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INSTITUTE OF BREWING

THE SECTIONS

London Section

On the 22nd October 1984, a joint meeting of the Incorporated Brewers Guild and the Institute of Brewing (London Section) was held at the London School of Economics, Houghton Street, The lecture, presented by I. D. M. Oag Esq., was entitled 'Practical Experiences of Packaging Beer in PET Bottles'.

Polyethylene terephthalate (PET) is a product of the Petroleum and Natural Gas industries. It is a fibrous plastic and was first used to make bottles in 1979, since then it has become well accepted by the soft drinks industry.

Allied Breweries began packaging beer in two litre PET bottles in 1981 and so now has three years experience of the operation. The bottles are produced from granules of PET which are injection moulded to produce preforms to precise specifications. The neck portion of the bottle to be is fully formed at this stage, including the screw thread. The final shape of the bottle is produced at high temperatures on a stretch/blow moulder. This method of production means that the fibres of the plastic are stretched first longitudinally then laterally and this treatment contributes to the final strength of the bottles (they will with stand pressures of 300–350 psi before bursting). The base of the bottles is rounded and so requires the addition of a base cap of cheap plastic (PET is expensive—£1,050 tonne) so that the bottle can stand upright.

The bottles arrive from the manufacturers in a sterile condition and must be stored in a 'no smoking' area because they are extremely flammable and need to be kept clean, cool and dry. Pallets can only be stacked three high because, when empty, the bottles may collapse.

The PET bottles are transferred to the packaging line conveyer (80 bottles/min) employing a sweep depalletiser. They pass to a rinser and thence, via a covered conveyer, to a forty-head filler. PET bottles are not resistant to heat and so cannot be pasteurised, thus the practice is to pasteurise the beer and then fill the bottles under sterile conditions. To this end the filler is surrounded by an area which is pressurised with sterile air and the beer dispensed with a short tube-filler. The bottles would collapse if evacuated prior to filling but oxygen pick-up is minimised with a quiet fill action and headspace air is further reduced by fobbing just prior to capping (oxygen level of beer 0·2 ppm at bottling). Roll-on aluminium caps, with plastic inserts, are used because the threads match better with the preformed bottle neck acting as a template. The beer fob acts as a very effective glue and so the capper torque has to be reduced to prevent the caps becoming stuck to the bottles.

Great care is taken to maintain sterility and checks are carried out on the beer, pasteuriser, sterile beer tank inlet and outlet, filler inlet, empty bottle rinses and cap rinses. The packaged beer is also held in quarantine for one week in case any of the tests prove positive. Labelling of PET bottles has caused many problems but can be achieved if the bottles are dry and the specifications of the glues and paper are strictly observed.

The total amount of beer packaged by U.K. breweries in PET bottles is expected to be 400,000 barrels in 1984. This figure could rise to 600,000 barrels in 1985 accounting for about one tenth of the small-packaged beer market. PET bottles are cost competitive and at 18p/two litre bottles are cheaper than cans. They are lightweight (70 to 80g each) and shatterproof. The main disadvantge of PET is the poor gas barrier properties allowing loss of carbon dioxide and pick up of oxygen. These problems have largely been overcome by adding a coating of polyvinylidene chloride (PVd.C) over the outside of the bottles. Shelf-life of the beer in PET bottles is quoted at 20 weeks, this compares with 30 weeks for canned beers.

On the 12th November 1984 a meeting of the London Section of the Institute of Brewing was held at the London School of Economics, Houghton Street. Four short presentations were given by a panel consisting of W. J. W. Lloyd, Dr P. A. Brookes, Dr C. C. Thompson and A. M. Upperton, on the subject of 'Malt Quality and Brewing Performance'. A question and answer session chaired by Mr P. G. W. Simmonds, followed the presentations.

W. J. W. Lloyd, began by saying that when using a poor malt in a brewery there was an 8–10% increase in the processing cost. Laboratory investigations had shown varietal differences in barley starch gelatinisation temperatures and that a low temperature differential between mashing and sparging temperatures minimised the amount of starch found in the wort. The friability of malt was dependant on the level of nitrogenous components.

Dr P. A. Brookes concentrated on the value of long term statistical analysis in relating malt quality to brewing performance. A multiple regression technique had indicated that most information about brewhouse performance was obtained from only four analyses of malt. Hot water extract alone yielded 70% of this information (coarse grind correlating with wort run-off). The soluble nitrogen ratio and inverse of the total nitrogen of malt correlated with brewhouse yield whilst the hot water extract at setting 7 on the Miag mill correlated with wort fermentability. Multiple regression techniques had also been used to derive an equation predicting malt S-methyl methionine levels from such factors as germination time, bromate levels and malt colour.

Dr C. C. Thompson stressed the huge amount of data collected by a quality control department during a year and suggested that this information could only be handled by computer. His company examined about a third of its

annual data on analytical values for malts but have found it difficult to find correlations with brewery extracts.

A. M. Upperton, pointed out that more research work was needed on the flavour effects produced by the use of crystal malt and roasted adjuncts (e.g. barley). He also expressed concern over the quality of some new malting barley varieties which had not lived up to earlier expectations.

A lively discussion followed the presentations and the main topics considered were:

1. Whether differences in quality of malt caused by either seasonal variation within a barley variety or differences between plants processing the same variety, are greater than the differences between varieties.
2. Techniques to evaluate new barley varieties.
3. Which malt parameters most affected beer had retention value (H.R.V.).
4. The effect of low barley nitrogen levels experienced in 1983 on beer H.R.V.
5. Whether feed barleys would eventually exclude malting grade barleys.
6. The effect of EEC quota regulations on the barley market.
7. Increased off-kiln malt moisture.
8. The effect of malt storage after kilning.

At the end of this discussion J. D. Hill, proposed a vote of thanks to all the panel members and contributors, who had made the evening such a success.

On the 10th December 1984 a meeting of the London Section of the Institute of Brewing was held at the London School of Economics, Houghton Street. The lecture, presented by Mr. J. Henley, of Showerings Ltd., Shepton Mallet was entitled 'Cider Making'.

Showerings manufacture Babycham (a perry) and both Coates and Gaymers range of ciders. In the U.K. there is a voluntary description of cider as a beverage obtained by fermentation of apple and pear juice (maximum of 25% pears if the produce is to be cider and the reverse i.e. 25% apples if the produce is to be a perry), to which may be added sugar and potable water. The amount of alcohol present ranges from 3 to 8·5% v/v dependent on the type of cider. Above 8·5% v/v alcohol the cider becomes a wine for taxation purposes and the tax leaps from £15/hl to £95/hl.

Nowadays a substantial proportion of cider apples are grown on bush trees. The resulting orchards contain 200 trees/acre and yield 10–15 tonnes/acre of fruit, the trees reaching maximum, cropping potential after five years. Although easier to spray and harvest than old style orchards they suffer from some disadvantages. They are more expensive to establish, require fencing protection against rabbits, do not allow grazing or intercropping and are more likely to suffer from biennialism (the phenomenon of alternating high yielding years with rest years). A selection of different varieties of apple are grown, the preferred types being the so called bitter sweet apples which are high in sugar and tannin content and of low acidity. Showerings also use some sharp apples of high acidity (e.g. Bramleys) as this produces a juice that is good for blending. One orchard will usually contain about six different varieties of applies to ensure cross pollination and long flowering and fruiting times (16 weeks). Other criteria considered when choosing the varieties are the amount of gross yield, disease resistance, the durability and pressing quality of the fruit. Harvesting is carried out by gently vibrating the tree with a mechanical shaker and employing a machine harvester to sweep up the applies from the ground.

The apples arrive at the processing site in anything from sacks to 2 tonne lorry loads. They are tipped into a silo and moved around by water to an elevator through a freshwater rinse, to the mill producing a pulp which passes to a mechanical press processing 5t/hour. The residue, known as pumice, is sold for cattle food or dried for the extraction of pectin. The yield of juice is about 170 gallons/tonne of fruit depending on the crop. The juice is either centrifuged and treated with SO_2 and culture yeast added to start the fermentation or the juice may be concentrated. This latter process enables the juice to be stored for subsequent fermentation. The concentration plant is capable of handling 3000 galls juice/hour from which is produced 330 to 340 galls of concentrate at 74° Brix.

After fermentation, which is not strictly temperature controlled, the cider is racked and centrifuged, fined, or filtered and stored in large tanks of varied sizes and materials (the largest of these tanks in the U.K. holds 7·5 million litres). Repitching of yeast from one fermentation to another is not practiced by Showerings. The cider is held in store for about 6 months, during this time malo-lactic fermentation can occur which results in the production of beneficial flavours.

Prior to packaging and sale the ciders may be blended, sweetened and clarified employing a variety of filtration systems. Alcohol and acidity levels are adjusted and SO_2 added to the cider which may also be carbonated as required. Packaging is carried out into 11 gallon kegs (kegging plant operates at 280 kegs/hr) or bottles, either glass or PET. Draught cider (i.e. in kegs) accounts for about 40% of the total U.K. market which in the last 10–12 years had increased from 20 to 68 million gallons/annum.

Biennial Dinner—15th October 1984

Over 550 members and guests of the London Section attended the biennial dinner at the Hilton Hotel on Park Lane on Monday, 15th October. The Section Chairman, Mr. John Pierce, presided. The President of the Institute, Mr. Norman Curtis, presented certificates to the successful candidates from the London Section in the Diploma Membership and Associate Membership examinations of 1984. He also made presentations to the Past President, Mr. Michael Chalcroft, Dr. Tom Carroll, recently retired from the post of Treasurer of the Institute, and Dr. Charlie Bamforth, winner of the Cambridge prize.

The toast to the London Section of the Institute of Brewing was proposed, most entertainingly, by Mr. Norris McWirter, editor of the Guinness Book of Records. His ability to recall and quote the obscurest items from its pages must constitute a record in its own right. Responding on behalf of the Section, the Chairman recalled the contributions to recent Cambridge Meetings by Professor Narziss, Professor Enari and Dr. Bamforth. He thanked the Section Committee for their support and his predecessor, Mr. John Fortescue for arranging an enjoyable visit to the Romford Brewery.

In proposing the health of the guests, the Chairman welcomed Dr L. R. Bishop and Dr. J. R. Hudson, both Horace Brown Medalists, Dr R. Neve and representatives of the European Brewing Convention, the Brewing Research Foundation, the Incorporated Brewers' Guild, the Allied Traders Association and the Maltsters' Association of Great Britain as well as representatives of the other Sections of the Institute. He also welcomed the Reverend L. E. M. Claxton, Honorary Chaplain to the Institute and Major General J. D. Lunt, previously Bursar of Wadham College, Oxford.

Replying on behalf of the guests, Major General Lunt spoke warmly of the occasions upon which Wadham College acts as hosts to the Institute for the biennial Oxford Meetings. His audience was left in no doubt that these brief invasions cause less disturbance to the even tenor of Oxford life than did the throwing open of the College to women students with its consequent need to regularise and upgrade the domestic arrangements.

This most successful dinner concluded, as is usual, at various times and in various places.

Western Section

The offices of Arthur Guinness Son & Company were the venue for the first meeting of the season on 19th October, 1984, chaired by Mr. James Craven-Smith, when Dr. C. Bamforth read his Cambridge Prize Lecture entitled 'Biochemical Approaches to Beer Quality' (for full text see J.I.B. Vol. 90. No. 6).

Members were most impressed with the range of topics covered and with the clear, but detailed, way in which they were presented. Following a lively discussion our hosts kindly provided a buffet supper and refreshments which were enjoyed by all.

With Mr. James Craven-Smith in the chair, the second meeting of the winter season was held on 5th December, 1984 at the Cardiff Brewery of Bass Brewing Limited, when Mr. R. M. Tollervey of H. M. Customs & Excise presented a paper entitled 'Her Majesty's Duty of Excise'.

Three hundred years ago the Excise gathered in some £500,000 a year compared with today's figure of over 31 billion pounds, beer duty accounting for £1,678·8 m net. The earliest records of Excise Officers visiting Breweries go back to 1660 when they had to check 'the gauge in the cask'—that is to measure its capacity. From that date the principle of Excise control of breweries was established, and by the end of the 17th Century the system had been so refined that many of its features survive even to the present day.

In 1830 beer duty was abolished. For some time it had been considered unfair in that large brewers were favoured while private brewers were exempt. Also, despite up to 8 visits per day to some breweries, numerous frauds occurred. This abolition left only a charge on the malt hops and sugar which in its turn was abolished in 1880 to make way for a revolutionary beer duty based on the Specific Gravity of beer, which since 1847 could be tested by saccharometer. This duty was charged on the amount of beer brewed at a standard gravity, and since it was considered that 36 gallons of beer brewed at a gravity of 1055° was equivalent to the duty from two bushels of malt, the standard was fixed at 1055°.

Over the last 100 years there have been four alterations to the system of beer duty collection and the way in which it was controlled. However, pressure on public spending is about to bring about a major change in brewery control and procedures. Within the Beer Regulations 1984, now in draft form for submission to the Minister, are proposals to introduce self assessment and trader gauging.

With self assessment the brewer has to record bulk litres from the dip at each gravity equivalent in standard litres at 1055°, and the gross charge from materials with the percentage of standard litres over or under the gross charge. The brewer also has to calculate month-end totals before delivering the Brewing Record to the brewery officer not later than the 7th calendar day of the month following. Together with the Brewing Record and Record of Collections, the brewer has to complete a monthly return of beer duty due which will be net of any deductions in respect of, for example, Spoilt Beer or Accidental Losses, as advised by the Officer.

After these three forms have been submitted, the brewer receives a 'Notice of Liability to Beer Duty' and duty is then paid as at present by the 25th day of the month following the month in which duty is due.

Under the proposals concerning gauging, the gauging of vessels used for raising revenue accounts will, in the future, be the responsibility of the brewer. If the brewer himself cannot carry out this task to the satisfaction of the Commissioners, he will have to employ a contractor to perform the gauging or regauging. If the Commissioners become dissatisfied with a gauging they will write to the brewer advising him that that particular vessel may not be used until it has been gauged to his satisfaction.

With such fundamental changes affecting the majority of the audience present, a long and lively discussion followed the paper, after which members enjoyed a buffet supper kindly provided by our hosts.

Council Meeting

A MEETING of the COUNCIL of the Institute of Brewing was held at 42 Portman Square, London W.1 on Monday 15th October 1984. Mr N. S. Curtis (President) was in the Chair and 26 members of the Council were present.

1. *Minutes.* The Minutes of the last meeting (30.7.84) were confirmed and signed.

2. *Obituary.* The Secretary reported with regret that the following members had died since the last meeting: J. H. Heard and L. V. Lecomber.

3. *Resignations.* The resignations of 17 individual members were received.

4. *Restoration of membership.* The Council approved the restoration of membership without break, of Mr M. E. Ogberagha (Member).

5. *Life members.* The Council approved the election of the following members: E. S. Allcott, A. D. B. Arroll, R. G. Ault, K. S. Baby, N. B. Baird, W. J. Baker, R. S. Burgoyne-Johnson, J. P. U. Burr, A. C. Case, K. L. Chandler, R. D. Combe, R. Dickins, J. Drummond, J. G. Duncan, R. M. Falwasser, J. H. Fletcher, K. M. Fuller, J. S. Gardiner, G. Grandison, A. P. Grant, E. N. Hamnett, J. B. Hampson, R. W. Harris, J. D. Heath, J. G. Heron, E. H. J. Hollebone, P. V. Hubscher, K. B. Jakobsen, G. A. Jessup, J. J. Kavanagh, C. A. Kloss, A. C. D. Lacey, H. Laing, R. Langford, J. R. Leachman, R. K. Logan, H. V. Lorenz, T. Manson, J. F. Marr, K. D. McNamara, K. E. J. Morison, E. E. Neschke, S. J. O'Leary, A. Parker, T. S. Pearson, L. L. Pike, D. O. Plummer, J. S. Pritchard, C. E. Resch, R. H. Roberts, H. N. Slater, D. Sharratt, C. J. D. Sleeman, A. F. Twist, J. G. Ure, A. L. Vale, D. W. M. Vaughan, S. E. Walker, N. H. R. Wardle, R. C. Webster, E. J. Whitton, W. A. Wiles, E. T. Williams, A. G. Williamson, J. R. C. Worrall, H. Wright-Winter.

