DYEING AND TANNING

THE Faraday Society held a General Discussion on "Dyeing and Tanning" in Leeds during September 8-10 under the chairmanship of the president of the Society, Sir Hugh Taylor. The Discussion was well attended and included a number of distinguished foreign visitors. The introductory lecture was given by Sir Eric Rideal, and, in all, twenty-two papers were read; these will be published in due course by the Society.

The picture of the theoretical aspects of dyeing and tanning arising out of the meeting showed that, while the general nature of these processes is well understood, a great deal of detail still requires filling in. This is especially true of tanning, where the nature of the natural tanning material is so complex. The points of interest arising from the two different subjects are best treated separately.

Dyeing Processes

The mode of attachment of the dye is still a subject for speculation and may range from a straightforward partition in the case of non-ionic dyes, or Donnan distribution for ionic dyes, to adsorption on specific sites, the extreme case being Langmuir adsorption. Non-ionic dyes absorbed by cellulose acetate and polyethylene terephthalate are examples of the former, and it was shown that the addition of benzoic acid alters the equilibrium partitions ratio. On the other hand, in the case of wool, resolution of optical antipodes on adsorption shows that specific sites must exist although, as the adsorbed molecule becomes larger, the resolution becomes less. Prof. W. Bradley interpreted this as due to a lower tendency for the larger molecules to be adsorbed on sites. There is, of course, a great deal of evidence to show that sites can exist. Both on synthetic and natural fibres in acid dyeing, the total dye uptake is stoichiometric with certain 'active' groups. The importance of the effect of the fibre constituents on fibre structure as well as their chemical nature, however, was emphasized by Dr. C. H. Bamford *et al.*, who have examined the dyeing behaviour of a number of synthetic polypeptides. The use of the surface balance, too, was described to demonstrate interaction between active groups in dyes and fibres, and on a similar topic Dr. Conmar Robinson demonstrated on the macro-scale stereochemical effects with an ingenious modification of the Stuart-type model. This allows a limited amount of deformation of the bonds such as does actually occur. One striking example was the easy manner in which one may be misled as to the stereochemistry of the adsorption of an azoic dye on cellulose.

So far as the equilibrium of adsorption is concerned, it appears that there is little to choose between the various theories on fundamental grounds because of the difficulty in devising critical experiments, and a choice is usually made on the grounds of expediency. One of the main obstacles is lack of knowledge of the state of the dye in solution. Thus R. H. Blaker *et al.*, in considering the adsorption of acid dyes by coppered polyacrylonitrile fibre, postulate a variation of the activity coefficient by a factor of 600; A. N. Derbyshire and W. J. Marshall, in attempting to measure thermodynamic changes by direct thermal measurement, noted an extra-

ordinarily large heat change on dilution of orange II (normally considered a non-aggregating dye), and Dr. A. B. Meggy described experiments on partition measurements and the effect of sodium sulphate on the solubility of this dye, from which he attempted to gain information on the activity coefficient. Further refinements in the thermodynamic treatment of adsorption data therefore await more complete knowledge of the activity coefficients of dyes in solution.

The rate-controlling steps in dyeing are now fairly well understood in the general sense, and Sir Eric Rideal showed how in many cases the rate of agitation can be a rate-controlling factor due to the relatively large distances the dye must be transported and the low concentration gradient in the external liquid phase. In these circumstances a conventional hydrodynamic flow treatment can be used satisfactorily to determine the thickness of the stationary layer. Diffusion within the fibre is fundamentally more complex, although it appears that the diffusion of acid anions is accompanied by adsorption on fixed sites. R. F. Hudson considers that, when appropriate allowances have been made, the 'free diffusion coefficient' is of the same order as that in water. He also accounted for an observed increase in activation energy with molecular size as due to deformation of the polymer chains by the larger molecules. It is interesting to note that radioactive tracer techniques are being applied to both equilibrium and rate measurements; but on the whole this technique is at present applied only as a refinement on existing ones. An interesting topic in kinetics is a study of absorption of aqueous solutions by dry cellulose, and, although the experimental technique is such that the results cannot be considered as quantitative, such studies must be of great practical and theoretical importance.

Tanning

Tanning is a relatively complex process, and the system presents greater difficulties than dyeing. It is, however, now clear that tanning processes which involve the combination of chrome and other metal complexes depend greatly on the form which the complex takes. K. H. Gustavson showed that the strong reaction of the cationic complexes of chromium is due to an initial adsorption on to single carboxy groups of the collagen, and afterwards the carboxy group enters the chromium complex irreversibly to give a strong covalent linkage. Special considerations, however, make it probable that less than 10 per cent of the total chromium complexes actually form cross-links. The slow nature of the covalent reaction is confirmed by J. Pouradier's study of the interaction of chrome and gelatine whereby he has found that viscosity increases occur over several hours.

The surface balance is being used in tanning as well as dyeing studies. By its means, J. H. Schulman and M. Z. Dogan have examined the effect of pH on the cross-linking of various fatty-acid and protein monolayers by a variety of metal ions, while S. C. Ellis and K. G. A. Pankhurst, by the same technique, supplemented by measurements of surface potential charges, have examined the effect of vegetable tannin on collagen monolayers.

