According to Hopson, the excavations around the nostrils of some hadrosaurs were filled with soft tissue, which could be inflated as a display structure and might also act as a resonator (as in elephant seals). He believes that the function of the elongate, hollow nasal tubes of other hadrosaurs was to provide a permanently dilated resonating system while at the same time providing a visual threat display.

The work of Geist and Davitashvili has provided a useful new approach for vertebrate palaeontologists. Though they cannot employ the experimental or observational methods in testing such hypotheses on fossil material, such techniques as Barghusen's analyses of associated structural adaptations, or Hopson's prediction-testing method, can provide adequate alternatives, and it is to be hoped that yet more fossil humps and bumps will find a function in the future. □

Liposomes to lysosomes

from a Correspondent

Now that many of the enzyme deficiences which cause the lysosomal storage diseases are known, efforts are increasingly being directed towards finding methods of therapy. One obvious approach is to replace the defective or absent enzyme (see for example, *Enzyme therapy in lysosomal storage diseases,* edit by Tager *et al.*, North Holland/American Elsevier, 1974). These diseases seem to be particularly suitable candidates for enzyme replacement therapy because extracellular macromolecules and particles are taken up by the process of endocytosis (phagocytosis) into the lysosomal system. Thus enzymes supplied (to the blood stream) may be expected automatically to reach the intracellular location where they are needed. They still, however, have to be directed to the particular tissue or tissues where most lysosomal storage occurs and these (brain and muscle, for example) often do not carry out much endocytosis. In order to remove the substances that have already accumulated and to maintain the corrected condition a regular supply of enzyme is required. Immunological complications arise from repeated injection of foreign antigens (either the enzyme itself or other substances copurified with it).

The idea of injecting enzyme entrapped in microvesicles, gel particles or red cell ghosts has recently been investigated. A non-antigenic vesicle would not only prevent the enzyme from eliciting an immunological response but would protect it from degradation before it reaches the required site. Liposomes, which are synthetic vesicles made of concentric bilayers of lipids alternating with aqueous compartments in which the enzyme can be carried seem to be useful vehicles because they are non-antigenic and biodegradable and their dimensions and constituent lipids can be adjusted to suit requirements. Attempts are now being made to direct liposomes to target organs by coating them with substances which are known to have an affinity for and (or) be taken up by a particular tissue.

In a recent paper Cohen *et al.* (*Biochemistry,* **15**, 452; 1976) describe *in vitro* experiments on the entrappment of N-acetyl hexosaminidase A (the enzyme deficient in Tay-Sachs disease) by liposomes and the uptake of these liposomes by the polymorphonuclear leukocytes of a patient with Tay-Sachs disease. Selective endocytosis was encouraged by coating the liposomes with aggregated immunoglobulin (IgG), a successful idea based on the known uptake of immune complexes by polymorphonuclear leukocytes (Weissman *et al., J. exp. Med.,* **134**, 149s; 1971). The liposomes were shown to be taken up by the lysosomes and N-acetyl hexosaminidase A was detected in the 'corrected' cells.

This type of *in vitro* experiment merits further study, not only to investigate the fate of the entrapped enzyme and the liposomal material, but also the breakdown of the accumulated substrate. The question of access of the liposome-entrapped enzyme to the 'residual bodies' of the lysosomal system where much of the stored material is found, needs to be resolved. Furthermore, as it is known that activity of N-acetyl hexosaminidase towards the natural substrate, the ganglioside GM_2 is lost on purification (Srivastava *et al., J. biol. Chem.,* **249**, 2043; 1974) it will be of great interest to see whether activity towards the natural substrate can be restored by replacing the purified enzyme within the cell.

While few animal models are available for the study of these diseases, *in vitro* experiments of this kind are clearly useful model systems. At the same time an investigation into the safety of the injected ingredients is of paramount importance and this can be done most conveniently using experimental animals. The release of lysosomal acid hydrolases which seems to occur parallel with the endocytotic uptake is a side effect that should be considered further. It is of interest to note that some of the pharmacological effects of liposomes are currently being investigated (Bruni *et al., Nature,* **260**, 333; 1976).

Successful treatment of Tay-Sachs disease as well as other infantile diseases with neurological involvement seems, however, unlikely to be practicable. The difficulty of penetrating the blood-brain barrier, a prerequisite for removing accumulated substrate from the brain is problem enough. Also substantial accumulation and possibly irreversible damage have already occurred as early as 16 weeks gestation (Schneck *et al., Pediatrics,* **49**, 342; 1972). Treatment of juvenile and adult onset diseases (such as Fabry's disease) seems on the other hand to be a more hopeful and justifiable proposition. □

Triton interactions

from P. E. Hodgson

THERE have been rather few studies of the interaction of tritons with nuclei, mainly because tritons are highly radioactive, with a half-life of about 12 years. Very stringent safety precautions have to be enforced, so work with tritons is usually done in Government laboratories. A series of measurements of the differential cross sections for the elastic scattering of tritons by nuclei was made some years ago at Aldermaston, and analysed to give triton optical model potentials. There were hardly any measurements of triton polarisation and these were of low accuracy, so very little was known about the spin-orbit term in the triton optical potential.

Recently a polarised-triton source has been installed on the Los Alamos Scientific Laboratory Tandem Van de Graaff accelerator, and this has made possible new measurements of triton elastic scattering of a higher accuracy than ever before. The Los Alamos group have measured the differential cross sections and polarisations for tritons elastically scattered from several nuclei, and analysed the results with the optical model (*Phys. Rev. Lett.,* **35**, 1623; 1975).

It is possible to calculate the triton optical potential by averaging the known nucleon–nucleus interaction over the three nucleons comprising the triton. This folding model, as it is called, has already been used successfully to calculate the optical potentials for deuterons, helions, and alpha particles, so it is important to test it for tritons as well.

The folding model gives for tritons an optical potential that is about three times as deep as the nucleon optical potential, has about the same radius and is slightly more diffuse in the surface region. The two neutrons in the triton are anti-aligned, so that the spin-