are:
Table 1: Air-cleanliness standards, static state

EU GMP	US 209E	USP <1116>	ISO 14644-1
A	Class 100	M 3.5	5
B	Class 100	M 3.5	5
C	Class 10,000	M 5.5	7
D	Class 100,000	M 6.5	8

For **static** conditions (or 'at rest'), there is a difference between European/ISO and US standards. The EU GMP defines the static state as a room without personnel present, following 15 – 20 minutes 'clean up time', but with equipment operating normally. The US standards indicate that equipment is not running.

For **dynamic** conditions, the equivalences are:
Table 2: Air-cleanliness standards, dynamic state

EU GMP	US 209E	USP <1116>	ISO 14644-1
A	Class 100	M 3.5	5
B	Class 10,000	M 5.5	7
C	Class 100,000	M 6.5	8
D	Not stated	Not stated	9

Dynamic conditions (or 'operational') are typically defined as rooms being used for normal processing activities with personnel present and equipment operating.

Based on the standards, the limits for airborne particles are:
Table 3: Particle count maximal values

Grade	Static				Dynamic			
	C/f³	C/f³	C/m³	C/m³	C/f³	C/f³	C/m³	C/m³
	0.5 μm	5.0 μm	0.5 μm	5.0 μm	0.5 μm	5.0 μm	0.5 μm	5.0 μm
A	100	0	3,500	1	100	0	3, 500	1
B	100	0	3,500	1	10,000	57	350,000	2,000
C	10,000	57	350,000	2,000	100,000	570	3,500,000	20,000
D	100,000	570	3,500,000	20,000	Not defined*	Not defined*	Not defined*	Not defined*

Where C/f³ = Counts per cubic foot
Where C/m³ = Counts per cubic metre

Classification of clean areas

Cleanroom classifications are confirmed by measuring particle counts per cubic metre in the **dynamic state**. ISO 14644-1 details three occupancy states for clean room classification: 'as built', 'static' and 'dynamic'. Of the three states 'dynamic' is more representative of in-use conditions and represents the 'worst case'. For these reasons the dynamic state is the condition of clean rooms selected for classification purposes.

Classification of critical cleanrooms is confirmed in the dynamic state by taking non-viable particulate readings at a defined number of locations for 5.0 μm and 0.5 μm size particles at the following frequencies (as stated in ISO 14644-2):

Table 4: Frequency of cleanroom and cleanzone classification

Grade	Frequency of classification
A	Six-monthly
B	Six-monthly
C	Annually
D	Annually

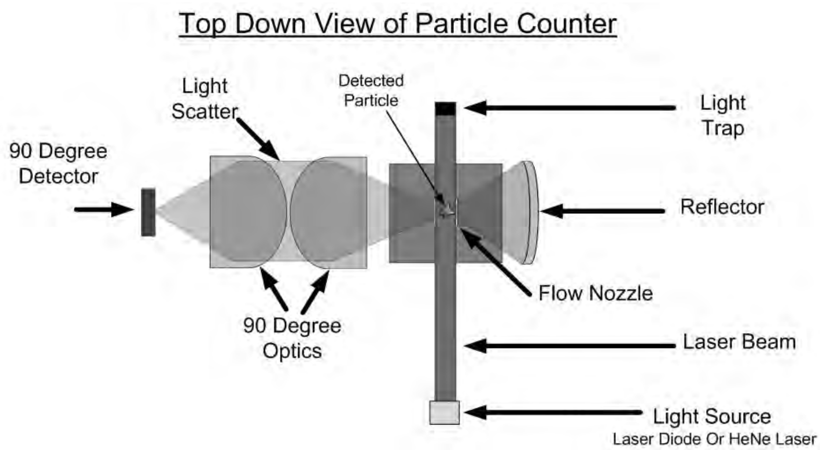
With cleanrooms it is important to define the 'critical' and 'supporting areas'. These terms generally relate to sterile manufacturing. The definitions are important in that the environmental monitoring programme should be biased towards the most critical areas of the manufacturing process. This general philosophy should also apply to non-sterile manufacturing.

Particle counting

There are three methods commonly used for detecting and measuring particles (though many others exist). These are: light blocking, light scattering and the coulter principle:

- The light blocking method is useful for detecting and sizing particles greater than 1 micrometre in size and is based upon the amount of light a particle blocks when passing through the detection area of the particle counter.
- The light scattering method is used for detecting and sizing particles from 0.05 micrometres and larger. This technique is based upon the amount of light that is redirected by a particle passing through the detection area of the particle counter. This redirection is referred to as light scattering.
- The Coulter Principle (Electrical Sensing Zone Method) has become the accepted 'Reference Method' throughout the world for particle size analysis and is the recommended limit test for particulate matter in large-volume parenteral solutions. The Coulter method of sizing and counting particles is based on measurable changes in electrical resistance produced by nonconductive particles suspended in an electrolyte.

A diagram of a standard optical particle counter is displayed in Figure 3 below.
Figure 3: Diagrammatic representation of an optical particle counter



The counting rate capability of particle counters is limited by physical coincidence for the specific instrument; and by the maximum counting rate capability of the electronic counting circuitry. Coincidence is defined as the probability that more than one particle will be present in the sensing zone at any time. The coincidence error is a statistical function of the concentration and the sensing zone volume. The saturation level, or maximum counting rate of the electronic counting circuitry, will be specified by the manufacturer and should always be higher than the particle counting rate at the specified maximum concentration.

Particle counter manufacturers generally specify sensitivity and counting efficiency on the basis of ideal test particles that are transparent and spherical. Most often, polystyrene latex (PSL) spheres, with a refractive index of about 1.59, are used for testing. In the particle counting industry there is a tendency to emphasize PSL sphere sensitivity and skirt the issue of OPC sizing accuracy and sensitivity with particles found in the real world. Unfortunately, real world particles come in a wide variety of shapes and refractive indices, leading to a significant degradation of sensitivity, resolution and accuracy. Sizing real world particles is an inexact science, and this impacts upon what can be achieved when calibrating the instruments.

The most commonly used particle counters are optical counters. The great advantage is that they are so-called 'real time' instruments, that they can indicate the presence of particles above 0.05 μm in diameter for each minute per volume of air-sampled. In addition to laboratory and manufacturing clean devices where asepsis is important, particle counters are also used by:

- Environmental Engineers to measure size distribution of particulate pollutants in the ambient atmosphere, in exhausts of industrial devices such as smelters, coal combustors, automobiles. They are also used for measuring efficiencies of particle control equipment, and can be used to calibrate other instruments.
- Industrial Hygienists to sample particles in occupational environments.
- Pharmaceutists to size and classify their powdered drugs.

It is important that particle counters are maintained and calibrated on a regular basis so that the user can have confidence in the accuracy of the results. Particle counters are calibrated using monodisperse polystyrene latex spheres[1] in deionised water. Particle standards of a known size are introduced into the particle counter and their voltage response (pulse heights) measured. In order to be acceptable, their pulse heights must fall within certain Software Selectable Threshold (SST) ranges that have been pre-established by the manufacturer of the particle counter. Calibration curves are then established based on a series of standards and their resulting SST values. The sizing of particles in unknown samples is determined by this calibration. The calibration curves intersect each of the calibration points so there is high accuracy at the chosen calibration sizes. The calibration response between points for most particle counters will be linear or exponential functions depending on which produces the best fit. The most difficult step is in establishing the lower counting limit at the given flow rate.

Other factors assessed when verifying particle counters include instrument parameters such as sizing and counting accuracy, flow rate stability, sizing resolution, environmental ranges, and calibration intervals. Particle counter operation standards discuss the procedures for operation within the cleanroom to minimize errors in sampling, counting, and sizing. The calibration requires specialised equipment which most laboratories do not possess. Therefore this requires particle counters to be calibrated by the manufacturer using specialised equipment.

[1] These are manufactured by fabricating the colloidal crystallization of aqueous emulsion droplets in a suspension system similar to a suspension polymerization system

Figure 4: Manufacturing clean air device (photograph courtesy of Bio Products Laboratory)

The most commonly used standard for the calibration of particle counters is:

- IES (1995): Recommended Practice for Calibration of Particle Counters. IES-RP-CC-014, 1995.This practice establishes definitions and procedures for calibrating single particle counting devices used in cleanrooms and discusses instrument specifications.

The document covers procedures for determining sizing and counting accuracy, particle counter sampling flow rate, and sizing resolution.

Conclusion

This paper has provided an overview of cleanrooms and cleanzones, focusing on the key aspect of maintaining cleanliness: the level of air-borne particles. The primary way to assess airborne particles is through the use of particle counters. Thus the assessment of particles and the use of particle counters are an important feature of maintaining contamination control whether that is a manufacturing process cleanroom or a laboratory laminar airflow cabinet.

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The History of Practical Surgical Workshops

Hands On and Skills Based Training in Medical Education

J.E.Ramcharan

Introduction

The training of surgeons before WW1 and WW2 was based on the apprenticeship system of education. This existed right through the period of the Association of Surgeons and the formation of the College of Surgeons, and then after a Royal charter, the Royal College of Surgeons. This system meant that the bulk of training was based on learning by experience, spending time as an apprentice to a senior and experienced surgical practitioner (Consultant Surgeon).

In the twentieth century and with the advent of the NHS, the development of clinical medicine and medical and surgical technology education for surgeons was via an academic degree (MBBS / MB/BCh), or also through the conjoint qualification of examinations leading to the membership of the RCS (MRCS) and Licentiateship of the College of Physicians (LRCP).The FRCS (Fellow of the Royal College of Surgeons) was always a postgraduate diploma (c.f. FIScT). In the late twentieth century after the Calman report on specialist training in 1993, and the earlier Flowers report on Postgraduate medical education, there was a consensus of opinion expressed by the Royal Colleges, that in the first two years of surgical training, there should be a concentration of core knowledge and basic skills, after which for the next five or six years, specialist training and exposure to research were to take priority[i]. There was a feeling also that those surgeons in training were already graduates and were capable of reading and studying by themselves and so did not need theoretical training and lectures. This suited the hospital reorganisation programme of the Conservative government under Margaret Thatcher[ii]. The perceived bad management in the NHS was used as a reason to sort out bureaucratic problems that were being experienced and was put forward originally by Roy Jenkins who, with Shirley Williams and David Owen, left the Labour party to form the new Social Democratic Party, which was later absorbed by the Liberal Party. Klein[ii], also claimed that Margaret Thatcher had created what he called an expansion in "managerialism". Some thought that from a Marxist viewpoint, all of this was about cutting costs and saving money and cutting the posts of lecturers in the teaching of surgeons.

The rest of this paper shows the chronological order of the development of practical surgical training, sometimes referred to as "Hands on Training" and shows how the first workshops starting with the first "anastomosis workshop" as it occurred at the Royal College of Surgeons of England. However, there was other training and development in the UK and overseas through other courses including the role played by the Armed Forces in courses like the ATLS course and other various practical workshops and tutorials. There was a need for training in all aspects of surgery, not only in anatomy but also in all surgical techniques. This paper therefore concentrates on the technique of "anastomosis" (The" joining together" of intestines, blood vessels, etc.). These workshops are listed in chronological order and the details are taken from files kept by the retiring Technical Services Manager of the Raven Department of Education, previously the Laboratory Manager and Principal Scientific Officer of the Hunterian Institute and previous to that, Senior Chief of the Department of Applied Physiology and Surgical Sciences. The author organised with Professor David Taylor and Professor Peter Bevan of Birmingham the first ever 'anastomosis workshop'.

Surgical training and practical workshops at the Royal College of Surgeons of England

The Microsurgical Workshop (1976)

The very first surgical workshop was a microsurgical workshop and was organised by the author (technical only) and Professor David Slome in 1976. Professor Slome was a keen (some say the best ever) teacher of Physiology. The surgeon who did most of the teaching was Earl Owen, FRCS from Australia. Also involved in the organisation and sponsorship was Sir Ian Capperauld of Ethicon Ltd and (J&J), a suture making company in Edinburgh. The support staff consisted of: administration – Wilfred Webber, technical—Jai Ramcharan, animal care –Peter Naylor and Margaret Jacques, AV—Ron Judd. The model used was the live rat, and each student had to apply for and gain a home office licence under the 'Cruelty to Animals Act'. The Home Office Inspector was present at the start of the course and towards the end of the course. There were twenty students on the course which was comprised of tutorials and practical sessions. The practical sessions were the anastomosis of the rat aorta (vascular) and the nerve repair of the rat femoral nerve. Professor David Taylor who succeeded Professor Slome was a keen hands-on scientist who had many hours of experience at Brunel University. He also was a Lieutenant in the TA (on reaching retirement he had risen to the rank of Brigadier). His love was anything practical but he was not, in my opinion, as good a teacher of Physiology as Professor Slome.

The anastomosis workshop, (1980)

The word "anastomosis" means joining together and thus vascular anastomosis is the joining together of blood vessels whilst intestinal anstomosis is the joining together of 'bits' of intestine.

Professor Bevan from Birmingham was keen on practical surgical teaching and initiated the first anastomosis workshop which took place in 1980. He became vice-president of the RCS in 1981 (1981-1983), and also initiated the Overseas Doctors Training Scheme (ODTS) in 1981[i]. The supporting company was once again Ethicon Ltd., and in attendance was Ian Capperauld. The first anastomosis workshop comprised the anastomosis of the small intestine, oesophageal, colon and rectum, vascular and anastomosis in an aneurysm, ureteric and biliary anastomosis. The supporting surgeons consisted of: Intestinal Anastomosis—Professor Bevan and Harold Ellis, Oesophageal—Jackson and Kirk, Colo-rectal—James Thompson (St. Marks) and Peter Lee, Vascular – H. Eastcott and Roger Greenhalgh, Biliary—Gallagher and Kirk, Ureteric—Peter Thompson (Dartford).

The technical support staff consisted of: Jai Ramcharan – coordinator, Brian Eaton, Margaret Jacques, June Baranowski, and in the preparation of tissues, Brian Eaton and John Mew. The intestinal anastomosis was of the small bowel and served as the first and introductory session. The second day was usually: a.m.—biliary anastomosis and p.m.- ureteric anstomosis. The third day was the longest and hardest for both students and staff and this was devoted to techniques in colo-rectal anstomosis. The afternoon session taught stapling of the bowel. The last day was Friday and was used to teach vascular anstomosis. The afternoon session was devoted to teaching how to deal with an aneurysm surgically and the use of synthetic aorta material was used to replace the 'damaged' aorta which was taken out. For the first ever anastomosis workshop the technical coordinator was Jai Ramcharan. The surgical coordinator was Joan Whammond and the animal material was prepared by the late Brian Eaton who was ably assisted by John Mew.

Before the first workshop a lecture was given on the 'History of Anastomosis' initially by Harold Ellis of Westminster hospital, and subsequently by RM (Jerry) Kirk (Royal Free Hospital). A permanent slot was suitably found before the evening dinner for this lecture, with a video entitled 'Not the Anastomosis Workshop' themed on 'Not the Nine O' clock News' comedy programme shown after dinner. The number of students attending each session was twenty. After the first two workshops held at the Buckstone Browne research Establishment in Kent, it was transferred to Lincoln's Inn Fields because of easier access for students and some tutors. Soon after a 'post mortem' meeting was held to find out problems and look for the way forward. Chaired by Harold Ellis, a secretary was appointed (Jai Ramcharan) with Ethicon Ltd always invited to attend. Changes in sutures and technical advancement were discussed as well as how useful the students were finding the course. Some tutors had observed too that there was a lack in basic principles. For example students were tying granny knots instead of reef knots, and some seemed not to know how to sew!

This corrective plan was in effect to start a new course, called "Basic Surgical Techniques" and this was succeeded by a pilot of the first "Basic Surgical Skills workshop". The first of both these workshops were held in Hull and the surgeons were Peter Lee and Jerry Kirk (whose idea it was originally) with some input from Professor Monson and some local surgeons. The first official Basic Surgical Skills course however, was held in London at the RCS and organised by W Thomas, FRCS (currently vice–president of the RCS). Professor Bevan with David Taylor in 1986 planned and carried out a replica of the workshop above for the first overseas anastomosis workshop which was held in Uganda. Since then, overseas workshops have been held on all of the continents.

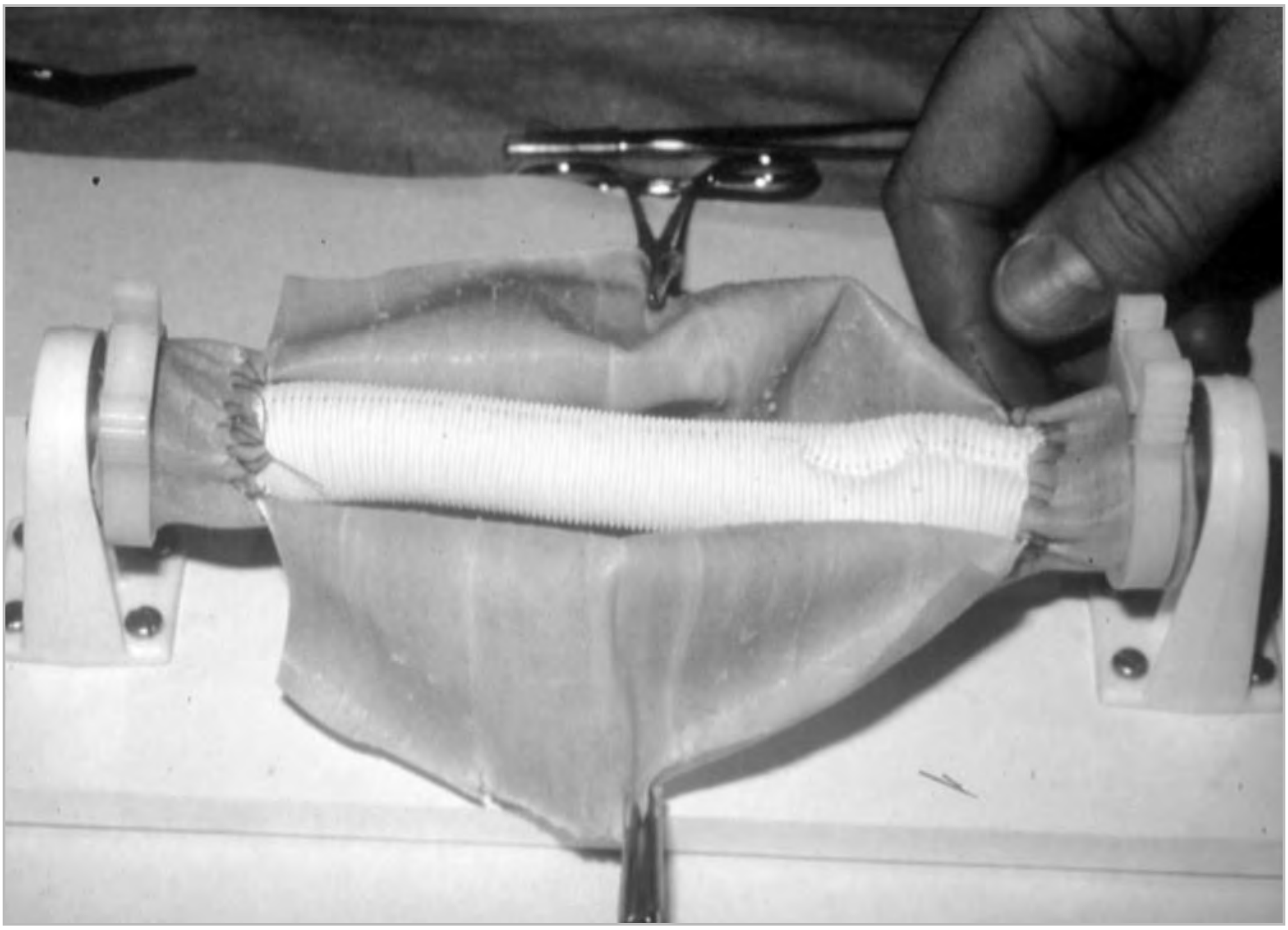

Figure 1 Aneurysm mould

Discussion and Conclusion

In the first ever workshop in 1976 (microsurgical), the model used was the live rat and so the first time simulators and simulated material was used was in 1980 when Bevan and Taylor ran the first ever anasromosis workshop in 1980. A simulator to do the small intestine anstomosis was used, one designed for vascular and aneurysm work was also used (See Fig showing aneurysm mould).