One further technique of interest which must be mentioned is that of D. M. B. Armstrong, who described a pyknetometric technique of following the diffusion of tannins into hide. In this way he has been able to follow the various steps in the tanning process and show that tanning with tannic acid is much more complicated than with Mimosa tannin.

W. J. MARSHALL

FIELD STUDIES IN URBAN AREAS

THE Joint Biology Committee consists of representatives of twelve organizations interested in the teaching of biology. It has now held ten public conferences. While the latest, which was held at University College, London, on October 24, and which was well attended, did not contribute much to the solution of the major problem for which it was convened, it threw light on a number of subsidiary issues which merit attention both by teachers and biologists in general.

In his opening address, R. S. R. Fitter said that although the Industrial Revolution might have driven Nature away from urban areas, there has been a vigorous return. Towns provide special opportunities for the study of processes of biological adaptation to changing conditions. He instanced the house-martin and rock pigeon, dwellers of rocky cliffs, that have taken readily to buildings, and the Oxford ragwort, the natural habitat of which is the lava flows of Sicily but which now is equally at home on sites reduced to rubble by air raids. Town sites tend to encourage a pioneer flora; in fact, modern civilization has greatly extended the area open to plants falling into this group, while upon any site the temporary associations so established are themselves subject to rapid change. He suggested that urban areas provide many opportunities for the study of local geology and geography, together with that of certain plant and animal species. He appreciates the limitations imposed by urban conditions; but he is inclined to view them as a challenge, emphasizing that a great deal still has to be learned about the natural history of even such common animals as the starling and house sparrow.

Miss M. Collis dealt with biology teaching in the secondary modern school, selecting for special consideration the claims of children in the *C* and *D* streams who might find it difficult to read and write. Yet work with them she feels to be well worth while. It might begin with sensibly directed observation and collection out of doors, the sorting and disposal in the classroom of the material so collected, leading to further inquiry and exploration and so to the production of records of educational worth. With older pupils the work might be given a more experimental approach, providing further training in the keeping of records while giving the children a clearer conception of the interdependence of living things and the factors that constitute their environment. Miss Hilda Franks, who followed, emphasized that 70-80 per cent of all children pass through secondary modern schools. The teacher's task, she feels, is to put meaning and value into their lives by fostering in them the love of plants and animals. Interest once aroused will provide the basis for more critical standards and so encourage better ways of living. To her it seems that many social ills might be solved through education based on direct contact with real things.

Field studies at grammar schools were discussed by C. T. Prime and W. H. Dowdeswell. Mr. Prime said that at his school, Whitgift, Croydon, biology specialists in the sixth form can elect to take field studies at advanced level in the examination for the General Certificate of Education. Several do so. One difficulty is that the scripts have to be submitted by the beginning of May; another one is that it is not easy for a young investigator to maintain interest in some selected project throughout a whole year. His procedure is to encourage the boys either to make a general biological survey of some fairly restricted area or to set them the task of making a more intensive study of the biology of one or two species of animals or plants. Problems of identification, which are basic, present difficulties, although in his mind they are not insuperable, for several of the smaller groups of animals and plants provide suitable material.

That young biology investigators should not be expected to take on too much was also the opinion of Mr. Dowdeswell. He has found at Winchester College that the survey of a ten-yard stretch of a local stream is the kind of task that they can manage. In his opinion the essential point is to concentrate on ecological principles, which can be brought out from a wide selection of material. He made a special plea for the study of the soil. It is very variable and it lends itself readily to investigation under school conditions. Experiments on its physical nature and mineral composition are comparatively easy to perform, and there are many biotic factors which can be studied in the field and laboratory bringing out the interrelations within the organic complex.

An account of what she is doing at the Children's Centre, and with the Junior Nature Group, at the British Museum (Natural History) was given by Miss J. Palmer. Altogether, during the past five years about three thousand children have passed through her hands, their ages ranging from eight to seventeen with a heavy preponderance around ten and eleven. Three-quarters of the children were boys and a similar proportion were of grammar school standard. Those that visited the Centre were motivated primarily by the urge to collect specimens. She tried to encourage them to draw, paint and model the living organisms in which they were interested and so train them to observe more carefully. Among young children the urge to collect objects is extremely strong, but after twelve it tends to diminish; her aim is to canalize it in the right scientific direction. She is finding that some of her early members are now anxious to remain at the Centre until they reach seventeen, and they are developing into efficient natural historians. While some of the claims made by the children for what they have observed are fantastic, a few are real additions to scientific knowledge.

Several further points emerged from the open discussions. Among those taking part, difficulties over finding time for field-studies were fully appreciated, although they did not always appear to be so by others. Problems concerned with work-rooms and other material facilities are not insoluble, given the right kind of teacher, for in the London area education authorities are said to be sympathetic. Nevertheless, it was generally felt that, as was revealed by a recent report issued by the British Association, the field-work done at schools in Great Britain falls far below what is desirable. The lack of field-work is all the more to be regretted because