effect observed in urea denaturation, and is assigned to certain tryptophan protons. Another peak moves similarly downfield, and this arises from another set of tryptophan protons. It is suggested that the two residues, try-62 and try-63, are implicated, and together form one of the "subsites", which lysozyme is thought to contain. Shifts are also observed in the upfield region of the spectrum, where there are peaks due to aliphatic methyl groups perturbed by proximity to aromatic rings. Evidently these are driven into closer contact by the substrate interaction, and from the X-ray data of Phillips and his group it is deduced that it is ile-98 and try-63—two residues on opposite sides of the active site crevice—that are involved.

The quantitative observation of binding of an inhibitor to α-chymotrypsin is the subject of an interesting paper by Gerig (*J. Amer. Chem. Soc.*, **90**, 2681; 1968). The ligand selected was tryptophan, which is known to inhibit the enzyme fairly strongly. The free amino-acid has a well-developed sharp spectrum, but when chymotrypsin is added it is progressively bound and immobilized, and its spectrum in consequence proceeds to broaden. It is thus possible to relate the line width in terms of the values for free and fully bound ligand to the binding constant. It is found that D-tryptophan binds more strongly than its antipode, and produces correspondingly greater broadening. A 1 : 1 stoichiometry is observed. No broadening occurs when the enzyme carries a covalently attached inhibitor.

NMR can under favourable circumstances be used to measure rates, since observed relaxation times will be related to the average lifetime of a ligand on its binding site. The possibilities of determining the forward and backward rate constants in a carboxypeptidase-inhibitor system from the nuclear magnetic relaxation times are discussed by Navon *et al.* (*Proc. US Nat. Acad. Sci.*, **60**, 86; 1968) and a complete set of kinetic parameters is promised for a future occasion.

Plankton Sampling

from a Correspondent

THE first scientific meeting of the International Association of Biological Oceanography (IABO), held at Wood's Hole Oceanographic Institution, Massachusetts, May 21–24, 1968, was devoted to the "Design and Analysis of Plankton Sampling". The programme was divided into five sessions: "The Objectives of Plankton Research"; "Design of Sampling Programs"; "Design and Use of Sampling Devices"; "Sampling Error in the Field"; and "Methods of Data Analysis".

R. S. Glover (Oceanographic Laboratory, Edinburgh) discussed oceanwide synoptic surveys of the type which have been carried out for many years from his laboratory using the Hardy plankton recorder. This has enabled long-term trends and other spatial and temporal patterns of variation in the North Atlantic plankton to be interpreted and related to similar patterns in the hydrology of the area. An improved version of the Hardy recorder is at present being developed which can be programmed to undulate through a range of depths and will record various physical environmental variables. A similar long-term synoptic survey of the distribution of planktonic teleost eggs and larvae was discussed by E. H. Ahlstrom (Bureau of Commercial Fisheries, La Jolla). While the main species being studied was the California sardine, the formidable task of enumerating and identifying eggs and larvae as far as possible of all species of fish has provided a very worth-while ecological background to the sardine programme. R. M. Cassie (University of Auckland) discussed problems inherent in deriving mathematical models for the interrelationship between plankton and their environment, a major difficulty being the assignment of appropriate error variances to the variates (plankton abundance and environmental properties). While some of these difficulties seem at present unsurmountable, certain quasi-statistical techniques, notably principal component analysis, seem to produce solutions at least consistent with the diagnoses which would be made by the more intuitive plankton ecologist.

J. M. Colebrook (Oceanographic Laboratory, Edinburgh) presented some of the principles involved in a census-type plankton survey, emphasizing the importance of relating sample design to the spatial and temporal scale of the population estimate to be made. He suggested the use of spectral analysis to resolve the continuous spectrum of variation of plankton populations into components which might, as a first approximation, be classified into the three categories: non-stationary trends, periodic variations and stationary stochastic processes. R. J. Conover (Dalhousie University) showed that the variability of samples taken at a drogue was not significantly reduced as compared with a similar series of samples at a fixed station, suggesting that the drogue had not been entirely successful in marking the changing position of the population. R. I. Clutter (University of Hawaii) described several ingenious new sampling devices including a plankton purse seine. He also described and showed underwater photographs of aggregations of a planktonic mysid and discussed the advantages of aggregation in survival of the species, notably the proximity of males to females for copulation, and the reduction of risk from predation. While the species concerned, because of its close proximity to the bottom, is possibly atypical, it seems that this study represents an important advance in the understanding of the structure and mechanism of "social" aggregations in plankton.

Two somewhat novel papers discussed the simulation of plankton populations (including the patchiness phenomenon) by electronic computer, thus enabling the comparison of various sampling regimes. E. P. dos Santos (University of São Paulo) found that aggregation of plankton induced an overestimate of the true population, using random sampling. P. H. Wiebe (Scripps Institution of Oceanography) used a similar procedure but based his patch structure on a detailed survey of a 500×500 metre area using the Longhurst sampler. In general, it was found that both accuracy and precision of estimates increased with diameter of net and with length of tow, although the longer tow was the more effective of the two expedients. P. Foxton used a parachute drogue to trace a relatively large (about 40 miles circumference) aggregation of *Thalia democratica* off Long Island. During seven days the aggregation moved approximately 90 miles upwind. It appeared, however, that continuous contouring of the aggregation was a more reliable method of tracing the movement of the aggregation than the drogue.