any moment indicates the job number on which an instrument is being used and the section where it is located. Any instrument not on a job number must be returned to the equipment store. Only by a procedure of this sort can the best use of instruments be assured within any one of the establishments or throughout the whole branch. For the latter purpose a Branch Equipment Register is held of all plant and equipment in the five Laboratories.

Reporting of Work

All work must be reported in one of the Branch's three recognized documents. The overall general structure and form of reports is agreed at the Research Board and is standardized for the Branch.

A 'technical memorandum' quotes factually the results of experiment and gives no opinions or recommendations. No special vetting procedure is necessary to ensure conformity to policy; but each memorandum must be addressed for the attention of an individual or body whose query prompted the exercise, or who can take any consequent executive action.

A 'technical note' gives the results of an investigation required to settle some point of policy or design. Conclusions are reached and recommendations made to guide further policy or design decisions. All technical notes are addressed for the attention of one of the Authority's recognized committees, or working parties. Technical notes likely to influence the policy of the Branch, either in respect of the prosecution of work within it or of the attitude which it will adopt to some proposal arising from other groups or branches, are addressed for the attention of the Research Board. Because of the influence that any technical note can have on policy or design involving the expenditure of large funds, it is the head of the Establishment's responsibility to ensure that the note has been properly vetted.

A full 'report' has all the requirements of a technical note with the addition that it deals with a completed block of work. It should be of the standard of a paper to a learned society.

The experimental worker is of course responsible for reporting on his own work, but his draft is subject to scrutiny particularly in regard to its general form. The section leader ensures that all experimental facts and observations have been used in the compilation, and the research manager makes any necessary comment as a result of his wider knowledge and experience. Full reports and technical notes before issue are finally approved by the head of the Establishment, who must be responsible ultimately for the quality of work from his own laboratory.

Distribution of all papers is subject to a number of provisions, depending on the status of the document in regard to its classification. The minimum standard distribution is agreed by the Research Board for each type of document, and additional distribution requires special authorization, depending on the category.

Conclusions

Particularly with applied research, the best work is based on the maximum of meticulous observation with scientific analysis of the results. Observations are amenable to timing and therefore to planning. The inspiration so necessary to the forward development comes to those suitably endowed, with or without a declared plan.

Scientific staff may fail to understand the need for, and therefore resent, the passage of paper and forms between one office and another. This is almost invariably a sign of bad management. The forms are not used as a discipline of the scientific staff but as a means of passing necessary information between the various sections which are concerned. Applied research is almost always a team endeavour involving many different skills, and it is a convenience to introduce a measure of formality into the administration, provided it is under broad-minded control. The formal organization of the scheme must not involve the scientific staff in more than a minimum of administrative work, and they should recognize it as reasonable. They must be allowed to make the proper use of their intellectual abilities without the need to digress every few days to consider administration. In each establishment a technical planning officer and administration officer with clerical assistance are quite sufficient to administer a scheme such as has been outlined.

It must be clear that in giving this outline of some of the methods used, we have not attempted to give a full picture. Only an indication has been given of the administrative and financial framework within which the scientific work can be carried out. It is pointless to construct such a framework and then not to use it; but its use must be, on every occasion, conditioned by the thought that the ultimate criterion of success of a research and development department is in the scientific and technical quality of the work done. The scientific staff must feel that the framework is provided to assist them in their work and not to divert them by form filling, committee attendances and so on.

During the period in which the development of the system of organization and management has taken place, opportunity has arisen to observe the reaction of the scientific staff. In general, scientific staff with experience of the system favour the control which it imposes, although about 1 per cent of recruits are unable or unwilling to work when so controlled. The main requirement is that in any establishment the system of organization must be devised by scientists and be acceptable to them.

In the development of this type of organization, responsibility has been given to all members of staff capable of accepting it. This has bred a responsible approach at a remarkably early age.

[1] *Nature*, 178, 524 (1956).