For the colo-rectal anastomosis a simulator of the pelvic area (often referred to as the 'pudding bowl') was used. This was designed by Bevan and Taylor. However simulators were used in medical training before, in the form of cadaveric (human dead bodies) material in the teaching of Anatomy and the "ResusciAnne" in the teaching of First Aid by the Red Cross and the St. John's ambulance service. Because of the emotive issues surrounding the British public in regard to the love of animals, the press and media concentrated on the issues around the rights of the animal and especially in relation to how old the 'Cruelty to Animals' Act was and this act has been replaced by the Scientific Procedures Act. The use of human cadavers and body parts was mentioned in the media on occasions especially from the ethical viewpoint but to my knowledge nothing else has changed.

It must be mentioned that in my experience, students and tutors alike, prefer to use animal tissues and whole animals since the real problems like those associated with haemostasis (bleeding) are not always replicated in plastic models. Some companies have started to make simulated blood vessels in the models used, but this becomes extremely expensive. In the same way, laparoscopic surgery (keyhole) has been using simulated material from the start of its training courses and now too, computer modelling is also used.

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The Transformation of Brewing

An Overview of Three Centuries of Science and Practice

Ray Anderson

At the dawn of the 18th century brewing was still largely a domestic or small-scale commercial activity supplying an essential element of diet and solace to an agrarian population. Three centuries later it is an industry increasingly dominated by a few large companies striving for global supremacy in the supply of branded recreational alcoholic beverages. This paper outlines the part played by science and technology in these changes.

18th Century

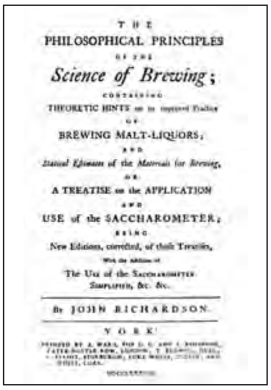
Perhaps the best claimant to be the founding father of fermentation science is Georg Ernst Stahl, a German chemist and Prussian court physician, who in 1697 published a book entitled *"Zymotechnica Fundamentalis"* - "Fundamentals of Fermentation Technology".

George Ernst Stahl (1680-1734)

In his book, Stahl takes fermentation out of the realms of magic, where it had been placed by the alchemists, and into the world of chemistry. He regards fermentation as being associated with chemical recombination and hence capable of analysis. His purely inanimate theory of the process is wide of the mark, but his book is important as arguably the first recorded attempt at an interface between science and brewing technology. Stahl was well aware of the economic importance of the craft of brewing in Germany and specifically set out to seek a chemical interpretation of the process[1]. In the event, there is no evidence that Stahl's book had any impact on practical German brewers at the time. Originally published in Latin, a German translation did not appear until 1734 by which time the industrialisation of brewing had begun in earnest elsewhere.

The growth in population of Europe's cities was to prompt step changes in the scale of operation of breweries. London, capital of the first industrialised nation and the world's biggest and fastest growing city provides the earliest example of this phenomenon. Even at the beginning of the 18th century beer production in London was dominated by 'common brewers' who distributed beer to a number of public houses, many either owned or otherwise tied to them. Output from this source exceeded that of 'brewing victuallers', who brewed only for sale in their own taverns by a factor of over 100:1. In the country as a whole the output ratio at the time was 1:1. By 1750 the average annual output of London's top five common brewers was an impressive 50,000 barrels; by 1799 it was 150,000 barrels[2]. The breweries of Thrale/Barclay Perkins, Whitbread, Truman, Meux and Calvert were wonders of Georgian England. The product of these mammoth breweries, which far outstripped in size any others elsewhere, was a vinous, bitter tasting inexpensive brown beer commonly known as porter.

Mass-produced porter arrived on the scene prior to mechanisation of brewing; man and horsepower achieved large-scale output two generations before mechanisation eased the burden. When Whitbread's became the second London brewery to install a steam engine in 1785, they were close to producing 200,000 barrels per annum of beer. Nonetheless, when it became available, the larger brewers were quick to make use of efficient steam power, purchasing the new improved engines of Boulton & Watt and others. When Charles Barclay, one of the partners of Barclay Perkins, referred to himself and his London brewer colleagues as "the power-loom brewers", it was more than a figure of speech[3]. It has been estimated that at least twenty-six steam engines were installed in breweries by the end of the 18th century, with use spreading to relatively small regional breweries thereafter[4].



THE
PHILOSOPHICAL PRINCIPLES
OF THE
Science of Brewing;
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OR
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AND
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New Editions, [illegible]
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By JOHN RICHARDSON.
YORK:
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Title page from John Richardson's 1788 book on brewing

The first record of in-process quantitative measurement in brewing operations is the use of the thermometer by the London ale brewer Michael Combrune in the 1750s. Combrune experimented with the drying temperatures required to give malts of different colours and recorded observations on mashing and fermentation temperatures. A big step forward came in the 1780s when John Richardson, a Hull brewer, introduced his saccharometer for the measurement of the of wort strength[5]. For the first time the relative value and efficiency of use of extract yielding materials could be quantitatively assessed with consequent economic benefit to the brewer[6]. By 1800 many of the larger common brewers had adopted the instruments which were promoted in treatises on brewing science and practice. From the writings of Richardson and his contemporaries[7,8] which recorded original and sometimes present gravities, a rough calculation of the alcoholic strength of beers at the turn of the 18th century is possible. The data show wide variations but tend towards the following approximate bands for percent alcohol by volume: strong ale 9-10%, porter 6-7%, common ale 5-7% and small/table beer 1-4%.

19th Century

Significant features of the 19th century were the growing output of breweries, the switch away from crude dark heavy beers to more delicate and more difficult to produce styles, and the advent of all year round brewing. All these encouraged, and were to an extent mediated by, the application of science in brewing.

The rise of lager in Europe and the USA, and of pale ales in the UK, prompted brewers to gain a greater understanding of their processes. In 1843, within a year of the production of the world's first pale lager in Pilsen, Carl Balling in Prague introduced his own version of the saccharometer. The instrument was quickly adopted in central Europe as were the teachings of Balling's seminal work on fermentation chemistry first published in 1845 which went to three editions by 1865[9]. Two other influential figures in spreading the word on the benefits of "scientific brewing" from the 1840s were Gabriel

Sedlmayr jnr of the Spaten brewery in Munich and Anton Dreher of Vienna[10]. The promotion of technical education in brewing followed. Brewing courses began at Weihenstephan in 1865 with eight students taught by Carl Lintner[11]. In the USA John Ewald Siebel, a German immigrant founded a laboratory in Chicago in 1868, which became the Zymotechnic Institute in 1872, and began a school for brewers in 1882. Similar institutions appeared at this time in Austria and Switzerland. The most impressive of all was the Research and Teaching Institute for Brewing (VLB) established in Berlin in 1883 under Max Delbrück. At the German brewing congress a year later Delbrück clearly announced his intentions[1] "With the sword of Science and the armour of practice German beer will encircle the world" he proudly told the audience. By then Germany was already the world's largest producer of beer having overtaken the UK. In Britain education was on a more *ad hoc* basis with prospective brewers being taken on as pupils and receiving on the job tuition; a system which survived until well after the Second World War. There was no brewing school in England until 1900, when largely through the financial support of a local brewer William Waters Butler, classes started at the newly formed University of Birmingham. Brewing tuition started at Heriot-Watt College in Edinburgh in 1904[12].

Max Delbrück (1850-1919)

Hansen's Pure Yeast Culture

Trade/technical journals and societies proliferated from the 1860s with Germany again leading the way[13]. The *Allgemeine Brauer- und Hopfen-Zeitung* (known today as *Brauwelt*) was founded in 1861 at Roth near Nuremburg. Carl Lintner's journal *Bayerische Bierbrauer* came out in 1866. In the UK, the *Brewers' Journal* appeared in 1865 and the *Brewers' Guardian* in 1871; the *Transactions of the Laboratory Club,* which became The *Journal of the Institute of Brewing,* was first issued in 1886. In 1882 The *Australian Brewers Journal* was launched and The Master Brewers Association of America was formed in 1887.

Until Louis Pasteur carried out his investigations on wine and beer fermentations in the 1860s and 1870s and showed the importance of eliminating deleterious bacteria, there was little useful known about the microbiology of brewing. Even the identity of yeast remained in dispute, despite convincing evidence that it was a living organism having been produced by three independent observers in the 1830s[14]. Curiously, although Pasteur's work on beer was carried out with the declared aim of redressing the balance in France's favour against the clearly superior German brewing industry, German breweries were amongst the first to employ heating of beer, i.e. pasteurisation, in order to preserve it[15].

Hansen's Pure Yeast Culture Apparatus 1883

Pasteur claimed the treatment as too severe for beer and did not recommend it in his famous book *Etudes sur la Bier* published in 1876. Rather, Pasteur devised a system of brewing which prevented ingress of bacteria in the first place, but his procedure found few users until closed fermenters became the norm in the second half of the 20th century. Emil Christian Hansen on the other hand soon found his ideas finding application after he introduced the concept and the technology for achieving pure yeast culture at Carlsberg in 1883. Within ten years Hansen's yeast propagation plants had been installed in 173 breweries in 23 different countries[16].

By then, Alfred Jorgensen was supplying some 65 other breweries with pure yeast from his laboratory in Copenhagen. The experimental station at Nuremberg was providing a similar service to 100 or so small German breweries and the Wahl-Henius Institute was servicing more than 60 breweries in the USA. In contrast to this example of rapid 19th century technology transfer, for a variety of reasons few UK brewers adopted pure culture methods. Certainly a single yeast strain was incapable of producing English stock ale, but the technique was readily applicable to the production of running beers[17]. Not until the 1960s would pure yeast culture begin to find wide application in the UK.

The brewhouse saw significant changes during the 19th century. Use of mashing rakes powered by horses and then steam were the norm by 1800 in large breweries. By then the old technique of multiple extraction of a batch of malt to produce worts of decreasing strength and then fermenting them separately to produce different beers had largely been superseded. Worts were now blended prior to fermentation in order to produce a single beer or range of beers (parti-gyle). After 1800 the technique of 'sparging' was increasingly introduced. This procedure, which seems to have originated in Scotland, was universal by the 1870s. James Steel introduced his external mashing machine to give efficient mixing of ground malt with water on entry to the mash tun in 1853 and it and devices like it soon found favour. Cast iron, which was seen as "clean and lasting" became the material of choice for the mash tun itself, taking over from oak. Copper also had its supporters but was usually ruled out on cost grounds. By the end of the century, the tower design which was entirely reliant on gravity for flow of liquids through the brewery, and only really worked well and easily in small breweries, had matured into the 'semi-gravitational' system. In the latter procedure wort is pumped once from the hop-back to the open cooler placed sufficiently high to command the water cooled "refrigerators" and fermenting tuns.

From the 1870s, following the work of Carl Linde in Germany, the increasing availability of efficient ammonia refrigeration machines freed lager brewers from the need for natural ice. Cold transport of beer became easier and lager and ale brewers alike adopted all year round brewing. Refrigeration was initially used to produce ice but was soon applied to direct cooling via expansion coils. In the USA use of high levels of adjunct coupled with the development of an accelerated brewing process where storage time was minimised and filtration used for clarification, led to the development of unique very pale coloured beers of unrivalled blandness. In the UK, Gladstone's "Free Mash Tun" act of 1880, which transferred tax from malt to beer allowed brewers to use any sources of extract they pleased. Soon the trade press was full of engravings of rather frightening "raw grain mashers" for processing maize and rice. In the event, brewers tended to buy liquid sugar, or cereals already converted into more manageable flakes or grits, rather than process the material themselves. Soon adjunct usage was heading towards 20% of the grist, even though the two biggest brewers, Guinness and Bass, eschewed their use. This prompted a campaign for "pure

Raw Grain Masher 1882

beer", i.e malt only beer, which was orchestrated by the barley growers and the maltsters who raged against the use of "adulterants". In fact the use of true adulterants had been in retreat since the beginning of the century when such abuses had reached a peak at the time of the Napoleonic Wars and consequent high malt taxes. Gone were the days when such ingredients as "Grains of Paradise" and "Cocculus Indicus" which "poisons fish and stupefies man" would find their way into beer.

Bottling of beer, although probably started in earnest in the early 1700s, was of little importance until the 1860s. Bottles were originally corked; internal screw stoppers were patented in 1872, swing stoppers in 1875 and crown corks in 1892[18]. Hand bottling was the only option until the 1880s when bottling machinery was introduced prompting a surge of interest. Lighter beers were produced specially for bottling using proportions of sugar and unmalted cereals. These adjunct beers tended to stay bright longer than all-malt beers. Narrow mouthed bottles were patented in 1886. Multiple head fillers appeared in 1899 and fully automatic rotary fillers in 1903. 'Naturally conditioned' bottled beer, packaged with a proportion of yeast and fermentable matter still present allowing continued limited fermentation which generated carbon dioxide and gave it sparkle, remained the most usual product in many countries well into the 20th century. Gradually however it lost ground to 'non- deposit' bottled beer which was filtered and artificially carbonated using techniques introduced from the US, where this type of beer was the norm by the 1890s. Bottled beer is estimated as having taken 20 percent of the US market by 1900 and ten years later one third of the beer sold in North Germany was bottled.

Appreciation of the importance of analytical data was a feature of the growing, if sometimes grudging, acceptance of the utility of scientific understanding in brewing in the 19th century. By the 1880s various levels of sophistication in chemical and microbiological analysis could be identified in UK breweries[19]. At a minimum, measurement of specific gravities was required for Excise purposes and thorough visual inspection of raw materials, casks etc was considered essential. A step up from this was the provision of a bench or table in the brewers' room to accommodate a microscope for checking yeast purity and perhaps an assortment of glassware for simple testing of water and malt. In some breweries analyses by brewers who had received training in chemical/microbiological techniques as part of their pupilage extended far beyond this to more extensive testing of water, malt, hops, wort, sugars and beer in relatively well equipped laboratories. Indeed a small laboratory attached to the brewer's office became a regular feature of the plans for new breweries which sprung up in the UK during the building boom of the 1880s and '90s[20]. Alfred Barnard in his travels around the UK's breweries in the late 1880s visited a total of 111 breweries and five maltings. He recorded a separate decently equipped laboratory room or rooms in no fewer than 36 of them, with a further 21 having at least a bench in the brewer's office containing typically a microscope, simple glassware and perhaps a forcing tray and colorimeter[21].

Specialist analytical chemists were engaged by only a handful of the largest breweries in the 19th century. The first brewery to appoint a qualified chemist in Britain (and perhaps the world) was the London firm of Truman, Hanbury and Buxton in 1831. This was Robert Warington, destined to become the first secretary of the newly formed Chemical Society ten years later.

A group of talented scientists led by Cornelius O'Sullivan at Bass, Horace Brown at Worthington, Horace's half-brother Adrian at Salts and Peter Griess at Allsopps advanced the cause of brewing science in Burton upon Trent from the 1860s to the turn of the century14. The Edinburgh brewer William Younger had a full time chemist, John Ford, by 1889. These men and a handful of contemporaries took a full part in the mainstream science of the day, contributed presentations to learned societies and published in scholarly journals. Analysts drawn into the brewing industry in the 19th century had predominantly received their scientific education in London or Germany, but with the establishment of specialist brewing schools in Birmingham and Edinburgh, recruitment from these sources and the new red-brick universities became common in the 20th century. Guinness looked to a somewhat higher stratum of society when they started employing chemists from 1893. Consistent with its standing as the world's biggest and most prestigious brewer, the company's early chemists were Oxbridge graduates who not only had firsts but were also blues[22].

Alfred Chaston Chapman (1870-1932)

The great majority of 19th century UK brewing companies, whether or not they maintained a laboratory for their brewer, relied upon consulting chemists for expert analytical services and advice, particularly in times of difficulty. There were over a dozen specialists operating from London by the 1880s with others in the provinces. Major figures included Edward Ralph Moritz, Alfred Chaston Chapman, John Heron and Lawrence Briant. These men built up considerable reputations and made a decent living from their practices which continued to thrive well into the 20th century. Chaston Chapman, a great self publicist who was elected a Fellow of the Royal Society in 1920, occupied a whole building in Aldgate. Outside the UK brewers sought to meet their analytical requirements in a variety of ways. In Germany, specialist brewing testing and experimental stations attached to higher education establishments at Weihenstephan, Berlin, Nuremberg and elsewhere provided analytical services, and few breweries employed specialist analysts. The USA followed the mixed English model, although German immigrants largely ran the industry. The Danish born Max Henius and the American Robert Wahl established a consultancy in Chicago in 1884 and consulting chemists operated in New York and elsewhere. Ahheuser-Busch claim to have started the first brewery research laboratory in the US in the 1870s[23]. The Pabst brewery in Milwaukee appointed a German Ph.D., Otto Mittenzurly, to their staff in 1886. Carlsberg, with the microbiologist Hansen and the chemist Johan Kjeldahl, established what was to become a world famous laboratory in Copenhagen in 1876. Their Danish rivals Tuborg followed suit on a somewhat less grand scale.

Emil Christian Hansen 1897

20th Century

Practicing brewers have always been more interested in technology than in science and innovations of obvious practical utility were eagerly adopted as the new century dawned. For example, the improved Seck mill introduced in 1902 which had three or even four pairs of rollers was an immediate success. Richard Seligman's counter current plate heat exchanger (the 'paraflow', originally used for milk and then adapted for use with beer) also met with wide acceptance within a few years of being patented in 1923. Other developments were more consumer driven. The habit in the USA of putting beer in the 'ice-box' prompted Leo Wallerstein to patent the use of proteolytic enzymes to prevent chill haze in 1911[24]. Even so, radical technological change was only attempted by the most adventurous brewers in the UK who experimented with mash filters, new designs of fermenters and metal beer containers. In general, faced with a stagnant market, the UK brewing industry cut a poor figure in the first half of the 20th century. Hidebound boards of directors presided over decaying breweries with ageing plant turning out dull beer which deteriorated quickly in poorly run pubs.

