ment was emphasized by a number of papers, including one on the role of play and sport in healthy personality development by Dr Emma McCloy Layman, one on the role of the spectator in the soccer player's dynamics by Dr Athayde Ribeiro da Silva of Brazil, and one on psychodiagnostic investigation of the personality of sportsmen by Professor Dr Miroslav Vanek of Czechoslovakia. Of particular interest were the papers on play and sport for retarded and other handicapped children. For example, Dr William P. Morgan (USA) found muscle fitness a better prognostic indicator for the length of stay in hospital than MMPI profiles; Dr Bryant J. Cratty (USA) described direct transfer of activity skills (jumping in number and letter grids) to classroom skills; Professor Bruce Fetz (USA) described intellectual and perceptual-motor development as a function of therapeutic play; and Dr James Widdop (Canada) identified environmental factors which relate to the physical performance of mentally retarded children.

PROSTHETICS

Engineers design Limbs

from a Correspondent

Two themes ran through a symposium on the problems of prehension, movement and control in artificial limbs held in London at the beginning of the month by the Institution of Mechanical Engineers. The first was introduced by a succinct account of portable power supplies for prostheses by P. M. V. Klein (University College, London) and S. R. Montgomery (Powered Limbs Research Unit). In comparing the energy density of batteries and gas bottles, the battery came out better, but because of the much inferior power-to-weight characteristics of electric motors (and gearbox) compared with pneumatic actuators, a precise specification of power demand against time was essential to save weight either of the electric actuator in the arm or of a hydraulic reservoir.

An attempt to produce a specification and to design an arm to meet it was described in three papers from the Powered Limbs Research Unit. A. B. Kinnier Wilson described a method for taking account of several design factors at once. R. McWilliam and S. R. Montgomery described the biological and engineering aspects of an arm which has been developed, and Dr Simpson from Princess Margaret Rose Orthopaedic Hospital, Edinburgh, gave details of a polar coordinate arm control and movement system primarily designed so as to be easy to learn to control. Both arms used gas-powered position servo systems. S. M. Livingstone and D. I. Crecraft (Lanchester College of Technology, Coventry) described an electric elbow joint with harmonic drive, and D. A. Stevenson (Northern Electric Research Laboratories, Ottawa, Canada) and A. L. Lippay (Rehabilitation Institute of Montreal) gave details of their electrohydraulic arm drive system operating at 250 pounds per square inch (at no-flow) directly on the actuators through solenoid valves without a reservoir.

Devices with semi-automatic control were described by Professor M. Rakic (Belgrade), whose automatically adapting hand prosthesis can close to thumb–fingertip contact or to palm–fingertip contact at the wearer's option. D. C. Witt (Department of Engineering Science, Oxford) read the only paper concerned with the leg.

The second group of problems were concerned directly with biological engineering. Some apparently straightforward papers sparked off a running discussion of the philosophical nature of the command messages occurring at different points in the central nervous system. In other words, what is the true meaning of a signal derived from movements of a limb segment with proprioception as in a finger movement, or without it as in a thalidomide digit? The discussion was deepened by papers on the lability of proprioceptive information which seems to require a visual fix, and on its possible use to alter muscle spindle bias through the basal ganglia; on the value of vibration to transmit information on joint angle or contact pressure; and the detection of slip or "incipient slip" in automatic grasping. True understanding of these points was not reached, nor is it likely to be for some considerable time.

MOLECULAR BIOLOGY

New Light on Chymotrypsin

from our Molecular Biology Correspondent

FROM the X-ray structure of chymotrypsin and a vast body of chemical and enzymological data, a picture of the function of this enzyme is gradually emerging. Some low resolution X-ray studies of the various forms of chymotrypsin have now gone some way towards disentangling the confusing subject of activation of chymotrypsinogen, and the relation between the forms of the resulting enzyme. Wright, Kraut and Wilcox (*J. Mol. Biol.*, **37**, 363; 1968) have 5 Å electron-density maps of several forms of chymotrypsin, and have compared these with the 2 Å data on tosyl-α-chymotrypsin (in which the tosyl group is an inhibitor) of Blow and his associates. The course of the chain could be traced and the side chains placed within an estimated error of some 3 Å.

Kraut *et al.* had reported last year that inhibited (phenylmethylsulphonyl) π-chymotrypsin, δ-chymotrypsin and γ-chymotrypsin, as well as free γ-chymotrypsin, were all isomorphous, despite their structural differences. These amount to the loss of a dipeptide (residues 14 and 15) in the π→δ conversion, and a further dipeptide (147 and 148) in the δ→γ reaction. α-Chymotrypsin occurs, however, in a different crystal habit from the others: there is a two-fold axis in the latter, which relates the molecules pairwise, with an interaction between tyr-146 (a C-terminus produced on activation) of one molecule with his-57 of the other. This interaction was thought to be the origin of the dimerization of α-chymotrypsin in solution, and Wright *et al.* now quote unpublished data which suggests that under conditions favouring this dimerization, δ-chymotrypsin does not associate.

Both the π- and δ-forms lack the C-terminus at residue 146, which is created by excision of the dipeptide 147-148. The γ-form, which does possess it, is moreover isomorphous and, but for the missing dipeptide, structurally identical with the other two. It is known to be possible to convert it by crystallization procedures into the α-form—an operation requiring only a small local change in the conformation. Wright *et al.* surmise that this involves the tyr-146 dimerization site—and indeed the electron density maps of α- and γ-chymotrypsin are apparently identical, except in this region.