SOCIETY FOR APPLIED BACTERIOLOGY

SUMMER CONFERENCE

MILK and cheese were the main, but not exclusive, topics discussed at the summer conference of the Society for Applied Bacteriology held in Reading during July 16–18. Several of the papers contributed were by members from the University of Reading and from the National Institute for Research in Dairying, Shinfield.

One of the first papers dealing with milk was by D. J. Williams, J. G. Franklin, Miss H. R. Chapman and L. F. L. Clegg (Shinfield), who described a method for assessing the sporicidal efficiency of ultra-high-temperature sterilization. Membrane filters are used for detecting trace contaminations in the large

volumes of milk employed. By adjusting the inoculum of bacterial spores appropriately, this technique allows killing-rates of more than 99·99 per cent to be assessed.

Consideration was given by D. G. Griffiths, R. G. Druce and S. B. Thomas (Aberystwyth) to the present microbiological standards and tolerances for raw milks, some of which, they suggested, should be tightened in view of the continuous improvements taking place in the methods of handling, storing and sampling milks on the farm. They thought that the present methods of testing should be retained, but that satisfactory milks should not have a total count exceeding 20,000 organisms per ml. and the V.R.B. coli-aerogenes content should be less than 10 per ml. J. G. Murray (Belfast) compared the coli-aerogenes test at 30° C. with that at 37°, using raw and pasteurized milks, and obtained no false presumptive results in three thousand samples examined. Of the pasteurized samples examined, 33 per cent were positive at 37°, and 67 per cent were positive at 30° but negative at 37°; of the raw milks, the comparative values were 76 per cent and 24 per cent. Bottles and dairy equipment gave similar results, but not dried milks.

Prof. E. L. Crossley and Miss M. Campling (Reading) described their investigations into the survival of *Staphylococcus aureus* in the production of spray-dried milk, in which they demonstrated undoubted proliferation during bulk storage, but a tendency for a decline in numbers during the evaporation stage. The survival-rates of four strains on spray-drying ranged between 0·25 and 3·5 per cent; such values are inexplicably lower than those reported earlier. It was thought that organisms picked up after the evaporation stage were likely to cause most trouble because of their capacity for selective growth.

Turning to the bacteriology of cheese, Miss M. E. Sharpe and Miss J. Naylor (Shinfield) commented on the desirability of adding bacteria to maintain particular flavours, and emphasized the importance of the starter in this respect. They examined the survival of lactic bacteria in Cheddar cheeses over periods up to six months and found that the streptococcal types declined in number but the lactobacilli grew slightly. Of the three media used for isolating the various types, acetate agar was best for the lactobacilli. In a similar vein, and on the assumption that farm-house cheeses have a better flavour than factory-made cheeses because they are made under less rigorously controlled conditions and with less pure cultures, Miss N. J. Hall (Reading) examined the associated growths of *Streptococcus lactis*, an organism found normally in cheese, and *Escherichia coli*, a potential common contaminant. Mixed cultures added to the cheese vats undoubtedly affected the flavours according to the amounts of the cultures used, and fortunately the *E. coli* always died out. In mixed cultures maintained in continuous daily subculture at 30° and 37°, *E. coli* disappeared in a few days, and it was not detected in cheese a few weeks after manufacture. The influence of rennet on bacteriophage multiplication in milk prior to making cheese was discussed by L. J. Meanwell and Miss N. Thompson (London). They found that rennet added to milk within 30 min. of inoculating with a starter culture protects the culture against phage attack by stimulating cell production and suppressing phage multiplication. This prolongs the time before phage numbers equal cell numbers and so allows acid production to continue for some hours.

H. B. Hawley (Yeovil) gave two papers, one of which was in collaboration with G. Bourne (London), on the bacteriological deterioration of processed cheese, and its micro-structure and fat distribution. The papers were well illustrated by slides which clearly demonstrated the effects of different contaminating bacteria on the appearance of the cheese, such as 'eyes' in Cheddar cheese due to propionic acid bacteria and deformation in packet cheeses due to bacterial spores. Histologically, the micro-structure has many resemblances to pathological specimens, and bacteria can be seen associated with the fat globules.

