four, one only used a good solution. Eight of the twenty-four took ten moves or more. The common errors made were to move along in short steps instead of dichotomizing, to check junctions instead of chains, and to go into a chain before first finding if it contained a fault.

After describing the results of this experiment, Mr. Dale went on to tell how he checked his finding against the kind of errors made by electronic engineers searching for real faults in real equipment. The evidence shows that there is a marked tendency to make the same kinds of errors in actual practice. A study carried out by Bryan in the United States, for example, showed that of seventy of the U.S. Navy's best technicians engaged on the maintenance of wireless sets, only 17 per cent of them dichotomized.

Mr. Dale concluded his paper by saying that the results of his experiments to date and those of other relevant studies indicate clearly that we cannot expect electronic engineers to know the best way of searching for faults. They need to be taught, and, it seems, they need to be taught by instructors in technical college, not by experience.

In the last paper of the session Dr. N. R. Cowan, medical officer of health, Rutherglen, Scotland, reported the results of an inquiry into the life-histories and opinions of 443 retired men, aged 65 to 93 years, who attended a Scottish Consultative Health Centre for older people. Approximately 80 per cent of the group had been compulsorily retired. The main purpose of the report on the inquiry given in the paper was to focus attention on the traumatic effect of retirement on the health of older men.

The information for the investigation was obtained from the men on a doctor–patient basis during their visits to the Centre. An analysis of the data showed how far it could be said that the members of the group were leading a 'full' life at the time when the inquiry was made. Three criteria of 'full' were used: physical activities, mental activities, and personal relationships. Each member of the group was given a 'high', 'medium', or 'low' rating on these, and, in addition, a grading for social status based on the occupational classification list of the General Register Office. This ranges through five levels, from class I (professional) to class V (unskilled). The distribution of the group along the five levels inclined towards the lower end: there were 24 in class I (professional) and 83 in class V (unskilled).

The results of the inquiry showed that 'high' ratings on the three criteria of a 'full' life were in no case above 10 per cent for the complete group and that these were found among men in classes I and II. The proportion of 'low' ratings was quite pathetic. In the case of 'mental activities' it was 44 per cent of the group, with 'personal relationships' at 32 per cent. It was apparent that the unskilled workers in the group tended to lead equally unskilled lives.

In the course of the paper Dr. Gowan directed attention to how the harshness of the fact that our economic system does not provide employment for all who wish to work operates to such a deplorable extent against men in the age-group covered in the inquiry. As he pointed out, it is a common occurrence to see older men unsuccessfully seeking work, and also those who have passed through this stage without finding employment, unhappily resigning themselves to retirement. There are, in addition, the partial casualties of compulsory retirement—those who are forced to change their jobs late in life because of age. Of the men in the present group, 79 per cent regarded compulsory retirement as detrimental to the health of older men. One can only agree with Dr. Cowan's suggestion that until society provides some sort of education and preparation for retirement it has a social obligation to provide and subsidize congenial work for those who wish to do it.

This concluded the occupational session. It was a new venture this year in the Psychology Section of the British Association meeting and proved to be a rewarding one.

J. G. McComisky

ANALYTICAL CHEMISTRY, PHARMACY AND MEDICINE

In his chairman's address to the British Pharmaceutical Conference at Llandudno on September 15, Dr. G. E. Foster, chief analyst of Burroughs, Wellcome and Co., expressed a more than personal pleasure in the election of an analyst to the chair. Such an election, he said, was a recognition of the indispensable services which chemical analysis rendered to pharmaceutical science and industry. The names of Scheele, Baumé and Mohr illustrated how analysis and pharmacy had always, in fact, gone hand-in-hand up to the establishment of 'classical pharmaceutical analysis'—a stage which could perhaps be considered as embodied in the British Pharmacopœia of 1932.

In taking as his title "Modern Analytical Chemistry in the Service of Pharmacy and Medicine", Dr. Foster directed attention to the great pharmaceutical value of 'post-classical' developments in analysis. Developments which made it possible to work on very small amounts of material were of particular value, partly because of the very expensive nature of many modern drugs, and also because of their very high potency, which implied that only small amounts would be present in many preparations. For a number of drugs (adrenaline, atropine, carbachol, vitamin B_{12}, digoxin, ergometrine, stilbœstrol and physostigmine being among the examples quoted) the human dose was only a fraction of a milligram.

Classifying these techniques into microchemical and microbiological, Dr. Foster defined microchemistry as "ordinary chemistry carried out on a small scale", and often with the aid of special instruments. Among these, the microbalance had its place; but it should be remembered that colorimetric methods—whether for actual assay of such drugs as morphine, ergot alkaloids or tubocurarine, or for the estimation of impurities such as trace metals—were also essentially microchemical in nature. The use of the photoelectric spectrophotometer in comparing colours of solutions, reducing error to about $\pm$ 0·1 per cent as compared with about $\pm$ 5·0 per cent in visual comparisons, was given as an illustration of the improved sensitivity which instruments could achieve.