Investment in scientific research in brewing has never been high, even in the context of the relatively low spending food industry. Until after the Second World War expenditure was vanishingly small in most countries as recession took hold and nervous management retrenched. In the UK the brewing industry was spending an estimated 0.003 percent of its turnover on research in the late 1930s - a figure lower by a factor of three than any other industry surveyed[25]. Raw materials were the primary targets for the limited research effort of this period, the brewing process itself receiving little attention. Breeding of improved hop and barley varieties began in the early years of the century, starting a trend which would lead to hops containing much higher levels of bittering power and barleys which combined high extract and good agronomic properties. New barley varieties became generally available in the 1920s and studies on the chemistry of hops revealed the basic structure of alpha acids in the same decade. Unraveling isomerisation and the consequent release of bittering power during wort boiling had to wait until the 1950s.

In the 1930s chemical and microbiological analytical techniques were extended and improved as the rise in sales of bottled beer required more attention to be paid to aspects of beer flavour, shelf-life and appearance (clarity, foam and sparkle). Analysis thus became increasingly a tool in seeking competitive advantage in the marketplace, complementing its long-standing role as a guide to production integrity and efficiency. But science only impinged on the periphery of the average brewer's vision. The brewers' chemist of the '30s held a relatively lowly place in the hierarchy, ranked around the level of the second brewer to judge from his remuneration, with a status similar to that of the head bookkeeper. As one insider was to note[26] rather sourly: '…brewers employed a chemist in an obscure laboratory as a sort of scientific chaplain in an otherwise unscientific industry..'. Certainly, excluding the special circumstances of those employed in the Carlsberg Laboratory, the days had gone when the brewers' chemist could make a contribution to mainstream science as had been the case with Cornelius O'Sullivan, Horace Brown et al. Indeed the community of scientists in the brewing industry became increasingly inward looking and took no part in the wider world of their disciplines. This insularity was to persist. Even in their heyday in the third quarter of the 20th century, scientists employed in breweries were rarely to be found publishing in journals, or participating in meetings and conferences, other than those specifically related to brewing.

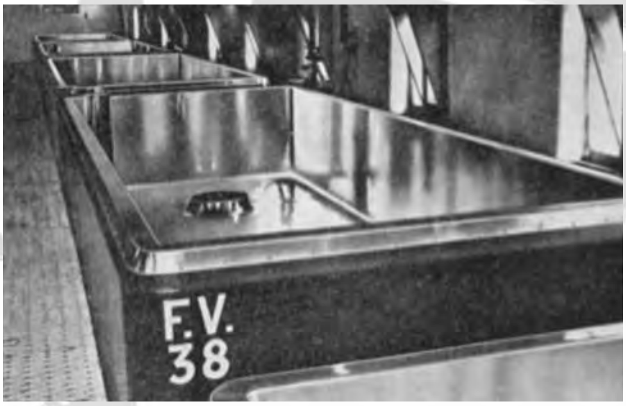
Although women were closely associated with domestic and publican brewing (hence the term brewster) they have been much less prominent in industrial brewing. Indeed some have argued that women became excluded from brewing once it became a viable commercial activity. Certainly, the laboratory was one of the first areas where women reached parity with men during the 20th century. Women provided much of the labour in bottling stores from the 1870s, were employed in clerical roles and as 'typewriters' from the 1880s, and worked as technicians in laboratories from the 1920s. After World War II, more responsible roles in laboratories, marketing, information science, finance, and eventually as brewers followed. But industrial brewing has remained essentially a male preserve at the highest levels. Few women have become directors of brewing companies.

From the late 1940s investment in scientific research into the brewing process was increased to unprecedented, if still modest levels. In the UK the Brewing Industry Research Foundation (BIRF), paid for by a barrelage-based levy of the British brewers, was officially opened at Nutfield in Surrey in 1951[27]. The first director Sir Ian Heilbron FRS, a prominent organic chemist from Imperial College, had firm views on what the Foundation should be about. In an early paper[28] outlining his aims for the new venture he noted that it would be 'A scientific headquarters furthering the application of science to the solution of tactical problems and to the strategic development of the industry'. He saw these activities as 'complementary and in no way conflicting' and stated that 'the engagement in fundamental research is a duty, not a luxury which the industry can permit itself'. In the first 25 years of its existence the staff of, at its peak, over 100 scientists and support staff at BIRF published over 700 original papers.

The post-war enthusiasm for science touched breweries in most countries, with specialist laboratories and pilot plant facilities established or extended in universities and technical institutes and by major brewers in the 1950s and 1960s. Detailed understanding of the chemistry, biochemistry and microbiology of malting and brewing followed. By the end of the 1970s highlights included knowledge of the enzymology of barley germination and mash conversion, the chemical structure of hop components and the mechanism of formation of major beer flavour compounds including diacetyl, esters, higher alcohols, and the prime determinant of the flavour of German helles lager, dimethyl sulphide.

In the first half of the 20th century beer output declined, although individual breweries and maltings continued to prosper. As early as 1907 there were reports[29] of fermenting rounds with capacities as high as 1000 barrels. But this seems to have been an exceptional development and generally, even in the most successful breweries, there was little increase in batch or vessel size. After the Second World War, the use of stainless steel, greater chemical, physical and biochemical knowledge, better analytical control, increased availability of process aids (plant growth regulators, enzymes, coagulants etc) and then automated computer controlled plant, led to step changes. Malting and brewing technology was transformed by new developments from both inside and outside the industry, or in some cases by adoption of techniques that had their origin many years earlier but had been held back by prevailing attitudes and difficulties of construction and operation[30].

Until the 1950s floor malting was the most usual procedure in many countries, with grain after steeping spread on a solid floor, kept cool during germination by hand turning with a shovel and dried in a kiln directly fired by coal or coke. This labour intensive system was largely replaced in the next 30 years. Maltings became mechanised, access to air was given during steeping, drums and then perforated rotating floors were adopted for germination. Oil and then methane gas were used for kilning. In the 1980s it was found that the latter promoted the formation of carcinogenic nitrosamines and indirect firing was introduced as standard. In a totally new departure the use of a plant hormone (gibberellic acid (GA)) together with a growth restrictor (potassium bromate) became popular in the 1960s as a means of accelerating malting without increasing losses[31]. The use of bromate ceased in the 1980s with improved temperature control, and the popularity of GA also decreased. A limited degree of battering or 'abrasion' of barley prior to steeping as a means of accelerating malting gained transient popularity, at least amongst brewer-maltsters, in the 1970s but soon faded from view[32]. By the end of the century, malting was carried out in large plants (annual capacity 50-100 thousand tonnes) and total processing time was about half of what it had been fifty years earlier. Consequently the malting industry experienced consolidation; 30 companies made 60 percent of the world's malt by the beginning of the 21st century.



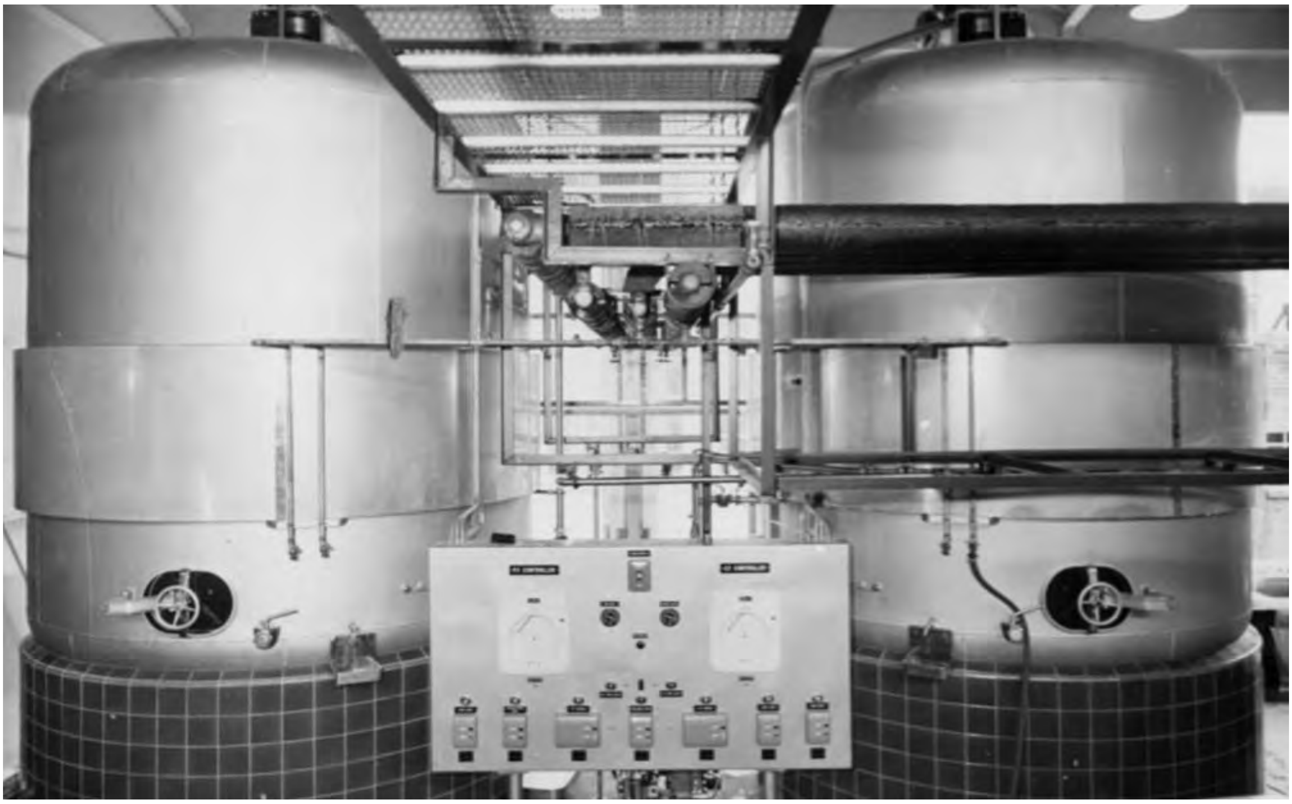
Tetley's Stainless Steel Yorkshire Squares 1938

Until the 20th century fermenters were usually fabricated in wood, latterly copper lined, or slate. Aluminium was used from the 1910s and limited depth stainless steel in the 1930s. Cylindro-conical fermenters became the norm everywhere after the 1960s and vessels of up to 4000 barrels capacity replaced smaller (100-200 barrel) round and box shaped vessels. Patented in 1910 and introduced on a small scale by the 1930s in continental Europe, Australia and America, cylindro-conical vessels lent themselves to rapid batch processing. The new shape encouraged the use of sedimentary strains of yeast for ale as well as lager and distinctions between the processing of the two became increasingly blurred as they merged as predominantly chilled and filtered beers. Process times generally were shortened, most notably in the case of maturation where understanding of the chemistry of diacetyl production and removal allowed adjustment of fermentation conditions to give swift attainment of low levels. Storage of beer in the presence of yeast to stabilise, carbonate and modify the flavour was increasingly replaced by the more rapid process, long practised in the US, of cold filtration and injection of carbon dioxide[33].

Steam boiling, as opposed to directly fired coppers, had been in use from the 1870s, but did not gain wide acceptance until well in to the 20th century. For malt extraction, the two vessel (mash and lauter tun) system of brewing which facilitated wort separation became the norm even for ale brewing from the 1960s. Lauter tuns in turn began to lose ground in some quarters from the 1980s as mash filters, first used a century earlier, were increasingly adopted in an improved form. The breeding of hops with much higher levels of alpha-acids - a more than four fold increase over the century - led to much lower hop rates[34]. Whole cone hops, the only method of bittering at the start of the century, came to be replaced by milled and later solvent extracted preparations. Commercial preparations of pre-isomerised alpha-acids became available in the 1950s and 1960s but failed to find wide acceptance other than for final beer bitterness adjustment in most companies. The whirlpool separator for removing hop and other residues after wort boiling, was introduced to replace the more cumbersome hop-backs at Molson's brewery in Canada in 1960[35], and was ubiquitous in breweries by the 1980s. Syrups produced using enzymes were being used by brewers in the 1950s and the first beer brewed using 100 percent barley converted with exogenous enzymes as a complete replacement of malt was sold in 1963[36]. Barley brewing never found wide acceptance, but the use of enzymes as palliatives became popular amongst nervous brewers who wished to avoid or prevent problems in wort production and beer stability. Adjustment of the mineral composition of water by addition of salts had been practiced since the previous century, and from the 1980s demineralisation followed by construction of the appropriate water from scratch, depending upon the type of beer to be brewed, increased in popularity. High gravity brewing, where beer is brewed and fermented at higher than sales gravity and is then diluted, was popularized and optimised in the 1970s and became the norm by the mid 1980s, allowing better plant utilisation. Sophisticated post fermentation treatments delayed haze development and improved techniques for excluding oxygen during packaging meant that beer flavour shelf-life was also extended, often to a year or more. Wood, then glass, lost out to metal as the keg and can, pioneered in the 1930s, gained ground and filling line speeds increased.

Not all scientific and technological changes worked out well. Leaving aside the ill-starred use of cobalt salts as foam improvers from the late 1950s, which led to around 100 deaths in North America and hasty withdrawal in 1966[37], the most conspicuous example of misplaced enthusiasm is continuous brewing. 'Much researched but little utilised', as one review[38] puts it, continuous brewing was seen as the technology of the future in the 1950s but failed to live up to expectations. The first entirely continuous fermentation brewery in the world was New Zealand Breweries Palmerston North plant which started commercial production in 1957. Despite footholds by the 1960s in the USA and the UK (where by one account it was responsible for 4 percent of the beer produced in the mid '60s), the continued operation of a plant in New Zealand and the introduction of continuous maturation in Finland in the 1990s, 99.99 percent of beer was still produced entirely by batch processes at the end of the century[39].

If hopes for continuous brewing in the 1950s went unfulfilled, then the same is true of the belief which took root in some quarters in the 1980s of the potential for utilising genetically modified (GM) yeast strains[40]. Again much research effort was directed at what became a hot topic and this was met by a measure of scientific achievement. A genetically modified yeast for use in low carbohydrate beer fermentation gained regulatory approval in 1993 and numerous other strains designed to give a technological advantage were constructed, but no GM strains have to date been used in commercial brewing. Similarly, targets for genetically modified barley have been identified by scientists and progress made towards achieving these goals, but the drinks industry remains unconvinced[41]. While public opinion on genetic modification, and genetically modified food in particular, remains so negative, companies are unwilling to imperil the expensively generated image of their brands for marginal advantage[42]. Only in the USA has there been apparent wide public acceptance, or at least indifference, to genetic modification. Transgenic maize has become ubiquitous in the USA and has necessarily used in brewing. Elsewhere in the world brewers took pains to reassure the public that their beers were free



Continuous Fermentation Plant Palmerston North New Zealand 1957

from genetically modified material. Carlsberg, leading European users of maize for brewing[43], turned their back on the cereal for this very reason in 2000.

With gathering pace, instrumentation transformed laboratory practice in academic and industrial laboratories in the second half of the 20th century. Wet chemical methods and laborious microbiological techniques largely disappeared and were replaced by sophisticated, sometimes automated, procedures. Productivity increased such that laboratories which had bustled with people in the 1960s and '70s had instead filled up with instruments by the 1990s. At-line, on-line and in-line analyses were taken up by increasing numbers of breweries from the 1980s and seemed likely to lead to the eventual effective disappearance of control laboratories altogether[44]. Breweries also relied increasingly upon external specialist laboratories rather than in-house expertise. This latter move, having echoes of the widespread use of the consulting brewer and chemist of a century earlier with all 'his dangers and his uses'[45], was consistent with an industry which embraced the attitudes and jargon of 'outsourcing', 'best value', 'externalisation' etc. throughout its activities.

The belief in the utility of scientific research which developed in the brewing industry after the Second World War proved short lived. Activity in breweries, never widely or firmly based, stalled in the 1980s[22] and all but evaporated in the 1990s[46]. Research laboratories and pilot plants closed and budgets were cut. Original publications from major breweries in the UK and North America, once major features in journals and at conferences, dried up. Remaining funds were directed primarily towards 'near market' product and packaging innovations. What is now called Brewing Research International (BRi) at Nutfield, lost central funding from the increasingly unstable British industry, reduced staffing levels to half of those of its heyday and re-focussed activities on service analysis, training and contract work, rather than research. An exception to this move to what its adherents called 'the new realism' and what its opponents called 'short-termism' was Japan, where contributions to brewing science had been increasingly evident from the 1980s. In a highly competitive industry, Japanese companies heeded the often given but seldom taken advice of economists on the particular need to continue to find the money to support both short and long-term research in a depressed economy.

The World's only approved genetically modified beer

Brewing of the same brand of beer in more than one plant, pioneered by Anton Dreher in Central Europe in the 19th century, was taken up by the Pabst Brewery Company in the USA in the 1930s. In 1948, following acquisition of other breweries, Pabst became the first brewer with plants from the Atlantic to the Pacific. By the late 1940s Schlitz and Anheuser-Busch had followed the trend. Multi-plant brewing of major brands spread around the world in the following decades, providing a challenge in flavour matching that was not always satisfactorily met. Reductions in numbers and increases in size of breweries, which had long been features of the industry, have accompanied new levels of consolidation in recent years. In many counties, an oligopoly now prevails despite the efforts of government regulation, the resentment of smaller brewers and the opposition of consumer groups. Major international brewers have erected plants of capacities up to 10 million barrels per annum. Regional brewers with 50 - 500 thousand barrel per annum plants have found themselves squeezed between these giants and craft or micro brewers producing <1-10 thousand barrels per annum. Science and technology have made it possible for the brewer to safely and economically produce good consistent beer with any size of plant. But if technical expertise has provided the means, it is not the cause of consolidation. For causes one must cast the net wider and consider technical developments in a wider social and economic context[47].

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Author Profile

Ray Anderson is a retired brewers' chemist and active brewing historian. He has been involved with breweries in one way or another since 1972 when he left the University of Newcastle upon Tyne with a PhD in microbial biochemistry and went to work at the industry's central research institute in Surrey. Formerly head of research and development for Allied Breweries, one of the now defunct 'Big Six' UK brewers, he is the author of over eighty papers and articles on science, technology, brewing and history in various combinations. Ray is a Fellow of three UK professional societies: The Royal Society of Chemistry, The Institute of Biology and The Institute of Brewing and Distilling.

