RHEOLOGY IN THE TEXTILE INDUSTRIES

THE British Rheologists' Club in association with some provincial branches of the Chemical Society, the Royal Institute of Chemistry, the Society of Chemical Industry and the Institute of Physics, together with the Textile Institute and the Society of Dyers and Colourists, recently organised a two-day discussion (March 19 and 20) on the rheological properties of textile materials. The meetings took place in the Department of Textile Industries of the University of Leeds under the chairmanship of Prof. J. B. Speakman, head of the Department and president of the Rheologists' Club. About a hundred and fifty scientific workers, including a number of overseas visitors, were present, and the problems discussed embraced such diverse phenomena as the flow of fibres over one another in the manufacture of yarns, and the state of orientation of long-chain molecules in viscose rayons.

The first day's proceedings commenced with a paper by D. R. Cox (Wool Industries Research Association) on "Fibre Movement in the Drafting Process". He derived the equations governing the velocity and distribution of the fibres in terms of general expressions for the frictional coefficient of the inter-fibre area of contact, which would depend on the pressure perpendicular to this surface. Only the relatively simple form of the equations was dealt with in the special case of short fibres. He then showed that the initial irregularity of the sliver, characterized by the values of its 'spectra', would be modified by the drafting process so that the spectrum of the issuing sliver could be derived from it by use of the fundamental equations. A single irregularity in the entering sliver was seen to give rise to an emerging wave of irregularities. R. Meredith (British Cotton Industry Research Association) read a paper on "Relaxation and Flow in Cellulose Fibres". The Tobolsky-Eyring-Halsey theory of viscous flow in high polymers was expounded and shown to provide a molecular picture of the delayed elasticity and creep properties of cotton and other such textile fibres. From these phenomena the theory enabled one to calculate the molecular dimensions of the 'flow unit' and the activation energy of the flow process.

Prof. W. E. Morton and F. Permanyer (Manchester College of Technology) then concluded the first session with a paper entitled "Torsional Relaxation in Textile Filaments". The behaviour of a wide range of textile materials had been studied and the data obtained were presented in graphical form. The logarithmic plots of the relaxation of stress with time illustrated the applicability of the Nutting-Scott Blair equations with only a few exceptions.

On the second day, H. J. Woods, R. R. Mukherjee and M. K. Sen (Textile Physics Department, University of Leeds) presented a short paper on "Some Tensile Properties of Jute". Results were given which emphasized the dependence of the values obtained for Young's modulus and tensile strength on the dimensions of the sample chosen. A significant negative correlation, for example, was shown to exist between the Young's modulus and the denier of the fibre (a measure of the thickness), which is in agreement with the 'weak spot' theory. Relaxation in jute fibres was negligible under the experimental conditions. The next paper, by L. Peters and Prof.

J. B. Speakman (Textile Industries Department, University of Leeds), on "The Viscous-Elastic Properties of Wool Fibres", proposed a new theory of the elastic properties of wool or other keratin fibres. Unlike the kinetic theories of the elasticity of rubber and related high polymers, where extension is regarded as the transition from a disordered to a more ordered state, the new theory makes use of the X-ray data which indicate that keratin is transformed from one crystalline state to another by unfolding of the main peptide chains. Assuming that these two forms are in dynamic equilibrium with one another, it follows that there must be some of the extended form present even in unstretched fibres. The load-extension curve of wool in formic acid indicates that this is by no means a negligible proportion of the total. Quantitative analysis of the curve was attempted, and estimates of the change in heat content and entropy of stretching have been evaluated. The creep properties are considered to be due to the transference of stress from the 'crystalline' to the 'amorphous' phase.

This was followed by a paper on "Stress-Strain Characteristics of Viscose Rayon in Relation to Anisotropy" by L. Rose and J. D. Griffiths (Messrs. Courtaulds, Ltd.). The outstanding feature of the work is the discovery of a linear relation between the birefringence and the logarithm of the slope of the load-extension curve of the wet rayon. This enables the birefringence of a specimen to be calculated with an accuracy of 0.001 from a simple measurement of wet tenacity and elongation when the axial swelling is known. It was shown that normal 'unstretched' rayons are anisotropic because of the profound contraction which takes place during drying on the bobbin. Under conditions where free contraction takes place, the material is optically isotropic and the properties of the filaments are in satisfactory agreement with the above linear relation.

The final paper was given by F. S. Warburton (Wool Industries Research Association) on "The Mechanical Properties of Horn". He described optical methods of determining the elastic constants of strips of horn with high precision at different humidities.

The papers, and the highly interesting discussions which followed, are to be published in the *Journal of the Textile Institute*.

L. PETERS

RECENT RESEARCH IN MARINE BIOLOGY

THE first number of the twenty-seventh volume of the *Journal of the Marine Biological Association* contains eight papers on varied aspects of marine biology.

Mr. G. M. Spooner and Dr. Segerstråle describe, in independent papers, their investigations on species of *Gammarus*, as the result of which we now have a clear picture of the species and varieties of these important marine scavengers. Mr. Spooner's pre-war studies on the quantitative and qualitative distribution in estuaries of *G. locusta*, *zaddachi*, *duebeni*, *chevreuxi* and *pulex* have been expanded, and linked with the valuable systematic work of Mrs. Sexton. He also had access to the collections of eight zoologists working on different parts of the British and Danish coasts. He distinguishes between the typical forms

of *G. zaddachi*, which he calls *G. zaddachi zaddachi*, and the saline or non-hairy forms, which he names *G. zaddachi salinus*. This separation of sub-species clears up difficulties met with by some observers on the range of the species.