Of microbiological assays, Dr. Foster said these had made their way into very wide and intensive use, calling as they did for little more than standard

bacteriological technique and equipment, while effecting great savings of time and expense as compared with experiments on larger animals. Moreover, they could fill the gap when suitable larger subjects were simply unobtainable. Progress in research on the active agents in liver extract had been extremely slow so long as the only subjects known to be suitable for assay were human sufferers from pernicious anæmia. The development of methods measuring the potency of the extracts as growth stimulants for *Lactobacillus* species contributed largely to the identification of folic acid and vitamin B_{12}, while at the same time providing an effective assay.

Microbiological assays were of use for the control of both growth inhibitors (antibiotics and bacteriostatics) and growth promoters (vitamins, etc.). The principles of assessment of the amount of microbial growth from the turbidity of the culture, or from the diameter of the zone of growth promoted or inhibited by diffusion around a spot of the active agent on an inoculated agar plate, were equally useful in either context. For growth inhibitors, serial dilution in order to arrive at the minimal effective dose was also a practical alternative ; while for growth promoters, titration of acid liberated in the metabolism of the growing organisms was often the most effective measure of growth.

Successful application of any analytical technique was largely dependent on preliminary isolation of the ingredient sought. In this connexion, Dr. Foster reviewed the group of varied procedures to which the name of 'chromatography' is customarily, though not very perspicuously, applied. Of these, the most universally serviceable is no doubt the solvent partition technique, with paper chromatography as its most usual adaptation. Counter-current solvent extraction, however, might logically be classed as an extreme modification of the same principle. Paper chromatography had been successfully applied in the study of the digitalis glycosides, the identification of the polymixins, the fractionation of liver extract, the separation of the penicillins, and the establishment of the molecular structure of insulin.

Adsorption and ion-exchange chromatography had had more limited though still extensive pharmaceutical uses, especially for isolation of vitamins (for example, D_2 and B_1) before colorimetric determination. Gas–liquid, also known as gas or vapour-phase chromatography, was the most recent arrival, but might well replace analytical distillation, especially for very small amounts of material. It had already been applied to the detection of impurities in Chloroform B.P., and the examination of essential oils seemed an obvious further application.

FORM AND FUNCTION IN THE MOLLUSCA

DURING the meetings of the British Association in Glasgow a session on "Aspects of the Evolution of Form and Function in Molluscs" was held in Section D, those delivering papers being all of them members of the Department of Zoology in the University of Glasgow. In his preliminary remarks, Prof. C. M. Yonge directed attention to the unique features of the Mollusca. The body is primitively bilaterally symmetrical with an antero-posterior axis of growth but over this extends a mantle, attached to the visceral mass and secreting a protective shell, which is initially biradially symmetrical growing by marginal increment. While such conditions continue to exist in the recently discovered monoplacophoran *Neopilina* and in a modified condition (by subdivision or by loss of the shell) in Polyplacophora and Aplacophora, evolution within the Gastropoda, Bivalvia and Cephalopoda represents interaction between the body, essentially head and foot, on one hand, and the mantle and shell on the other. In the Gastropoda a balanced condition often exists, but the mantle may dominate as in the sessile vermetids or it may diminish and disappear as in the opisthobranchs ; in the Bivalvia the mantle completely encloses the body and is entirely responsible for external form, so largely controlling habit.

The respiratory chamber of the Mollusca consists of a primitively posterior mantle cavity containing the characteristic gills, paired ctenidia which consist of an axis containing afferent and efferent blood vessels, a branchial nerve and muscles, with rows of filaments alternately disposed on the two sides. Lateral cilia on the filaments set up a respiratory current which flows upward between the filaments within which blood flows in the opposite direction. Supporting rods within the filaments prevent buckling of the delicate tissues ; cleansing cilia on marginal surfaces remove particles carried in suspension by the respiratory current.

No organs in the animal kingdom have been more successful or proved more adaptable[1]. With folding of the filamental surfaces and creation of a more powerful respiratory current by pulsations of the funnel and then of the mantle wall, these ctenidia cope with the oxygen needs of modern dibranchiate cephalopods, while with filaments greatly increased in numbers and in individual length they have become organs of feeding in the bivalve Mollusca, the most successful group of ciliary feeders. In the Gastropoda the effect of torsion has been to bring them to the anterior end, and that of asymmetrical coiling of the shell with loss of the marginal slit or apical aperture has been the reduction and loss of the right (post-torsional) ctenidium. In the Mesogastropoda reduction to a single (right) row of filaments on the left ctenidium occurs, but with enhanced efficiency. In the pulmonates the ctenidium is lost but the possibilities inherent in a mantle cavity with vascular walls become apparent, this forming a lung and being possibly the most important factor in colonization of the land and also of freshwaters by Gastropoda.

In the evolution of the Bivalvia[2] the original dome-like shell must have extended marginally and been laterally compressed. The mantle also became attached near to the margin of the shell. The final stage of compression was made possible by reduction of calcification along the mid-line dorsally while at each end there was cross-fusion of the pallial attachments to the shell in the regions of bending. There thus came into simultaneous existence the ligament and the two adductors, the means of opening and of closing the bivalve shell. Complete enclosure of the