6. *Members in Retirement.* One Member-in-Retirement exercised his option to commute his subscription.

7. *Election of New Members.* The following were elected in the grades and Sections indicated:

MEMBER. M. Aitken, A. K. Basu, S. G. Charkham, P. R. Clark, G. M. Cosma, N. A. Evans, C. J. Khan, E. Reid, S. C. Whitbread, A. J. Whitehead (*London*); S. J. Kirby, T. Parker (*Yorkshire & North Eastern*); B. Breslin, B. A. Linblom, A. A. MacDonald, S. K. R. Naidu, R. S. Wall (*Scottish*); C. A. Boulton, J. M. Bexon, W. E. Lancashire (*Burton-on-Trent*); S. L. Mould, J. Pugh (*North of England*); S. Henderson, A. A. McDiarmid (*Central & Southern African*).

STUDENT. J. M. Banda, W. L. Lawrence.

8. *Reports of Standing Committees.*

8.1. *General Purposses:* The Deputy President reported that the GPC had agreed that it would be appropriate to award two Horace Brown Medals in 1986, one to be a UK recipient and the other from overseas, to recognise the increasing international activities of the Institute.

8.2. *Research Board:* The Council adopted the report of a meeting held on 5.9.84. Dr G. A. Howard reported that a sub-committee of the Research Board would be formed to discuss nominations for the Horace Brown Medal.

8.3 *Joint Maker/User Committee:* The Council adopted the report of a meeting held on 11.10.84. The Scientific Secretary outlined the structure of the JMC Workshop on The Processing of Surplus Yeast and Tank Bottoms to be held at BRF in March 1985.

9. *European Brewery Convention:* Mr Curtis reported that the Institute had been extremely successful in their applications to present papers/posters at next years EBC

Congress in Helsinki. Seven papers, and 16 posters had been selected. In addition Dr A. L. Whitear was to give a Survey paper on Hops, and Dr A. D. Portno was to Chair a Workshop on the Effects of the New Malting & Brewing Equipment and Processes on Quality.

10 *President's Report*

10.1 BRF Council (8.10.84): The President reported that there had been a highly successful meeting with the Brewer's Society concerning the future financing of BRF which would preserve the income in real terms for the foreseable future.

For the first time in recent years the Brewer's Society grant was above that of RPI.

10.2 *Classes of Membership:* A report on the first meeting of the Membership Committee would be made at the next Council meeting.

10.3 *Brewing Technology Services:* Mr Richardson reported that the three Institute representatives (himself, Mr M. Chalcraft and Dr A. D. Portno) had now been formally elected as Directors of the re-constituted BTS.

10.4 *IOB Centenary 1986:* Mr Curtis reported that the Steering Committee had held their inaugural meeting. It had been decided that the major project would be to raise funds to provide a Lecture Hall at BRF.

10.5 *Brewster:* The Secretary reported that the Committee were now finalising the Conclusions and Recommendations.

10.6 *Oxford Meeting:* Another successful meeting had been organised by the London Section. The meeting had been well supported, particularly by younger members.

10.7 *Belgium Study Tour:* The Secretary reported that the delegation of 26 Institute members led by the President would be attending the Study Tour from 22nd to 26th October 1984.

OXFORD MEETING

The Institute of Brewing Oxford Meeting, arranged by the London Section, was held on 25th and 26th September 1984. The meeting comprised five lectures in the afternoon of the first day with a further five the following morning. The meeting was opened by the London Section Chairman, Mr J. S. Pierce, who introduced the first lecture 'Rapid Microbiological Methods in the Brewing Industry' which was presented by Dr S. Shaw.

Dr Shaw described the need for more rapid methods of microbiological quality control to allow earlier warning of a potential spoilage incident and to reduce its extent should an incident occur. In addition there is a need to reduce the labour content of microbiological testing. Three rapid methods are currently attracting considerable interest in the brewing industry: ATP measurement, the direct epi-fluorescence microscopy technique (DEFT) and electrical techniques.

ATP measurement using the luciferin—luciferase luminescence assay is both rapid and sensitive. ATP is, however, produced by all living cells and the assay cannot distinguish between yeasts and bacteria. Yeasts contain one hundred times more ATP per cell than bacteria. Endogenous ATP and quenching factors in beer can also, unfortunately, interfere with the assay. Dr Shaw felt that the method is restricted mainly to the analysis of bright or sterilised beer samples although it has value in the examination of swabs, water samples and some raw materials. Samples with low infection levels are best preincubated for 24 hrs prior to the assay. Overall he felt that the method needs considerable operator skill and is not applicable for routine testing.

The DEFT technique involves filtration of the sample on a polycarbonate membrane, staining of the organisms present with acridine orange, and counting of the cells using fluroescence microscopy. The method is simple, cheap and rapid and provides some morphological data to assist in primary identification. However, the method is relatively insensitive (requiring 10^5 cells/ml), dead cells can be detected, and it is relatively labour intensive. Both DEFT and ATP measurement are regarded as having limited applicability for quality control monitoring and are best used for trouble shooting.

Electrical techniques are based on the decrease of conductance of a growth medium as organisms multiply. Readily detectable changes occur at around 10^6 cells/ml so that the time taken to reach that level can be used as an index of microbiological quality. Detection is not, therefore, very rapid as periods up to 48 hrs may be required. However, the technique is sensitive, and amenable to automation.

It is specific in that selective incubation media can be used and only living cells are detected. It can, for example, be used to rapidly detect bacterial contamination in pitching yeast. The technique requires very accurate control of the incubation bath temperature and the instruments available are of high cost.

Dr Shaw concluded that despite the high cost this technique should have widespread applications in routine microbiological quality control monitoring.

The second speaker, Pamela Geddes, presented a paper entitled 'Bacteriology in the Scotch Whisky Industry'. She began her lecture with an outline of whisky production. There are six basic steps, malting, milling, mashing, fermentation, distillation and maturation. As malted barley is the sole source of fermentable carbohydrate and starch degrading enzymes the mashing regime is very important, with a target temperature in the tun of 61·5°C. The first 'wash' is drained directly into the wash back (the fermenter) with the enzyme systems still active so that conversion of dextrins continues during the fermentation. Second and third 'washes' are added to fermenter at very high temperatures (near to boiling) as extraction effectiveness is the main objective of these latter stages. There is no boiling stage prior to fermentation as this would inactivate malt enzymes and sterilize the wort, neither of which are desirable in whisky production. Fermentations are normally carried out with a mixture of distillers 'M' yeast and brewers yeast, and are usually complete in 35 to 40 hrs. As the yeast cells autolyse a late lactobacillus fermentation sets in, building up to 10^8 cells/ml. This growth occurs without spirit loss and is considered beneficial to the flavour and quality of the final product. After fermentation a series of distillations leads to a spirit of around 70% strength. The spirit is diluted to the appropriate level and the whisky is stored in oak casks for at least three, and frequently up to ten, years prior to bottling.

The bacteriology of whisky production involves the following areas:— Quality Control of raw materials, plant hygiene, interactions between bacteria and yeast, the lactobacillus fermentation and the effect of bacteria on whisky flavour. The bacteria present at each stage are identified using a variety of selective media.

Considerable numbers of bacteria are present in malt with lactobacillus reaching 350,000 per gm and gram negative flora up to $2{\cdot}3 \times 10^6$ per gm. Very few bacteria survive the mashing process, although certain gluconobacter and lactobacillus species do so and the latter are ultimately responsible for the secondary fermentation. Bacillus species present in the cold water used to adjust sparge temperature survive mashing but not the environment encountered during fermentation. Brewers yeast is used on occasion and can also be a source of bacterial contamination.

The lactobacillus fermentation is non competitive with the yeast fermentation as the lactobacilli metabolise carbohydrates that have not been utilised by the yeast, such as residual dextrins and pentoses. After autolysis trehalose, the storage of yeast, is also available. However, if the plant is in poor condition and high lactobacillus numbers are present at the start of fermentation, competitive fermentation can occur, reducing the spirit yield.

Identification of the lactobacillus species present in dis-

tillery isolates is very difficult due to their ability to adapt to the changing conditions in fermenting worts. Only limited classifications are undertaken noting, for example, their ability to ferment certain carbohydrates.

The main products of the secondary lactobacillus fermentation are lactic acid, acetic acid, CO_2 and ethanol, although ethyl lactate and various acetate esters are also produced. A study of the effect of non competitive bacterial infection on the flavour of spirit was undertaken, examining spirits produced after 37 and 85 hours. The latter, after the lactobacillus fermentation, was found to be more estery and less 'feinty' so that this secondary fermentation was felt to be desirable. The advent of capillary GLC has allowed the identification of around 400 congeners in scotch whisky and Ms. Geddes felt that some of these will be the result of bacterial interactions with yeast or even simple bacterial metabolites. She concluded her lecture with the view that although distillation and maturation are of the utmost importance to the flavour of whisky, the non competitive lactobacillus fermentation also has a role to play in whisky flavour.

The third speaker, Dr T. Webb, presented a lecture on the 'Computer handling of QC data'. Dr Webb described how Allied Breweries, in late 1981, considered the introduction of computer handling of data at their Central Technical Department. It was decided that computerisation would only be of benefit if it helped each brewery as well as the Central Technical Function. Use of one large computer was rejected and eight ACT Sirius 1 microcomputers and software were purchased for less than £30,000. Each brewery uses the microcomputer to enter data on floppy disc, and copies are sent monthly to the Technical Centre. The software programme selected has a large data capacity and can sort and select up to eight parameters from three fields at the same time. Dr Webb described the layout of the files in some detail with, for example, the analytical file containing 42 fields, and these include data on liquor, wort and process analyses, BBT data, and 'in pack' data. The operator enters data in each field with the aid of a 'mask' Dr Webb described examples of the specification system used for control of the brewing process, with a variety of levels set at different increments from the target value, depending on need. A typical data field was described showing a layout for actual analytical value, upper and lower limit values, an average value for a selected range, the SD level, the number above and below specification and the total number out of specification. He described the recent acquisition of more powerful software allowing improved data handling and the production of graphs and pie-charts.

Dr. Webb moved on to describe the advantages and disadvantages of using such a system. Advantages include the increased ease of handling of data, an improved understanding of computer technology by the operators, and promises future links to automatic analyses together with the potential to use the machines as a 'network' system. Disadvantages included a significant learning period, data input time is additional to normal recording of data, and some of the commercial software available seems limited in value. Disc problems can also occur, and there is a need to keep 'back-up' discs.

The regional breweries have, however, also found their machines to be of value for other purposes including malt analysis data storage, cask beer surveys, large and small pack condition reports and recording data on beer returns including original racking details.

Dr Webb concluded his lecture with a description of the use of this microcomputer to compare the results from comparative analyses between up to 20 laboratories using the Youden technique. The computer not only generates a Youden diagram for each analyses but also produces a league table for each laboratory for each analysis. Results falling outside the 95% confidence limits are listed separately to rapidly spot laboratories with 'outliers'. Dr Webb concluded that the microcomputer can be used to successfully monitor overall QC performance in a number of breweries, and the data processing time has been considerably reduced.

The next lecture, presented by Mr D. G. Porter of the Laboratory of the Government Chemist (LGC), was entitled 'The potential for the use of Robotics in the Analytical Laboratory'. Mr Porter covered three areas;—the hardware currently available, their practical application and the future of robotics in the laboratory. He felt that it was important to define precisely the term 'robot' which he uses to describe 'a reprogrammable mechanical manipulator'. There are basically two types currently in use, the industrial robot, which is too powerful for laboratory use, and the teaching robot, which is low powered and safe to use near people. A robot needs an arm and a gripping device, and is normally controlled by a variety of 'stepping' motors. Four basic types of arm are available. The 'Cartesian' has XYZ geometric movement, can reach anywhere in an envelope, but all movements are at right angles. The 'Cylindrical' rotates, moves up and down and can extend or retract. This type is good for servicing peripheral units. The 'Polar' or spherical arm, rotates and extends, but while favoured for industrial applications is of no particular value to the laboratory. The anthromorphic or jointed arm can reach any point in a particular working volume, but with more sections to the arm, flexibility is increased, but the arm is more difficult to control. The later type is the most likely to find application in the laboratory.

A Laboratory robot will not be used for cost saving but rather to assist in laboratory automation. Mr Porter then described his own work on developing a control system that allows a robot to undertake what seems at first sight a straightforward task,—placing a flask on a balance. The main problem proved to be one of reproducibility in precise positioning of the flask. The robot needs a 'home' position so that it 'knows' where it is at any time relative to that base position. Mr Porter described his work on a vision system, whereby the robot can recognise an item by a code on the equipment, using a television camera and computer. He has now moved on to develop a new arm design.

Current teaching aid robots are slow, with limited precision and reliability and can only handle loads up to 500 g. They usually require modification to the gripping device. Normally little operation software is available. The LGC are building a prototype robot of novel modular construction with a target selling price of around £2,000. Mr Porter concluded his lecture by reminding the audience that most currently available robot arms are of limited use. The time needed to develop software for a laboratory robot is large, with up to two man years already spent on the FORTH computer language system for the LGC arm. A lot remains to be done before a robot is available for general laboratory use. The LGC has set up a laboratory robotics club to encourage Research and Development in this area.

The last lecture on the first day was presented by Dr K. Greenhoff and was entitled 'Flavour analysis on a practical basis'. Dr Greenhoff described procedures for the automated analysis of beer headspace volatiles and for computer assisted flavour profile analyses. He began by describing the advantages he had found in using capillary columns for GC analysis of beer volatiles compared to more traditional packed columns. Capillary columns gave improved sensitivity, resolution and reduced analysis time. Analysis time was reduced from 50 to 18 minutes and was reduced still further, to 10 minutes, when hydrogen was used as carrier gas rather than nitrogen. It was then possible to analyse 12 samples in duplicate in a working day. Operator technique is most important if good GC separation is to be achieved, and Dr Greenhoff had examined an automatic headspace sampling unit designed to be compatible with most GC

systems. He described the function and operation of the unit which holds 24 samples in a temperature controlled bath, and which injects a sample of headspace vapour from the sample into the GC via a heated transfer arm. Dr Greenhoff described his use of two fused silica capillary columns connected to a single splitless injector using a two hole ferrule. One column of Carbowax 400 was used with an FID for ester and alcohol analyses and the second, dinonyl sebacate column, was coupled to an ECD diacetyl analysis. The detector signals from the two columns is processed by a computing integrator capable of handling data from both columns simultaneously. The layout of the integrator printout and data recording was explained at the point made that it was now theoretically possible to analyse 36 samples in duplicate in a 24 hour period.

Dr Greenhoff then moved on to describe the application of a low cost microcomputer to the handling of flavour profile data. The system utilised an old 32K PET microcomputer with software written by Dr J. R. M. Hammond. Profile data is entered with the aid of a 'mark sense' card reader. Profile panelists score the beers tasted using preprinted computer cards and use an intensity scale of 1 to 5. A zero score, or attribute 'not present' score, has to be entered also. Panelists taste and score up to three beers in one 30 minute session. The panel leader feeds the cards through the reader which transmits the data to the computer VDU for visual examination. Editing and correction facilities are available. The computer calculates the panel mean scores and prints out the flavour profile of each beer. This is normally presented in tabular form, but both histogram and spider plot facilities were also developed. Profiles can readily be stored on disc and can be used later in the calculation of mean profiles from several tastings.