Dr. Segerstråle writes on the distribution and morphology of *G. zaddachi* and its sub-species. Using material from the Baltic (Gulf of Finland to Denmark), the North Atlantic (Norway to Newfoundland) and the Arctic (Novaya Zemlya to Greenland), he distinguishes three sub-species of *G. zaddachi*, the oceanic, typical and saline forms. He regards the large arctic species *G. setosus* and *G. wilkitzkii* as allied to *G. zaddachi*.

Dr. R. Gurney contributes notes on parasitic Copepoda of the family Lernæopodidae, summarizing those with free or with suppressed nauplius stages. He describes the copepodid stage of *Lernæenicus sprattæ*, probably, he thinks, the attacking stage.

There are two fishery papers. Mr. P. G. Corbin gives a comprehensive account of the spawning of mackerel in the Celtic sea, between Land's End and southern Eire. His investigations showed that spawning occurred between mid-March and the end of July, with the maximum in mid-April, spreading east and slightly north from the western edge of the Continental shelf towards Eire and the mouth of the English Channel. The young also moved eastwards.

The pilchard spawns at the mouth of the English Channel from March until December and spreads eastwards likewise. *Sagitta* spp. and *Muggicea atlantica* were used as zooplankton indicators.

Mr. P. H. T. Hartley writes on the marking and recapture of flounders, with the object of discovering their migrations, distribution and growth-rates. Of the thousand specimens marked in the Tamar and Lynher estuaries in 1937-38, only 152 were recovered in the estuaries. Rewards were offered for their capture, and if brought in alive, they were measured and released. Seven were caught twice and one three times. Most of the fish do not travel far from the area in which they had been marked, but two showed more enterprise, moving up-channel to the east. One of these got as far as Brighton, two hundred miles away. The fish grew very little or not at all during the winter months. In the spring the young moved upstream, the mature fish down to the sea for spawning, but their movements subsequent to spawning vary considerably.

Prof. N. J. Berrill describes the interesting Ascidian *Pycnoclavella aurilucens*, peculiar to the Plymouth area, and recorded by Garstang in 1891. Its colonies are found in shallow water, growing on gorgonians, large hydroids and calcareous algæ. In structure it closely resembles *Clavelina*.

Mr. R. G. Evans, in a continuation of his ecological studies in Cardigan Bay, discusses the influence of wave action on the fauna and flora of twelve selected localities in the Plymouth area. He investigated wave effects on horizontal distribution and vertical zonation, on the size of individuals of certain common species, and on their toleration of exposure to the air. Although many factors make broad generalizations difficult, he establishes the existence of critical levels in the upper zone (between M.H.W.S. and E.H.W.N.) and the lower zone (between M.L.W.S. and M.L.W.N.). In the former many species attain their highest limit, in the latter some littoral species achieve their lowermost limit and sublittoral species their upper limit. The least critical level lies between E.H.W.N.

and E.L.W.N., because here all conditions are more regular than in any other level on the shore.

Lastly, there is Mr. D. P. Wilson's paper on *Physalia physalis*, with an account of its occurrence in the British and adjacent seas during the past hundred years, and of its feeding habits. Swarms of this floating siphonophore appeared off our south-west coasts in the summer of 1945, and off La Rochelle in 1946. Mr. Wilson concluded that *Physalia* is wind-borne, not current-driven; that it was blown north from its normal limit of 40° N. latitude. Associated with it were other southern species, from stalked barnacles to loggerhead turtles. From a single specimen sent from the Scillies by Major A. A. Dorrien Smith, Mr. Wilson was able to observe the rolling action of the pale blue pneumatophore, causing wetting of the pink crest in the water, the elongation of the dark blue dactylozooids, and the attachment of the purple gastrozooids to an unfortunate wrasse provided as food for the *Physalia*. This interesting account is illustrated by three of Mr. Wilson's superb photographs of the living animal.

Abstracts of papers published elsewhere, but written from Plymouth, and the report of the Council of the Marine Biological Association complete the volume.

N. B. EALES

NAPLES ZOOLOGICAL STATION

THE director of the Stazione Zoologica di Napoli writes to say that the institute is now in full working order again. In 1947 there were fifty-seven visiting scientific workers, of whom nearly half came from countries outside Italy. There were visitors from America, Belgium, France, Great Britain, Greece, Holland, Hungary, Spain, Sweden, Switzerland and Turkey. This variety of guests and the very varied research work being carried on revives the characteristic feature of the institute as a 'permanent international biological congress' in which valuable new contacts are made, both personally and in the symposia which are held from time to time. Advantage of these new contacts has been taken by the staff in obtaining advice for refitting the various departments of the institute. Laboratory facilities have been not only restored but also improved; in this work help has been given by official bodies and learned societies, both in Italy and abroad, and also by the Rockefeller Foundation, the United Nations Educational, Scientific and Cultural Organisation and the International Union for Biological Sciences.

The research work done in 1947, as in the past, stretches the title 'zoological station' to the utmost, for it embraces the whole field of biology. The more familiar fields of ecological, histological and cytological investigations have been extended to the ultra-structure of cell components, and to experimental embryological investigations along new lines. Many workers were engaged on the analysis of behaviour in fish, *Octopus* and Crustacea. Biochemical investigations included studies on molluscan muscles, the metabolism of the electric organ of *Torpedo*, the chemical nature of respiratory pigments in ascidians and annelids and the active principles concerned in the fertilization of echinoderm eggs. These widely different researches were made possible by the variety of apparatus now at hand. In this connexion thanks are due to the Swedish Research Council and the Wenner-Grens Institut for help in obtaining freeze-drying apparatus (Flossdorf and Mudd) for the rapid