Ray is Honorary President of the Brewery History Society, a body that draws its membership not only from the brewing industry and academia, but also from those with a general interest in the subject. For further details see *www.breweryhistory.com*

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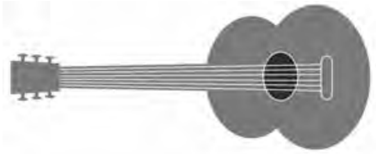
Noise at the Hop



An investigation to determine the noise levels emitted by the various bands appearing at the Preston Street stage during the 2006 Faversham International Hop Festival.

Paul Durkin

Background

The Faversham International Hop Festival is a celebration of the hop harvest and the heyday of hop picking, when thousands of Londoners came down to the Kent Hop-Gardens during September for a country holiday with pay. As the hop pickers worked, they exchanged stories, scandals and songs. In the evenings they sang, drank and played music and games. Many families returned to the same farms, generation after generation, to be joined by every available local worker to form the largest agricultural workforce the UK had ever seen.

The festival, from small beginnings in 1990, was an attempt for people to re-live that experience. This is done with a weekend of traditional festival fun, set in the picturesque medieval market town square and surrounding streets of Faversham.

During the Hop Festival celebrations, the town's normal population of 18,000 will swell to about 25,000 and resound to the clatter of clogs, music and song with dance groups performing in the narrow streets and on the main town centre stage.

The entertainment has progressed over the 19 years of the annual festival and now includes live music featuring local, regional, national and international talent, world renowned street theatre, colourful processions and an array of Kent's local produce for sale throughout the town. In 2005, both to broaden its appeal and to allow young local talent to perform, a second stage was erected at the end of a street where formerly there was little activity. In doing this and by having a less traditional form of music, we had a few complaints from a local resident about the level of noise. Consequently, an application to the licensing sub-committee of the local council (Swale Borough Council) had to be made for a new premises licence for Faversham Town Centre and its adjacent streets (Licensing Act 2003). This application included the music stage in Preston Street, the subject of this article.

Licence Conditions:

The Sub-Committee granted this licence following the complaint with the following special conditions:

(1) *"Mr Durkin (Hop Festival Committee) will be responsible for monitoring the level of sound at the Preston Street stage and will be the point of contact for any complaints".*

(2) *"The Hop Festival Committee will publicise a telephone number for complaints".*

(3) *"The Hop Festival Committee will write to the bands and notify them that Mr Durkin will monitor the sound, and 'unplug' them if they refuse to 'tone it down' and they will not be able to play at the Faversham Hop Festival again".*

Investigation

The purpose of the report described in this article was to determine the noise emitted by the groups to satisfy the Licensing Sub-Committees, (condition 1 above).

Monitoring equipment

A simple digital mini sound level meter (SLM) with outdoor windshield, costing less than £60 from Maplin electronics, was used (accuracy +/- 1.5 dB).The SLM was mounted on a tripod and was sited mainly at the audience position. The meter was set to record dB(A) at its fast setting and occasional peak determinations were made. The meter was calibrated before and after use at the council's (SBC) office.

Equipment (mixer desk) used for sound balance and output

4 kW personal address system, including bass bins; 16 channel mixing desk; graphic equaliser on main and monitor outputs; selection of good quality microphones, i.e. Shure, AKG, microphone stands and Di boxes; multi effects unit; CD player; 4x monitor wedges on 1 or 2 sends.

Noise measurements

Noise is unwanted sound; its intensity ('loudness') is measured in decibels (dB). To address the way the human ear responds to sound of different frequencies (pitches), an A-weighting is commonly applied and the measurements are expressed in dB(A). Table 1 below is used to illustrate typical levels of everyday noise.

It is not just the intensity that determines whether noise is hazardous. The duration of exposure and the distance away from the noise source is also very important.

Table 1 Typical noise levels

Noise source		Decibel level (dBA)
Whisper[1]		30
Offices[2]	Open plan	50-70
	Noisy	70-85
Hotel bedrooms[2]	TV off	28-35
	TV on	60-75
Vacuum cleaner[1]		62-85
Hair dryer[1]		59-90
Maximum output of stereo[1]		100-120

Legislation

The **Licensing Act 2003** gives powers to Licensing Authorities / Local Authorities to grant licences in respect of the sale / supply of alcohol and provision of regulated entertainment and late night refreshment for audiences over 499 people.

There are four licensing objectives:

1. The prevention of crime and disorder;
2. Public Safety;
3. The prevention of children from harm and
4. The Prevention of public nuisance (which includes noise)

The **Environmental Protection Act (EPA) 1990:** Sections 79 and 80 give powers to Environmental Health Departments to respond to allegations of noise nuisance, i.e. a statutory nuisance. Section 82 has provision for a private individual to take their own action.

The **Noise at Work Regulations 1989** (NAWR) were applicable in 2006. These regulations set three different action levels, which must be acted upon to reduce the risk of damaging hearing. Briefly, employers must make hearing protection available to workers exposed above the lower action level and make its use compulsory for anyone exposed at or above the upper level (see Table 2).

The new **Control of Noise at Work Regulations 2005,** to protect workers came into force for the music industry in April 2008. These new regulations reduce the 1st & 2nd action levels by 5dB(A). A noise exposure limit value and peak values were also introduced.

(Note: a 3dB(A) reduction would half the noise intensity, however, to the human ear a 10dB drop would be a subjective halving of loudness).

Previous and current noise action levels at which precautions need to be taken are outlined in Table 2.

Table 2 Action levels (averaged over an 8h working day)

Applicable (2006) Action Levels	Action Levels (April 2008)
Action level 1 – daily personal noise exposure of 85dB(A)	Action level 1 – daily personal noise exposure of 80dB(A) peak value 135 dB(A)
Action level 2 – daily personal noise exposure of 90dB(A)	Action level 2 – daily personal noise exposure of 85dB(A) peak value 137 dB(A).
Exposure limit value 87 dB(A)	
Peak Action level – noise level 140dB(C) (maximum pressure reached by a sound wave i.e. a single loud noise)	

Controls

(a) Time

Equivalent action levels using time i.e. the shorter the duration of exposure (playing time), the higher the Action level as shown in Table 3a.

Table 3 (a) Action levels limited by time

Noise exposure	1st Action level(dBA)		2nd Action level (dBA)	
Time	2006	April 2008	2006	April 2008
8h	**85**	**80**	**90**	**85**
4h	88	83	93	88
2h	91	86	96	91
1h	94	89	99	94
30 mins	97	92	102	97
15 mins	100	95	105	100

NOTE: (1) If maximum output of stereo is120 dB(A) Table 1, time limit is 28 seconds

(2) Groups played for a maximum of 30 minutes.

(b) Distance

The law that relates distance to sound pressure level is the 'inverse square law' The general rule of thumb is that, under ideal conditions (no reflecting surfaces or other background sound or interference), a sound level drops 6dB for every doubling of the distance from the source (see table 3b).

Table 3 (b) Noise reduction by distance

Distance from source (metres)	Sound Pressure Level (dBA)		
	Reduction	Value	Condition
1	0	98	Noise set @ Mixer desk
2	6	92	Approx. noise@ audience front
4	12	86	Approx noise @ audience centre
8	18	80	Approx noise @ position A
16	24	74	Approx noise @ position C

Music events standards/guidance

There are three main guidance documents relating the noise output at outdoor music events:

1. **Guide to Managing H&S @ Exhibitions & Events 2002** (The red book)

   This includes information based on the NAWR quoting maximum levels of background 80-85 dB(A) – Peak of 96dB and 110 dB (peak) in special enclosures.

2. **Managing Large Events (Licensing Act 2003) A LACORS Guide (2005)**

   This deals with the relevant licensing act (2003) and gives a case study based on the Glastonbury Festival. Conditions given were that the NAWR were complied with; the peak sound pressure level should not exceed 140dB; the equivalent continuous sound level should not exceed 110dB and no-one allowed within 2m of any loudspeaker with a rated output in excess of 1kW.

3. **Noise Council's Code of Practice (1995) on Environmental Noise Control at Concerts (Pop Code)**

This addresses the environmental issues of noise from large music events using high powered amplification in stadia, arenas and open air sites from the performance and sound check perspective only. **The Pop Code notes that research shows that levels below 95dB(A) will be unlikely to provide satisfactory entertainment for the audience.** This Pop Code also provides guidance for setting the "music noise level" (MNL). It provides a guideline figure for both urban stadia and other urban rural venues for 1-3 concert days per calendar year per venue of75 and 65 dB(A) respectively (l m from the façade of any noise sensitive premises). For longer events and for all venues it gives a more realistic guidance in that MNLs should not exceed the background level by more than 15dB (A)over a 15 min period.

Method

The sound level meter (SLM) was normally positioned on a tripod at a height of about 1.2m directed towards the noise source at three positions (A, B and C – see map). Every band that performed on the stage was monitored (see Table 4). Ambient noise measurement levels were also taken before start-up and at intervals between band change-overs. This consisted of general street noise of people passing or standing outside the local pub (Chimney Boy) and the audience.

The cartoon depicts the unsatisfactory nature of these measurements. In a narrow street there is great difficulty in differentiating ambient (crowd) noise from the music .Music tends to be weighted in low frequencies (63 & 125Hz) however as the complaints were from a local resident A-weighting was deemed to be sufficient and conformed to current guidance (Pop Code).

Most readings were taken with the 'fast' setting in dB(A)-hi-scale (60-120). During the performances (including Sunday Parade) estimates were made of the equivalent continuous noise level (L_A eq), i.e. music noise level (MNL) and spot readings were taken of the peak noise level (MNL_{pk}) with the meter on max-hold.

Results

Table 4 below gives the results of MNL readings at three locations. Figures in parenthesis refer to the residual reading when the street noise without music reading is deducted.

Table 4 Sound pressure level readings

Group	Sound Pressure Level (dBA)						
	Music off	Position(A) (Centre) Music on		Position(B) 58, Preston St Music on		Position(C) 4, Limes Place Music on	
	$L_A$eq	Peak	$L_A$eq	Peak	$L_A$eq	Peak	$L_A$eq
Saturday							
No Folds Barred	66	97(31)	88(22)	85(19)	77(11)	93(27)	84(18)
Monkey Republic	66	97(31)	87(21)	83(17)	76(10)	89(23)	83(17)
Diatribe	74	95(21)	88(14)	86(12)	80(6)		
Miles Cookham	69	93(24)	86(17)		80(11)		
The Diversions	82	89(7)	85(3)	78(<0)	76(<0)		
Broken Biscuit	80	89(9)	88(8)				
Reign Parade	76/ 101*	90(14)	88(12)				
Sunday							
Parade march past	70/101*	90(20)	75(5)				
Forty Store	72	87(15)	85(13)				
Seven	70	90(20)	83(13)				
Chums	68	87(19)	80(12)				
Priapism	75	90(15)	85(10)				
Happy Trails	75	89(14)	81(6)				
Camine	75	87(12)	83(8)				

* Audience applause (MNL pk)

Conclusions

The results from Table 4 show that there was effective control at the mixer desk to prevent noise levels exceeding the self-imposed limit of 98 dB(A). Peak noise levels were 87 to 97 dB(A) hence at no time was there a need to impose any further reduction, particularly as the only reading above the limit was from audience response (101 dBA) on one occasion. This value was also exceeded when the Sunday parade marched past.The sound engineers concerned reduced the low frequency (base) noise when a low frequency spot check was taken at location B (98dBC).

With regard to the current(2006) NAWR for music, based on a 30 min$L_A$eq of 97dB(A)(Table 3a) this first action level was not exceeded (range 88 to 80 dBA). Furthermore music noise levels (MNLs) at locations B&C near residences, were further reduced (B:80 to 76 dB(A)) and (C:84 to 83 dBA). There were only three occasions when the MNL ($L_A$eq) exceeded the residual street noise when no music playing by more than 15 dB(A) this may reflect the transient nature of the background uncontrollable (audience) noise (66 to 82 dBA).This is exemplified when one of the quietest groups (The Diversions) followed the loudest audience level, resulting in an apparent negative value .Therefore their music could not be heard near the noise sensitive residence. Consequently the monitoring continued opposite the stage only.

Outcome

The music noise levels at the 2006 Hop Festival had been well controlled and within the limits expected and set by the Hop Festival Committee. Further evidence to support this claim, was that the only complaints (3 in total) received, apart from those who questioned why I had to be there in the first place, had been that the levels were too low. It showed that the Noise Council's CoP (Pop Code) is not appropriate to use for this type of event or location as the measured street noise levels without music playing were all above the lower of the two guideline levels (65dBA) and half were above the higher level (75dBA). A balance has to be struck between audience approval and a one off disturbance to noise sensitive individuals.

This Pop Code introduced in 1995 by the now defunct Noise Council is out of date and out of print, hence urgently requires review. It is understood (3) that the Chartered Institute of Environmental Health (CIEH) will undertake this as a substantive review and aim to produce a draft code by late 2010.However, until this happens, I would suggest a more appropriate criteria for this type of festival would be to base the MNL on the Pop Code's all venue criteria of 15dB(A) above the ambient street noise level, one metre from the nearest noise sensitive dwelling, with the addition ofa maximum level of 98dB(A).

During this event, the relevant (2006) noise 1st action level for music events (Table 3a) based on atotal playing time of 4h of 88dB(A)had not been exceeded on either day.

Paul DurkinCMIOSH, MIIRSM, FRSPH, LFIOH, MIScT

Author Profile

Paul Durkin left school at age 15 to follow the dream of working in a Chemistry lab. In 1961 he started work as a laboratory assistant at the new Technical College of Monmouthshire, Crosskeys, S.Wales.

Paul joined the IST in 1964 and was a founder member and Hon.Secretary of the Monmouthshire Branch from 1965 to 1971 (probably the first and only student member to hold such a position?). From 1968 to 1971 he worked with the late Don Watkins (IST Council, 1968 to 2006) as his Research Technician.

Paul also worked as a Chemistry Technician then Occupational Hygienist for Shell Research in Kent from 1971 to 1995 (IST Council 1972 to 74). Since 1995 to the present Paul worked as a Health & Safety Adviser for Kent Adult Social Services (KCC).

The article covers his voluntary work for the Favesham International Hop Festival, where since 2006, he has acted as the event's Noise Controller.

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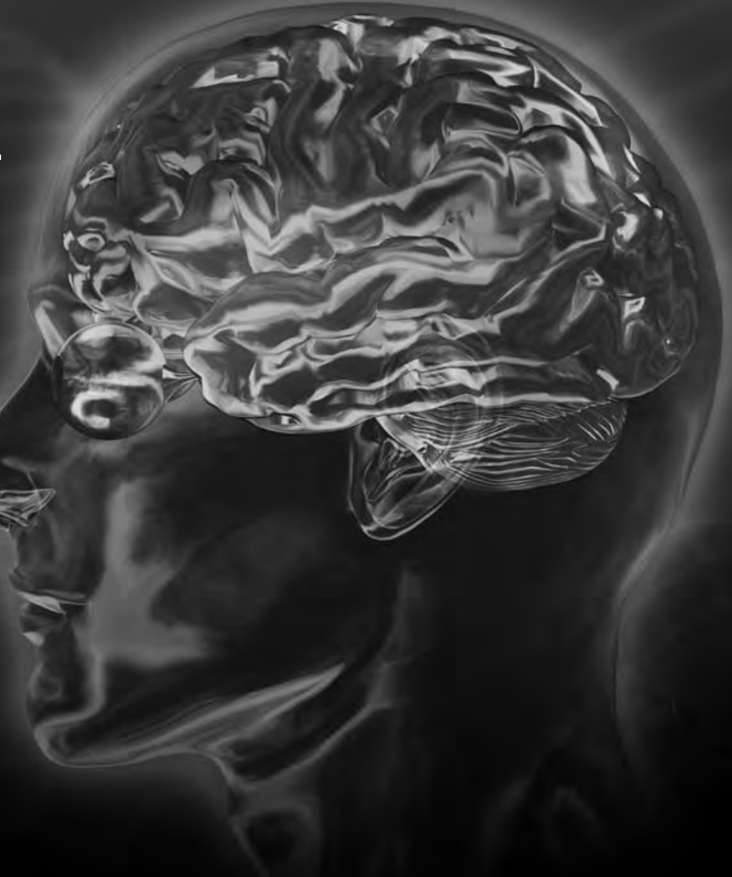
Crowd photo by permission of Alison Shelley, Shepherd-Neame Ltd.

Pioneers of X-Rays – The Aimer Brothers



Alan Gall, IST Archivist ▶

The Röntgen rays, the Röntgen rays,
What is this craze?
The town's ablaze
With the new phase
Of X-rays' ways.
I'm full of daze,
Shock and amaze,
For nowadays
I hear they'll gaze,
Through cloak and gown – and even stays,
Those naughty, naughty Röntgen rays.

(A ditty published in the journal *Photography,* 1896)

How X-rays came to England

In his *Biographical Fragments* and elsewhere, physics professor Arthur Schuster of the Victoria University of Manchester recounted how he first learnt of an astounding new discovery. Returning from a Christmas holiday early in January 1896, he decided to call in at his office on the way home from the station. Schuster left his wife sitting in a horse-drawn cab. Also waiting for him was an envelope from Wilhelm Röntgen[1] of the University of Würzburg containing a pamphlet and some of the most unusual pictures ever seen, but no covering letter. The pamphlet, a reprint of a scientific paper from the journal of the Würzburg Physical and Medical Society, described a new discovery: a ray that could penetrate matter and leave an image on a photographic plate. So absorbed did Schuster become with the revelations that he forgot his wife was still outside in the cold.

Professor Schuster lecturing at Manchester in 1902.

As the first person in England to learn of Röntgen's X-rays directly (Lord Kelvin, in Scotland, was also informed), it might be imagined that Schuster had a head start. In fact, the vital part, in the form of the Crookes tube[2] for generating cathode rays, was already available in many laboratories and work started almost immediately. The medical applications had been apparent from the start and Arthur Schuster found himself deluged with requests for diagnostic X-ray images. Not everyone approved of the new discovery, however. The Pall Mall Gazette of March 1896 acidly remarked:

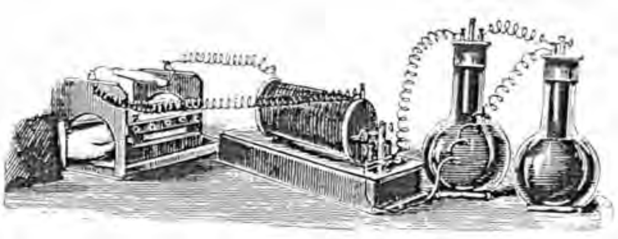
'We are sick of the Röntgen rays. It is now said, we hope untruly, that Mr Edison has discovered a substance – tungstate of calcium is its repulsive name – which is potential (whatever that means) to the said rays. The consequence of which appears to be that you can see other people's bones with the naked eye and also through eight inches of solid wood. On the revolting indecency of this there is no need to dwell.'

Much comment about the subject was based on the public's early, mistaken idea that X-rays provided a simple extension of existing photography. One notion was that a lady's modesty might be compromised and some traders took advantage of this fear by offering X-ray proof underclothing.