The software also provides for an assessment of individual panelist performance by listing his or her deviations in score from this panel mean. This allows troublesome areas to be identified, such as consistent over or under scoring, and emphasises the areas where retraining is needed. Dr Greenhoff emphasised that flavour profile data can be readily handled with a low cost microcomputer system.

The first lecture on the second day of the meeting, presented by Dr G. Buckee, was entitled 'HPLC Analysis Of Hops, Hop Products and Beer'. The polarimetric, spectrophotometric and conductometric methods currently in use are useful for commercial transactions but are not specific for α acids. The specific methods currently available, such as CCD, GLC, paper chromatography and ion exchange chromatography are all labour intensive. A number of HPLC systems have been developed recently but they suffer from a variety of problems including the instability of internal standard, use of gradient elution and long analysis times. The aim of the BRF work was to produce a universal method that was reliable, reproducible and fairly rapid, that could be used for hops, hop products and beers. Dr. Buckee described the radial compression cartridge system which uses a column with flexible walls to give a particle bed free of voids and channels. Octadecylsilane bonded silica particles, (5 μ) treated to remove silanol groups, was used in the cartridge. The system used is basically reverse phase partition using methanol; water; phosphoric acid as solvent. Detection is by UV absorption at 313 nm, for α and β acids. Dr Buckee described the analytical procedure for hops analysis which is based on an initial extraction with toluene, followed by HPLC using an internal standard that elutes after the hop substances.

Comparison with LCV analyses shows good agreement with fresh hops, but not for aged hops. A variety of hops and hop extracts have been examined using this procedure. Aged hops with 5% and 40% deterioration were extracted with ethanol and with liquid CO_2 to produce hop extracts, and these were then examined for soft and hard resin contents. The ethanol extracts contained large amounts of oxidised material whereas the CO_2 were free of this hard resin material.

Dr Buckee described brewing trials with fresh and deteriorated hops, hopped to the same LCV value. The extracts of the fresh hops gave beers of similar EBU iso α acid levels and of similar taste bitterness. The 40% deteriorated hops gave beers with similar bitter flavours but the beer prepared with ethanol extract contained 35 EBU whereas the liquid CO_2 hop extract beer contained only 24 EBU. The measured actual iso α acid contents of the two beers, using a new BRF HPLC procedure, were very similar as expected from their taste bitterness. The HPLC analysis showed the beers prepared with ethanol extract to contain at lest 10 components in addition to the iso α acids when compared to the beers prepared with liquid CO_2 hop extract.

Dr Buckee explained that as his original HPLC method for iso α acids was time consuming a new method, based on direct injection of beer into the HPLC, was developed to give an analysis time of 7 minutes. The method uses a different solvent and internal standard to the α acid method, and uses detection at 280 nm. He has established that the BRF HPLC method gives slightly lower levels of iso α acids than found by the standard EBC ion exchange chromatographic procedure but that this HPLC method gives an accurate indication of the iso α acid level in beer.

The next speaker, Dr G. T. Taylor, presented a paper entitled 'Methods of Wild Yeast Detection'. He described briefly the properties of wild yeast, methods for their detection and finally proposed the adoption of a new medium (MYGP+Cu). Brewing wild yeasts generally belong to the genera: Saccharomyces, Hansenula, Pichia, Debaromyces, Hanseniaspora, Candida, Brettanomyces, Kloeckera, Rhodotorula and Cryptococcus. Spoilage problems encountered as a result of their presence in beer includes: haze and turbidity, frets and over-attenuation, loss of alcohol, production of off-flavours and the production of zymocins. Standard methods of detection include microscopy as many have a distinct morphological appearance, selective and non-selective growth media, now regarded as routine, and immunoflourescence. The latter involves the production of specific antisera labelled with a fluorescent marker. The technique is rapid but expensive. Forcing tests at 25 or 37°C are traditional but still useful. Heat resistance, in which yeast is plated into non selective media after heating at 53°C, is also effective but non specific. Sporulation can also be examined.

Growth on a selective medium remains the most popular method of detection, but current selective methods suffer from the disadvantage that they detect either Saccharomyces or non-Saccharomyces species. A novel medium has been developed (MYGP+Cu) to span the range of wild yeasts, which is based on Lin's copper sulphate medium for non-Saccharomyces yeasts. The medium was evaluated by comparing the growth of pure cultures of pitching yeasts and wild yeasts on MYGP+Cu, Crystal Violet and Lysine media. Ale yeasts were inhibited by Cu levels above 130 ppm, and lager yeasts above 180 ppm. Wild yeasts were detected by growth on media containing 200 ppm of Copper. This MYGP (+200 ppm Cu) medium suppressed the growth of pitching yeasts to a greater extent than did Crystal Violet or Lysine media. In comparative tests 13 out of 16 wild Saccharomyces isolates grew on this MYGP+Cu medium, and all of 28 non-Saccharomyces cultures grew. The medium also detected those wild yeasts in brewery samples that were detected in Crystal Violet or Lysine media. It was therefore proposed that MYGP+Cu medium has a role in the brewery laboratory.

The third speaker, Dr D. J. McWeeny, presented a paper entitled 'N-nitroso compounds—Formation, Inhibition and Analysis'. Many nitroso compounds are known to be car-

cinogenic. Nitroso dimethylamine (NDMA) and nitroso pyrollidine, for example, are carcinogenic while nitrosoproline is not.

Dr McWeeny divided his lecture into three areas: The chemistry of nitrosamine formation, means of minimising nitrosamine formation, and methods of analysis. Compounds that are good nitrosating agents such as NOBr, NOCl and N_2O_3 can all liberate NO^+ in acid conditions, but in malt the reaction is slower in acid conditions so that the reaction cannot involve a simple nitrosation. It is well established that SO_2 needs to be applied early in kilning to have any effect, yet there is no evidence that NDMA is formed at that time, formation occurs after the 'break point'. A variety of alternative nitrosating agents were discussed including nitrolic acids, nitrosothiols and nitrosophenols. The latter act as catalysts in the presence of nitrite. Hordenine, a tertiary amine could be utilised to form nitrosohordenine after a dealkylation step, and this step may require a preliminary oxidation with a phenol oxidase. SO_2 is a good inhibitor of phenol oxidase and it could reduce NDMA fermentation by acting in this way.

Dr McWeeny went on to describe the analysis of nitroso compounds using the GC-TEA principle which allows the analysis of volatile nitrosamines down to the 0·1 µg/kg level. The TEA can be used in LC mode (liquid chromatographic) using a large bore furnace where the solvent is flashed off and the N-NO bond cleaved. He then described in detail methods of analysis for nitrosoamino acids and nitrosopeptides. The level of total non-volatile nitroso compounds can be determined in a sample using a method based on the reaction of nitroso compounds with HBr. Tocopherol is added to the sample to stop nitrosation, and free NO is liberated using repeated injections of glacial acetic acid. The liberated gas is swept away from the sample using argon to a TEA after passing through KOH and liquid nitrogen traps. Once the signal has established HBr is added to the sample, cleaving the N-NO bond of the nitrosocompounds present, and the liberated NO is quantified. Finally, a standard amount of NDMA is injected into the HBr—sample mixture and the anticipated standard response examined as a further check on the system.

Some compounds such as nitrosothiols and nitrolic acids do interfere with the assay. Reagents blanks are run as every third sample to ensure that the extraction system has stabilised between samples. The apparatus has a sensitivity of 10 µg of NNO/kg for a 1 gm sample. A variety of foodstuffs have been examined including biscuits (<10 µg/kg), dried milk (<14) and tea (<50). Cured meats are very high (>250). Beers examined to date have shown very variable levels (<10 to >250 µg/kg).

Procedures that reduce NDMA levels in malt to low levels, such as sulphur in the kiln, do not reduce total non volatile N-nitrosocompounds to the same extent. SO_2 appears to be a specific inhibitor for NDMA. Levels of total N-nitrosocompounds in malts are therefore now at similar levels to those found in malts prior to the efforts in recent years to reduce NDMA levels. It is unlikely therefore that recommendations will be made in the future to limit the levels of these compounds in malt.

The next speaker, Mr R. C. Rooney, preented a paper entitled 'The Determination of Trace Elements in Beer'. He described how an instrumental method of trace element analaysis should be sensitive, selective, easy to use and should be of reasonable capital cost. Running costs can be very high for some methods and should not be forgotten when choosing between various alternatives. A variety of methods are now available and Mr Rooney outlined briefly the main features of the most widely used current procedures. Emission spectroscopy is sensitive but is not easy to use or to interpret. Xray fluorescence and Mass-spectroscopy are both very sensitive but are both rather expensive. Atomic absorption is available in a variety of forms including flame absorption, electrothermal atomisation, hydride generation absorption and atomic emission (or inductively coupled plasma emission). Polarographic methods can also be used. While copper, lead, cadmium and zinc are readily analysed by this procedure, iron is not easily seen. Calcium, magnesium and tin can best be analysed using atomic absorption whereas sodium and potassium are best analysed by atomic emission. Copper, iron or chromium are best analysed by AA or by plasma spectroscopy while lead and aluminium are best analysed by electrothermal platform atomisation. Hydride generation provides a useful method for the analysis of arsenic, selenium, antimony, bismuth, cobalt manganese and mercury.

Mr Rooney described the limits of detection of the above methods for different elements and concluded his talk with mention of sample preparation. Solid heterogenous samples are difficult to handle. They need careful sampling and examination of relatively large amounts of material ($\triangleq$ 100 g). Liquid samples should be stored prior to analysis in polythene bottles. Equipment should be cleaned and washed with 30% nitric acid to remove traces of most metals, although strong hydrochloric is needed to remove traces of tin. Beer samples are normally 'ashed' by charring with sulphuric acid at 110°C, with 15% hydrogen peroxide, giving a clear beer in around 3 hr. The sample can then be analysed by some of the procedures described above.

The final paper of the meeting, presented by Dr J. R. A. Pollock, was entitled 'Thoughts on New Methods of Malt Analysis'. Dr Pollock said that malt analysis has two purposes: to provide a means to regulate commercial transactions and to indicate the suitability of a particular lot of malt for brewing. Around 100 years ago, at a congress in Vienna in 1890, the wide variety of analyses in use were codified into an analytical system. Since then there have been many modifications, but only in details, and methods of wort preparation prior to analysis are essentially unchanged from that time. The analytical systems developed have provided a framework within which commercial transactions are possible.

The fine grind estimation gives a good idea of extract likely to be obtained in the brewhouse under good conditions. The ratio of soluble nitrogen to total nitrogen of the malt, wort viscosity or difference in fine-coarse extract all give information on the degree modification of the malt. These analyses assist in calculating the volume of wort of a given gravity that is likely to be obtained from a unit weight of malt and also some idea of wort quality. They also confirm that the grain has been malted. The extent of interaction of enzymes and substrates during mashing is dependant upon the mashing conditions used. The mash thickness affects many of these interactions and some mashing conditions prior to analysis do not reflect brewing practice. It is not surprising, therefore, that apparently normal malts can give severe problems in practical brewing. A thin analysis mash does not give the same mixture of products as a thick brewery mash. One should, however, try to correlate analytical figures to performance in the brewery.

There are three types of approach to the problem of obtaining methods that are better correlated to brewhouse performance. Firstly, use an analytical mashing system similar to those in use in a brewery. Secondly, evaluate the extent of modification for individual grains to ensure that the malt is uniformly well modified and thirdly one may attempt to measure the physical properties of finely ground malt.

The first route has been studied by the group at Tepral who developed an analytical microbrewhouse where the mashing and sparging techniques mimic those used on the large scale. Correlations with actual brewery extract were good although the actual extract achieved was very different from the brewhouse process. The second route requires that

in a good malt the whole endosperm should have been attacked. The friabilimeter, which measures the hardness of individual grains, can give a good idea of the homogeneity of the grain sample. Parallel to this work is that of Carlsberg where the β glucan remaining is measured with a specific stain (Calcofluor). The Heineken method uses methylene blue to stain the modified part of the grain. Dr Pollock felt that while these methods provide a check on malting efficiency they do not take the place of conventional analyses.

The third route involves the analysis of ground malt. For example near infrared reflectance spectroscopy (NIR) can now be used to readily measure the moisture, protein and fat content of cereal grains by means of assessing the absorption of NIR bands associated with these substances. NIR may be able to give results that correlate well with wort analysis, and it is now in use in France to measure extract, fine-coarse extract difference, protein and moisture on individual malt deliveries. It should be realised, however, that if the conventional analyses do not correlate with main brewery performance then NIR correlation with them is not that helpful. NIR is best used to monitor malt intake and then efforts should be made to correlate these results with performance in the brewery. Malt specifications may ultimately be written as desired NIR reflectance levels at specific wavelengths.

Dr Pollock felt that such physical methods have the best long term potential provided they are related to brewery performance. He concluded his lecture by suggesting that a congress be held in 1990 to bring malt analysis up to date with proposals for new methods that might prove workable for the next one hundred years.

STUDY TOUR OF BELGIUM
22nd to 26th October 1984

The Study Tour of Belgium attracted 26 participants who were rewarded with an intensive, but very interesting, visit. Members attended from Canada, Ireland and Tanzania as well as from the United Kingdom. The course comprised nine lectures, six by Belgian speakers and three by Institute members, and visits to four breweries, a maltings, and to the CERIA Research and Teaching Institute.

The party was welcomed by Professor Devreux who introduced the first speaker, Mr Derdlinckx from the University of Louvain-La-Neuve, who gave a brief lecture outlining the structure of the Belgian brewing and malting industry. Belgium produced 14 MHL of beer in 1982, and imported a further 0·9 MHL. Around 2·4 MHL was exported, mostly to France and to Germany. The number of breweries has decreased steadily over the last few years but Belgium still had over 130 breweries in production in 1982. Most of the breweries are located in the north of the country.

The Belgian barley crop in 1982 was 0·8 m tonnes, mostly of winter barley, with only 0·24 m tonnes needed for brewing. The malting industry operates 10 maltings and currently exports 80% of its production. Mr Derdlinckx concluded with an outline of the teaching of malting and brewing in Belgium. Professor Devreux is responsible for the laboratory of Brewing Science and Technology at the Catholic University of Louvain La Neuve. Professor C. Masschelein is responsible for teaching and research work at The Institute of Fermentation Industries (CERIA) which teaches students at the high school and technical college level.

The second speaker, Professor Verachtert, described the production of traditional 'gueuze' or 'lambic' beer and some of his recent research work on the course of lambic fermentations. Lambic beer is produced by the spontaneous fermentation of wort over a one or two year period, followed by a further fermentation in bottle, when the final beer is known on 'gueuze'.

Wort, prepared from a 40% wheat grist, is boiled with hops (600 g/hl) and is then allowed to cool overnight in a large shallow open vessel. Fermentation is then left to proceed over a period of up to two years in large (600l) wooden casks. Professor Verachtert has found that actidione resistant, maltose non-fermenting yeasts and enterobacteria are the main organisms that grow in the first month followed by a period where *S. bayanus* and *S. uvarum* dominate. The beer pH falls to around 3·2 after six months as lactic acid producing Pediococcus take hold, and finally, Brettanomyces yeasts grow in number and complete the fermentation. The final beer contains large amounts of acetic (500 pm) and lactic acids (5000 ppm) together with high levels of ethyl acetate, lactate and caprate. Ethyl acetate reaches levels of around 100 ppm after 2 years. Gueuze beer is produced by mixing 1 year old and 2 year old lambic to initiate a further fermentation and yield the desired final flavour.

Professor Verachert has studied the uptake of wort components and also the metabolic by products produced by a number of isolates from lambic fermentations grown either in pure culture or as mixed fermentations of both yeast and bacteria.

