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CURRENT REVIEW

TERCENTENARY CELEBRATIONS OF THE ROYAL SOCIETY

ONE of the outstanding events of 1960 was the celebration by the Royal Society of the Tercentenary of its foundation. The Institute of Brewing felt much gratification at being amongst those organizations which were invited to present a message of congratulation to the Royal Society on this occasion. The document conveying this message is reproduced as a frontispiece to this issue of the *Journal*; it was handed to the President of the Royal Society, Sir Cyril Hinshelwood, at a ceremony at Burlington House, by the President of the Institute, the Rt. Hon. Lord Gretton, O.B.E., and the Secretary, Mr. G. E. R. Sandars, C.M.G., M.B.E., M.A.

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BREWING INDUSTRY RESEARCH FOUNDATION

Scientific and Technical Advisory Committee

THE 1960 Autumn Meeting of the Committee was held at Lyttel Hall on Tuesday, 4th October, under the Chairmanship of the Assistant Director, Dr. W. P. K. Findlay; the audience was characteristically large and representative. In the first of the two papers presented, Dr. J. R. A. Pollock spoke on *New Approaches to the Problem of Haze in Relation to Tannins*. Setting the background against which recent developments had been made, Dr. Pollock spoke of the close relationship which had been established between the anthocyanogens and the formation of haze in bottled beers, noting that four compounds of anthocyanogen type had now been isolated from barley and that steps were being taken to establish their constitution; there was reason to suppose that they were not of the flavan-3,4-diol type found in other plants. However, much other information was now available which did not demand a knowledge of structure; in particular, useful assessments of their concentrations in barley and malt could be made using the nylon-adsorption technique followed by acid conversion to red anthocyanidins (this *Journal*, 1959, 331). Many barley varieties have been examined, and the corns of each—whether or not they also contain anthocyanin pigments—contain substantially the same concentration of anthocyanogens; on the other hand, cereals such as wheat and maize, as well as some (but not all) wild grass seeds, are anthocyanogen-free (this *Journal*, 1960, 389). In barley, the anthocyanogens are mainly localized in the region of the aleurone layer, though there is some general distribution throughout the endosperm. During normal malting, there is little change in the concentration or distribution of anthocyanogens, but if dehusked barley is malted the bulk of these compounds is rapidly leached out from the grain, the remainder disappearing as germination proceeds. Consistent with the distribution now established for whole grains, beer made from fine malt grist shows less tendency to haze than that from whole malt; beer from coarse grist (which contains most of the aleurone) is the most prone to haze formation. Barley has also been shown to contain enzymes capable of destroying anthocyanogens in presence of air or of hydrogen peroxide. An enzyme concerned in the reaction between anthocyanogens and hydrogen peroxide is active in unboiled wort, so that addition of hydrogen peroxide to such wort leads to partial or complete removal of wort anthocyanogens. There is at the same time some increase in wort turbidity and darkening of colour; it therefore remains necessary to solve such problems as wort clarification after boiling, but it has been shown that if low concentrations of hydrogen peroxide are used (*e.g.*, 10–50

p.p.m.) a useful improvement in the shelf-life of beers can be achieved parallel to the reduction of anthocyanogen content.

In the discussion, it was said that brewing studies were in hand using hydrogen peroxide at the concentrations mentioned. No obvious effects on fermentation had been noted, and it was too early to discuss the flavours of the beers obtained. It was unlikely that hydrogen peroxide applied during malting would have any useful effect in the present connection, but the suggestion was welcomed that it might be useful to investigate the effect of generating hydrogen peroxide by enzymic means in trace amounts in the wort itself. Autoxidation of anthocyanogens was thought to be of only limited importance in relation to their destruction, and—when considering their removal from wort by adsorption on proteins—it had to be remembered that, to be fully effective, adsorption had to be allied to oxidation. The % removal of anthocyanogens could be correlated with the stability of a particular beer, but predictions from one beer to another could not be made on this basis. Of other tannins concerned in the brewing process, catechins were also adsorbed on nylon and their brewing characters were worthy of further study, as were also those of hop polyphenols of types not represented in barley.