To support the demand for both medical and research apparatus, a new industry came into being. Many a glassblower turned his hand to making the tubes, and instrument makers and electricians combined them with high-voltage sources to make complete sets of equipment. Some manufacturers were quick of the mark. Newcastle-based medical supplier Brady and Martin reported:

'We had in stock for some years Crookes's radiant matter tubes, which, upon being tested, gave excellent results with various metallic bodies, coins needles, forceps, etc., wrapped in several thicknesses of paper.' And ' The most useful purpose …was to obtain accurate pictures of the bones in the living body, and this at once brought the subject within the sphere of our taking an exceedingly active interest in it …'

Soon after this, Brady and Martin designed their own tube - which won a silver medal from The Sanitary Institute in 1896. The benefits of the new technology were obvious but the dangers were not.



A small X-ray set made by Brady and Martin before WW1. The batteries (housed in round-bottom flasks) fed a coil via an interrupter to step up the voltage.

Enter the Aimer Brothers

Two pioneers in the construction of glass X-ray tubes were George and Bert Aimer. Their enthusiasm for the subject was considerable. In small commercial premises off the Tottenham Court Road, London they conducted experiments without realising that the radiation entering their bodies was causing irreparable damage. Although George survived long enough to see his 82nd birthday, by then he had become blind and a contributory cause of death was radiation-inducted tumours. Bert, who had lost several fingers, amputated because of severe radiation burns, pre-deceased him by 13 years.

James Aimer second from left at the front. The occasion is the wedding of his son, Jim, to Marjorie Hollyer, 17th August 1946. *(Photograph courtesy of Peter Walker)*

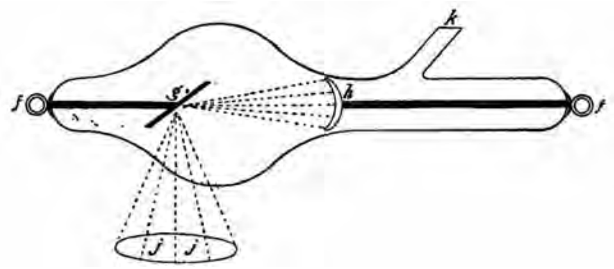
George Charles Aimer was born in 1882, his brother Herbert (Bert) James Baird Aimer nine years later. The two were actually half brothers as George's father had died in 1885 and his mother, still in her thirties, gave birth to Herbert without remarrying. Little is known of their formative years except that George became an apprentice to Alfred Ernest Dean, one of the major developers and producers of X-ray apparatus. It was at A.E.Dean's that George learnt his glassblowing skills.

There were three other Aimer brothers: James, David and Edwin. James joined up with George and Bert only when the family enterprise started to flounder, the other two followed alternative careers.

To generate useful X-ray concentrations, all that is required is a vacuum tube, in which cathode rays (fast-moving electrons) are induced to strike a solid target, and a supply of electricity.[3] The tube shown here illustrates the simplest layout. Terminals marked *f* are connected to the high voltage generator. Current flows to the cathode *h* - a dished plate constructed of aluminium because this metal was found to be resistant to erosion. Electrons are emitted from the plate and travel towards the anode at high velocity. On striking the platinum target[4]*g*, the X-rays stream out to irradiate the subject. In some designs, a separate target (anti-cathode) and anode were used, whereas in the above scheme the target serves as both anti-cathode and anode. The side arm *k* makes provision for connecting to a vacuum pump when the tube requires re-evacuation.

Ernest Harnack lost both hands because of over exposure to X-rays.

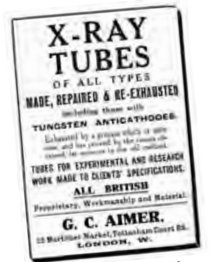
Early attempts at construction were, of course, rather primitive and electrocution was an ever-present hazard. Exposure times were often incredibly long (see The Hartley Murder Case – an episode in the history of X-rays, this journal April 2004). Another problem with the first tubes[5] was that they relied on a very small amount of gas being present for the discharge of electrons to take place. As the glass walls adsorbed the gas so the vacuum increased. This resulted in a twofold effect: the discharge of X-rays with greater penetrating power, and the necessity for ever-higher voltages to drive the electron emission. Tubes were said to become 'harder' as this process continued. For medical applications, the radiographer Ernest Harnack[6] recommended segregating the tubes into soft, medium and medium-hard varieties, each suitable for use in particular applications depending on the part of the body under examination.[7] A new tube started life in the soft condition and could be re-evacuated when it became too hard for use. This provided further work for specialists, like the Aimers who offered a repair service. There were more elaborate tubes designed to control internal gas pressure but these variants were not always cost-effective. The introduction of heated cathodes helped solve the problem as this modification allowed operation under higher vacuum.



A simple arrangement called the "focus tube". The vacuum was deliberately poor to leave some residual gas for ionisation by the applied voltage.

When exactly George Aimer started his business is uncertain. Later catalogues claimed the foundation as 1906 and various earlier dates have also been quoted.[8]

The 1911 census shows that George was engaged on making X-ray tubes but not yet working for himself. So the probable formation date is between 1911 and 1915, the later date given by the first listing to be found in the London trade directory (dated 1916 but compiled the year before). The start of the First World War would have been an appropriate time as it looked likely in 1914 that there would be a serious shortage of X-ray tubes (as it proved to be).

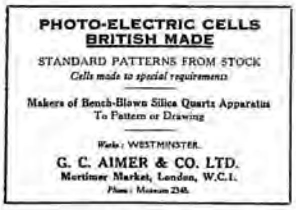


Advertisement 1916

Advertisement 1922

Manufacturing started in modest accommodation with only a ground floor area of about 250 square feet, at number 32 Mortimer Market, Tottenham. This was later supplemented by taking on adjacent units. One advantage of this location was the proximity to various departments of the University College Hospital and to the Middlesex Hospital.

Another pioneer, this time in the development of radios, was Greenleaf Pickard[9].Following his researches, radio construction started to attract the hobbyists and before the era of mass production radio valves could be made competitively in a glassblowers' workshop. This attracted the Aimers who catered for crystal sets (requiring little more than an aerial, a tuning coil and a crystal) and the more up-market, amplified versions needing valves. The trade name 'Welbeck' came into use for both Aimer X-ray tubes and radio valves. A pointer to the possible origin of the name is that the Society of Radiographers was on Welbeck Street.



Advertisements 1928 (left) and 1930 (right)

On the 10th March 1927 George Aimer filed a patent application[10] for 'Improvements in or relating to Mercury Vapour Lamps'. The patent agent that George used for submitting the complete specification was called Alfred Stuart Cachemaille and Alfred's brother, Harvey Cachemaille, became a co-director with George upon the formation of G.C.Aimer & Co Ltd on 21st September 1927. Cachemaille resigned the following year, to be replaced by Bert Aimer. Shares were redistributed in 1928 to give each of the brothers, now joined by James[11], a third interest each.

As the 1920s came to a close, trading conditions were becoming difficult. As a result of this, combined with developing ill health from the long exposure to radiation, the brothers accepted a deal to sell-out. Jim Aimer, son of George's brother James, says that the firm was sold to a Jewish businessman on the understanding that the Aimers would continue to be employed. As it turned out, the business was sold on and the brothers were not given jobs. G.C.Aimer & Co Ltd ceased trading at the end of December 1931 and a new company, Violite Ltd, came into being. George was particularly bitter about this turn of events.

Violite Ltd occupied a works, offices and showrooms at 41 Great Windmill Street, off Piccadilly Circus. A trade counter could be reached, and deliveries made, through Ham Court at the side. As well as taking over Aimer's, Violite merged the scientific glassblowers R.L.Grant & Co into the enterprise. The price paid for G.C.Aimer & Co Ltd must have been a pittance as George & Bert were compelled to continue working. They formed G.C.Aimer & Co as an un-limited company to carry on glassblowing at new premises, 14 Maple Street, London.

Maybe the brothers derived some small satisfaction from the fact that Violite did not survive very long. In 1933 the company was dissolved, then briefly resurrected as Violite (1933) Ltd. The second attempt ended shortly after as did the life of a subsidiary company, Neon Installations Ltd.

Around this time, the plight of the brothers attracted the attention of the press. *The People* newspaper ran a touching story after sending a reporter to interview George at his workshop (reproduced here but unfortunately the original cutting is undated). The concluding remarks by George 'We may be down, but we're not out yet' proved to be justified.

With prospects looking bleak, the Aimers applied to the British Institute of Radiology in 1934 for financial aid. There was some sympathy expressed by the Council but no money forthcoming:

'*Their physical disabilities, coupled with the failure of more than one business venture has resulted in their finding themselves in financial circumstances of great stringency, and an application for assistance was made to Council. Unfortunately, neither of the brothers Aimer has ever been a member of the Institute, nor of its predecessor the Röntgen Society, and it is therefore impossible for any grant to be made to them from Institute funds.*'[12]

Somehow, the brothers managed to keep the business afloat. Fifteen years after the Violite episode it re-emerged as a limited company once again, this time under the name Aimer Products Ltd. It was incorporated on 19th October 1946 with H.J.B. Aimer as the sole director. It was time for Bert to pass on control and during January 1947 two other directors were appointed: Walter Frederick Dowden and Douglas Arthur Sanderson. Bert kept overall control at this stage by retaining just over 50% of the shares.

George had originally taken on Walter (Fred) Dowden as a young lad, to look after the cleaning duties. Fred proved his worth, becoming an accomplished glassblower, and ended up owning the company with Sanderson. Stan Miller, who visited the factory over many years, recalls:

'I remember both Fred Dowden and Doug Sanderson when the business was at Rochester Place. Fred was a rather serious man who as company secretary also managed the day-to-day company finances, while Doug who was very cheerful and friendly was sales manager. It was not long after Fred Dowden retired that Doug died suddenly and unexpectedly. He lived on his own and when he did not arrive for work one morning someone from the company went round to his home where they found him dead in bed. He was such a lovely man who radiated happiness and kindness and I always enjoyed seeing him when I visited Aimers.'


Telephones GULLIVER 3618 / 6466

Dr. to

INVOICE

AIMER PRODUCTS LIMITED

LABORATORY AND HOSPITAL FURNISHERS

SCIENTIFIC & INDUSTRIAL GLASSBLOWERS

Nº 35046

Man. Director: W. F. DOWDEN

Works Director: D. A. SANDERSON

AIMER

56-58, ROCHESTER PLACE, CAMDEN TOWN, LONDON, N.W.1.

Invoice from 1965 when 'Fred' Dowden and Doug Sandersan ran the business.

David Leveridge, who started at Aimer's in 1955, recalls that Doug Sanderson spoke of visits to see Bert Aimer in hospital. Bert was particularly appreciative for help with rolling cigarettes, a task he couldn't easily perform for himself because of his missing fingers. He died on 6th January 1951 and was cremated at Golders Green.

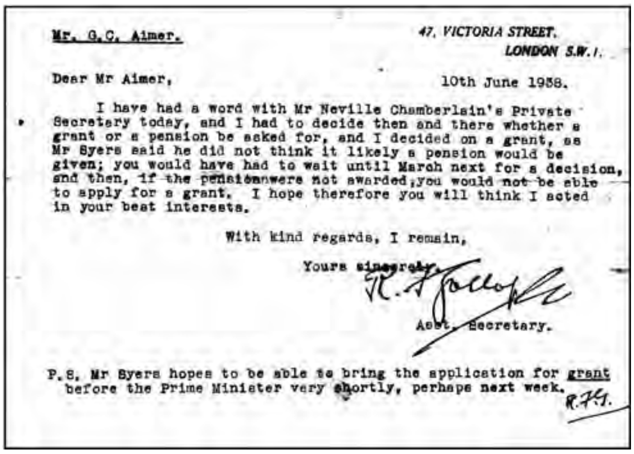
Records for the formation of Aimer Products Ltd in 1946 show that George was no longer involved with the business. In 1938 he had applied for financial help from the Government via the National Society for Cancer Relief. In support of his claim, he needed references and received a great many from former customers who were aware of his condition. Typical of the replies were:

'Knowing your good work as I have done for many years past, I shall be only too glad to be of any assistance in my power and greatly regret that it is necessary for you to ask.' (H.J.Edz, X-ray Department, Royal Veterinary College, Camden Town, 25th April 1938)

An ex-president of the Röntgen Society, George B.Batten, also offered his support:

'I can testify to your being a pioneer in X-ray tube and apparatus manufacturing from nearly or quite the beginning ie

for forty years or more. I know how you are crippled by effects of x-rays and believe you to be worthy of every help that can be given you.'



Mr. G.C. Aimer.

47, VICTORIA STREET,
LONDON S.W.1.

Dear Mr Aimer,

10th June 1938.

I have had a word with Mr Neville Chamberlain's Private Secretary today, and I had to decide then and there whether a grant or a pension be asked for, and I decided on a grant, as Mr Syers said he did not think it likely a pension would be given; you would have had to wait until March next for a decision, and then, if the pension were not awarded, you would not be able to apply for a grant. I hope therefore you will think I acted in your best interests.

With kind regards, I remain,

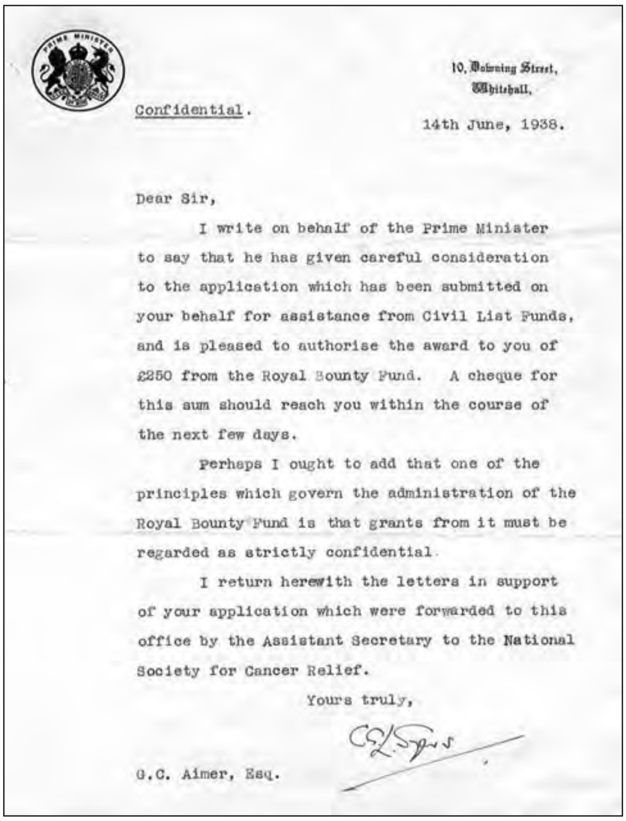
Yours sincerely,

Asst. Secretary.

P.S. Mr Syers hopes to be able to bring the application for grant before the Prime Minister very shortly, perhaps next week.

Letter from the National Society for Cancer Relief

Instead of a pension, the National Society for Cancer Relief decided that an application for a lump sum would be more likely to succeed. The Prime Minister's office wrote to George advising that £250 had be awarded from the Royal Bounty Fund, with a request to keep the details confidential. To put this sum in perspective, the average UK house sold for about £500 in the early 1940s.[13]



10, Downing Street,
Whitehall.

Confidential.

14th June, 1938.

Dear Sir,

I write on behalf of the Prime Minister to say that he has given careful consideration to the application which has been submitted on your behalf for assistance from Civil List Funds, and is pleased to authorise the award to you of £250 from the Royal Bounty Fund. A cheque for this sum should reach you within the course of the next few days.

Perhaps I ought to add that one of the principles which govern the administration of the Royal Bounty Fund is that grants from it must be regarded as strictly confidential.

I return herewith the letters in support of your application which were forwarded to this office by the Assistant Secretary to the National Society for Cancer Relief.

Yours truly,

G.C. Aimer, Esq.

Letter from the Prime Minister's Office

Someone who became curious about George Aimer's career was Dr Frederick Gordon Spear[14] who contacted Aimer Products Ltd for information, initially asking about H.J.B.Aimer. Part of the reply stated that George had worked in the physics department at University College, Gower Street, London. It was also said that George might have been in direct contact with Röntgen himself. Writing from Cambridge, on 6th October 1955, Dr Spear asked if this could be true. Unless George had visited Germany, the possibility was doubtful since Röntgen had never left his native country except on one occasion, when he travelled to Sweden to accept his Nobel Prize in 1901.Spear suggested a possible explanation: '… I am wondering whether the confusion has arisen between the names of Professor Ramsay and Professor Röntgen.' Unfortunately, there is no record of any response.

Dr Spear was a medical doctor, radiologist and Deputy Director of the Strangeways Laboratory at Wort's Causeway, Cambridge. He joined in 1924 and after the death of the founder, Dr T.S.P.Strangeways[15], took charge of the Radiological Department. In collaboration with Joseph Rotblat[16], Spear worked on 'The lethal effect of high energy radiation on tissue cultures.' The Strangeways Research Laboratory is a private research organisation funded by grants from various bodies. In the early days, when known as the Cambridge Research Hospital, it housed patients so that their diseases could be studied at close quarters. It was decided in 1923 to close the wards and the clinical work passed to St Bartholomew's Hospital. Strangeways then concentrated all effort on the study of cell biology. Past members of the Laboratory's Advisory Council include Sir Lawrence Bragg[17] and Sir John Cockcroft[18].Other notable names, to be found in the list of 'Past and Present Members and Visiting Workers' (1962) are Francis Crick[19], Howard Florey[20], Peter Medawar[21] and Charles Coulson[22].

It may now seem odd that at the time the Aimer brothers were experimenting so little regard was given to the danger. A Boston dentist called Rollins had reported in 1901 that X-rays could be fatal – for guinea pigs at least. He placed his subject in a Faraday chamber (to exclude the effect of any electric fields) and after 11 days of exposure for two hours per day the guinea pig died. Although his results did not travel much further that the Boston area, others were starting to ring the alarm bells. Despite this, it seems that the lessons could only be learnt by bitter experience.

A stir was caused in 1921 with the death of Dr William Ironside Bruce at age 42, a radiologist working at Charing Cross Hospital, London. Another sufferer was Ernest Harnack who lost both hands. In conjunction with George Aimer's old firm, A.E.Dean, he developed the Harnack-Dean Precision Couch. This set-up allowed X-ray sources to be moved over the length of the patient from above and below the body.

A good example of the consequences of ill-considered applications of X-rays comes from the story of the 'Tricho System'.[23] As is well known, radiation causes hair loss. A Dr Albert C.Geyser in the USA had the bright idea of removing unsightly body hair by doses of X-rays in the 1920s. To do this he used a tube that he had developed (the Cornell tube) with an aperture of common glass, the rest being fabricated from leaded glass for its screening effect. In the *Journal for Cutaneous Diseases* he claimed that: ‘when using the Cornell tube no protection of any kind, either for patient or operator, is needed.’