It was found that mixed cultures of *Brettanomyces Lambicus* and *Pediococcus* gave a beer of higher attenuation than *Brettanomyces Lambicus* alone. *B. Lambicus* is capable of utilising malt tetraose (G4) and pentaose (G5), while finished Gueuze is free of G4 and G8 carbohydrates. Pediococcus, present in 2 year old Lambic is postulated to produce dextrinases. When 2 and 1 year old Lambic are mixed the dextrinases from the 2 year old beer are thought to act on the carbohydrate present in the 1 year old Lambic allowing the Brettanomyces to grow further.

Most Lambic beer (90%) is now made rapidly, and filtered, to give an accelerated 'gueuze'. Only 10% of this specialised beer is now made by the traditional process.

After the lecture the study group visited a traditional Lambic beer brewery in Brussels. Although production had not restarted for the winter period a good impression was obtained of the unusual working practices involved in producing this specialist beer. A formal dinner of welcome at the Brewers-Guildhouse in the centre of Brussels completed the first day.

The second day began at the University of Louvain la Neuve with a review lecture by Professor Goffeau on the topic of 'Transport in Yeast'. Potassium ions are transported across the yeast cell wall membrane against a very high concentration gradient, a process that requires large amounts of energy. An electric potential exists across the cell wall and moves ions by the action of either a permease or by proton cotransport. Professor Goffeau reviewed research work on this topic. The driving force is now known to be an ATP-ase that moves potassium, sodium or calcium across the cell wall. The ATP ase responsible for proton transport was only identified a few years ago. It has recently been purified by Dr J. P. Dufour at Louvain and shown to be a plasma membrane ATP ase. The pure enzyme was inserted into artificial phospholid vesicles and found to work effectively in that the inside of the residue became acidic and the outside alkaline.

It has now been established that this ATP ase pushes protons out of the yeast cell which becomes negatively charged on the inside with a potential of −120 MV across the cell wall. This potential drives the uptake of cations and the departure of anions. In effect the proton ATP ase creates a membrane potential, creates a proton gradient and generates a proton motive force which drives ion transport and also regulates the cell internal pH. Professor Goffeau concluded with a summary of areas where work is still needed to allow a better understanding of the mechanisms of ATp hydrolysis and of the factors controlling the biosynthesis and regulation of ATP-ase.

The following lecture by Dr J. P. Dufour was entitled 'S-Methylmethionine, quantitative analysis by HPLC'. This compound is present in malt and suffers thermal degradation during wort production to DMS, which is a major feature of lager beer flavour. Current methods of analysis for SMM involve indirect measurement by analysis of DMS produced on heating a sample in alkali. The method is not specific and requires analyses before and after the hydrolysis. An HPLC method has been developed using gradient elution at elevated temperature (55°C) on a strong cation exchange resin originally prepared for amino acid analyses. Post column derivatisation with fluorescence detection was used to give an HPLC analysis time of less than 2 hr. α amino β guanidino propionic acid was used as an internal standard. The method gave a linear response over a wide range of SMM and the detection limit was found to be 0·3 μg/g malt and 250 ppb in beer. Good sample preparation and clean up procedures were found to be vital. Finely ground malt was extracted with trifluoracetic acid at 0°C, and the supernatant after centrifugation passed through an activated charcoal cartridge to remove lipids, polyphenols and small peptides. 8 malt samples could be prepared for HPLC in 1 hour.

The method was applied to a study of SMM production during malting. Studies with the winter barley Sonja and the spring barley Aramir showed both varieties to give the same pattern of SMM generation during germination. Raw barley was free of SMM. A rapid rise in SMM was noted between 2 and 7 days germination at 15°C followed by a fairly stable level thereafter (up to 14 days). Kilned malt contained SMM levels that were around 50% of the levels found in the same samples that had been freeze dried. The first phase of rapid SMM production coincides with the evolution of α amino nitrogen. A total of 33 different varieties comprising 2 row, 6 row, malting barleys and feed barleys were examined for SMM levels and wide differences found between varieties. Environmental effects were also important as the same variety grown on different sites was also found to give variable SMM levels. Malt levels of SMM (as DMS) of between 4 and 19 μ g/g malt were observed, so that choice of barley variety may prove a useful method of controlling SMM levels in malt. Levels of soluble nitrogen and malt colour were not correlated with SMM content. The final SMM level in a malt is controlled by variations in the malting process, germination time and temperature, use of bromate or gibberellic acid and the malt kilning programme.

The first Institute lecture, by Dr R. E. Wheeler was entitled 'The role of aldehydes in maturation, conditioning and staling'. Many different aldehydes have been found in beer, and in malt, and this class of compound shows a very wide range of flavour threshold levels. The most flavour active are the long chain unsaturated aldehydes such as trans-2-nonenal. Long chain mono-unsaturated aldehydes are major contributors to stale beer flavour when present at levels of less than 1 ppb. Procedures for the analysis of these substances in beer were described. HPLC of their dinitro phenylhydrazine derivatives can be used after preliminary clean up and separation using TLC and liquid chromatography on magnesia silica gel. This method is however rather slow and a more recent rapid procedure, published by Nordlov, allows 8 samples a day and is based on capillary GLC analysis of aldehyde penta-fluoro benzyl oxime derivatives.

Possible sources of aldehydic compounds in beer were reviewed. Aldehydes derived from malt can be expected to be reduced to alcohols during fermentation. Other routes considered were the oxidation of isohumulones, the involvement of melanoidin materials, the oxidation of higher alcohols, the Strecker degradation of amino acids and the auto oxidation of unsaturated fatty acids. One likely source is the oxidative degradation of acids such as linoleic acid to yield a range of trihydroxy octa decenoic acids. These substances have been found in beers at levels between 8 and 12 ppm in European beers. There is however disagreement in the literature over the extent to which substances can break down to give unsaturated C7 to C9 aldehydes in beer.

A major factor in the increase in levels of flavour active unsaturated aldehydes during the storage of beer is the breakdown of bisulphite aldehyde complexes. Research at Pripps in Sweden and Labatts in Canada has shown that SO_2 is lost rapidly from beer on storage, and as it is lost, aldehydes are released into solution. Short chain aldehydes, was little effect in flavour, can displace SO_2-bound flavour active long chain aldehydes. For example addition of acetaldehyde to a nonenal-bisulphite complex was found to release nonenal. There are likely to be two main routes leading to increased levels of unsaturated aldehydes in beers; the breakdown of oxidised fatty acids derived from linoleic acid and the breakdown of nonenal bisulphite complexes.

Two basic methods have been used to predict the flavour stability of a particular beer, storage of the beer at elevated temperatures for short periods or examination of the beer for a chemical marker related to flavour stability. Short term forcing (up to 24 hr) at 60°C has been found to give similar stale character intensity to that found for storage at 18°C for 9 months, or at 37°C for 3 weeks. The Bass method of elevated temperature storage (up to 48 hr at 50°C) followed by reaction with thiobarbituric acid was also described, leading to the concept of a resistance to staling value (RSV) for a particular beer.

Control of aldehyde production during the ageing of beer was discussed. Both EDTA and SO_2 have been found to be very effective in controlling stale flavour development even at low levels of addition. Care is needed if SO_2 addition is the chosen route as some beers have been found to develop marked sulphury taints after the addition of relatively small amounts of (10 ppm). Good flavour stability depends on control of the extent of oxidative damage during the process, both during wort production and after the completion of fermentation.

The lectures were followed by a visit to the Artois Brewery at Leuven for lunch and for a tour of the maltings, brewery and the new effluent treatment plant.

Two lectures were presented at the University on the Wednesday. The first by Professor P. Rouhet was entitled the 'Immobilisation of Yeast'. Immobilsation is possible by incorporation of yeast cells in membranes, gel matrices, aggregates or by retention on a variety of supports. Adhesion to a surface offers the best form of immobilisation, and this can be achieved by use of electrostatic forces, Van der Waals forces, and Dipolar or hydrogen bonding.

Control of electrostatic interactions by treatment of yeast with limited amounts of Al^{3+} as aluminium nitrate, reduced the negative changes on the cell surface and gave good adhesion to glass surfaces. Treatment with 0·37 mM aluminium nitrate solution at pH4 followed by a distilled water wash left a one cell thick layer on the glass surface with between 20 and 40×10^3 yeast cells per mm^2. At pH levels >4·5 aluminium hydroxide begins to collect on the yeast surface altering the yeast properties. If glass is treated with a solution containing Fe^{3+} ions yeast will adhere to the surface. Glass treated with haematite (Fe_2O_3) gave a single cell layer after immersion in a yeast suspension.

The metabolic activity of such single cell layers of yeast on glass were examined by checking the extent of glucose to ethanol conversion. Yeasts attached with the aid of either aluminium of ferric ions both showed the desired activity. A variety of different bacteria could also be attached to glass in this way.

Professor Rouhet then moved on to discuss the surface properties of yeast, including the chemical composition of the surface. Using Xray photo-electron spectroscopy

(ESCA) information is obtained on the elements present in a surface layer around 30 angstrom units thick. The nitrogen phosphorous ratio was examined for *S. cerevisiae* and *S. carlsbergens* is in different physiological states and was found to be related to the isoelectric point. Nitrogen near the surface can be protonated giving a positive charge whereas phosphorus is responsible for the negative charge. The overall balance of the two determines the isoelectric point. A high nitrogen level gives a high isoelectric point while a high phosphorus level gives a lower isoelectric point. A study of calcium in the cell wall was also in hand and this had shown that calcium was distributed over the first 10 nm of the surface layer.

The next lecture, presented by Dr F. R. Sharpe entitled 'The relationship between particle size and haze' was the second Institute paper. Dr Sharpe discussed haze particle size distribution, haze composition, haze measurement and standards, and haze identification. Chill haze particles are normally around 10^{-1} to 1 micron in size whereas permanent hazes are usually from 1 to 10 micron. No biological hazes are diverse in origin and can contain a wide range of materials. Polyphenols and large molecular weight proteinaceous materials can be present due to inadequate beer stabilisation. Metals such as copper, tin and iron can become concentrated in beer hazes and can later catalyse oxidative changes in the beer. Calcium oxalate, which is easily identified microscopically, can be present due to inadequate cold storage. Carbohydrates such as α and β glucans can also form hazes in beers. Hop materials such as β acids, α acid oxidation products or impurities in isomerised hop extracts have also been known to form hazes.

Methods of particle size analysis and haze measurement were reviewed. The Coulter Counter system can size particles between 0·3 and 20 microns, while the Malvern Particle Size Analyser measures particles between 0·1 and 3 microns. The latter uses a laser to measure the rate of Brownian motion and this yields information on particle size and density. Methods of haze measurement suitable for quality control purposes were reviewed and compared including use of the Radiometer haze meter, Monitek, Dr Lange and Drott meters and the Zeiss Pulfrich unit. Standardisation of these units is normally achieved using the standard EBC formazin haze solution, but a new approach is now possible using polymer beads of very uniform size that are available in very stable suspensions.

Methods of identification of beer hazes were described including the use of the microscope as an important first step. A variety of staining techniques, as pioneered by Glenister, were described.

In conclusion, Dr Sharpe discussed a number of examples of materials that have been known to give haze problems. Alginates can give hazes if not mixed properly, or if the ester content is low. Can contaminants can also lead to haze problems due to dust in the can bodies, use of excess laquer or to traces of the lubricants involved in 'ring pull' insertion reaching the inner surface of the lid. The haze from the latter source was identified by mass spectrometry which showed the presence of butyl palmitate and C6 to C22 straight chain hydrocarbons in the lubricant.

The party visited the CERIA as guests of the Director General who explained that the complex included five schools (three French and two Dutch speaking) and two Research Institutes. Around 4,000 students attend the schools, while the Research Institutes employ around 60 staff. Professor C. Masschelein conducted the party on a tour of the Departments of Brewing Science, Fermentation Technology and Process Engineering. A wide range of research projects were in hand including work on the immobilisation of yeast, the genetic engineering of yeast and on new methods of yeast drying. The day ended with a visit to the Moortgat brewery at Breendonck where the party viewed the production of a range of naturally conditioned high gravity beers.

The last full day of the tour commenced with two lectures. The first, prepared by Professor A. Devreux, was entitled 'Flavour regulation in fermentation' and was presented by Dr J. P. Dufour. Flavour problems can arise in beers if the fermentation is not regulated adequately. Factors controlling the production of flavour active materials in beer have been studied. The lipid composition and concentration of the wort and of the yeast plasma membrane are critical factors. The level of unsaturated fatty acids and sterols in the yeast at the end of fermentation are insufficient for normal membrane function representing only 20% of the required levels, successive pitching of lager worts can lead to further reductions. This lack disturbs the normal uptake of sugars and amino acids and can lead to slow or stopped fermentations. Levels of zinc are also known to be critical, the rate of fermentation increasing with increasing zinc levels up to around 0·25 ppm. While most of the malt lipids remain on the spend grains, considerable amounts pass into the wort, frequently associated with sediment. Worts can vary between 80 and 800 mg/l of lipid. The work of Professor Narziss showed clearly the link between trub haze level and the level of linoleic acid. Yeast can synthesise unsaturated fatty acids and sterols in the presence of oxygen and growth depends on the oxygen content of the wort at pitching.

A second important factor in the control of beer flavour is the successive uptake of amino acids by yeast, in four groups, as originally described by Jones and Pierce. The metabolism of amino acids by yeast leads eventually to higher alcohols and esters. The level of esters is under the control of the acetyl CoA content of the yeast. Their synthesis is however inhibited by the presence of unsaturated fatty acids.

Stirring fermentations leads to improved yeast growth due to increased access to limiting compounds. Additional growth of yeast leads to more amino acid uptake, and reduction in ester synthesis due to depletion in acetyl CoA levels and also by lipid inhibition. The resulting beers had alcohol-ester ratios ranging from 9 to 12 instead of 2 to 3 for non stirred fermentations. The stirred fermentation beers are also more acidic with the pH falling from 4·2 to 3·7. CO_2 evolution in CCV's leads to a natural 'stirring' action, with more intense actions in the upper part of the vessel. Uptake of valine and alanine are considerably increased in stirred fermentations. The levels of esters in a CCV were found to decrease markedly with increasing height reflecting the increased agitation at higher levels. A stirred laboratory fermentor gave beer amino acid analyses much closer to that found from a CCV than an unstirred fermenter.

Production of diacetyl is dependent on valine synthesis, which occurs at the start of fermentation, at the same time as acetolactate synthesis, time. Once the uptake of wort valine starts acetolactate synthesis stops. If yeast growth goes further the third group of amino acids is taken up and acetolactate is synthesised again toward the end of fermentation ultimately giving problems with high diacetyl levels. As shown recently by Nakatani the uptake of the third group of amino acids should be minimised by ensuring an adequate level of free amino nitrogen and so preventing acetolactate synthesis in the latter stages.

Fermentation temperature also affects the levels of flavour compounds with increases leading to increased levels of both esters and higher alcohols including β phenyl ethanol. However the response to temperature varies considerably from one yeast to another, with some showing only small increases. Lipid levels should also be controlled as linoleic acid inhibits ester production. Excessive or extended oxygenation at the start of fermentation also reduces ester levels.

Dr Dufour ended his lecture with some comments on

yeast handling. Once flocculated, yeast should be quickly refrigerated, to avoid the production of caproic, coprylic and capric acids during yeast autolysis. Yeast in suspension must be kept at a higher temperature to excrete amino acids and sugars to allow the development of mellow flavour.

The final lecture of the meeting, and the third Institute lecture, entitled 'Filtration—Novel Proposals' was presented by Dr R. J. R. Reed. Beer hazes comprise protenaceous materials 1 to 4 μ in diameter and single or multiple yeast cells 5 to 16 μ in diameter. Membrane filtration and kieselguhr filtration operate by a similar action of surface entrapment. Depth filtration, however, utilises material which has pore diameters greater than the particle diameter and operates by surface attraction. Flow rate through a filter depends on a number of variables, the most important of which is permeability. Permeability itself is dependent on the porosity of the material and on the diameter of the filter bed material. Kieselguhr has a permeability of around 300 units, while sand can have a permeability of 100,000 units.