Having disposed of the papers on milk and cheese, the conference heard M. Lev and C. A. E. Briggs (Shinfield) describe their investigations into the establishment of the gut flora in the newly hatched chick. Somewhat surprisingly, they found a balanced flora to be present after two days, and even after 24 hr. the broad groupings are established. Highest counts are found in the cæcum, and the next highest in the crop.

The effect of various detergents on the activities of a number of quaternary ammonium compounds at different temperatures and in waters of different hardness was the subject of a paper by Miss C. M. Cousins and L. F. L. Clegg (Shinfield). In general, lower temperatures meant lower activities, although the temperature coefficients varied with the compounds. Water hardness was very significant, to the extent that a mixture active at 50 p.p.m. in distilled water may not be completely effective in a hard water at 200 p.p.m. The activity of the quaternaries themselves bore little relation to their activities in detergent mixtures.

Another topic discussed was the preservation of organisms of the *Pseudomonas* type under mineral oil. Miss M. E. Rhodes (Reading) emphasized the need for cultures to be totally sealed with the oil to effect preservation and described it as an improved method because only slight changes occurred in the saccharolytic and proteolytic properties of the cultures so treated. She preferred it to freeze-drying. Of 170 organisms examined, only 6 per cent changed their reactions to sucrose and 2 per cent to galactose, whereas those maintained in continuous culture underwent significant changes. W. B. Hugo (Nottingham) described a new, or rediscovered, *Pseudomonas* species which is very similar to, or identical with, *Ps. lemonnieri*. It occurred as a contaminant and was singled out for investigation because it produces a characteristic blue pigment which is different from pyocyanin as shown by ultra-violet absorption spectra. The pigment is protein in nature, insoluble in water, and is only produced aerobically in the presence of carbohydrates.

The last two papers dealt, in effect, with the systems of classification of organisms. S. T. Cowan (Colindale) discussed the biochemical and other characteristics of various members of the coli-aerogenes group of bacteria, showing how irregular are some of the divisions of the different genera. This was illustrated by examples such as *Klebsiella pneumoniae*, *Kl. aerogenes*, *Cloaca* and *Citrobacter* spp. He pointed out that any system of nomenclature depends on the system of classification used, and added that utility is another factor to be considered. In a similar way, Joan Taylor (Colindale) discussed a subject on which opinions have varied from time to time, namely, the pathogenicity of *E. coli*. This organism as an infective agent is essentially

confined to babies three to six months old. It is infectious in close communities; but the same serotypes are found universally. These serotypes may differ slightly in their biochemical characteristics; but fundamentally they are all typical *E. coli*. At the same time, they may have serological identities with certain of the *Salmonella* group. So what of their classification?

These papers will be published in full at a later date in the *Journal of Applied Bacteriology*.

INTERNATIONAL LIGHT METALS CONGRESS AT LEOBEN

THE international Light Metals Congress, held in Leoben, Austria, during June 7–9, was the third such meeting there, the previous ones being in 1934 and 1948, and as on the former occasions, the purpose of the Congress was to give a comprehensive picture of the present state of the light metals industry and to permit informal discussion and exchange of views among the delegates. Organized by the Montanistische Hochschule with the assistance of the Austrian light metals industry, the Congress was attended by more than three hundred and fifty representatives from nineteen countries. The programme included an exhibition of the applications of aluminium, various visits and social functions, and six technical sessions at which more than thirty papers were read. In addition to the usual facilities for lantern slides and films, arrangements were made for the whole proceedings to be televised to a second audience in the overflow meetings.

The opening session was devoted to reviewing the part played by light metals in the economy of the major countries represented, which included Austria, France, Great Britain and the British Commonwealth, Italy, the German Federal Republic, Switzerland and the United States. The papers were contributed by W. C. Binz, R. Carmina, Th. Dirksen, A. Dumas, F. C. Frary, B. K. Klein, G. V. Schulthess and W. J. Thomas, respectively. All told, much the same story of rapid post-war growth of the industry, encouraged by the continuing strong demand for light metal products. An interesting fact brought out by these papers is that the present and estimated future demand for aluminium exceeds existing supplies of electrical energy and bauxite—the chief raw materials of the industry—so that attention is being turned to additional sources, notably those in undeveloped areas of western Canada and Africa.

