the transferrin value in estimating the severity of kwashiorkor. Transferrin concentration was normal in almost all the children with marasmus. Children with marasmus showed little change in the serum proteins but almost all had elevated amino-acid ratios.

When the clinical classification and the transferrin value conflicted, the transferrin value was a more accurate guide to the prognosis. All the children classified as moderate, mild or early kwashiorkor with transferrin values less than 0·45 mg/100 ml. were subsequently admitted to hospital, died, or failed to return to the clinic and were presumed dead. Those whose transferrin value at the second visit was lower than the first value usually failed to return and were presumed dead. The immunochemical test for transferrin used in this investigation is rapid, easy to perform even in primitive conditions, and costs only two shillings per test. It seems to be a very suitable and specific test for protein deficiency. Transferrin has been shown to inhibit the multiplication of some bacteria and viruses, so the low transferrin values associated with kwashiorkor may be related to the increased susceptibility to infection in malnutrition.

CELL BIOLOGY

Assembly of Phage Tail

from our Cell Biology Correspondent

THE use of conditional lethal mutants in the analysis of the assembly of T phage is, of course, firmly associated with the names Edgar, Epstein and Kellenberger. Their pioneering work established that various steps in the morphogenesis of T phage occur in precisely ordered sequences and has served as a model for the investigation of morphogenesis in other organisms—*Chlamydomonas*, for example. In two papers from Edgar's group in the current issue of the *Journal of Molecular Biology*, King and Wood (*J. Mol. Biol.*, **39**, 583; 1969) and Wood and Henninger (*ibid.*, 603) report a detailed analysis of the assembly of T4 phage tail fibres and their attachment to the phage capsid.

Although no fine structure has been reported in electron micrographs of T4 phage tails, there is ample evidence that the organelles are functionally complex and made of more than one protein species. According to King and Wood, the products of at least six genes—genes 34 to 38 inclusive and 57—are involved in tail formation. Gene 34 specifies one antigenic component, A, which appears in the electron microscope as a half tail fibre and sediments at 9*S*. Genes 37 and 38 specify another component, the C half fibre, sedimenting at 8*S*. This reacts with the product of gene 36 to produce one component with the C antigen and another with the B antigen. The BC precursor sediments at 8*S*. The product of gene 35 takes the sequence another step forward by converting the BC component to a form BC′ which can then react with the A component, specified by gene 34, to yield the whole tail fibre, which sediments at 10*S* and contains the three antigens AB and C. What does gene 57 do? The only evidence as to its function is the discovery that the product of gene 57 is required for the production of the three tail antigens. It is also noteworthy that the product of gene 57 is synthesized throughout most of the latent period of infection, whereas the other genes are not expressed in these early stages.

Despite its detail, the pathway that King and Wood have suggested only superficially describes the assembly process; as they admit, other as yet unidentified genes may be involved, and there is little evidence about the nature of the interactions between the various gene products in the pathway. The A component may, for example, carry the site of attachment to the phage capsid, but, if it does, the site must be modified by reaction with the BC′ component because the A component alone will not attach to particles.

Wood and Henninger have defined some of the conditions necessary for the attachment of complete tail fibres to phage capsids. By incubating tailless phage with a cell extract containing tails, they have shown that the kinetics of tail attachment, to yield infectious phage, suggest that the tails are added randomly one by one and that less than six tails are required to make the phage infectious. The rate of tail attachment is apparently dependent on temperature and requires a divalent or monovalent cation as well as a factor which has the properties of a protein. This factor seems to act catalytically and is probably the product of yet another gene, gene 63. This protein is made from the early stages of infection and is synthesized irrespective of whether or not phage DNA synthesis is blocked. Paradoxically, however, all the evidence suggests that gene 63 protein has no function in any of the earlier steps in phage maturation.

Attachment of the tails does not appear to require free energy or low molecular weight cofactors. Thus if the attachment involves the formation of covalent bonds—and the requirement of gene 63 protein suggests that it may—cofactors must be bound to the reactants or the reaction must occur without appreciable net free energy change. There is a precedent for such a reaction. The transpeptidization which occurs during the stabilization of fibrin results in little free energy change.

BIOCHEMISTRY

Laboratory Medicine

A ONE-DAY conference at the Middlesex Hospital Medical School last week, "Some Recent Advances in Clinical Biochemistry", left the feeling that the contribution of biochemistry to medical practice is growing steadily if not spectacularly. Dr G. A. Rose of the Institute of Urology started the day with a discussion of body calcium, emphasizing its endocrine aspects—calcitonin and parathyroid hormone. Dr S. B. Rosalki of St Mary's Hospital, Paddington, surveying clinical enzymology, said that there have been very few recent additions to the list of clinically significant enzymes. The most important contemporary advance has been the appearance of convenient and direct spectrophotometric assays for phosphatases, esterases and the like.

A paper starkly entitled "Drugs" was given by Dr V. Marks of the Area Laboratory, Epsom. He described how a willingness to assay body fluids has given lithium therapy a new lease of life. Twenty years ago, lithium salts were used in treating mania, but they caused many sudden deaths and waned in popularity. Recently it has been found that people differ enormously in their rates of excretion of lithium ion: the earlier fatalities are linked to low excretion rates.