Filtration media can be expensive at 350 pounds per tonne for kieselguhr. Filtration of IMHL pa could cost around £30,000 plus the cost of disposal of waste material. Depth filtration using sand, or 'cross-flow' filtration, are possible alternatives to conventional filtration. They have a high initial cost but potentially a long 'life'.

Dr Reed gave details of a pilot scale sand filter plant that can take a one metre bed depth, with a diameter of 50 mm. Flow rates of up to 100 HL/m^2/hr were achieved.

The sand used has a narrow range of particle diameters (75 to 100 micron) to give a highly permeable bed and long filtration run. The quality of the filtered beer was found to be inversely proportional to the run velocity. Rough beer with a haze of 6·3 EBC units gave a product of 1 EBC haze units when filtered at 15 HL/m^2/hr, but 2 EBC when filtered at 25 HL/m^2/hr.

Sand filter regeneration is achieved by back washing with water, expanding the bed by a factor of two. The back wash liquid is dicharged to waste but incurs only a very low effluent charge. Cleansing of long term fouling is achieved with 0·2% caustic solution. Production scale filters will have both diameter and height of around 3 meters so that they will be larger than conventional filters, but overall space requirements will be similar as body feed plant is not required. The cost of the sand is around £100 per tonne, with a life expectancy of around 10 years.

Dr Reed concluded his lecture with a brief description of his work on the 'crossflow' filtration of beer. This system uses a membrane filter set up to allow the retentate to be recycled or sent to waste when solids have built up to a high level. A small scale filter unit was described comprising 7 parallel 50 cm polypropylene tubes, of 5 mm ID, with walls 1·5 mm thick, and a total surface area of 0·05 m^2. The mean membrane pore size was 0·2 microns. The unit has been used to give beers of low haze (0·4 EBC) and is readily cleaned using alkalis or acids. In brewery trials the unit has achieved 1 HL/m^2/hr so that a full scale unit would need around 300 m^2 of membrane, but the unit should have a long working life.

The lectures were followed by a tour of the Brewery Sciences and Technology Laboratories at the University. The Party subsequently visited the Dreyfus Maltings at Herent where malt is produced using the Nordon tower system. During the evening the Institute president, Mr Norman Curtis, was host at a dinner given to thank the staff of the University and of the various breweries and maltings visited. The study tour ended with a visit to the Trappist monk brewery at the Abbaye de Scourmant. The brewery produces a range of very high gravity beers that are conditioned in bottle, using a variety of 'non-traditional' methods including a mash filter, hop extract only in copper and a rapid high temperature fermentation.

RESEARCH BOARD

Workshop on Purpose and Practicalities of Taste Panels BRF Nutfield, Thursday 15th November 1984

A total of 7 lectures were given, 4 in the morning and 3 in the afternoon; the last half hour of the day was devoted to review and discussion.

The first lecture of the morning was given by Dr Frank Binns of Allied Breweries who gave the meeting an insight into the trials and tribulations of establishing taste panels and the difficulties of producing meaningful results. Among the pitfalls identified were inadequate training, inadequate screening of tasters, too many beers per session, profile system too complicated, ambiguous terms, complicated presentation of results, 1–9 scale not fully used, beers poorly defined by ideal profiles, and corrective actions difficult to identify and implement. These problems have been avoided in the operation of his Company's current trueness-to-type panel. An essential feature of the latter is group discussion immediately following tasting although the panel leader has the right of 'veto' over the concensus view of the panel.

Dr Phil Theaker was the second speaker and he described the Courage version of the Arthur D Little profile training system. One element of their training is concerned with making panelists aware of the physiology of tasting. Thus their training programme includes experimentally detecting where the basic taste buds reside in the mouth and the use of falsely-coloured taste samples for stimulating objectivity. Dr Theaker also stressed the importance of controlling the environment of the taste and carrying out the test in a scientific manner.

Mr Mike Upperton, Greene King, described his Company's introduction of the flavour profile system describing the particular difficulties of operating this type of taste test in the 'smaller' company. Apart from the small pool of potential tasters that are available in these circumstances there are also problems with keeping panellists 'in training' as the number of samples which need to be analysed tends to be small. There are compensations: Greene King use their flavour profile only for the analysis of ales and because of the restricted range of samples they are able to categorise flavour terms into positive and negative.

The last lecture of the morning was given by Mr Derek Penny of DPA Research. Mr Penny gave us a distillation of 30 year's experience in probing our customers, their expectations, their preferences and their motivations. Only 25% of the 'men in the street' are regular beer drinkers but, these are the group whose views are critical. Mr Penny advised the use of two types of consumer test—a 'sensory' test which is particularly appropriate for small-pack products and a 'visceral' test which is more applicable to draught beer as it requires the consumption of between 3 and 5 pints during the test (often referred to a session testing). Consumer tests of a sensory nature should include visual and tactile sensations as well as taste and olefactory ones. 'Visceral' tests seek to assess drinkability by including satiety factors such as sweetness, gassiness, alcohol, and the modification of sensory perception with the continued consumption of the test product. He made three other points at the end of his talk, firstly that the public was increasingly conscious of temperature and seemed to want all beers, even ales, served at lower temperatures. Secondly, that no one beer can be right for everyone. Lastly he stressed the importance of the rate of metabolism of alcohol on the assessment of drinkability as the former, although constant for an individual, varies considerably from individual to individual.

The first lecturer in the afternoon was Mr Dave Andrews of Watney Mann and Trueman Brewers who talked about the practicalities of taste testing and the links between chemical and flavour analyses. He stressed the variability of the flavour effects of chemical constituents depending on the chemical composition of the beer in question; this makes correlations difficult if not impossible to establish. However

he was able to show clear correlations between the concentrations of some chemicals such as diacetyl, dimethyl sulphide and acetate esters and their flavour contribution.

Miss Sue Rowe, Bass, described the use of an Apple II micro computer, complete with conductivity-type card reader and printer, for handling flavour profile data. Of particular note was the presentation of results in both tabular and graphical form. Miss Rowe spelt out both the advantages and disadvantages (the latter being mostly human!) and described the improvements that are being considered—an optical card reader, alternative forms of graphics and corelations with other available information.

The last lecture of the day was given by Mr Ted Hickman, BRF who spoke of the Foundation's work in which untrained tasters have been used to assess the flavour intensity of individual components and 2- & 3-component mixtures. As other lectures indicated, interactions of flavour constituents are critical and it was encouraging to hear of fundamental work directed towards this aspect of beer flavour. Mr Hickman wound up his lecture by pointing out that his techniques could have particular application to new product development.

English Hop Competition 1984

'These are worrying times for hop growers. World overproduction continues. Hop stocks are high and beer consumption shows no sign of increasing', said Mr Tony Redsell, Chairman of the Institute of Brewing's Hop Industry Committee at the presentation of prizes to winners in the 1984 English Hop Competition in London on Friday 7th December.

These factors, together with the trend towards lager drinking, using fewer English hops and accounting for more than 40% of beer production, plus the continuing improvement in hop utilisation in the brewery inevitably had reduced the demand from UK brewers, he said.

It was against this background that growers welcomed the new initiative of English Hops Ltd., the industry's new-look marketing organisation, from which fresh, radical ideas were coming forward, together with 'a new sense of commercial realism'.

'We are in times of great challenge but there is no doubt that we have growers capable of providing the customer with the right product at a competitive price,' he said. 'I am sure the UK grower can demonstrate that hop growing in England is not necessarily a steady slide into oblivion and English Hops Ltd, under their new Chief Executive, Ian Wordsworth, will instill new confidence in both grower and customer.'

Mr Redsell said the 1984 crop was 156,100 zentnors (7805 tonnes) a fall of 8·3% on 1983. Growing area was down but yield/hectare was up by 1·3%. Total tonnage of alpha acid produced was 668 tonnes, a decrease of 9% on last year.

Despite the smaller crop, there had been a record 289 entries for the competition. The standard of the winning samples was very high and the 'general level of excellence' indicated the great interest that growers took in the competition.

Mr Redsell also paid tribute to the work of Mr Ray Neve, the recently retired head of the Hops Research Department at Wye College and to Mr John Paine from the Weald of Kent, who stood down after 25 years on the Hop Industry Committee.

Mr Norman Curtis, President of the Institute of Brewing introduced Mr Charles Tidbury, Chairman of the Brewers' Society who presented the prizes.

RESULTS

Class A—Hop Merchants' Cup Offered by the Hop Merchants Association for the best sample of seeded hops bought on the basis of their flavour character regardless of α-acid content

	Grower	Variety
1st	F. P. Clift & Sons Ltd., Lulsley Court, Lulsley, Worcester.	Golding
2nd	Hawkins & Turner Forstal Farm, Lamberhurst, Tunbridge Wells, Kent.	Whitbread Golding
3rd	P. Davies & Son, Claston, Dormington, Hereford.	Wye Northdown

Class B—Brewers' Cup Offered by Courage Ltd., Arthur Guinness Son & Co. Ltd., and Whitbread for the best sample of seeded hops that are bought primarily for their large α-acid content

1st	A. W. F. & P. A. Parker Crowhurst Hop Farm, Bullen Lane, East Peckham, Kent.	Wye Target
2nd	Admin. of R. E. Daws, Kitchenham Farm, Bodiam, Robertsbridge, Sussex.	Wye Target
3rd	Mr. P. A. Corfe, Rock Farm, Nettlestead, Maidstone, Kent.	Wye Target

Class C—Hop Growers' Cup Offered by the Association of New Varieties of Hops for the best sample of seeded hops which combine an acceptable aroma with large α-acid content.

1st	P. Davies & Son, Claston, Dormington, Hereford	Wye Northdown
2nd	E. R. Lane & Sons, Old Court, Bosbury, Ledbury, Hereford.	Northern Brewer
3rd	F. Wilesmith & Co., Townsend Farm, Leigh Sinton, Malvern, Worcester.	Wye Northdown

Class D—Wigan Richardson Cup Offered for the best sample of seedless hops

1st	W. Rogers & Son, The Court Lodge, Horton Kirby, Dartford, Kent.	Wye Northdown
2nd	W. Alexander (Shoreham) Ltd., Castle Farm, Shoreham, Sevenoaks, Kent.	Bullion
3rd	W. Alexander (Shoreham) Ltd.	Northern Brewer

EUROPEAN BREWERY CONVENTION

7th Council Meeting, Naples, Italy, 18 October 1984

The Council decided by acclamation not to increase the subscription fees for 1985, and to maintain the total amount at the level of 1982. It will be the fourth year in succession that fees are not raised.

The Scientific Programme of the 20th International Congress, to take place at Helsinki, 2–7 June 1985, was approved by the Council. The programme had been compiled by the 'EBC International Selection & Programme Committee', and presentations were selected from contributors from all over the world. The programme features:

- Seven Invited Papers
- A Workshop, entitled 'Influence of Malting and Brewing Equipment and Technology on Beer Quality', comprising a half-day Session during which five papers will be presented by specialists.
- Twenty-two lectures
- An extended Poster Session, comprising 43 posters.

Ample time will be available for poster discussions, and the programme has been arranged such that there will be no interference with the lecture programme.

The Provisional Programme and registration papers of the Helsinki 1985 Congress will be mailed in December 1984. A considerable number of technical visits, excursions and post congress tours is being organised. It was announced that the Congress would officially be opened by the Prime Minister of Finland.

Preparations for the 21st (Madrid, Spain) and the 22nd (Zurich, Switzerland) Congress are well under way. Celebration of the centennial of the 'Versuchsstation Schweizerischer Brauereien' (Zurich), is planned to coincide to coincide with the 22nd Congress.

It was announced that 'Brewing Technology Services' had decided to concur with EBC in the sense that after 'Brew '87' the then following event would for once be held three years (1990); only thereafter the four-year cycle would come into effect.

The Council highly appreciated this gesture.

Negotiations with Interbrau have not yet been concluded; the situation will be reviewed after the coming EBC Congress.

The Council decided that the topic of the 1985 Symposium would be 'Wort Production'; a General Chairman still has to be nominated.

Activities of Committees and groups were reviewed, and there was general satisfaction with the work carried out.

In the Analysis Committee Ir. B. J. Mees was nominated new member for The Netherlands, in succesion to Dr B. W. Drost.

The Ad-hoc Working Group 'Aging of Crates' had submitted its Final Report, elucidated in the meeting by the Chairman, Mr H. J. Veistrup. The Council complimented the Group with which was thought to be a most useful piece of work.

EBC Member Organisations will be informed on its contents. At the Helsinki 1985 Congress one of the Invited Papers will be dedicated to this topic.

The establishment of the EBC Information System is taking shape. During the coming Congress it is envisaged to demonstrate an operational information system, similar to the one to be established through EBC.

The next Council Meeting will be held during the 20th Congress, on 2 June 1985.

ANALYSIS COMMITTEE

In its meeting of November 27th, 1984, the Analysis Committee discussed the subject germination energy. In Analytica-EBC nr. IV new wordings will be given for the techniques used in the Aubry, BRF and Schönfeld methods.

Special attention was given to the differences in germination times in these methods. These are 5 days for the Aubry method, 3 days for the BRF method and 3 and 5 days for the Schönfeld method. Taken into consideration the shortening of germination times in practical malting that occurred in the last decades the point was raised to limit the germination times in the Aubry and Schönfeld methods to 3 days. A majority of the members was of the opinion that a good barley should germinate nearly completely within 3 days and that, accordingly, the period of judgement in both methods should be shortened to this time.

The decision was taken to publish a press-report with this intention of the Analysis Committee. Those interested are invited to give reactions before March 31st, 1985, to the secretariat of the European Brewery Convention, P.O. Box 510, NL–2380 BB Zoeterwoude, The Netherlands.

SYMPOSIUM ON QUALITY ASSURANCE

This meeting was held at the Heineken Brewery in Zoeterwoude on the 12th and 13th November, 1984 and was attended by 31 invited delegates.

Fourteen papers were presented, 6 by speakers from outside the brewing industry. Papers on Quality Assurance Policies included one from the Dutch Ministry of Agriculture on the development of quality assurance policies in the Dutch agricultural industries. The group of papers on quality assurance schemes operated in international brewing companies included a paper on Quality Control Circles in the Kirin Breweries, Japan. There were 3 papers dealing with Sensory Analysis, Relationship between Chemical Data, Physiological Response and Consumer Perceptions.

The monograph containing the full texts of the papers and discussions is expected to be published in January, 1985.

THE FINNISH BREWING INDUSTRY YESTERDAY AND TODAY

Introduction

Finland is located in northern Europe, bounded by Sweden to the west, Norway to the north and the Soviet Union to the east. Finland has traditionally maintained very close ties with the Scandinavian countries. With Sweden, for instance, Finland shares hundreds of years of history, for the country was once part of the Swedish kingdom. Finland has an area of 338 000 km^2 and the country is today home to just over 4·8 million people.

In 1983 Finnish breweries produced 290 million litres of beer and 195 million litres of soft drinks. Per capita beer consumption was 57 litres in 1983 and that of soft drinks 40 litres. Today there are 12 breweries in Finland, and these are operated by five independent companies. Expressed in 100 per cent alcohol, total alcohol consumption in 1983 amounted to about 6·4 litres per capita, with beer accounting for 2·6 litres of this total. As regards total alcohol consumption, Finland ranks halfway up the list among the countries of the world.

