Aberdeen, but Dr. Bosanquet is clearly delighted that the MRC has decided to move it to Newcastle.

## Education by Museum

THE New York Museum of Natural History is preparing for its centenary in 1967 and this year's annual report describes a large expansion programme. Education is among the departments being extended, but what there is already appears to be cheerfully advanced.

Lectures "exploring the world of nature" for large audiences of adults and children are to be added to the existing school programme "The World We Live In". As part of the Federal Government's Operation Head-start, children of pre-kindergarten age are attending the Natural Science Center for young people, to learn about small live animals and plants which are native to New York. Similar, but more advanced, instruction is already given to groups of children from primary schools. There are also courses of six lectures for young people, given on Saturday mornings, in archaeology, amphibians, reptiles, nature study for beginners and the ecology of mammals. High school scientists have a series of lectures and field trips on the 'principles of geology'.

The Louis Calder natural science laboratory provides facilities where project work submitted by young people can be carried out. In the first year, projects were carried out by nine children aged from nine to sixteen. One boy carried out a learning experiment with ants; another prepared an exhibit of an Indian shell heap which he had discovered, and a third carried out a horticultural project.

The museum has a special programme of instruction for children in hospitals and special schools, and natural science kits prepared by the staff of the Natural Science Center are sent out to schools in New York. The contents of the kits include mosses, fungi, shells, feathers and insects. There are also collections of films, slides and exhibits available and these can be borrowed by groups outside the museum.

## Optical Activity of Proteins

### by a Correspondent in Molecular Petrology

THE observation of optical activity (optical rotatory dispersion or circular dichroism) has, for some years now, been the principal method available for studying the conformation of the polypeptide chain in solution. On the simple assumption that the only ordered structure which it is necessary to consider is the α-helix, semi-empirical procedures, particularly the well known equation of Moffitt, have been used to analyse conformation and to follow conformational changes. With improved instrumentation it became possible to examine directly the Cotton effects associated with the peptide group, and the three states of the polypeptide chain which now appear to be important in globular proteins—the α-helix, the β-structure and the random form—have been well characterized. More recently, however, several examples have come to light of measurable Cotton effects in proteins associated with the absorption bands of the aromatic amino-acids in the neighbourhood of 280 mμ. The origins of these effects have been uncertain, but they have seemed of interest both because they vitiate conformational analyses in terms of optical rotatory dispersion and also because they suggest a new means of studying the environment of the aromatic amino-acids, which appear in a number of cases to be implicated in biological function. A prominent example is the suggested presence of tryptophan at the binding sites of antibodies.

The first systematic attempt to clarify the origins of aromatic Cotton effects in proteins appears in an article by Rosenberg (*J. Biol. Chem.*, **241**, 5119; 1966). In the first place, it must be understood that the Cotton effects of the free aromatic amino-acids are very small; thus the absorption band of tyrosine at 270 mμ has a rotatory strength two orders of magnitude smaller than that attributed to the $n-\pi^*$ transition of a peptide group in the α-helical state. In the absence of specific environmental perturbations, any aromatic Cotton effects in proteins must therefore be vanishingly small. There are two ways in which the Cotton effects observed near 280 mμ can be thought to arise: the first is from resonance interaction between appropriately oriented identical groups (exciton interaction), as in polynucleotides and α-helical polypeptides, and the second from perturbations by a charged environment. Rosenberg has shown that large changes in rotatory strength of the free aromatic amino-acids or their derivatives can be induced only by changes in their charge state (ionization of α-carboxyl or amino groups). It is certainly most likely that the effects in proteins come about through the presence of charged groups in close proximity to the aromatic residues.

Rosenberg also describes an important consequence. Whenever a Cotton effect in an aromatic amino-acid or its derivative is observed in the 260–280 mμ region, a very much larger effect appears at 210–240 mμ where the chromophores have their second $\pi-\pi^*$ absorption bands. In proteins, such Cotton effects would be obscured by those of the peptide backbone, which occur in the same region. It does appear, however, that in the increasingly large number of proteins in which aromatic Cotton effects are observed, extreme caution must be exercised in interpreting the Cotton effects in the peptide region in terms of conformation. At the same time, there now appears some hope of understanding the bewildering variety of Cotton effects in the range 190–240 mμ in the large number of essentially non-helical globular proteins, where the spurious simplicity imposed by dominance of the α-helix is eliminated. The same journal also contains reports of the studies by Rosenberg (*ibid.*, 5126) and Edsall and his associates (*ibid.*, 5150) of the optical rotatory dispersion and circular dichroism of carbonic anhydrases in which aromatic Cotton effects are very prominent and in which they were first reported (from Edsall's laboratory). It is now shown how these Cotton effects vary with the state of the protein and how they may be analysed, at least tentatively, into contributions from the particular aromatic amino-acids.

## Snow and Ice and Cold

THE International Conference on Low Temperature Science, which was held at Sapporo (Japan) in August 1966 to celebrate the twenty-fifth anniversary of the Institute of Low Temperature Science, Hokkaido, concentrated on two fields: the physics of snow and ice and cryobiology.

Creep phenomena in ice were explained in terms of the movement of dislocations, and the velocity of dislocation was shown to be dependent on stress. One