The second paper, entitled *Yeast Biochemistry*, was by Dr. G. Harris, and aimed at giving a general survey of several lines of investigation of yeast growth and fermentation. The yeast cell wall, rather than representing a molecular sieve, was now considered to have a complex structure across which ions and non-ionic material can be passed into the cell against the concentration gradient (this *Journal*, 1960, 293). Concentration of maltose within the cell does not occur with yeasts unadapted to maltose fermentation, but the permeation mechanism is itself adaptive, appearing when yeast is incubated with solutions of this sugar; permeation by oligosaccharides and their hydrolysis within the cell must be distinguished as separate processes. Permeation with maltose in conjunction with maltase action ensures an abundant supply of sugar for fermentation, but the rate of permeation by maltotriose may act as a limiting factor for its fermentation; yeasts which cannot ferment maltotriose, but which contain the appropriate hydrolase, presumably lack the permease mechanism for this trisaccharide. In another direction, considerable attention is now being given to the synthesis of nucleic acids and proteins, processes which derive their energy requirements from such compounds as adenosine triphosphate, this energy being passed to the more immediate precursors of the nucleic acids or proteins. Even during the lag phase of growth, intense metabolic activity is taking place, preparing the cells for the process of division. By selecting cells of even size from an old culture and growing them alternately in rich and in poor media, development becomes synchronized; individual cells behave in substantially the same way and the whole culture develops as one unit over two or three division cycles, as is evidenced by nutrient uptake and nucleic acid synthesis; such synchronous growth clearly makes possible detailed study of many aspects of cell metabolism. Again, a new class of energy-rich nucleotides has been shown to exist (this *Journal*, 1960, 371) which, in theory at least, can act as precursors of either nucleic acids or proteins; it is suspected that they are involved in ribonucleoprotein synthesis. Further study of the balance of energy-rich nucleotides should throw useful light on events during the lag phase, and the synchronous cultures should be very helpful in this connection. Another aspect of theoretical importance, and of importance in relation to continuous fermentation, is the relation between growth and fermentation, which are to some extent conflicting processes. During continuous fermentation with constant loss of yeast (this *Journal*, 1958, 404), the cells passing from the system must be made good by new growth; the energy for this can conveniently be supplied by respiration, demanding limited aeration. In some continuous systems, the required high rate of fermentation can be assured by replacing the yeast or—using a highly flocculent yeast (this *Journal*, 1960, 301)—by retaining it in the fermenting vessel; even here, however, greatest efficiency is not attained if conditions are entirely anaerobic despite the fact that the yeast shows some power of eventual adaptation.

In the discussion, several speakers paid tribute to the comprehensive nature of the work in progress and to the foresight which had been shown in devising such a

programme. Referring to metabolic paths involved in sugar utilization, it was regretted that there was at present no information on the relative importance of the pentose cycle in yeast metabolism under a variety of conditions. It was noted that maltotriose utilization had been used in attempts to differentiate yeast types, and it was also indicated that variations in uptake of this trisaccharide depended on the rate of maltose utilization; de-adaptation to individual oligosaccharides might well be important in relation to yeast storage problems. The high rate of fermentation in certain continuous systems was, it was emphasized, due to the high concentration of yeast cells.

In conclusion, warm thanks were expressed to the two lecturers for their outstanding surveys of such important topics, and to those who had taken part in the discussions for their contributions to the success of the meeting, whilst the President of the Institute —the Rt. Hon. Lord Gretton—thanked Dr. A. H. Cook and Dr. Findlay on behalf of all present for the excellence of the arrangements made for the meeting.

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EUROPEAN BREWERY CONVENTION

Barley Committee

THE twentieth meeting of the Barley Committee of the European Brewery Convention took place in London on 28th June, 1960.