History of Brewing

Brewing was known in Finland as far back as the pre-Christian era during the first mellenium A.D. Kalevala, the Finnish national epic, contains four verses about the origins of brewing. During the early Middle Ages brewing in Finland was quite widespread, especially in monasteries and castles. In a book about the Nordic countries dating back to the mid-16th century. Olaus Magnus finds the consumption of beer in Finland to be widespread and the Finnish birth rate therefore to be quite high. Of the Swedish kings, Gustavus Vasa, John III and Erik IV were devotees of Finnish beer. The widespread consumption of beer was, of course, a result of dietary habits at the time. The food eaten was very salty, especially in the winter. This called for much drinking, and since all the milk available went towards the production of butter, beer was the natural beverage to have with meals. Brewing continued at a rather high level in the 17th century, though it declined towards the end of the century. At this point the distilling of spirits spread among the peasants, and this replaced beer. In the 18th century beer consumption declined again as the distilling of spirits increased, so much so that in 1801 brewing was considered to be so limited in scope that it was no longer felt necessary to levy taxes on it. The right to distill spirits for their own consumption was withdrawn from the peasants in the mid-18th century. Distilling was engaged in by 11 distilleries owned by the government. The withdrawal of distilling rights aroused so much opposition among the peasants, however, that it was permitted again in the early 19th century. During the first half of the 19th century towns began to favour brewing again, seeking to grant the sole rights of brewing within town limits to certain people.

As regards Helsinki, designated the capital of Finland a little earlier, sole brewing rights were granted to the merchant Nikolai Sinebrychoff in 1819. This can be considered

the beginning of brewing on an industrial scale in Finland. During the first half of the 19th century beer consumption was still rather negligible. Spirits were the leading alcoholic beverage. In the mid-19th century the temperance movement began to call for restrictions on distilling rights, and also demanded promotion of the establishment of breweries. The aim was to reduce the frequently intemperate consumption of spirits by making a milder alcoholic beverage more available. This in fact led to a sharp increase in the number of breweries in Finland in the latter half of the 19th century. Thus there were no fewer than 90 breweries in Finland in 1890. At this point, however, attitudes to alcohol policy changed in line with developments in the United States. The Finnish temperance movement rejected mild alcholic beverages and called for total prohibition in Finland. They did not achieve prohibition, though increasingly heavy taxation of beer was employed to weaken the position of the industry with the result that the number of breweries began to fall rapidly.

The 1907 Parliament enacted legislation prohibiting the sale of alcoholic beverages. Nevertheless the then ruler, Grand Duke of Finland and Czar of Russia did not append his signature to the decision. The 1909 Parliament re-enacted prohibition. And again the decision was rejected. During the First World War the consumption and availability of alcoholic beverages in general were severely restricted. This also applied to beer.

On Finnish independence in 1917 Parliament again rushed enactment of legislation on prohibition. This legislation was passed and took effect in early June 1919. It restricted production to malt beverages containing under 2·25 per cent alcohol by weight. As in the United States, prohibition in Finland resulted in a sharp rise in the smuggling of alcoholic beverages and in other crime. Public opinion was soon calling for repeal of prohibition.

In 1932 the time had come for a referendum on the subject. More than 70 per cent of the voters cast their ballots in favour of repeal. This consultative referendum is the only one of its kind in Finnish political history. The new legislation came into force on April 5, 1932. The legislation adopted the monopoly principle previously introduced in other Nordic countries. Trade in and the production of alcoholic beverages is, as a rule, in the hands of the government monopoly. The monopoly principle is still applied today to the distribution of alcoholic beverages. According to the law, the alcohol monopoly is entitled to grant concessions for the production of alcoholic beverages to private factories considered to be reliable. In practice the monopoly principle has been applied since 1932 so that the government has reserved the right to produce strong spirits, while the right to produce wines, liqueurs and beer has been conceded to private factories. Thus, when the new alcohol legislation took effect, Oy Alko Ab granted brewing rights to 44 breweries. The sale of beers containing more than 2·25 per cent alcohol by weight was nevertheless channelled through government alcohol shops. With respect to brewing, a change was made in the monopoly principle in early 1969 similar to that introduced in Sweden, whereby the right to sell medium-strength beer containing at most 3·7 per cent alcohol by weight was granted to convenience goods shops. The sale of stronger beers and other alcoholic beverages is still channelled through government alcohol shops.

Types of Beer Brewed In Finland

The beers made in Finland are chiefly light pilsner-type lager beers produced using low fermentation yeast. The only exceptions to the main types are the low-carbohydrate light beers, strong bock-type beers and the dark porter beer made using top yeast.

In Finland beers are graded according to their alcohol content. The various classes are as follows:

A Tax Class I beer is 'low-alcohol beer', with an alcohol content of less than 2·25% by weight. Respecting their wort strength, Class I beers are 6–7·5%. This beer does not come under Alcohol Act regulations, so that alcohol and beer advertising do not apply to 'low alcohol' beers.

The share of Class I beer in total beer sales is 6%.

Class II beer is not produced at all. The latest regulations stipulate an alcohol content for beers of this class of 2·5—3% by weight.

Class III 'regular beer' is Finland's commonest beer, with a market share of 57%. The alcohol content of regular beer is 3—3·7% by weight and its wort strength varies between 9–11%. Class II beers have a bitterness of 15–25 EBC units.

Tax Class IV A 'export' beers have a maximum alcohol content of 4·5% by weight and a wort strength of 11–12·5%, while their bitterness varies between 20–25 EBC units. Class IV A beers are retailed only by State Alcohol Monopoly stores and by restaurants satisfying the regulations under the Alcohol Act. The Class IV A beer share of total sales is approx. 37%.

Porter beer, which is the sole Finnish top yeast beer, has a wort strength of 17%.

The market share of special beers is only marginal.

Taxation of Alcoholic Beverages In Finland

The taxation of alcoholic beverages in Finland today is based on a proportional tax, which is staggered to some extent according to alcohol content. All strong alcoholic beverages and wines carry a tax of 60 per cent on the retail price of the product. The tax on class IV beer is 40 per cent of the product's retail price, while that on tax class III beer is 30 per cent of the product's retail price. As far as these products are concerned every increase in price also entails an automatic increase in the tax. Changes in the retail prices of alcoholic beverages are approved by the Supervisory Board of the alcohol company, though in practice not before the opinion of the Council of State has been heard. Thus the producer of products subject to the provisions of alcohol legislation cannot himself influence the retail prices of his products directly.

When the above taxes on alcoholic beverages and beer are added to the turnover tax, which currently stands at 15 per cent, the tax burden imposed on alcoholic beverages in Finland, beer included, is among the heaviest in the world. Indeed official alcohol policy in Finland is based on the premise that one of the most effective means of regulating alcohol consumption is the tax and price policy applied to alcoholic beverages. On the other hand, in Finland as elsewhere in the Nordic countries, the tax on alcoholic beverages plays a substantially bigger role in the government budget than elsewhere in Europe.

Since class I beer is not reckoned to be an alcoholic beverage, the tax on it is currently no more than 15 pennies per litre.

Beer containers

Most of the beer sold in Finland comes in plastic crates containing 24 bottles each. Several different types of crates are used today, though the aim in future is a standard crate for all breweries. The bottle is brown and holds 1/3 of a litre. It accounted for almost 79 per cent of all the beer containers in 1983. There are no other sizes of beer bottle in Finland. During the last ten years, however, there has been a big increase in draught beer consumption, the current proportion of the total being 16 per cent. Beer in tins accounts for only just over 5 per cent of total beer consumption. The tin holds 0·45 litres. No other sizes of tin are used in Finland. The price of tinned beer is increased by a special tax on the disposable container. Containers other than those mentioned above, such as throw-away bottles and other tin sizes, are used only for export purposes. In Finland 34 per

cent of total beer consumption takes place in licensed premises and 64 per cent at home.

Trends in Beer Consumption in Finland

Official beer consumption figures are available for Finland from the early 20th century onwards. It has been pointed out that beer consumption in Finland was very high in the Middle Ages. Beer consumed in those days was normally rather mild, however, with strong beers consumed only on festive occasions or among the nobility. At the beginning of the 20th century beer consumption in Finland amounted to about 30 million litres, which works out at about 10 litres per head of population. Beer consumption remained stable at this level for surprisingly long, right up to the '30s. During the prohibition era, of course, consumers could only get hold of low alcohol beer. On the eve of the Second World War beer consumption had already doubled to 60 million litres, i.e. just over 20 litres on a per capita basis. Consumption at the time was roughly distributed so that 60 per cent of total beer consumption was accounted for by milder malt beverages and 40 per cent by beer subject to alcohol legislation. In the mid-'50s total beer consumption had risen to just over 100 million litres, i.e. almost 30 litres per capita. Even then, most of the beer consisted of mild types not subject to legislation on alcoholic beverages. By the halfway point of the following decade the picture had altered substantially, however. Total consumption had risen by no more than from 100 million litres to 120 million litres, but now almost half the total amount of beer consumed consisted of strong beers covered by alcohol legislation. In 1968, a year before the reform of alcohol legislation, beer consumption had risen to 145 million litres, but now no less than 70 per cent of the beer consumed consisted of strong beers.

In conjunction with the reform of alcohol legislation in 1969 medium-strength beer came on sale in convenience goods shops. In a single year sales of this beer more than tripled. This also meant that total beer consumption rose from 145 million litres to 250 million litres in one year. Per capita consumption growth was no less than 20 litres on an annual basis. The present breakdown of beer consumed by strength in Finland was also established at the time. In 1983 the consumption of beer was distributed by tax class as follows:

Strong beer (tax class IV beer)	1·04 mill. hectolitres
Medium-strength beer (tax class III beer)	1·61 mill. hectolitres
Low alcohol beer (tax class I beer)	0·13 mill. hectolitres
Tax-exempt beer (low gravity)	0·4 mill. hectolitres
Total	3·18 mill. hectolitres

The consumption of medium-strength beer has not increased since 1974, and has instead declined slightly from the record level of consumption achieved that year. On the other hand, the consumption of strong beers has increased steadily. Strong beer is particularly popular in the licensed premises sector.

Brewing Technology

Since 1968, when sales regulations relating to regular beer were relaxed to some extent, Finland's beer production has practically doubled. Alongside this rapid growth in beer consumption, the brewing industry has also undergone drastic changes during the past 15–20 years, with the result that today the Finnish brewing industry as a whole is a highly modernised institution.

For beer making in Finland 80% of the ingredients are required to be malt, and the adjunct content may be at most only 20%. All the ingredients used must be of Finnish origin. Hence the main adjuncts are sugar and barley starch syrups. The hops used are imported.

Finnish beer is made from Finnish malt, which in turn is made from Finnish malt barley. Malt barley cultivars have been carefully improved to suit the Finnish climate. The brewing industry generally uses malt made from two-rowed barley and the main varieties are Kustaa, Ingrid and Karri. Multi-rowed barley is used mainly in the production of enzyme malts. Owing to its northerly position, Finland does not cultivate either autumn or winter barley. All the malt for brewing purposes is produced from grain grown under contract, so that Finns are able to procure malt from good quality, pure strain two-rowed malt barley. Two malt-production plants, Lahden Polttimo and Lahti and Raision Tehtaat at Raisio, satisfy Finland's entire malt demand and also produce enough for export. For the production of wort temperature-controlled infusion mashing is the most universal method. For filtering off the wort the lauter tun is the most common method, while a whirlpool separator is generally used for removing the hot break. The mashhouse equipment is mainly of German origin.

Beer fermentation and storage are traditional operations in which cylindro-conical tanks and single-tank fermentation are nowadays frequently employed. High gravity brewing has a limited application, chiefly in the production of 'low alcohol' beer. For beer filtration both kieselghur and plate filtration are used. Some breweries pasteurise their beer before bottling.

Beer Exports and Imports

It could generally be said that beer in Finland is a domestic product and brewing a domestic market industry. Both exports and imports are negligible. Under Finland's 1962 EFTA free trade agreement, foreign beers appeared in the alcohol monopoly's shops. The popularity of domestic beer has been so great, however, that imports, which at the time came from almost all the EFTA countries, have declined so much that today beer is imported into Finland from Denmark alone, and even here the volume is low. Nor have exports of Finnish beer been of any major importance to the Finnish brewing industry. An exception here are the exports to the Soviet Union during the first half of the current decade, though signs of a slump began to show in 1983. Equally significant have been the deliveries of beer to the foreign travel sector, that is to the 'shipboard' trade.

Beer Distribution System

The special features of alcohol policy in Finland have moulded the beer distribution system in Finland into something different from what it normally is in Europe. The cornerstone of these special features is Oy Alko Ab, the government alcohol monopoly. Mention has already been made of the distribution of labour between Alko and private factories in that beer, wine and liqueurs are produced by factories that have been granted concessions by Alko, whereas Alko itself attend to the production of strong alcoholic beverages. With the exception of that of medium-strength beer, however, the distribution of all alcoholic beverages takes place solely through Alko's retail outlets or through licensed restaurants.

This means that the consumer has rather few purchasing outlets to choose from by European standards. The distribution of strong beer takes place either through 209 alcohol monopoly retail outlets of 1552 licensed restaurants. Medium-strength beer is distributed to a minor degree through the aforementioned outlets, but mainly through 8147 convenience goods shops entitled to sell medium-strength beer and 2535 'medium-strength beer cafés' licensed for medium-strength beer. Despite the fact that medium-strength beer is sold through more than 10 000 outlets, medium-strength beer accounts for only 23 per cent of total alcohol consumption in 1983. Although strong alcoholic beverages are sold through proportionately far fewer outlets, they account for a good 44 per cent of consumption, when measured in terms of 100 per cent alcohol.

As regards channels of distribution, the reform of alcohol legislation in 1969 brought a major upheaval, for alcohol was earlier available in towns only. All the monopoly retail outlets and almost all the licensed restaurants were located in towns.

The alcohol monopoly controls and regulates the distribution of alcohol and the whole field of alcohol very closely in other respects, too. Thus every producer under a concession enters into an agreement with the alcohol company that closely defines rights and obligations. The alcohol company determines the sizes and types of pack that can be used by the Finnish industry. The alcohol company also issues orders regarding labels, bottle caps and so on. Brewery operations are thus very closely regulated by the goverment.

The alcohol company used to set sales districts of a kind for all the breweries; only the product of a particular brewery could be sold within districts. This division into sales districts was abandoned for strong beer in 1964 and from medium-strength beer in 1967. Not until this happened could breweries move into nationwide distribution. The elimination of these distribution limits has in fact contributed to the current situation, where the 12 existing breweries, each one of which used to be an independent company, now form five different groups. The following companies engage in brewing in Finland today:

— Oy Hartwall Ab, with the breweries in Lappeenranta (capacity 250 000 hectolitres per year), Tornio (capacity 450 000 hectolitres per year), Karrina (capacity 520 000 hectolitres per year) and Vaasa (capacity 100 000 hectolitres per year) and beer bottling plant and manufacture of soft drinks in Helsinki.

— Oy Mallasjuoma, with breweries in Lahti (capacity 480 000 hectolitres per year) and Heinola (capacity 279 000 hectolitres per year) and beer bottling plant and manufacture of soft drinks in Oulu.

— Olvi Oy, with a brewery in Iisalmi (capacity 80 000 hectolitres per year).

— Oy Pyynikki, with a brewery in Tampere (capacity 160 000 hectolitres per year).

— Oy Sinebrychoff Ab, with breweries in Helsinki (capacity 500 000 hectolitres per year) and Pori (capacity 500 000 hectolitres per year).

In view of the fact that Finland extends over a wide area geographically, the population figure is fairly low and population density is therefore also low, the costs of distribution play a rather big role in brewery operations. Thus the Finnish breweries are in fact spread out rather evenly over the country. Since, however, more than half the population lives in an area which corresponds to 1/3 of the total area of the country, there are more breweries in the more densely populated southern part of Finland.

Alcohol Consumption And Alcohol Policy in Finland

Finland is one of the few countries in which alcohol has been subject to prohibition. The temperance movement plays a big role in Finland, especially in rural areas where it constitutes a rather strong pressure group. The above notwithstanding, the proportion of the adult population in Finland accounted for by abstainers has dwindled constantly over the last 30 years, and today amounts to some 10 per cent of the total.