In the session dealing with advances in metallurgy, M. O. Sem (Oslo) described the importance of the Söderberg electrode in modern large electrolytic cells, and P. Gross (Stoke Poges) examined the conditions to be fulfilled in the sub-halide distillation of aluminium. A. Brenner (Lend) gave an account of the production, properties and uses of super-purity aluminium—a material which is of growing industrial importance. The single paper devoted to magnesium was presented by C. J. P. Ball (London); this was a comparative survey of the methods currently used for the extraction of magnesium.

Interest in titanium, the latest member of the light metals family to be used industrially, was evidenced by the five papers dealing with this metal. Two of these described extraction processes: R. Kieffer (Reutte) summarized the present methods of production, with figures illustrating the astonishing growth in output during the past few years, and E. Fitzer, H. Hofbauer and H. Hohn gave an account of a process in which an alkali amalgam is used to reduce titanium tetrachloride to titanium amalgam, the mercury being afterwards removed by distillation. M. Hansen (Frankfurt) dealt with the physical metallurgy of titanium and its alloys.

An encouraging sign of improved international relations was the participation of scientists from the U.S.S.R., who contributed two papers on the metallurgy of titanium alloys, including one by Dr. M. A. Pavlov, of the Moscow Academy of Sciences.

Papers dealing with the technology of light metals included one on foundry practice by Prof. A. von Zeerleder, a pioneer of the light metals industry, who discussed the advances in foundry technique from the historical point of view, with emphasis on recent improvements in gating systems. K. Schneider (Nuremberg) described the methods used in the recovery and treatment of secondary metals, and M. Lamourdedieu (Paris) dealt with current practice in the rolling of light metals. Much interest was aroused by R. D. Hamer's paper on experience with the continuous casting and rolling of aluminium strip, which was supported by a short film depicting the operation of installations at Rorschach and Banbury. During recent years a demand has arisen from the aircraft industry for large structural forgings to replace members which otherwise would be built up from extrusions and sheet, and G. W. Richards and C. Wilson (Birmingham) discussed some of the metallurgical problems which arise in the production of these forgings, particularly the control of internal stresses. An account of recent advances in welding practice, including inert gas welding, cold welding and the high-frequency welding of tubes, was given by E. Zurbrügg (Neuhausen), and G. Luft and F. Sacchi (Novara) read a paper on surface treatment with reference to Italian experience.

Six papers were devoted to topics in physical metallurgy and metallography. R. Mitsche (Leoben) described the effect of superheating on the structure of as-cast metals, while E. M. Onitsch-Modl (Winterthur) surveyed the powder metallurgy of aluminium, magnesium and titanium. P. Brenner (Lend) discussed an urgent engineering problem, that of the fatigue strength of aluminium alloys and its relation to other properties of the material. The connexion between processing conditions and the properties of extrusions was considered by E. Nachtigall (Ranshofen), and G. Siebel (Singen) discussed a perennial production problem—the earing of certain aluminium alloys during deep drawing and the influence of processing variables on this behaviour. E. Schmid (Vienna) contributed a necessarily brief account of the part played by lithium, beryllium, magnesium, aluminium, silicon and titanium in certain applications to physics, with particular reference to nuclear energy.

The final session was devoted to applications of the light metals. The way in which new applications are evolved, developed and finally established was discussed by de Ridder, and M. Langegger (Ranshofen) described the various applications of semi-finished products in Austria. L. Kirste (Vienna) examined the essential requirements to be met for successful light-weight construction, and C. Panseri (Novara) mentioned some of the problems which arise when aluminium is used in architecture; he also described a new magnesium-silicide alloy which has been developed in Italy for spandrel sections. A