Barley trials micro-malting results, 1959.—The Chairman, Dr. H. van Veldhuizen, reported that, in the micro-malting trials of 1959, Union and Wisa gave good results; Svalov 50/102 was rich in enzymes, but its malt extract was rather poor. Ingrid did not make a favourable impression, and among those varieties which were not grown at all stations only Volla seemed promising. In January, 1960, samples of the same lot of Wisa barley were malted three times for comparison in the different micro-maltings. The resulting malts were analysed collectively at Stockholm Breweries and, bearing in mind the number of different systems of malting used, the agreement of the analytical results was surprisingly good. The overall average of fine grind extract (dry matter) was 83·7 $\pm$ 0·5%. It was arranged to carry out an extended statistical analysis of the results, and it was decided to include in the 1959 Report of the Committee a paper on the micro-malting trials.

Barley trials, 1960.—To help the planning of Portuguese and Spanish trials of 1960 barleys, it was decided to draw up a list of probable obligatory varieties at the next meeting of the Committee. Discussion of a memorandum on the micro-malting trials of the 1960 crop barleys was postponed until the next meeting. Dr. Bishop reported that the E.B.C. Analysis Committee was satisfied with the small-scale method of determining malt extract which it was asked to develop, and that details of the method would be published in *Analytica*. The Chairman thanked the Sub-committee on New Varieties for preparing the first supplement to *Barley Varieties* which appeared in April, 1960. Report was received on a meeting of the Hop Liaison Committee in Copenhagen. A list of genetic stocks of barley had been published by F.A.O., and a letter of thanks had been received for the co-operation involved.

On the two days following the meeting the Members paid very instructive visits to Rothamsted Experimental Station and to the National Institute of Agricultural Botany (Director: Mr. F. R. Horne) and the Plant Breeding Institute (Director: Dr. G. D. H. Bell) at Cambridge. Members were entertained at dinner by the Institute of Brewing in London and by Arthur Guinness, Son and Co., Ltd., in the historical surroundings of Trinity College, Cambridge, under Holbein's famous picture of King Henry VIII.

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PRIMITIVE BEER-BITTERING AGENTS

IF one criterion of a "scientific" approach to a problem is the capacity to act wisely on results accruing from carefully planned experiments, then prehistoric man must surely have possessed considerable scientific acumen. Man's choice of basic food materials is essentially little different from that of many other mammals, but his habit of improving on nature by incorporating in his food preservative and flavouring agents of virtually no nutritive value is surely unique in the animal kingdom. It may be interesting

at times to contemplate the centuries of trial and error which preceded the adoption of the flavouring materials and spices at present in fashion, but it is still very difficult to determine what led man to select and develop certain culinary herbs from the surrounding natural flora. The history of the preservative and bittering agents employed in beer brewing occupies one small corner of this vast topic, and a scholarly and interesting account of the antecedents of hops has recently been written by Dr. Nils von Hofsten and published in *Acta Academiae Regiae Gustavi Adolphi*. Apparently bog myrtle (*Myrica gale*) long enjoyed popularity in brewing; one of the earliest references to its use is in the writings of the learned abbess Hildegard, but there seems little doubt that bronze-age vessels found in Denmark contained a type of ale flavoured with bog myrtle. Surprisingly, perhaps, bog myrtle beer is still brewed—and presumably drunk—near Floro on the west coast of Norway. Certain mediaeval records suggest that *Myrica* beer may provoke violent headaches in the consumers, but results of a recent trial brewing by AB. Stockholms Bryggerier have shown that *Myrica* beer is a palatable drink which can be consumed in moderate amounts without giving rise to noticeable disorders. Dr. von Hofsten suggests that the reputed ill effects may have been connected with the quantities drunk rather than with the quality of the drink. *Myrica* leaves and fruits (which are extremely rich in aromatic resins) also formed an ingredient of the German *Grut*, a concoction of butter and aromatic herbs used in brewing from the 10th till the 15th centuries; other plant materials represented were *Ledum* and juniper berries. By the 16th century *Grut* beer was fighting a losing battle and decrees were issued in several German states prohibiting the use of "improper herbs"; hopped beer, however, was still frequently flavoured with many other aromatic plants such as wormwood, avens, bog-bean, wood sage, gentian and thistle. In 16th-century England there was violent controversy over the merits of hopped versus unhopped beer, but many who disapproved of hops still preferred their ale to be spiced; Henry VIII, for example, was said to have been a great lover of spiced ale. The romantically-named heather ale of the Picts may have been a type of mead or, more prosaically, the term heather may have been loosely applied to heath plants in general, including bog myrtle.

