maximum concentration reached varied in different experiments, there was a clear tendency for it to decrease over the 6 days in culture. After 2 days in culture the maximal stimulation was approx. 50% of that at 1 h and had decreased to 20% by 6 days.

A concentration of approx. $0.05 \mu\text{M}$ -glucagon caused a half-maximal stimulation in liver cultured for 2 and 6 days, whereas a concentration of $0.6 \mu\text{M}$ was required to cause half-maximal stimulation in liver cultured for 1 h. The different sensitivities of liver cultured for 1 h, 2 days and 6 days and of the perfused liver (Exton *et al.*, 1971) or isolated liver membranes (Pohl *et al.*, 1971) may be due to slow diffusion or destruction of the hormone in this culture system.

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Permeability of Human Buccal Mucosa to an Amino Acid Analogue, the Antibiotic D-Cycloserine

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Absorption of organic amines and organic acids from the mouth has been reported. Such permeability was maximal at the pH value corresponding to the un-ionized form of the compound. Absorption was also proportional to the partition coefficient of the compound between a lipophilic solvent and water (reviewed by Beckett & Hossie, 1971).

D-Cycloserine (D-4-amino-3-isoxazolidone) is an antibiotic inhibiting the incorporation of D-alanine into bacterial cell walls (Strominger *et al.*, 1960). It has an amino group and a phenolic hydroxyl group giving an isoelectric pH (pI) of 5.9. Absorption from the mouth was measured as with other drugs (Beckett & Hossie, 1971), and D-cycloserine was determined colorimetrically (Jones, 1956).

Loss from the mouth was proportional to initial concentration at pH 5.9 over the range 1–5 mM with a 5 min test period. The linear transport kinetics excluded metabolism of the D-cycloserine by buccal mucosa accounting for its loss from the buccal cavity. This result suggested passive diffusion or, conversely, a carrier-mediated process with a very high affinity constant.

D-Cycloserine transfer at a concentration of 1 or 2 mM was not inhibited by equimolar L-serine, D-serine, L-alanine, D-alanine, β -alanine or L-methionine. These results are compatible with passive diffusion of the un-ionized molecule. This type of transport was also found for D-cycloserine with rat small intestine *in vitro* (Wass & Evered, 1971). Further, buccal transfer was not inhibited by the presence of a metabolic inhibitor, Amytal, at an equimolar concentration (2 mM).

Permeability of the human buccal mucosa to D-cycloserine was also shown by L-proline and L-cycloserine. The lack of stereospecificity is also compatible with passive diffusion.

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Micro Methods of Osmometry Based on the Equilibrium Swelling of Gels

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Edmond *et al.* (1968) and Ogston & Wells (1970) showed that the changes of diameter of a single bead of Sephadex can be used to measure colloid osmotic pressure in solutions of solutes that do not penetrate the gel. Because of its low sensitivity (about 1500 dyn/cm²), this method is not suitable for measuring low osmotic pressures, e.g. for measuring molecular weights of proteins. Also, Sephadex G-50 is too permeable to proteins of molecular weight less than 100000.

Several-fold increase of sensitivity, accompanied by decreased permeability to solute, can be achieved by use of a thin (0.5 mm or less) strip of polyacrylamide gel, of length greater than the diameter of a Sephadex bead, and of concentration 18% (w/v) or higher.

A far greater increase of sensitivity is achieved by use of a thin layer of polyacrylamide gel cast on to a narrow strip of cellulose tissue, about 15 mm long. This curls into an almost closed loop, whose ends separate in proportion to the osmotic pressure of a solution of non-penetrating solute. Sensitivity of 20 dyn/cm² can be achieved, with impermeability to relatively small molecules. For example, the molecular weight of cytochrome c (12384) measured in

this way was 12320 ± 170 (S.E.M.). Each measurement requires only 0.4 ml of solution; equilibrium is reached within 20 min.