The cornerstones of Finnish alcohol policy today are, in addition to the alcohol monopoly, controls and consumption by means of prices and taxes and municipal alcohol sales bans. Thus the serving or sale of medium-strength beer was not allowed in a total of 50 municipalities at the end of last year. Normally, however, the municpalities that enforce this ban are of the kind in which alcohol consumption is in any case negligible, that is in which temperance people play a very big role. The heavy control of consumption through taxation meant that government alcohol revenues last year rose to FIM 6·2 billion, the excise tax on beer alone accounting for FIM 1·1 billion of the total.

From the '70s and right up to the last few years the temperance people have demanded that the sale of medium-strength beer be transferred back to Alko or that the alcohol content in medium-strength be lowered as it is in Sweden. Most recently, the Parliamentary alcohol committee, which completed its work in 1978 and in which temperance adherents were in the majority, proposed a reduction in the alcohol content of medium-strength beer to 3 per cent by weight and a reduction in the alcohol content of class IV beer to 4 per cent by weight. For the time being, however, government authorities have not found it necessary to tighten its alcohol policy approach along the lines put forward by the temperance people.

The Malting Industry

The cultivation of malting barleys plays a big role in Finnish agriculture. In the last few years the malting barley crop has more than covered the malting barley requirements of the industry in Finland. Malting barley is grown on special contract farms and the cultivation contracts are made by the two malt houses operating in Finland: Lahden Polttimo Oy in Lahti and Raision Tehtaat in Raisio.

In 1983, the total area under barley in Finland was a good 550 000 hectares. All in all, malting barley contracts were made for 160 000 metric tonnes of barley. The Finnish brewing industry consumed about 40 000 tonnes of this barley in malted form. In addition, Finland exported 50 000 tonnes of malt and 25 000 tonnes of malting barley. On the world market Finnish malt is known for high quality. Contributing factors here are the light northern nights of the growing season and the unpolluted natural surroundings. The top quality technology employed in the malting process lends a finishing touch to the impact produced by favourable natural conditions.

Research in the Brewing Industry

Finnish breweries have well-established traditions in the field of brewing research. As the total volume of beer produced by the Finnish brewing industry is rather small and individual breweries consequently have limited resources for research, the breweries and malt producers with a view to concentrating brewing research resources in 1956 decided to establish a joint laboratory, Oy Panimolaboratorio—Bryggerilaboratorium Ab. The breweries participate in the funding of the laboratory to an extent determined by the size of their beer sales. The purpose of the brewing research laboratory is to carry out research serving the entire brewing and malting sector, to maintain an analysis service, and to offer breweries facilities for their own research projects. Nowadays the brewing research laboratory operates in conjunction with the Technical Research Centre of Finland, so that the resources at the brewing industry's disposal are now greater than ever.

Oy Panimolaboratorio represents Finland as a member organisation in the European Brewery Convention, EBC, and the laboratory's head of many years' standing, Prof. Tor-Magnus Enari, is currently the EBC's president.

CONSUMPTION OF BEER IN LITRES OF PRODUCT PER CAPITA

	1968	*1970*	*1975*	*1980*	*1982*	*1983*
Tax class IV	8·4	11·2	15·7	19·7	20·5	21·5
Tax class III	10·7	32·2	37·5	34·2	32·7	33·0
Tax class I	11·3	4·8	3·0	2·7	2·6	2·7
	30·4	48·2	56·2	56·6	55·8	57·2

PER CAPITA CONSUMPTION OF OTHER DRINKS IN LITRES OF PRODUCT

	1968	*1970*	*1975*	*1980*	*1982*	*1983*
Spirits	3·6	4·5	7·5	7·3	7·5	7·5
Wine	3·6	4·1	8·8	8·2	8·8	8·5
Soft-drinks	25·3	40·1	44·7	40·1	40·1	40·4
Juice	1·0	1·0	8·4	17·5	10·2	7·8
Milk	270·0	265·0	229·0	218·0	207·0	198·0
Coffee	8·9	9·6	10·1	10·3	11·1	10·9

BEER SALES BY CONTAINER

	Draught beer	Returnable bottle	Can
1975	2·0	90·2	7·8
1980	14·2	80·6	5·2
1982	15·7	79·4	4·9
1983	16·0	78·6	5·3

NUMBER OF RETAIL OUTLETS FOR SPIRITS AND BEER

	1970	*1974*	*1980*	*1983*
State Monopoly Shops	167	188	204	206
Licensed restaurants				
—spirits	1011	1222	1294	1294
—only wine and beer	170	236	231	258
Licensed only for medium beer				
—retail outlets	16736	12625	9248	8147
—premises	3299	3189	2655	3535

SALES OF BEER, by types of beer (1·000 hl)

	1960	*1970*	*1980*	*1983*
Tax class IV	75	525	1006	1092
Tax class III	255	1514	1653	1607
Tax class I	588	227	132	132
	918	2266	2791	2831

EXPORTS OF BEER INCLUDING SALES TO FOREIGN TRAFFIC (1·000 hl)

1974	42·1
1980	66·7
1981	104·9
1982	96·8
1983	54·9

CONSUMPTION IN LITRES OF ABSOLUTE ALCOHOL PER CAPITA IN FINLAND

	1933	*1960*	*1968*	*1969*	*1982*	*1983*
Spirits	0·67	1·30	1·43	1·58	2·82	2·83
Fortified wines	0·01	0·12	0·32	0·32	0·47	0·43
Table wines	0·01	0·08	0·18	0·20	0·52	0·51
Beer	0·12	0·35	0·94	2·11	2·54	2·60
Total	0·81	1·85	2·87	4·21	6·35	6·37

PER CENT SHARE OF DIFFERENT PRODUCTS IN ABSOLUTE ALCOHOL

	Spirits	*Wine*	*Beer*
1933	83	2	15
1950	80	5	15
1960	70	11	19
1968	49	18	33
1969	38	12	50
1975	45	16	39
1980	44	15	41
1983	45	15	40

THE SCIENTIFIC PROGRAMME OF THE 20th INTERNATIONAL CONGRESS OF THE EUROPEAN BREWERY CONVENTION, HELSINKI, FINLAND, 2–7 JUNE 1985

Compared with previous EBC Congresses, the scientific programme of the 20th Congress, which will be held in Helsinki, Finland, in the Finlandia Hall from 2–7 June 1985, incorporates a number of special features:

Invited papers

In the Invited Papers subjects of general interest for the brewing industry are treated. Seven Invited Papers will be presented. These papers will on the one hand deal with subjects which are the domain of scientists from outside the actual field of brewing research; on the other hand also issues will be discussed which have so far been typical of EBC Congresses, like the survey of an EBC Symposium or the results obtained by an EBC Working Group.

For Invited Papers, the principle applies that the author's own viewpoint on the subject to be treated will be elucidated in depth, whereas at the same time the paper can deal with results of their own research. The papers need not necessarily cover the topic comprehensively.

The Council of EBC, in collaboration with the International Selection & Scientific Programme Committee, have indicated the topics to be presented and have selected and invited the speakers.

Workshop

A novel feature in the Congress, taking all Wednesday morning, is a Workshop on a technology-oriented topic, entitled: 'Influence of Malting and Brewing Equipment and Technology on Beer Quality'.

Five specialist papers will be presented in this Workshop, which will be concluded by a panel discussion on questions related to all morning's programme.

Poster session

The Poster Session, which, during the London Congress (1983) attracted a large number of delegates, has been increased and now comprises a total of 43 posters.

Great attention has been paid to the fact that ample time will be available for poster discussions; these have been arranged such that there will be no interference with the lecture programme.

Lectures

Twenty-two lectures will be presented, selected from amongst contributors all over the world.

Taking into consideration the extension of the programme, it is not surprising that the number of the 15-minute lectures has been reduced when compared with previous EBC Congresses.

To summarise, the as usual comprehensive programme totals 77 scientific presentations.

What sort of information may we expect from the various lectures or lecture groups? To what extent will subjects be dealt with which are of interest to scientists and brewers alike? Subjects to be considered in this context are genetic engineering, fermentation, new barley varieties (either hybrids or mutants) and permanent problem areas such as those concerning foam, stability and filtrability. Are new insights to be expected here? Apart from all this, new information on developments and practical applications will have become available in the fields of energy conservation and pollution control.

To start with the catchwords 'genetics' or 'genetic engineering', the congresses held after 1979 have seen an ever increasing number of presentations on this topic. This time, the programme incorporates as much as two lectures and eleven posters. Hence, here a survey can be presented, which otherwise only could be exceeded by specially arranged events.

The subjects in question can be grouped as follows:

First, *Molecular genetics of diacetyl formation* by brewers' yeast, involving the identification of the nucleotide sequences of the genes that are responsible for the repression of leucine and valine synthesis (Petersen, DK).

The unfavourable fermenting behaviour of diacetyl-negative mutants could be improved with the aid of mitochrondrial DNA from bottom-fermentation yeasts (Ramos-Jeunehomme *et al.*, B).

The introduction of *foreign genes for amylases and*

glucanases, for instance, of a beta 1–4 glucanase (cellobiohydralase I) from filamentous fungi (Trichoderma reesei), which secrete an active enzyme (Knowles, SF). Endo-beta 1–3, 1–4 glucanases of Bacillus subtilis have been implanted in Saccharomyces cerevisiae by Cantwell *et al.* (IRL), while in a further project, by making use of this type of glucanase genes, an increase in brewhouse yield and improved beer filtrability could be achieved (Hinchliffe *et al.*, GB).

Also to be classified in this group are those subjects which concern the manipulation of yeasts for dextrine fermentation without this provoking the negative effects that, for instance, *Saccharomyces diastaticus* causes (Stewart *et al.*, CND). A trial to improve yeasts with reduced maltotriose processing properties by transplanting mitochondria top-fermenting varieties using rare-mating techniques, remained without success, however (Hammond *et al.*, GB).

The third group of activities in the field of genetics is the one characterising the various yeasts. To give just one example: Thanks to the research into cytoplasm and cell nuclei an overview could be obtained of the major properties of yeast, such as dextrine fermentation, flocculation, maltotriose processing, alcohol formation and ester profile. Here, too, use is made of rare-mating techniques (Russell *et al.*, CND).

Hybridisation patterns, such as those showing the distribution of TY elements, are not only suitable for varietal characterisation, but also for the identification of fusion products (Decock *et al.*, B).

Identification by means of DNA fingerprinting is possible in a number of ways, for instance, by molecular techniques. Using hybrids of radio-labelled DNA (Pedersen, DK), or with the aid of restriction enzyme digests of mitochondrial and defined chromosomal DNA (Martens *et al.*, NL), particularly relationships and differences—mainly among bottom-fermenting varieties—could be established.

Using a plasmid vector system (Meaden *et al.*, GB) genetic manipulation of barley varieties can be described in a highly specific and controlled manner.

By way of individual protoplast labelling techniques, A. Gillis-van Macle *et al.*, (B) have found a way, using differing fluorochromes, to monitor fusion processes, and to formulate optimum conditions for this to be achieved, so as to arrive at new varieties that are free from undesired side-effects.

As concerns the subject of '*Fermentation*' the programme includes a number of very fundamental contributions: Two of the Invited Papers deal with this subject. These contributions, presented by scientists from outside the actual field of brewing research, are:

'Novel approaches to fermentation control' by Goma (F), and 'The control of alcoholic fermentation in wine production' by Ribereau-Gayon (F), lectures which will, no doubt, induce further reflection on fermenting processes.

A metabolic function of the formation of higher alcohols by yeast will be possible by fine-adjusting the NADH/NAD ratio, i.e. the equilibrium between the redox ratios during fermentation. The synthesis of glycerol and higher alcohols shows an excellent correlation, so that the effect on beer taste can be derived from the influence on the various factors (Quain *et al.*, GB).

Oxygen has a known effect on the fermentation cycle of brewers's yeasts (Lie *et al.*, N), in which context wort composition also plays a part. With the aid of small-scale trials, simple routine methods for testing the influence of oxygen are being worked out.

The formation of sulphur dioxide during fermentation is closely connected with the development of acetaldehyde. A survey of the factors as regards a possible influence might prove important for breweries operating in countries where regulations to limit sulphur dioxide contents are in force (Nordlöv, S).

The hydrophobicity of top-fermenting yeasts exerts a decisive influence on the yeast's capability to rise to the surface during fermentation. This is dependent on the yeast's flocculation characteristics. Particularly in cylindro-conical tanks, this property is of importance because it might be possible to influence it with the aid of genetic and physiological methods (Walton *et al.*, GB).

Another frequently discussed subject at previous congresses is the utilisation of immobilised enzymes and cells. It has been suggested to deal with this subject once again in an Invited Paper, which Linko (SF) is willing to undertake.

The application of this technology will be discussed in two lectures: Onaka *et al.* (J) have succeeded in mastering the well-known problems with the former 'Bioreactor' (EBC 1975) by introducing two new reactors, i.e. one for yeast propagation and one for fermentation as such. Masschelein *et al.* (B) make use of a horizontal yeast bed in alginate gel pellets. They, too, have been confronted with the drawback of yeast propagation coming to a standstill due to amino acid absorption, as well as the spectrum of fermentation by-products.

The subject of fermentation and maturation also includes a contribution dealing with the movement of biological and non-biological particles during fermentation and maturation. Using the well-known 'Turbidoscope', these particles and the influence exerted by beer density and viscosity, as well as carbon dioxide development, have been studied, and a method to obtain improved depositing characteristics has been suggested (Takahashi *et al.*, J).

Alcohol, even in the relatively low concentrations as present in beer, is a subject that is constantly studied from various angles. An interesting concentration in this field is to be expected from Vallee (USA) (Invited Paper), who will take a novel view on human alcohol metabolism: 'On the isoenzymes of alcohol dehydrogenase'.

In the number of lectures, the subject of *Wort Preparation Technology* slightly lags behind compared to the other subject fields:

Starch inclusion compounds are not only capable of influencing the wort preparation process (lautering, for instance), they are also the cause of lacking iodine normality in wort, for instance, after boiling. Also to be derived from this is the significance for beer quality and beer filtrability (Krüger *et al.*, D).

Wheat flour has proven to be a useful adjunct, provided that it be carefully milled so as not to be faced with clarification problems at relatively high wheat ratios. New commercially available enzymes to promote cell wall breakdown have brought about a considerable improvement in brewhouse activities (Forrest *et al.*, GB).

Also, the addition to the mash of an enzyme preparation extracted from enzyme-rich malt will accelerate clarification in all-malt worts or worts containing up to 20 per cent barley. This further improves both the yield and the filtrability. Filtrability was also improved when the enzymes were added during fermentation, and the final degree of attenuation was increased, which is particularly important for beers with low carbohydrate contents (Lamminmäki *et al.*, SF).

Wort production methods including elements such as the lautertun, the mash filter, the Strainmaster and additional clarification facilities (decanter, centrifuges, whirlpool, kieselguhr filtration) have all been investigated, with emphasis on sedimentation volumes and the various wort components. During subsequent further processing to beer of the various differently clarified worts it became clear that the clarification of the wort during cooling has a decisive influence on certain quality properties (Dupire *et al.*, B).

As regards the new energy-saving methods of wort boiling the answers to many a question still have to be provided:

A subject of current research is the minimum required total evaporation with and without overpressure during a constant period of heating in small-scale trials (Hug *et al.*, CH), but also the formation of proline-specific taste and

flavour substances is being investigated (Tressl *et al.*, D). It is primarily these substances which, in high-temperature boiling processes, create taste-affecting compounds; in the future they may well serve as the major components for the assessment of these boiling methods.

By treating the worts to be clarified with adsorption agents, the quantity of coagulable nitrogen can be brought down and, thus, during subsequent boiling, sludge formation can be reduced; hop utilisation can be improved; and the relocation of the heating surfaces may be omitted. Beer stability will be improved. In relation to the subject of cold hop addition, this procedure may lead to the question whether wort boiling is necessary at all (Maule *et al.*, GB).