In Finland in the 13th century, spruce cones were added to beer which failed to ferment, but the better-known spruce beer incorporating shoot tips is of American-Indian origin. This form of spruce beer has marked antiscorbutic properties.

Although hops are now an almost universal ingredient of beer, with bog myrtle, ground ivy, yarrow and the like completely ousted from favour, it would be a great misfortune if the scientific brewer of today remained in ignorance of the alternative bittering methods of his predecessors: Dr. von Hofsten has fortunately rescued from obscurity many of the relevant historical data and, in doing so, has compiled a fascinating treatise on early methods of beer-bittering.

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PLANT BREEDING INSTITUTE, CAMBRIDGE

Annual Report, 1958–1959

THIS is the first *Report* of the Cambridge Plant Breeding Institute to be published. Others will be produced annually in future, giving short accounts of the Institute's activities and from time to time featuring articles dealing with special topics. The article on this occasion has been written by the Director, Dr. G. D. H. Bell, and describes the way in which the work of the Institute has developed since 1952, when it was established as a research organization with its own governing body. It had its genesis in the Cambridge University Plant Breeding Institute set up in 1912, which was centred at the School of Agriculture and University Farm. The change of status and title came when the new premises at Trumpington were occupied and it became possible to expand the work. A biochemical section and a chemical laboratory were the first additions, to be followed in 1955 by a phytogenetics section and a pathology section to deal primarily with cereal diseases, and in 1957 by an extension of earlier work on the artificial induction of mutations.

Although the first concern of the Institute is to serve agriculture by the breeding of

improved varieties of crop plants, it also carries out research into the fundamental aspects of crop yield and quality and plant breeding. Thus the success in 1953 of the new spring barley variety, Proctor, was followed by the development of improved techniques for the isolation of hybrid forms showing the desirable characters of earliness and resistance to disease. At present efforts are being concentrated on the search for a better barley for autumn sowing, and for highly specialized feed barleys of both types. The most recent advances in winter wheat breeding have carried to a higher level the combination of yield, baking and milling quality and disease resistance, whilst work on oats has aimed at producing spring varieties better suited to low rainfall conditions, and increasing the yield of winter varieties without loss of hardiness. These three cereals, with potatoes and sugar beet, are the basis of a great deal of the rotational farming in England and together they have comprised the main part of the breeding work of the Institute since its expansion. Breeding problems have arisen in recent years, however, in other arable crops. For example, the production of more reliable and better yielding varieties of field beans and of better, special purpose varieties of kale would greatly assist English farming.

Dr. Bell's survey is followed by more detailed reports from the Sections. From the results of one of the malting barley investigations it seems that percentage insoluble carbohydrate could possibly be a varietal factor which is independent of the husk or protein content. Prediction of extract on samples of Proctor from various parts of the country, made by means of Bishop's equation relating extract with nitrogen and insoluble carbohydrate, was found to be far more accurate than prediction based on nitrogen and 1000-corn weight. This confirmed the previous year's findings, and was substantiated on samples of Proctor, Beorna and Maythorpe which were obtained from a maltster. The extracts predicted on these malts from nitrogen and insoluble carbohydrate were in good agreement with those obtained by the maltster and by micro-malting at the Institute, but in every case they were 2–3 lb. per Qr. lower than the extracts predicted from nitrogen and 1000-corn weight.