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Quaternary Structure of Helical Proteins with Globular Subunits

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The theory proposed (Milner-White, 1971, 1972) for studying the possible range of structures of oligomers assuming equivalence of the protomers also applies to helical proteins with globular protomers [e.g. actin filaments, bacterial pili or some rod-shaped virus coats; some enzymes (Olsen *et al.*, 1970) form enzymically active helical polymers]. For a summary of helix symmetries consult Klug *et al.* (1958).

Such proteins may be divided into two classes (heterologous-type and isologous-type). In one there is only heterologous binding between the protomers forming a helix. In this case the opposite ends of a single helix are different; such helices have polarity. In the other class each protomer has a minimum of two isologous site-pairs. The ends of such a helix are identical because of the dyad axes perpendicular to the helical axis; these helices lack polarity. (Sometimes two or more heterologous-type helices may lie antiparallel; in this case the protein will lack polarity).

In order to describe heterologous-type helices in terms of their binding-site structure it is necessary to define the angle ϕ (see Milner-White, 1972). ϕ is the angle between the planes of θ of two adjacent protomers measured in the plane perpendicular to the line joining their 'centres'. ϕ is defined as the clockwise rotation of the plane of θ of one protomer relative to that of the other protomer (as seen from the first protomer).

Parameters of the helix used are: $2\pi/\alpha$, the number of protomers per turn; r , the radius; h , the axial distance per protomer. ψ is another helix parameter. d is the distance between the centres of two adjacent protomers. These are related to ϕ and θ by the equations below (they apply for one heterologous site-pair; others may also be present). This approach will, we believe, be useful for the study of quaternary structure rather as the work of Ramachandran & Sasiekhara (1968) is useful for studying secondary structure.

$$h = d \cdot \sin \psi$$

$$d \cdot \cos \psi = 2r \cdot \sin \left(\frac{\alpha}{2} \right)$$

$$\sin \left(\frac{\alpha}{2} \right) = \cos \left(\frac{\theta}{2} \right) \cdot \sec \psi$$

$$\tan \psi = \tan \left(\frac{\theta}{2} \right) \cdot \sin \left(\frac{\phi}{2} \right)$$

Isologous-type helices with the same dimensions may be built if all the distances d are equal and if $\zeta_A = \zeta_B$. For such helices ϵ and $(\pi + 2\zeta)$ should be substituted for θ and ϕ in the above equations. With different geometry isologous binding may also generate more complex helicoid structures.

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Differences in the Metabolism of Glucose between Normal and Dystrophic Human Muscle

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Fibre-bundle preparations of muscle biopsies were incubated with [^{14}C]glucose. HClO_4 extracts were made and chromatographed on paper, and the radioactivities of radioactive spots were counted. Metabolites were identified by co-chromatography with authentic substances; fructose was identified as its 1-methylphenylhydrazine (Neuberg & Mandl, 1946).

Fructose contained significantly more label in muscle extracts from patients affected with Duchenne-type dystrophy than in those from normal subjects. Radioactivity of fructose, expressed as a percentage of total incorporated ^{14}C , was $14.4 \pm 10.1\%$ (9) for normal subjects, compared with $43.2 \pm 14.7\%$ (8) for dystrophic subjects ($P < 0.001$ in the t test). The same parameter in other control groups had the following values: neurogenic muscle disease, $11.0 \pm 11.0\%$ (3); adult muscular dystrophy including myotonic dystrophy, $15.9 \pm 18.1\%$ (8); polymyositis, $25.0 \pm 21.8\%$ (6); normal foetal muscle (12–18 weeks' gestation), $21.2 \pm 17.8\%$ (6); female carriers of Duchenne-type dystrophy, $48.7 \pm 21.2\%$ (7). The value in Duchenne dystrophy is significantly raised compared with those in neurogenic muscle disease ($0.001 < P < 0.01$), foetal muscle ($0.02 < P < 0.05$) and adult muscular dystrophy ($0.001 < P < 0.01$). The value