Obviously, the 'beta-glucan' subject field bears on the entire process required for the conversion from malt to beer:

With the aid of barley mutants with low beta-glucan contents it has been possible to accelerate the modification during malting. In this context, the lower strength of the endosperm cell walls appeared to be the decisive factor, since enzyme capacities were identical (Aastrup *et al.*, DK). This offers considerable possibilities for both barley cultivation and malting technology.

Beta-glucans are known to be a complex group of substances. The capacity of its molecules to form gels is of importance for breakdown processes, such as during malting. The gelatinising potential is not necessarily related to the molecular weight of the beta-glucans. This might be an explanation of the poor correlation between beta-glucan content and beer filtrability (Letters *et al.*, IRL).

Both alpha- and beta-glucans produced from malts at differing degrees of modification and with mashing processes of differing intensities showed differences and their sensitivity to the mechanical strain on the beer prior to filtration. Particularly favourable results were obtained with mixed malts, whose analysis results were more or less identical to those of malts which had purposely been undermodified (Esslinger *et al.*, D).

Beta-glucan breakdown during malting, with the aid of cellulases of Trichoderma reesei filamentous fungus, has proven to be successful. The enzyme preparation can, however, also be used during mashing and fermentation, in which processes it has a very favourable effect, without any negative elements, on the quality of the beer (Oksanen *et al.*, SF).

A little more space than usual will be allowed at this Congress for analyses and new analytical equipment;

In his Invited Paper on Quality Assurance, van Eerde (NL) reports on the results and conclusions of the EBC Symposium organised under his General Chairmanship.

For rapid analysis of beta-glucans and the corresponding enzyme systems, Calcofluor and Congo Red are used, which are compared with the conventional methods of analysis (Jensen *et al.*, DK).

The ELISA technique (Enzyme Linked Immuno Sorbent Assay), which has so far been used for the determination of enzymes in barley, malt and yeast may also prove useful for beer production with respect to quality checks and legal checks (Vaag, DK).

Near infrared spectroscopy is also used for the analysis of barley and malt, but hardly ever for analysing wort and beer. In trials in this field, the principle of transmission appeared to be more suitable than the reflection principle. In addition, the transmission technique has the advantage that it does not require any communition of, for instance, solid matter (Halsey *et al.*, GB).

With the aid of an infrared analyser comparisons could be made in six laboratories with respect to extract, apparent extract and alcohol content. Propositions have been made on this subject to arrive at an improvement of the system (Baker, GB).

NIR spectroscopy is also used for in-line checking of beer density, which is especially important when high-gravity beer is blended with a standardisation liquor (White *et al.*, GB).

A novel system, hydronamic chromatography for the determination of particle sizes in colloidal solutions, suspensions and emulsions, will be discussed. Two possibilities for application are described: Passage through a filter bed consisting of non-porous grains with spectrophotometric detection as well as application together with ion exchangers calibrated with standard laser particles (Leitzelement *et al.*, F).

In a further contribution, identification and research of hazes and deposits are described, for which a simple though comprehensive working programme has been worked out, which, in practice, has resulted in the elimination of the causes of haze formation (Buckee, GB).

Microbiological analysis is dealt with in three posters:

It is possible, for instance, to directly establish the presence of living beer-spoiling bacteria with the aid of conductometric measuring methods. With these methods, and also, simpler yet, by making use of light or fluorescent microscopy, it will be possible to determine the chance of spoiling in pasteurised beer (Evans, IRL).

A filamentous bacterium has been isolated from a highly viscous low-alcohol beer. Electron microscope testing has revealed that protein was secreted from the bacterium's albumen layer (Haikara *et al.*, SF).

Thanks to the heat resistance determination of beer-spoiling organisms it has, allowing for the factors alcohol and carbon dioxide, been possible to establish the time and temperatures required for killing off the organisms with the highest degree of heat resistance (Kilgour *et al.*, GB).

The subject of *Hops* is discussed in an Invited Paper by Whitear (GB) on 'Hop products and Processing Technology', and in a number of 15-minute lectures and posters.

Beta-acids, as by-products resulting from the isomerisation of alpha-acids, have been transferred into extracts, thus rendering beers with acceptable bitterness (Hutcheson *et al.*, GB).

A reproducible hop character similar to that of delayed hop additions is obtained by means of fractionated hop oil from carbon dioxide extracts (Westwood *et al.*, GB).

Substances that are responsible for the hop aroma of a beer have been determined in two different ways: one of these is based on liquid/liquid extracts of beer distributed over granulated kieselguhr gel; the other one uses absorption to a reversal phase (octadecylsilyl-bound kieselgel), and subsequent elution with methanol (Irwin, CND).

The technological factors influencing hop aroma substances in wort and beer relate to hop products with different storage conditions and differing times of addition during wort boiling in both small-scale and large-scale trials. The organoleptically determined hop aroma of the beer is compared against a series of reference substances (Gresser *et al.*, D).

In view of the large number of hop varieties, much importance is attached to varietal determination. For this purpose, use is also made of polyphenols, in addition to bittering substances and hop oils. The various data are recorded and stored, so that the varieties can be allocated on the basis of varying exemption probabilities (Seeleitner *et al.*, A).

Once again, beer foam is dealt with in a number of presentations.

Exerting a direct influence on foam is possible by the extraction of protein from the raw materials (barley, for instance), as well as addition at a late stage of the brewing process. Another possibility is to increase protein hydrophobicity by means of organic derivatisation techniques (Bamforth *et al.*, GB).

The foaming ability of a beer has been determined at a high degree of significance using three selective extraction methods on 21 malts. In the studies, both the varieties and

the germination and kilning factors have been taken into consideration (Vancraenenbroeck *et al.*, B).

With the aid of HPLC, both based on gel filtration and with the aid of a reversed phase column, profiles could be obtained of beers with differing foaming characteristics. It proved to be possible to arrive at a correlation between the determination methods as applied; the quality of the raw materials, and the production process (Cuvellier *et al.*, F).

Due to possible difficulties in clarification, the raw wheat throw had been reduced to 10 per cent; at additions as low as 2 per cent of rye and milo corn a noticeable improvement in foaming characteristics could be achieved. It is suggested that these products be directly added so as to facilitate the process (Stowell, GB).

A further series of novelties has been incorporated in the subject field comprising *barley, malt and malting:*

By intensive cultivation of spring and winter barleys (fertilisation, growth regulators, fungicides, insecticides and trace elements) on 100 sq.m. lots during a three-year period, it is intended—on the basis of small-scale malting and brewing trials—to prove that the produce quality resulting from this type of cultivation is equal to that obtained from conventional cultivation, and, further, that the gross yields of the good varieties are not inferior to those of other cereals (Moll *et al.*, F).

Barley composition is discussed in a number of presentations:

As will be known, beers from proanthocyanide-free malt and tannin-free hops have very good stabilities. Studies of malts and hops with and without proanthocyanidine have shown that satisfactory beer stability can be achieved by combining, for instance, proanthocyanide-free malt and low-tannin hops or tannin-free hop extract with a malt mixture (Erdal *et al.*, DK).

The location of barley flavonoids and their characterisation during the growth period should provide information on the significance of these substances for the grain itself. By way of a vanilline-HCl colouring technique it has been shown that the latter are situated in the testa of mature barley grains. It has furthermore been established how the flavanoid pattern behaves in the course of the growing period (Aastrup *et al.*, DK).

On the basis of three groups of enzymes (alpha-amylases, beta-amylases and limit dextrinase) barley maturation has been monitored in five varieties. It appeared that the various methods applied (gel diffusion, isoelectric focussing, immune absorption and quantitative immunochemical chemistry methods) provoked the consecutive or simultaneous occurrence of the various enzyme groups and their isoforms, while changes were noticeable after the enzyme synthesis phase, which are considered to be relevant to maturation characteristics (Daussant *et al.*, F).

Varietal purity is not only established with the aid of morphological or electrophoretical techniques, but also with immunochemical methods. The latter have a high degree of specificity and are a guarantee for absolute certainty as to the qualitative and quantitative detection of a number of winter barleys (Deichl *et al.*, D).

Varietal characteristics, and also the conditions under which a variety has been cultivated, are responsible for the differences in how barleys behave during steeping and germination. Of the parameters tested, particularly temperature, gibberellic acid have addition during malting, diastatic power and alpha-amylase appeared to be very effective (Rouiller *et al.*, F).

The germinative powers of four varieties have, on the basis of germinative energy testing, been monitored in storge trials at temperatures ranging from +26°C to −20°C and at three different water percentages. It was shown that in barleys with pronounced dormancy an improvement in germinative energy could be obtained when storage temperatures were lowered. A correlation could be determined between malt modification and germinative energy at two different temperatures. Thus, new possibilities are offered in the field of barley storage (Bourne *et al.*, GB).

Barleys which were grown in humid climatic conditions showed very strong, uncontrollable protein modification. This might be attributable to microflora. Disinfection of the steeping water had a favourable effect. It should be ensured, however, that the properties of the malt (such as fermentability) remain intact (Klopper *et al.*, NL).

Beta-amylase contents are highly dependent on the barley variety. Further influencing factors are climatic conditions during the growth period, and soil fertilisation at the time of harvesting. The aspects that were monitored were the development of free and bound beta-amylase, and of the protein content during maturation of six-rowed varieties, as well as the influence of the time of harvesting on the quality of the barley and the development of the diastatic power of the malt (Home *et al.*, SF).

The only 'real' malting subject deals with a malting at low humidity, the aim being to achieve lower production losses and to save energy. For this purpose, the barley that was steeped to 35 to 37 per cent, was pressed through a roller mill, after which germination took place with and without gibberellic acid addition. The analysis results obtained for these malts were as usual and the resulting beers were unobjectionable (Northam, GB).

The subject of 'flavour' is dealt with in a number of presentations, but the evaluation of flavour impressions is discussed in one poster only. Using the example of a beer whose taste had deteriorated on account of sulphuric substances, the author shows that the beer in question was differently evaluated, which was, in some cases, dependent on the recognition level of the flavour impression concerned. His studies relate to the individual evaluation of taste deviations, yet taking into consideration the average values as obtained by the taste panel as a whole (Jounela-Eriksson *et al.*, SF).

Technological subjects are by no means undervalued at this Congress. To make a general statement: Technology is at the root of it all. Yet, in daily brewing operations, not only raw materials selection, mashing processes, wort preparation, fermentation and beer quality are of importance but also subjects like sewage and refuse disposal, rest beer recuperation etc., and the treatment of bottles and kegs.

One of the Invited Papers entitled 'Aging of Crates' reports on the work of an EBC Working Group, which had at its disposal information from experts of leading European breweries, who also took part in an intensive exchange of experiences (Van de Bergh, NL).

The subject of waste water is dealt with in two further papers.

One of these describes a pilot plant which anaerobically processes the waste water from a combined maltings/brewhouse and a soft drink bottling plant, as well as the results obtained. In addition, information is provided on the start of the system as a commercial plant (Swinkels *et al.*, NL).

Another system, which is applicable in the industry, is capable of further modification, seeing that it is based on filling and emptying methods as well as on continuous technology (Eyben *et al.*, B).

An interesting variant has been added to rest beer processing: The introduction of ultrafiltration techniques have made it possible for yeast press beers of high quality and stability to be recuperated, which are fit for immediate blending. Seeing that the yield resulting from ultrafiltration is slightly lower than that obtained with separation, a combination of the two might be preferable (Cantrell *et al.*, GB).

The intensity of keg cleaning has always been considered to be at a lower level than that of bottle cleaning. The usage of ultrasound, high-pressure jetting and chemicals has been

tested under different conditions. Problems were encountered with mixed keg populations comprising aluminium kegs, high-grade steel kegs and other containers. The outcome of these studies has contributed to better hygienic standards and lower cost of cleaning (Stillman *et al.*, GB).

L. NARZISS
ARTHUR GUINNESS SON & CO (DUBLIN) LTD
ST JAMES'S GATE
DUBLIN. 8.

5 December 1984

CORRESPONDENCE

Direct Measurement of Yeast and Bacterial Viability

Sir,

The methylene blue staining method for estimating yeast viability[1] can suffer from a lack of sufficient contrast between stained (presumed non-viable) and unstained (presumed viable) cells. This problem is exacerbated if the method is extended to bacteria where one may wish to know, for instance, if bacteria sometimes found in packaged beers have potential for growth. When measuring bacterial viability we have found it necessary to increase the prescribed methylene blue concentration from 0·01% to 0·5% in order to maximise colour contrasts without affecting the accuracy of the test. There are many other stains, including fluorescent stains, which are purported to give indications of microbial viability but we have developed a simple, reliable and direct approach for both bacteria and yeast using crystal violet (hexamethyltriaminotriphenylmethane).

1 g of crystal violet is dissolved in 100 ml of de-ionised water and 2 g of trisodium citrate dihydrate added. Any solid material remaining is removed using a 0·45 μ membrane. An equal volume of this stain is mixed with an equal volume of the microbial culture and a wet preparation made under coverslip for microscopic examination at 100 × magnification using oil immersion. Dead bacteria (lactobacilli, acetic acid bacteria and coliforms) and both brewery and wild yeasts have been found to absorb the dye and appear dark purple whereas their viable counterparts appear unstained. The distinct contrast between the two types of cells (especially where these can be brought into focus in the same field of view) is, we believe, easier to appreciate visually than what is afforded using methylene blue.

We are presently determining the reliability of the method in comparison with the methylene blue approach. To date the results look promising but opinions from other brewery microbiologists would be welcome.

Yours Sincerely
H. A. V. EVANS
P. CLEARY

REFERENCE

1. EBC Yeast Group, *Journal of the Institute of Brewing* 1962, **68**, 14.

OBITUARIES

Noel Eric McElnea

Eric McElnea died on the 7th September 1984 at the age of 54 after an extended and courageous bout with cancer. He is survived by his wife Cecily and their four children, Margarite, Juliette, Catriona and Angus.

Eric was a Queenslander by birth and after completing a Science Degree at Queensland University joined Carlton and United Breweries Limited in Melbourne in 1955. After some period in Melbourne he was posted to Fiji in 1958 to supervise the commissioning of the Company's new brewery in Suva. In 1963 Eric was posted to Brisbane as Head Brewer, which position he held for 12 years, and was still in Brisbane at the time of his death as Trade Quality Control Manager. Eric was an Associate Member of the Institute of Brewing, who joined in 1959, served on the Committee from 1967 to 1977 and was Chairman of the ANZ Section from 1973–1975 at the time of the 13th Convention in Surfers Paradise. Eric had been for some time and still was at the time of his death President of the Brisbane Beer and Beef Club.

Eric was well-known for his sporting prowess on the cricket field, golf course and tennis court both at University and subsequently. He made friends easily and his personality alone assured him recognition wherever he went. He will be long-remembered by his many friends both in Australia and overseas.

Stephen Laufer

Dr Stephen Laufer died in Spring Valley, New York, United States of America on 4th October 1983 at the age of 89.

He obtained the degree of Doctor of Engineering at the Hochschule für Bodenkulture, Vienna in 1922. He joined Schwartz Services International Limited in 1929 and became Director of Research, Director of Laboratories and from 1952 until his retirement in 1976, Vice President.

He was author of some eighty papers in the science and technology of malting, brewing and fermentation. In 1936, he was the recipient of the Master Brewers Association of the Americas Cincinnati Achievement Award for outstanding and conspicuous research work on current brewing problems.

An enthusiastic supporter of the American Society of Brewing Chemists, he was a founder member and served as Chairman of the Technical Committee and as its President in 1952–53.

In 1932, he became a faculty member of the United States Brewers' Academy and served as its Director from 1954 until he retired in 1976.

Dr Laufer was a well known and well loved brewing scientist appreciated for his contributions to the biochemistry of malting and brewing and for his quiet, warm, friendly personality.