DETERMINATION OF SMALL AMOUNTS OF ARSENIC IN ORGANIC MATTER

THE *Analytical Methods Committee* of the Society for Analytical Chemistry has, through its sub-committee on *Metallic Impurities in Organic Matter*, produced a report on the determination of small amounts of arsenic which has been published in the Sept., 1960, issue of *The Analyst* (pp. 629–643). One of the sub-committee's first tasks was to investigate the determination of arsenic by the molybdenum-blue method, and they have expressed the opinion that this method has an advantage not possessed by the Gutzeit method in that the means of measurement used (spectrophotometric) is completely objective. Since the evaluation of the stain obtained in the Gutzeit procedure depends to some slight extent on the judgement of the analyst, the sub-committee regards the latter method as one of estimation rather than determination. They concede, however, that the Gutzeit method is adequate in many circumstances provided that the recommended procedure is strictly observed, and also it is less intricate and time-consuming than the molybdenum-blue method. It may be added that it requires apparatus which is much less costly. The report contains, therefore, not only a recommended method for the determination of small amounts of arsenic by the molybdenum-blue method, but also a revised procedure to be followed when using the Gutzeit method.

Both methods require the preliminary destruction of organic matter by wet oxidation. In the molybdenum-blue method the arsenic is then separated by extraction with diethylammonium diethyldithiocarbamate (prior distillation as arsenic trichloride being necessary only if excessive amounts of heavy metals or insoluble matter are present) and converted to the arsenomolybdate complex, which is reduced by means of hydrazine sulphate. The intensity of the resulting blue colour is measured in a spectrophotometer at a wavelength of 840 mμ. The method covers the range of 1·5 to 15 μg. of arsenic, but the range can be extended to the lower level of 0·5 μg. by using specially purified reagents. It is specific for arsenic except for the very unlikely possibility of interference by the rare element germanium. In the Gutzeit method the arsenic is separated by distillation

as trichloride, and determined in the usual way by evolution as arsine and passage through filter paper impregnated with mercuric chloride. This method is of general application and covers the range 0·5–5 μg. of arsenic. Exact procedural details are given of each method, together with directions for the special purification of reagents used in the molybdenum blue method.

It should be borne in mind that these recommended procedures have been devised to cope with the determination of trace amounts of arsenic in all kinds of organic material. Faced with the problem of making the determination in one particular set of circumstances or on one particular type of material, the analyst will sometimes find it possible to simplify the method (except for the final stage of measurement) or introduce a change in procedure without loss of accuracy.

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METHODS FOR THE DESTRUCTION OF ORGANIC MATTER

WHEN making a determination of metallic impurities in organic material it is almost always necessary to destroy the organic matter first, and the way in which this is done will depend on the composition of the material, the metal to be determined and the method used in its determination. A report prepared by the *Metallic Impurities in Organic Matter* sub-committee of the *Analytical Methods Committee* of the Society for Analytical Chemistry, and published in the Sept., 1960, issue of *The Analyst* (pp. 643–656), sets out a number of recommended methods of carrying out the destruction, together with statements of their applicability to various types of organic material, their advantages and disadvantages, and any hazards that their use may entail. Their suitability for particular metals is set out only in general terms (except in the case of mercury, which necessarily requires special treatment), since it is intended that more specific recommendations as to choice of method will be made in the report for each metal as it is published. In this way it is hoped to provide a wide choice of methods without the need for repetition.

The methods are of two main types, employing either wet combustion or dry ashing. The former make use of nitric and sulphuric acids, with or without the aid of perchloric acid or hydrogen peroxide; nitric and perchloric acids; nitric acid and ammonium nitrate; and potassium permanganate with nitric and sulphuric acids. They may be used for almost every kind of determination since conditions can readily be adjusted to prevent loss of the more volatile elements such as arsenic, antimony and mercury, but it is emphasized that small-scale trials under skilled supervision should be made with an unfamiliar material in order to lessen the risk of accidents.

Details of six methods of dry ashing are given. In one no ashing aid is used, but the others make use of light magnesium oxide, magnesium nitrate, sodium carbonate and sulphuric acid. The advantages of dry ashing are that it needs little attention and only the simplest of apparatus, can handle larger amounts of material more conveniently than wet combustion can, and avoids the use of large quantities of reagents. The method is of particular value in circumstances where sulphuric acid is to be avoided because of its liability to form insoluble sulphates which occlude heavy metals such as lead, but it cannot be used where mercury is to be determined. The reason for this is obvious, but not every analyst would agree that, with an ashing aid such as magnesium nitrate, which provides oxidizing conditions during combustion and a readily decarbonized alkaline ash, dry ashing is not to be recommended where arsenic is being determined. The importance of producing a light ash where possible, having only the slightest of contacts with the surface of the ashing vessel, especially if this is of silica, also appears to have been overlooked. In the absence of this condition significant amounts of some metals, such as copper, are liable to be held very strongly by the silica and extracted with difficulty by mineral acid. Such loss is only partially mitigated by the recommended means of ashing at a low temperature.