Hypertrichosis is an overabundance of hair in unwanted places so when Dr Geyser established his hair-removal service as a commercial enterprise, he called it the Tricho Sales Corporation. Patients were informed of a miraculous depilatory method without being told of the details. Indeed, sales literature assured ‘nothing but a ray of light touches you’. Hairy people descended on the clinics that were offering the treatment in a number of American states. The staff at these centres had little or no training in the use of X-ray equipment and over-exposure resulted in many cases of severe radiation burns. Some patents did not feel serious effects until many years after the doses were given.

At one time the precious metal refiners Johnson, Matthey & Co offered quartz glass (fused silica), a material with a very low coefficient of thermal expansion that is used by glassblowers to fabricate superior heat-resisting apparatus. Possibly through this connection, and/or the supply of platinum for constructing electrodes, Aimer’s had established a cordial relationship with Leslie Clarence Montague at Johnson Matthey. L.C.Montague had started at Johnson Matthey in 1919 as a junior clerk and progressed to company secretary before being appointed a director in 1946. He seems to have been involved with efforts to secure a pension for George’s wife. A letter written by him to George’s son Maurice confirms that this was successful: ‘…I am most pleased to learn that Mrs. Aimer has been awarded a full pension by the National Benevolent Institute.’ By this time George had gone completely blind. As others had found to their cost, a little knowledge can be a dangerous thing indeed. Yet many had benefited from the sacrifices of the few pioneers so perhaps George took comfort from this.

George Aimer died on 7th December 1964 at his home in Leigh-on-Sea, Essex.Although he lived to a respectable age, the later years were painful and difficult ones. He seems to have borne his misfortune with fortitude judging by the words of Leslie Montague in 1958:

'*It is distressing to hear that the specialist holds out no hope of being able to restore your father's sight, but it shows wonderful courage on his part that in spite of it he keeps in good heart.’*

George did leave a legacy. The company he founded has not only survived but prospered. Still trading as Aimer Products Ltd[24] it is run by the Leveridge family: David, John and Lee, successors to Fred Dowden and Doug Sanderson.

JUST TWO UNKNOWN HEROES

And the Price They Paid

Special to “The People”

PROBABLY you have never heard of the brothers Aimer. I suppose their names—George Aimer and Bert Aimer—mean nothing to you. They are just two of London's unknown heroes.

Just now with their backs to the wall they are fighting a battle against poverty and suffering.

This is their reward for their devotion to science in the pioneer days of X-ray research—a legacy of tortured years and want.

Bert, who is slowly losing his fingers as the result of X-ray cancer, lies helpless in hospital while his brother George with his sight permanently affected and racked with internal pains struggles to make a living in a tiny glass-blowing workshop off Tottenham Court-rd.

Mr. George Aimer

I met him there yesterday and he told me something of their tragic story.

“Bert and I were in X-ray work at the beginning,” he said, “before its deadly dangers were realised.

“Now we are paying a bitter price for those early years, but it would not be so hard if we could make a living.

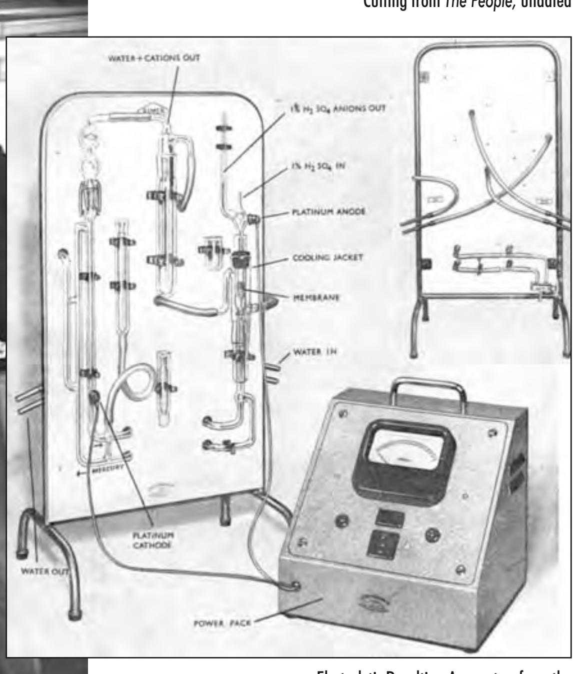
“Ill-health and misfortune, however, have beaten us. Once we had a splendid business as manufacturers of X-ray apparatus, but now we have lost everything and I am down to touting for ½d. and 1d. glass-blowing orders to keep things going.”

Now a third brother, Jim, has given up his job as an electrician to throw in his lot with them and try to help them pull through to better times.

“And we shall,” says George Aimer, with a brave smile. “We may be down, but we're not out yet.”

Cutting from *The People*, undated

John Leveridge, Managing Director of Aimer Products Ltd, Enfield (2009) *Image:www.josealyphotography.com*



Electrolytic Desalting Apparatus, from the 1963 Aimer Products Ltd catalogue.

Telegraphic Address—VETERNOSIS, LONDON.

Telephone NORTH 5414.

Camden Town, N.W.1

X-RAY DEPARTMENT:
H. J. Eve, M.S.R.

London
Church St
Square

Ap 25 38

Dear Aimer
Knowing your good work as I have done for many years past, I shall be only too glad to be of any assistance in my power and greatly regret that it is necessary for you to ask.
Please let me know of anything definite that I can do
Yours truly
Henry J Eve

PROFESSOR F. L. HOPWOOD.

TELEPHONE: NATIONAL 4444.

PHYSICS DEPARTMENT,
THE MEDICAL COLLEGE OF
ST BARTHOLOMEW'S HOSPITAL,
CHARTERHOUSE SQUARE, E.C.1.

26/4/38

Dear Mr Aimer,

I am glad to hear that there is a possibility of your securing assistance from a Government source. You may certainly use my name as a reference in support of your application.

With all good wishes
Yours sincerely
F. L. Hopwood

WELBECK 3332.

107, HARLEY STREET,
W.1.

27th. April 1938.

I have known Mr. G.C. Aimer since before the war and know that he worked very hard at the manufacture of X-Ray tubes. I have also used some of his tubes. I have every reason to believe that he is a person of integrity and he always behaved with absolute honesty in any dealings which I had with him. He did his best to forward the science of X-Ray tube manufacture and has suffered from the results of his exposure to X-Rays.

N.S. Finzi

N.S. Finzi
Director of the X-Ray Department

13, Waldegrave Park
Strawberry Hill,
Middx.

25th April, 1938.

Mr. G.C. Aimer,
9, Derwent Avenue,
Hatch End, Middx.

Dear Mr. Aimer,

In reply to your letter of 21st April, I shall be very glad for you to use my name as a reference in your application for financial aid from the Government.

Wishing you every success,
Yours faithfully,
G W C Kaye

G.W.C. Kaye. O.B.E., M.A., D.Sc., F.Inst.P.
President. The Society of Radiographers.
32 Welbeck St. W.1.

London County Council
PUBLIC HEALTH DEPARTMENT
Radiological Dept.
Hammersmith Hospital,
Du Cane Road,
Shepherd's Bush, W.12

Reference

Telephone:
SHEpherd's Bush 4465

23rd April 1938

NOT OFFICIAL

Dear Mr.Aimer,

I am in receipt of your letter of the 21st inst.

You may certainly give my name as a reference when you apply for a grant. Some time ago I suggested to the B.I.R. that the attention of the Carnegie Fund Trustees should be drawn to your condition, but I do not know the outcome.

With all good wishes,
Sincerely yours,
J. Duncan White

J.Duncan White.

TEL. LANGHAM 2709.

21, HARLEY STREET,
W.1.

25 April. 38.

Dear Mr. Aimer.

I have your letter of the 21st inst. & you may certainly give my name for reference or as a referee.

I sincerely trust you will get some Grant in these difficult times.

Yours truly.
R W A Salmond

36, HARLEY STREET, W.1.

LANGHAM 3260.

25th April, 1938.

Dear Mr. Aimer,

I am glad to hear from your letter of the 21st inst. that there is a possibility of you securing a small pension or grant from a Government source.

Having known you for many years now, and known of your work as a manufacturer of X-ray tubes and apparatus, I should have pleasure in speaking on your behalf at any time, and you may use my name as a referee if occasion requires. You may also show this letter if it would help you in any way.

Hoping your efforts will be successful.

Very truly yours,
Russell J Reynolds

X-RAY DEPT.
ST. THOMAS'S HOSPITAL,
LONDON, S.E.1.

26th April 1938.

Dear Mr. Aimer,

I am in receipt of your letter of 21st April and shall be only too glad to act as referance, if I can be of any assistance.

Yours sincerely,
[signature]

Director.

G.C. Aimer, Esq,
9, Derwent Avenue,
Hatch End. M'SEX.

Acknowledgements

Thanks to:

Jim and Tony Aimer.

Dr Sally Jones, Johnson Matthey Ltd.

David and John Leveridge of Aimer Products Ltd.

Stan Miller.

Julie Vallis of the Strangeways Research Laboratory.

Peter Walker.

Tony Aimer kindly provided copies of the correspondence concerning the pension/grant application and the newspaper cutting. Jo Sealy interviewed and photographed John Leveridge at the Enfield works of Aimer Products Ltd.

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References and Notes

1 The spelling Roentgen is often used in place of Röntgen.

2 Named after William Crookes (1832-1919) who developed the tube whilst investigating electrical discharges in gases at low pressure.

3 In the days of unreliable or non-existent mains electricity supplies a high voltage could be obtained by electrostatic means (such as a Wimshurst machine) or from a coil and interrupter fed by batteries.

4 The target in an X-ray tube generates a considerable amount of heat, and also vibration. It needs to be firmly fixed in the glass envelope and extra means provided for heat dissipation (such as a copper backing).

5 Commonly called 'gas' or 'ion' tubes.

6 Ernest Harnack and his three colleagues, Reginald Blackall, Harold Suggars and Ernest Wilson, all suffered from radiation injuries.

7 According to R.Kennedy (1915).

8 For example, D.R.Guttery (2003) gives a date of 1903.

9 Greenleaf Whittier Pickard (1877-1956). American inventor who introduced 'the cat's whisker', a pointed wire that produced a good semi-conductor effect when in contact with certain crystals.

10 Patent accepted 11 June 1928, No 292215.

11 Prior to this, James was employed as an electrician in the printing industry.

12 'A case of disability and hardship sustained in the manufacture of X-ray tubes', *The British Journal of Radiology* (1934), vol.7 p.642.

13 http://www.wwwk.co.uk/culture/housing/index.htm

14 Dr Spear had written about the dangers of radiation: see F.D.Spear (1956), 'Radiation Martyrs', British Journal of Radiology, vol. 29, p. 273.

15 The founder was actually born as Thomas Strangeways Pigg. He added a hyphenated extension to his surname (giving Thomas Strangeways Pigg-Strangways) before relegating 'Pigg' to the status of a middle name.

16 Joseph Rotblat (1908-2005), recipient of the Nobel Peace Prize 2005. Associated with the Pugwash Conferences to promote the peaceful use of nuclear technology. Elected FRS 1995. Knighted 1998.

17 William Lawrence Bragg (1890-1971). Famous for Bragg's law in X-ray crystallography. Nobel Prize in Physics awarded in 1915 jointly with William Henry Bragg, the only one to be won by a father and son team. FRS in 1921 and knighted in 1941.

18 John Douglas Cockcroft (1897-1967). Worked under Ernest Rutherford. With Ernest Walton, received the Nobel Prize in Physics 1951. Elected FRS 1936 and knighted 1948. Appointed the first director of the Atomic Energy Research Establishment at Harwell.

19 Francis Harry Compton Crick (1916-2004). Published the discovery of the double helix structure of DNA in 1953 with James Watson. Awarded the Nobel Prize in Physiology or Medicine with Watson and Maurice Wilkins in 1962.

20 Howard Walter Florey (1898-1968) Australian-born British bacteriologist who developed (with Ernest Chain) the commercial production of penicillin, accidentally discovered as a mould by Alexander Fleming about 10 years earlier. He was knighted in 1944 and received the Nobel Prize with Chain in 1945. Elected FRS 1941.

21 Peter Brian Medawar (1915-1987). Active in the fields of zoology and immunology. Elected FRS 1949 and received the Nobel Prize for Physiology or Medicine (with Frank Burnet) in 1960. Knighted in 1965.

22 Charles Alfred Coulson (1910-1974). Author of the influential book *Valence* and first professor of theoretical chemistry at the University of Oxford. FRS in 1950.

23 For an account of the Tricho clinics see: Paul Collins (2003), 'Nothing but a ray of light', *New Scientist,* Sept 8, pp.68-69.

24 Alan Gall (2008), 'A History of the Pyrex Wholesalers: Part One – Aimer Products Ltd', *British Society of Scientific Glassblowers Journal,* Vol 46 No 1.

Technical Skills Training Courses

For a full listing of courses available through the IST website please go to http://www.istonline.org.uk/TSCP/technical_skills_courses.asp.

The University Of Sheffield.

Safe use of Laboratory Gases & Practical Tungsten Inert Gas (T.I.G.) Welding

Tim Haycock the Training Coordinator in the Central Workshops at The University of Sheffield leads both 'Safe use of Laboratory Gases' and 'Practical Tungsten Inert Gas (T.I.G.) Welding' courses for HEaTED. Tim has recently travelled to Loughborough University to run the Safe use of Laboratory Gases course, and the TIG course ran a few weeks ago in the Central Workshop at Sheffield University. The satisfaction Tim derives from running the courses is clear as he states "There are no limits to the amount of pride and enjoyment training gives, every day we all learn new things, and to see that the information has been understood and acted upon, is probably the most rewarding factor."

Tim demonstrating on the Lab gasses course

Tim is keen that all delegates get as much out of the courses as possible so that they all have a full understanding of the subject. The courses are run in such a way that everyone gets the chance to ask as many questions as they need and each delegate is given written booklets and leaflets with regard to the subject matter. Tim also aims to teach the technicians something new about the subject, and stresses that for him one of the most important aspects is giving them the chance to meet technicians from other universities, creating networking opportunities to share experience and knowledge.

As a result of becoming involved in training Tim has had the opportunity to gain professional qualifications, and is able to keep up to speed with current legislation. He also enjoys travelling nationwide to train in other Universities and external companies, where he relishes meeting new people, many of whom have become good friends.

Without blowing his own trumpet too loudly, Tim says he as never received any bad feedback, he believes this is because the attendees are interested in the subjects, and because they have the opportunity to get involved, they enjoy themselves and learn more.

In terms of setting up the courses the problems Tim encountered were to do with collating all the relevant information and setting it into a course that would benefit all, as well as getting written permission to include photographs and information from the relevant regulatory bodies. For others thinking of setting up courses and workshops Tim recommends that course providers try to fit into Peoples working environments, times and needs, which has greatly helped him when doing training. He also suggests keeping it light hearted, and including humour which can help to captivate the audience, but stresses again that most of all, having their interaction is paramount to a successful training session.

The University is Sheffield is a staunch supporter of the HEaTED project although as Tim states "HEaTED has an uphill struggle to get the message across to personnel that there are many dynamic women and men who could pass on their expert knowledge to other members of staff. Working together with HEaTED has proven that with enough resources, our target audience is so much more easily obtainable."

Tim also commented that being a Training Co-ordinator does not just stop at the end of each course. He always explains that he is available to anyone, if they have a problem or question regarding the subjects taught, if they cannot get the answers they require. He believes that this has shown on so many occasions how his style of training is not just a way of putting forward the information, but allows others to use the experience on offer, and subsequently, he has also used the experience of attendees for his own benefit in University life.

For any one wanting advice on setting up courses or workshops, Tim is happy to make himself available to talk things through and share his experiences (please contact Michelle Jackson in the first instance michellejackson@istonline.org.uk).

Lab Gases

This course is designed for those who use compressed gases in a laboratory or workshop environment. It instructs delegates in the safe use of compressed gas cylinders, regulators etc. in both environments, and how to deal with the associated hazards. Delegates are taught how to identify, assemble, operate and maintain compressed gas cylinders and associated equipment. The course also provides instruction on the choice of regulators and how to use them in a correct and safe manner.

Comments received from delegates included

Having never fitted a regulator, I was given good instruction on fitting and leak testing a cylinder regulator.

I found the safety aspects of the course very interesting and useful.

I found the practical demonstration of fitting and leak testing helpful.

I found all aspects helpful.

Fitting of regulators and handling of bottles.

Practical demonstrations of leak testing.

Practical Tungsten Inert Gas (T.I.G.) Welding

This course should appeal to both the complete novice and to those with a basic understanding of the technique and who wish to develop their skills. (Those attending are sorted into groupings of similar ability). Although the course covers the theory of T.I.G. welding the emphasis is on developing practical welding skills. Demonstrations are provided of the skills required for welding a variety of materials including stainless steel, mild steel and aluminium. On completion of the course technicians should have developed their practical welding skills, understand the theory of T.I.G. welding, appreciate the safety implications and be confident in preparing weld sites and electrodes for different materials.

Comments received from delegates included

Feedback on our attempts at welding was positive and helpful.

I enjoyed the practical side. (several versions of this).

Hands on experience was very helpful.

Research fluorescence microscopes- how they work and getting the best out of your images & Research fluorescence microscopes- image acqusistion and image processing 21st October 2009

MANCHESTER 1824
The University of Manchester

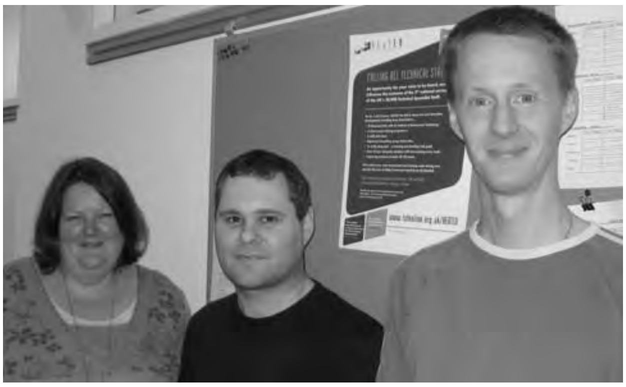
Peter March (Senior Experimental Officer), Jane Kott and Robert Fernandez (both Senior Technicians) in the Faculty of Life Sciences at The University of Manchester run the 'Research fluorescence microscopes- how they work and getting the best out of your images' (1 day) and the 'Research fluorescence microscopes- image acquisition and image processing' (2 day) courses.

Peter's team is based in a multimillion pound, state of the art Bioimaging Facility that provides training and advice to over 180 research groups in the Faculty of Life Sciences at the University of Manchester. Between them the imaging facility team has several years of experience and have helped to produce images which have appeared in many high impact journals. The facility boasts 18 microscopes ranging from basic fluorescent to multi-photon microscopes

Peter, Jane and Robert already run workshops for staff and students at The University of Manchester, and gain a great deal of satisfaction from leading these courses. Jane stated "It makes you really think about how to communicate the knowledge you have to others, and some of the questions can throw open new areas of knowledge that you need to explore." Peter hopes that the courses will save people time and money by reducing down time on broken microscopes and will also the reduce the need to call out engineers. He believes that with proper guidance technicians will be able to acquire and process better images, as he says "It doesn't matter how good your sample prep is if you have a badly aligned microscope or if you are using non-optimised dye filters. If you know your microscope is properly maintained and utilised then you will know for certain if your sample prep is up to scratch".