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CELL GROWTH

THE elucidation of the chemical processes which control the growth of living cells may be said to be one of the basic problems in biochemistry. But biochemistry is expanding at an enormous rate, and it is not always

easy to see how some of the discoveries that are made are contributing towards our understanding of the process of cell growth. It has become essential, therefore, occasionally to tarry awhile and to reflect on the progress that has been made. Just such an opportunity was taken recently by a group of Japanese biochemists who assembled, under the auspices of the Institute of Applied Microbiology of the University of Tokyo, to discuss various aspects of cell growth. The abstracts of the papers—some 15 of them—read at this symposium are published in the March, 1960, number of the *Journal of General and Applied Microbiology, Japan* (6, (ii), 117).

A fact which soon emerges on reading these abstracts is that the biochemist is still a long way from understanding the biochemical processes concerned in cell growth. Progress has perhaps been greatest in studies concerned with elucidating the biochemistry of the reactions concerned in the production or replication of cell constituents (polysaccharides, proteins, nucleic acids). But the events that take place subsequent to this—increase in size of the cell and cell division—have been little investigated, and the contributions to the symposium which touch on these aspects of cell growth are, therefore, all the more valuable. Thus, the paper by Dr. E. Hase gives an informative account of work that has been carried out on the role of sulphur compounds in cell division in the alga *Chlorella*. There is, also, a valuable group of papers on the effect of nutritional conditions on the morphology of micro-organisms; in particular, the paper by Dr. S. Kinoshita and Dr. S. Itagaki on cell elongation in *Micrococcus glutamicus* and that by Dr. K. Kitahara on abnormalities in the morphology of lactic acid bacteria provide interesting reading. The findings described in these papers cannot but lead one to question even more the value of morphology as a criterion in microbial taxonomy. Another group of papers, dealing with cell viability, gives witness to the difficulties encountered in studying this phenomenon; it would seem that it is not as easy as one would think to decide whether a cell is alive or dead.

The contributions to this symposium—all of them by Japanese workers—attest the high standard of fundamental biochemical work that is being carried out in Japan. The Japanese have, for some time, been well to the fore in studies on the industrial applications of micro-organisms, and it is clear that they are making equally rapid strides in the more fundamental aspects of microbial biochemistry. The work of these Japanese investigators deserves to be more widely known in the western world.

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OBITUARY

Walter Scott

1879—1960

WALTER SCOTT, J.P., who died on 19th August, aged 81, was a man who lived his chosen way of life to the full, and rose to the highest ranks of his profession. He was born in Blackburn in 1879 and started his brewing career at the Lion Brewery there in the 'nineties of the last century. He moved to Birmingham in 1900 to join Ansells Brewery as a Junior Brewer, where his ability and drive were soon recognized, and he became Head Brewer in 1909. In those days it was unusual for an operative brewer to rise beyond the status of departmental head, and it is greatly to his credit and that of his Company that his was one of the first instances of an operative brewer being recognized as having something to contribute to the management of his Company outside the Brewing Room; he was elected a Director in 1927 and Managing Director in 1933. He became Deputy Chairman in 1945 and held both these posts until 1955, when he retired from active business, but remained a Director until his death.

During his long career as an operative brewer he invented a number of processes which made his name known throughout the brewing world.

His work for his fellow brewers and the Industry was diverse and tireless, and he was, in turn, Chairman of the Birmingham Section of the Incorporated Brewers' Guild (1914–1918), President of the Guild (1936–1938), and President of the Institute of Brewing (1945). He was a former member of Brewers' Society and its Parliamentary Committee, and was nominated a Vice-President of the Society.

Apart from the record of his life and work for the industry, Walter Scott was widely