Both courses are aimed at people who have a fluorescent microscope in their laboratories and wish to learn how to maintain them and how to get the best images from them. The one day course includes demonstrations of microscope alignment, fluorescent dye filter optimisation, and experimental design. In the two day course the focus is on experimental design and delegates are taken through the process of preparing samples, acquiring and processing images. The courses are hands on and not just theory based.

These are new courses for the IST, and the first one day course will be run on 21October 2009.



Jane, Robert and Peter

Technologists in Nigeria

A personal view on the decline of University Science Laboratory Technologists in Nigeria

Paseda Ademola Adefemi

About 47 years ago, Science Laboratory Technology (SLT) was introduced in Nigeria with the great conviction that it would contribute immensely to national and individual development. Many students applied for this course with a certain expectation that it would fulfil their ambition, and further give them prestige alongside other professions. But this seems not to have been the case in the long run, and expectations have not been met.

Today, the office of technologist is not being valued in Nigeria, and to a larger extent a Graduate Assistant (GA) is given greater recognition than the Chief Technologist (CT). Ironically, most students seem to regard a senior technologist as a laboratory attendant, which demonstrates the perceived low profile attached to such position. There are some technologists, who hold a Higher National Diploma (HND) or Final Diploma (FD), which is a four year course accredited as equivalent to a pass degree, who now apply to study for a bachelor's degree because they feel that the profession has been relegated to the background. Instead they hope to gain teaching jobs at the end of their course. I have observed that today technologists are no longer interested in this as their first choice profession but now seek other jobs.

The number of technologists in Nigeria has continued to decrease geometrically and, at the time of writing this article, technologists in the country have embarked on a nationwide strike, agitating for a pay rise from the Federal Government. Statistics show that Nigerian universities have a shortage of technologists, to the extent that many technologists work double their normal hours in the laboratory and conduct several practical classes for students daily. Some of them have confessed that this pressure on their time and the reduced numbers has meant that they could not continue their education because they are the only one supporting the laboratory.

Staffing data reveals that there are now more female technologists than male, with a greater high end age profile in those males that remain in the profession. Younger generation males are no longer interested in the profession. Personally, my fear is that within the next 20 years there won't be skilled technologists in the universities or possibly any skilled technologists in the country if nothing is done urgently.

There is one national body for technologists in Nigeria and that is the National Institute of Science Laboratory Technology, which was founded on 25th of March, 1972. The National Secretariat is situated in Samonda, Ibadan. In 2006, its membership strength was put at 5,053 of which 1,760 are paid-up members, with their names and licenses up to date. Could it be that the people who have not renewed their membership feel that they no longer want to be in the association? I think that this is a very serious question, and one which we need to find the answer to.

In an interview with one of the state chairmen of the body, I was informed that he believed that technologists are receiving the recognition due to them. In terms of

remuneration they are being paid on the same scale as other prestigious professions in the country. The question remains then, that if this is true, why are members continuing to move to other professions? What has happened to the 3,293 members?

To address this question a questionnaire was distributed, despite the on-going strike, to 50 senior technologists (35 female and 15 male). The results showed that 15 percent said that, in spite of the way they are being treated by the Government, they still love the profession and their universities, but 85 percent confessed they are now ready to quit as university technologists for another Job.

In consideration to the current economic realities, a technologist working in a university should receive the appropriate recognition and be earning a reasonable living wage commensurate with their grade and years of experience. The current unrest suggests that this is not the case.

The over arching concern is that a downward spiral in the quality of Nigerian higher education will further encourage Nigerian families to send their children overseas for their education, with a resulting heavy cost to the Nigerian economy in both terms of finance and jobs.

In conclusion, I believe that the future of this great nation, the giant of Africa, lies in the hands of its technologists. Nigeria needs to recognise quickly that this profession must be recognised and encouraged, to both protect its current HE infrastructure and to develop and invest for its future.

Paseda Ademola Adefemi

University of Sebelas Maret
Faculty of Letters and Fine Arts

HEaTED
HIGHER EDUCATION & TECHNICIANS
EDUCATION & DEVELOPMENT

HEaTED Mentoring Support Network

Background

We are introducing a new Mentor Support Network utilising Technical, Managerial and Specialist staff with appropriate experience. These will be key people, equipped with many years experience in technical, administrative, managerial and specialist areas. They will have a specific role to facilitate guidance and offer advice to members (particularly new or young) both at a specialist level and on a wider spectrum such as personal and career development.

Through the HEaTED project, staff will forward initial mentee enquiries to an appropriate mentor. If the mentor feels that they are able to help the mentee with their requirements they will establish an initial contact. It will then be the responsibility of the mentee to drive any further contact and arrange meetings (our vision that this will take the form of telementoring to overcome the problem of geographically distant mentors and mentees). Guidance and direction will be offered by the mentor from the answer to a simple technical question to the more detailed review of skills training requirements.

The Benefits of Mentoring

Evidence from a variety of sources confirms that mentoring can be an effective and focused method for assisting personal/career development. The mentoring relationship provides opportunities for individuals to review and refine their skills and practices within a supportive and confidential environment. HEaTED is committed to providing improved support to its members and mentoring opportunities should help us to facilitate this.

Selection of Mentors

During 2009/10 the HEaTED project intends to build a network of mentors with proven experience or training in mentoring. Once these mentors have been inducted into the network their advice and guidance will be available for HEaTED members as and when required. If you are interested, either as a mentor or mentee, please complete the enclosed form and return it to the Institute of Science and Technology office who are our administrative partners. The information detailed on the form will enable us to build profiles of mentors and will facilitate the future matching of individuals in terms of interests and needs. Data gathered will be treated in the strictest confidence and will not be made available to any 3rd party outside of the mentoring network.

Support for Mentors

The HEaTED project is offering highly subsidized training for anyone interested in becoming a mentor. Completion of the course will qualify the candidate to become a HEaTED mentor.

Course details: 'Mentoring and Coaching Skills for Technical Specialists - an introduction to the IST/HEaTED scheme'

A workshop for Technical Colleagues interested in using their skills and expertise to support and help develop UK HE Technicians

Who for: This workshop has been designed for HEaTED members so that mentoring and coaching support systems can be established across the UK HE sector

Learning Outcomes

At the end of the programme delegates will have

- explored the benefits of mentoring and coaching
- assessed what is required to become an effective mentor/coach
- developed an understanding of the skill set required
- considered appropriate media and associated techniques
- reflected on their own performance from the practical elements of the programme
- considered how best to take this forward in their own workplace
- considered how best to support the wider HE Technical community through the IST/HEaTED scheme

Cost: HEaTED members £40 non-HEaTED members £80

Venue: Sheffield University other venues to be announced

Dates: 29th October 2009 other dates to be announced

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Book Review

THE CHEMISTRY OF FIREWORKS by Michael S.Russell

Review by Alan Gall, IST Archivist.

Chapter 1 Historical Introduction

Chapter 2 The Characteristics of Black Powder

Chapter 3 Rockets

Chapter 4 Mines and Shells

Chapter 5 Fountains

Chapter 6 Sparklers

Chapter 7 Bangers

Chapter 8 Roman Candles

Chapter 9 Gerbs and Wheels

Chapter 10 Special Effects

Chapter 11 Fireworks Safety

Chapter 12 Fireworks Legislation

When I was a lad we made our own entertainment, and occasionally even our own fireworks. Gunpowder proved too difficult to master so we used a certain weed-killer mixed with sugar. This had the advantage that we could create any desired colour effect, as long as it was yellow. Of course, a few added iron filings did produce some exiting sparks. These days such antics are not encouraged.

With my schoolboy pyrotechnic background and a year at the Nobel's Explosives Company learning about blasting, I was pleased to see the chemistry of fizzles and bangs featured in the aptly named *The Chemistry of Fireworks*. This is the second edition of a book that originally appeared in 2000. The first edition described it as part of a series of inexpensive texts on selected areas of chemical technology suitable for teachers and students. Its successor is not quite so inexpensive and may deter those with only a casual interest.

In an episode of the TV science-fiction series *Star Trek,* Captain James T. Kirk is shown stuffing a tube with sulfur, potassium nitrate and lumps of coal. With this makeshift weapon, using diamonds for shot, he defeats a lizard-like alien called a Gorn. We are led to believe that he has made gunpowder! The reality is very different and a workable black powder needs intimate mixing of the ingredients in the correct proportions. Centuries of refinement have resulted in a commonly used empirical formulation that that is actually quite close to the stoichiometric ratios required for the reaction.

The products of combustion can be quite varied, as is illustrated by the 'approximate' equation given in the historical introduction:

$$\begin{aligned} 74KNO_3 + 96C + 30S + 16H_2O &= 35N_2 + 56CO_2 + 14CO + 3CH_4 + 2H_2S + 4H_2 \\ &+ 19K_2CO_3 + 7K_2SO_4 + 8K_2S_2O_3 + 2K_2S \\ &+ 2KSCN + (NH_4)_2CO_3 + C + S \end{aligned}$$

The above corresponds to 75.7% potassium nitrate, 9.7% sulphur, 11.7% charcoal and 2.9% water. Also, there are all the combustion products from the added ingredients used for colouring and/or other effects, and some of these are compounds with known heath hazards. Indeed, there are lobby groups that would like to see fireworks banned on the grounds of pollution.

Some errors that crept into the first edition have been removed and a number of graphs have been re-drawn. In the chapter on The Characteristics of Black Powder, equations 2.10 and 2.11 have had a negative sign removed to correct them, for instance.

Amongst the interesting variations on the basic firework is the 'whistle effect', a high pitched noise produced by a series of small explosions when suitable aromatic compounds are incorporated into the mixture. Another special effect is created by adding a dye, such as the bright orange 1-(phenylazo)-2-napthol, to colour the smoke evolved. The dye content needs to be quite high because the added oxidiser (commonly potassium chlorate) and fuel, burning at a high temperature, tend to decompose the dye.

A welcome extra in the second edition is a brief history of some of the once familiar names in the business: Brock, Wells, Wessex, and Standard. Other changes are an expanded glossary, and the inclusion of extra photographs that originate from Pains Fireworks Ltd. Amongst the added definitions in the glossary is 'Burst Charge', offered as an alternative to 'Burster', which will please our American cousins who have adopted a terminology that does not always tally with our own.

The author is a practical firework-maker as well as a theorist. Figure 10.7 shows a set-piece display that he constructed on the occasion of his daughter's wedding. However, this illustration would have benefited greatly from being in colour, as would many of the other effects shown. The monochrome presentation hardly does justice to the subject and the reader will have to be content with the bright display shown on the front cover. To fully appreciate the text, the reader should be at about A-level standard and perhaps it will be in colleges that the book finds its main role. Readers without a scientific background can, of course, just skip over the more involved technical parts and there is much to interest those with an enquiring mind.

Personally, I very much enjoyed reading this book. Michael Russell is clearly a man who loves his subject and as he says: '…having a degree in chemistry and a birthday on the 5th November, what else could a person choose to write about?'

The Chemistry of Fireworks is published by The Royal Society of Chemistry 2009

ISBN 978-0-85404-127-5

150 x 230 mm. 166 pages, including index

Cost £24.99 (plus £3.50 postage if bought from the RSC)

See www.rsc.org/books

Thanks to Bob Hryndyj, Graphic Designer and Phil Murray of Black Cat Fireworks Ltd for the photos of fireworks in action, pictured on the cover of this issue.

HEaTED update

Michelle Jackson

In the summer IST journal I introduced the HEaTED project (Higher Education and Technicians Education and Development), which has formed a partnership with the IST. Through the IST, HEaTED aims to become the recognised professional association and advocate for technicians, raising the profile of technicians and getting the profession recognised as a valued community of practice within the UK higher education sector. There are a number of things HEaTED has already achieved

- A professional working relationship with IST as a base for national qualifications and development activities
- An annual 'showcase' UK conference for technical specialists, staff developers and HR professionals attended by over 300 people.
- A technical specialists mailbase for networking HEaTED
- Two UK surveys of the 30,000 Higher Education technical staff to find out what they really think and need completed by over 6,000 staff
- A central team committed to delivering the up to date services
- 'In at the deep end' – a learning and teaching online guide
- An accredited online national CPD programme
- Regional collaborative events in partnership with LFHE
- A membership of over 50 Universities so far
- A growing presence at major UK HE events
- Successful bids for funding to help the sustainability of the HEaTED agenda
- A short course training series
- A skills database highlighting information on providers of technical training and development

However the project team are not complacent, there is so much work to do in order to offer a service that is seen as being at the very centre of Higher Education.

The 2009 HEaTED Survey

This summer saw the launch of the largest ever co-ordinated survey of staff working in Higher Education. Built on the success of an earlier survey of staff views back in 2006, HEaTED 2009 asked technicians what it is like to work in UK HE right now. An amazing 3555 colleagues gave their opinions from 110 different organisations across the UK.

A full report is being produced outlining the main themes to be presented by the end of October – action will then be planned and promoted to members via the brand new HEaTED web site.

HEaTED
HIGHER EDUCATION & TECHNICIANS EDUCATION & DEVELOPMENT

The new HEaTED website

In conjunction with Green Hat (Graphic Design Consultants Limited), The HEaTED team have been designing a new bespoke website. The website will allow easy navigation to areas available to non-HEaTED members as well as password protected areas for members. It is hoped that the site will be available before the end of the year

The HEaTED newsletter

This autumn saw the launch of the HEaTED newsletter. The quarterly newsletter is sent out to the HEaTED mailbase but is freely available to anyone interested. It aims to give a brief update on HEaTED initiatives and progress in a format that can be emailed or printed out. To have a look at the first HEaTED newsletter visit http://www.heated.ac.uk/pdf/HEaTED_Newsletter_Autumn_09.pdf.

Train the Technical Trainer, University of Manchester 30th June 2009

Developed by members of the HEaTED project team a pilot course for a 'Train the Technical Trainer' event was hosted by the Staff Training and Development Unit at The University of Manchester. The event was a forerunner for more events of this kind to be held around the UK, and was specifically designed to enable technicians currently carrying out training, or those who might want to do so in the future, gain the skills and confidence to effectively run courses, seminars and workshops.

Twelve candidates from all over the UK, from Bath to St. Andrews, came to Manchester to experience this unique training session. Roger Morley led the session, and was assisted by Ken Bromfield.

The course was lively and highly interactive, using a number of different learning approaches. All candidates had the opportunity to do a short presentation which they all found useful if daunting to begin with.

Feedback from candidates about the course was very positive. Roger and Ken, the course leaders were rated very highly with nine out of twelve candidates stating

Roger Morley with course candidates

they were excellent and the remainder scoring them as good As a result of reports from candidates to their employer institutes both Durham and Newcastle Universities have invited Roger to present TtTT later this year.

Comments about the course

'Well planned'

'Relaxed atmosphere, positive feedback'

'Impressive and entertaining presentation'

'Really enjoyed the course, full of useful information'

'I shall be recommending it to colleagues'

'Course providers both very enthusiastic and informative'

'I enjoyed the course and took away some valuable ideas'

'The overall experience was both rewarding and enjoyable, and I heartily recommend this course for anybody thinking of setting up one of their own.'

The HEaTED project is planning to host two further free 'Train the Technical Trainer' events in Scotland and Brighton/Sussex. Please contact Wendy Mason (wendy.mason@heated.ac.uk) to enquire about places on the courses. We are also hosting more events (Nottingham, Durham and Newcastle Universities have signed up to host an event), however because of limited funds any additional courses will incur a fee of £95 per candidate, to cover running costs. If you are interested in hosting a 'Train the Technical Trainer' event in your institute please contact Michelle Jackson (michelle.jackson@heated.ac.uk, 01248 714965 mob: 0759 691 3058)

Contact HEaTED

If you would like any further information about HEaTED and the work it is doing please get in touch.

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Michelle Jackson
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Chairman's View

John Robinson

October 2009

As usual, when looking for inspiration to get the creative writing mood flowing, my mind focuses on recent events. I don't know why it does this; there are many other things to write about, such as progress in the restoration of the drop head Hillman Super Minx (slow), neglect of the bonsai collection (mildew and a variety of sap sucking beasties) and tales of injuries to kamikaze friends and relatives at a recent long weekend at Center Parcs. Bizarrely, mostly unrelated to the various unfamiliar activities during which one might expect to be injured; wild water chutes, horse riding, paddling kayaks and boxercise to name but a few, I think a dislocated shoulder incurred whilst playing Scrabble has to be some sort of record. And, yes, there was some alcohol consumed, but, Scrabble!? Whichever way you look at it, four ambulances called out and two visits to Carlisle Hospital A&E in three days is pretty impressive. And there were only eight of us!

But to events more recent; today has been, with the exception of a half hour meeting to discuss the School's strategies for increasing our alternative income streams (more pithily known as trying to raise a profit due to the inevitable forthcoming effects of the economic situation on government funding), occupied by reading application forms for the position of Stores Assistant. As if the recession wasn't obvious enough, 185 applications is a sharp reminder that it is for real and a colleague of mine reports over 300 applications for a junior admin post. Although one is very conscious of the human suffering that such a large response represents one has to remain pragmatic and continue with the prescribed short listing process. Which brings me to the very point I was intending to make; for every good, concise, well presented application I have seen today there are about 20 which miss the mark for a wide variety reasons, some trivial, but many which are seriously flawed. It's sad enough that there are so many desperate for a job, but how did we get into a situation where the majority are so disadvantaged by their experiences in life that they seem unable to put a decent application together?

The stark reality is that the blame lies squarely at the door of our managers who are failing to look after the all round development of their staff. As a manager myself I subscribe to the view that everything is the manager's fault; if we don't prepare ourselves and our staff for the future we are sadly lacking. Of course that's a tall order, and few of us are lucky enough to survive a stint in management without a few incidents they would rather forget; I still cringe over some of mine.

We all want to employ really good staff and when we have worked hard to recruit, train and develop them, the temptation is to try to keep them. There are those around who think the best way to do that is to block their progress and avoid developing them. I have even come across colleagues who won't allow very relevant training for the very reason that if they develop they are more likely to move on and progress. From my perspective this is complete madness as it will inevitably result in staff that reach a stalemate in their career progression and taken to its ultimate conclusion will result in poorly trained and disgruntled staff who can't find another job because they haven't got the skills to demonstrate a decent track record and put an application together that will get them short listed for interview, let alone perform well at an interview and work out how to get ahead of the other candidates.

It's not rocket science for managers to work out that they want staff who deliver, are sharp and on the button, solve problems before they (their managers) have even spotted them, are willing to take on new tasks, like to get stuck into new challenges and have superb personal and interpersonal skills. Those same managers however fail to see the other side of the equation: people with those skills tend to have confidence in their own ability and are highly likely to be ambitious and successful. So if it's a choice between that and someone who is poorly trained, prevented from developing, and ends up disgruntled and can't move on, I know which I'm going for – even if it only lasts a few years. I'd rather have three years of the former than twenty of the latter.

Being of a certain age I have friends and colleagues who have also "been around a bit" (apologies if you identify yourself here!) and their one, common, deep satisfaction is to see staff flourish and develop under their guidance. I know of one technician who became the head of the research institute that first employed him and another who established his own successful laboratory supplies company, although my "personal best" is much more modest. Nevertheless I am delighted to have watched a couple of staff rise to the level that I am at now and another well above me, albeit in a different field.

So if a member of your staff wants to develop, encourage her or him and get them to start with a decent CV and job description; these contribute to an effective annual review process or appraisal and so should really be routinely updated. On top of that, if they are applying for a new position, offer your help with that too. And my over-riding comments for anyone applying for a new job is; read the paperwork thoroughly and do what it asks you to do. Then make sure that your application is tuned in to that particular job description and that it clearly demonstrates as many as possible of those skills which are listed in the person specification. Then, if you are lucky, (and there's always an element of that as there's no way of assessing the competition) you might get shortlisted. At which time you will need to think about interview skills: but that will have to wait for another time.

If you can't wait though, I've just put "interview skills" in Google and got: Results **1 - 10** of about **81,400,000** for **interview skills** (**0.27** seconds); it's easily available if you need it.

Your Professional Standing

IST Registered Practitioners

Since 1987, the Institute of Science & Technology has operated a Register of competent and qualified technical practitioners. As the professional body for specialist, technical and managerial staff, we are actively involved in improving the status of, and the services offered by, technical staff in education, research, government and industry and it is our view that the Registration Scheme for laboratory and other technical practitioners is essential if their status, career prospects and expertise are to be recognised and enhanced, or indeed maintained.

Registered Practitioners must have attained a high level of technical proficiency supported by sufficient knowledge of modern technology to enable them to relate to operating practices in their chosen field.

Criteria for Registration include:

- Corporate Membership of the Institute of Science & Technology
- Higher National Certificate or Diploma (other qualifications judged to be of equivalent standard also satisfy the requirements)
- NVQ/SVQ level 3 or 4 in an appropriate occupational area
- Completion of the HEaTED/IST CPD award
- Appropriate experience (in terms of breadth, depth and length)

There is also a route for mature applicants who have achieved a high standard of professional competence but who may not have appropriate formal academic qualifications.

Registered Practitioners are permitted to use the post-nominal, designatory letters MIScT(Reg) or FIScT(Reg).

Registration must be renewed each year and the renewal application should be accompanied by evidence of Professional and Personal Development. Registered practitioners may be removed from the Register if:

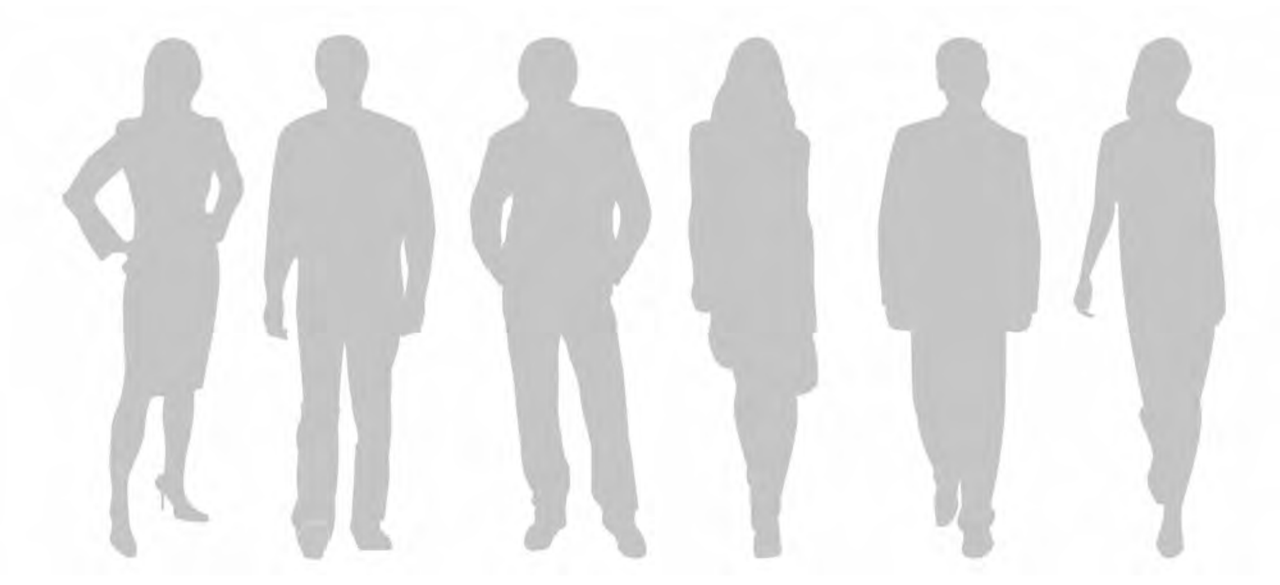
i) they fail to undertake any PPD in a 4-year period, or

ii) there is evidence that their professional conduct falls below the standard expected, or

iii) they cease to be a technical practitioner.

There is a fee for admission to the Register and a nominal annual renewal fee.

For further information, and an application form, contact the IST office or visit the website.



IST New Members

June - September 2009

NEW MEMBERS LIST

Membership No	Members Name	Grade
T14673	Mrs O O Akinwunmi	MIScT
T14674	Mr N A Gurney	MIScT
T14675	Mr D Gill	MIScT
T14676	Mr N Alderman	MIScT
T14677	Mr G Yeo	MIScT
T14678	Mr D Thomas	MIScT
T14679	Dr C Reuter	MIScT
T14680	Mr R B Nicholson	MIScT
T14681	Mr E Adu-Ofori	AssocIScT
T14682	Miss B Scott	MIScT
T14683	Mr E Lazarou	MIScT
T14684	Mr D Cox	MIScT
T14685	Mrs I Abina	MIScT
T14686	Mr A P Rigby	MIScT
T14687	Mrs S M Johnson	MIScT
T14688	Mr D J Fishlock	MIScT
T14689	Mr C W A Clements	MIScT
T14690	Mr J Kerwin	FIScT
T14691	Mrs H Bischof	MIScT
T14692	Mrs A Shergill	MIScT
20 IN TOTAL		

UPGRADES

Membership No	Members Name	Grade
T14618	Ms C J Davison	FIScT
1 IN TOTAL		

ELECTED VICE PRESIDENTS

Membership No	Members Name	Grade
T8897	Mr I A Gray	MIScT
T14297	Mr T D Evans	MIScT
2 IN TOTAL		

Institute Officers and Structure

The Executive

President
Bob Hardwick MEd FCIPD MIScT

Chairman
John Robinson FIScT MInstLM

Honorary Secretary
Mandy Taylor MIScT

Treasurer
Michelle Jackson FIScT

Education Officer and Chair of the Education Board
Philippa Nobbs FIScT

Marketing Officer and Chair of the Marketing Board
Terry Croft MBE BA PGDC FIScT

Fellowship and Overseas Secretary
Derek Sayers FIScT MInstLM

The Education Board

Sheila Chapman MIScT
David Forster FIScT
Jacky Holt MIScT - CPD Officer

The Marketing and Editorial Board

Alan Gall FIScT
Stephen Gamble MIScT
Ian Gray MIScT
Ian Moulson FIScT – Editor

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Maida Davidson FIScT
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Dr K Christie BSc PhD
Terry Evans MIScT
Ian Gray MIScT
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Prof DJ Waddington BSc ARCS DIC PhD
Prof FR Winton MD DSc MB BS MRCS LRCP
Lord Perry of Walton OBE MD DSc FRCPE

THERE'S A FLY IN MY SOUP

… and other brainteasers.

Alan Gall, IST Archivist ▶

From soup to fly

Starting with the word SOUP change each letter in turn to obtain the word FLY according to the following rules:

1. Only one letter at a time can be changed and the new word must be a valid 'dictionary' word.
2. To eventually arrive at the word FLY, one of the letters must be discarded.
   This can be done at any time provided the word produced is also valid.
3. Each change of letter or the removal of a letter counts as one step in the process.
4. To make life more difficult, the word SOY is not allowed.

Find any route that uses no more than four steps.

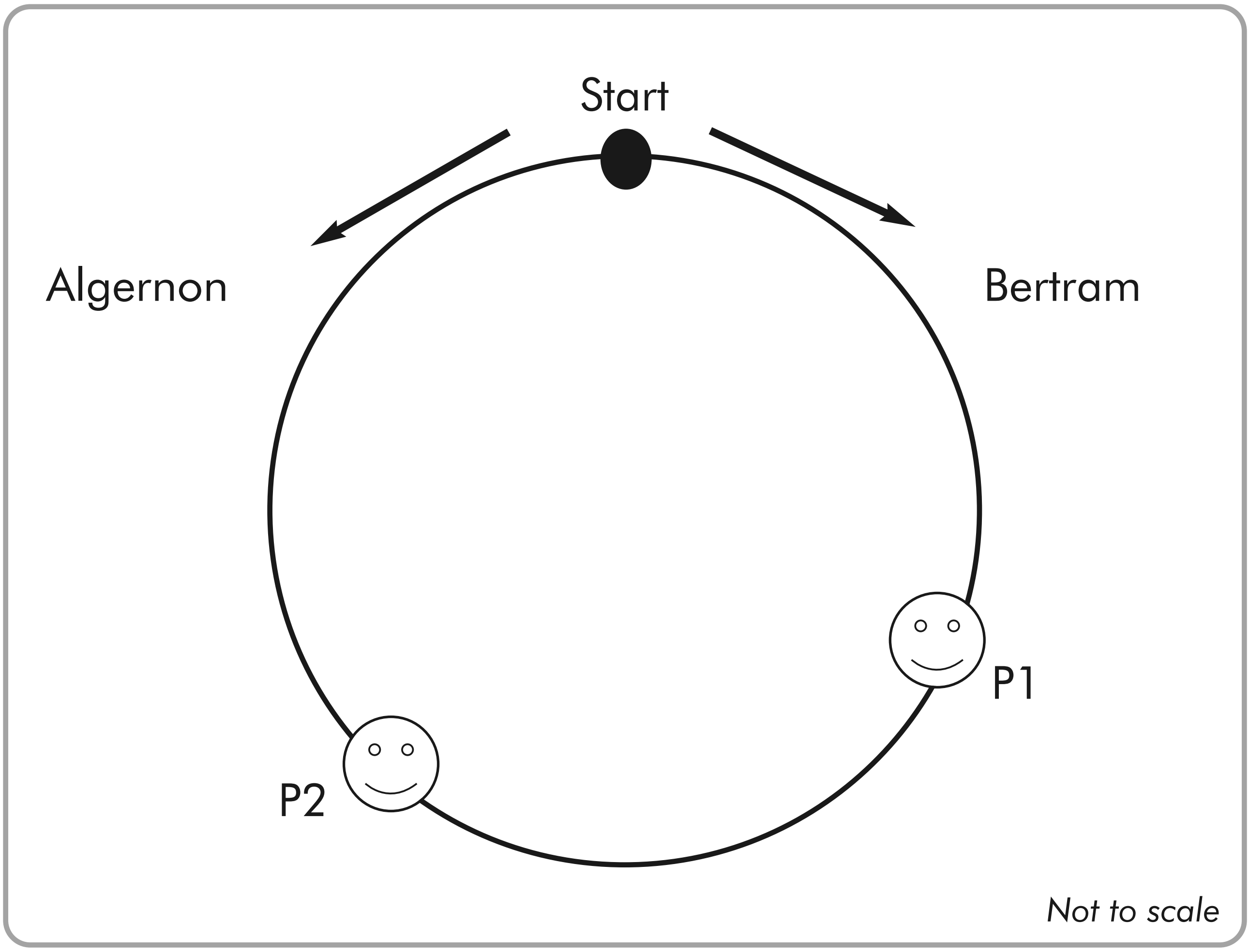
Bluebottle Soup

Two bluebottles, Algernon and Bertram, are practising their breaststroke in a bowl of chicken broth. Both set off from the same point but in opposite directions. They swim along the inside edge of the bowl and since Algernon has eaten less of the soup beforehand, he is faster than his companion.

The flies first meet each other at a point P1, which is 176mm from the start (measured clockwise). Algernon meets Bertram for the second time at a point P2 207mm past the start point (measured anticlockwise).

How big is the bowl in circumference?

Assume that each fly swims at constant speed and that distances are measured along the circumference.



Hint: The solution can be obtained without the need to solve a quadratic equation.

Same flies, different bowl

Bertram swims around a square soup bowl. Along the first edge he swims at 1 kph, along the second 2 kph and along the third 3 kph. Algenon has been observing with his stopwatch and works out that the average speed over the whole distance was 2 kph.

How fast did Bertram swim along the fourth edge?

String Theory

Take a piece of string with unit length. Make two cuts at random places. What is the probability that one of the three resulting sections is at least half a unit long?

Thanks to Bob Cutts and Martin Fraser for suggesting problems.

Solutions to **alangall@hotmail.com** or the **IST office.** Please include your name and membership number.

For the first correct answer to each question we are offering a separate £10 book token (a total of £40).

From the Archives

Alan Gall

Sod's Law, in one of its many variants, says that a really good illustration for an article will turn up just too late for publication. The following are a few of the pictures that almost made it on time.

William Alexander Kay: Technician Supreme - IST Journal April 2003

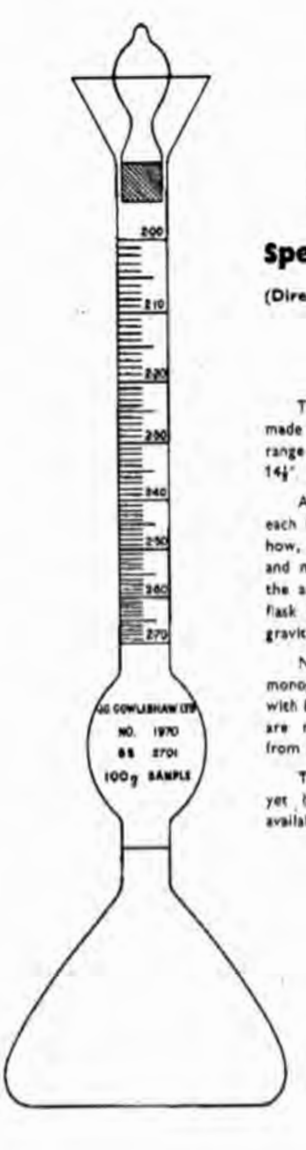
Unique amongst university chief technicians, William Kay not only received an honorary degree but had a university building named after him as well. His assistance with the research work of Nobel Prize-winning physicist Ernest Rutherford gained him worldwide acclaim as one at the very pinnacle of his profession. In the original article, I speculated on why William signed his marriage certificate with a cross. Thanks to Darelle Craig, William's granddaughter, all can be revealed.

On what was probably a night out on the town, William managed to put his hand through a window and sever an artery. This had to be ligatured, a procedure that caused permanent damage to his hand.

William Kay's honorary MSc certificate (Courtesy of Darelle Craig and James Kay)

Rutherford's Glassblowers – IST Journal December 2004

Otto Baumbach will forever be remembered for his construction of the apparatus that Rutherford used to prove the identity of alpha radiation as a stream of fast-moving helium nuclei. After his university career, cut short by internment, Otto went on to establish a successful business as a commercial glassblower under the trading name of J.C.Cowlishaw Ltd. The photo shown here is of Otto working in his premises at 42 Bridge Street, Manchester. Also from the Bridge Street days (the Company moved on to Peary Street in 1963) is a drawing taken from the catalogue.



The Rees Hugill Specific Gravity Flask

(Direct Reading Powder Density Flask)

The Rees Hugill flask illustrated is made to comply with B.S.2701 and has a range of 2·00 to 2·70. Height approximately 14½".

An instruction book is supplied with each flask providing a table which shows how, by using different sample weights, and multiplying the resultant readings by the appropriate factor, this one range of flask can be used to cover any specific gravity range between 1 and 5·4.

N.P.L. tested flasks, marked with their monogram, indicating that they comply with B.S. 2701 in every respect (certificates are not issued), are normally available from stock.

The following ranges, which have not yet been standardised, are also usually available from stock.

2·30 to 3·00	3·00 to 3·70
2·60 to 3·30	3·30 to 4·00

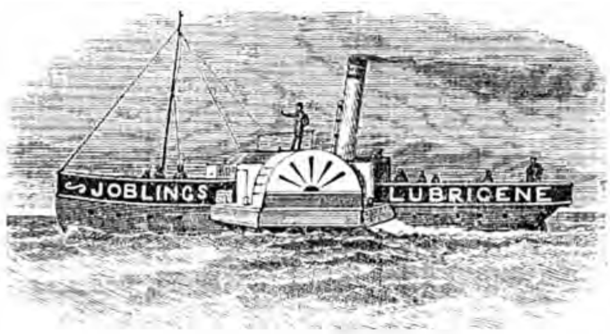
Fig. 20

An item from the Cowlishaw Catalogue, undated but probably late 1950s (Courtesy of Stanley Taylor)

Otto Baumbach at work in 1928 (Courtesy of Philip Baumbach)

James Jobling and Pyrex – IST Journal Autumn 2007

Well before Pyrex came on the scene, indeed before James Jobling even started running a glassworks, his name was associated with oil and grease. In 1882 James Augustus Jobling registered a trademark for Lubrigene lubricating oils. Elaborate trademarks were often used in those days and the one chosen by Jobling depicts a paddle steamer that he may well have seen from his grease factory near the banks of the River Tyne. It was James Jobling's nephew who saw clearly the potential of Pyrex in the UK and secured a deal with America's Corning Glassworks, transforming the fortunes of what was an unremarkable manufacturer at the time.



James Jobling's 1882 trademark, reflecting the shipbuilding tradition of the Tyneside area

Ernest Joseph Jobling-Purser, nephew of James Augustus Jobling

GEC and the Telephone – IST Journal Spring 2008

A devastating fire in 1895 destroyed much of GEC's original main factory in Salford. The founders of GEC bought the property when the Electric Portable Battery and Gas Igniting Company Ltd went bankrupt in 1887. Engravings, like the one shown here, were not always accurate. Often, a sketch was made at the location and taken back to a workshop were others would engrave the image without ever seeing the original building. Appropriately, an automatic telephone exchange was built partly on the site. When completed in 1928 it held the record as the largest post office building in the country.

The main works of GEC from 1888 to 1895 at Clegg's Court, Chapel Street, Salford.

The Post Office's automatic telephone exchange on Chapel Street, Salford. Building work was completed in 1928 and installation of equipment begun. (Courtesy of Sue Richardson)

Institute Merchandise

We do have plans to introduce additions to our corporate merchandise over the next few months but for now we just have ties available. These are smart and modern, navy blue and are of a high quality. Please contact the IST office.

***New Style* Blue Ties**

£10.00 + postage

Reverse of cover page.

The Institute of Science & Technology

The Journal

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