which confirms radar and spectroscopy measurements from Earth. The greatest difference between the readings for the two tracks was approximately 6 km. The Soviet data for the region of latitude 40° S differed considerably from the Mariner 6 ultraviolet readings, which gave heights some 3 km lower. This may have been the result of a local ultraviolet haze during the Mariner 6 readings.

LAKES AND SEAS

Surface Circulation

from a Correspondent

IN a recent issue of the *Proceedings of the National Academy of Sciences* (**70**, 93 ; 1973) Emery and Csanady report their investigations of the surface circulation of forty lakes, marginal seas, estuaries and lagoons, all in the Northern Hemisphere. Their studies are based on records obtained by various means, such as surface drifters, current meters used from anchored ships, drogues, buoyed fishing nets, and theoretical calculations based on the temperature and salinity stratification. Few, if any, of these results were based on their own measurements. They find that with one exception, that of the Aral Sea (45° 00′ N, 60° 30′ E) in the Soviet Union, the circulation is always anticlockwise if the mean is taken over a sufficiently long time. The examples include all the Great Lakes, Lake Constance, Lake Geneva, the Caspian Sea and the Dead Sea, and the marginal seas include the Baltic Sea, the Black Sea, the Adriatic Sea, Hudson Bay and the Persian Gulf. Unfortunately no records were obtainable for the Southern Hemisphere, but the implication is that the circulation there is clockwise.

Emery and Csanady discuss various mechanisms by which such a circulation could be set up. They discount the effect of long surface waves and internal waves, even though these would be propagated in an anticlockwise direction, for their effects would average out over the times considered. They ascribe the effect instead to Ekman drift. This follows from Ekman's theory of wind-driven currents, which was propounded in the early 1900s and allows for the effect of the Coriolis force. This arises because in establishing and using equations of motion based on a set of axes fixed on Earth rather than in space there seems to be a force acting towards the right of the direction of movement and proportional to the speed when there is motion with respect to these axes. Ekman showed that when the wind acts on water for a long time, this force has to be counterbalanced by a movement of water to the right of the wind direction. This movement is called the Ekman drift. It is then suggested that when a temperature-stratified water basin is heated while under the action of the wind, there is, looking along the wind direction, a movement of warm surface water from left to right and the water on the left is replenished by colder water ascending from underneath. In the end the right side of the basin has warmer surface water than the left.

Emery and Csanady then go on to suggest, further, that the drag of the wind on the water surface depends strongly on the difference between the temperature of the air and of the surface water. When the air temperature is less than that of the water, the air close to the water surface tends to become warmer than the air above and ascends. This leads to the formation of eddies and turbulence which increase the frictional effect of the wind. Thus under certain conditions the wind drag on the right of the water basin would be greater than on the left and so there would be a net anticlockwise circulation.

This theory is quite a plausible one. It is, however, possible to argue against the view that the effect of internal waves can be neglected ; I have recorded such waves with a period of 48 h in a relatively small lake and there may well be some with even longer periods in the basins considered by Emery and Csanady. The amplitude of these waves would depend on the stratification and this could change significantly during the wave period and so lead to asymmetry and a net current transport. The validity of this view depends on the length of time for which the records have been taken, and this is not stated. The anomalous behaviour of the Aral Sea may be a consequence of some such effect.

SEDIMENTOLOGY

Tectonic Control

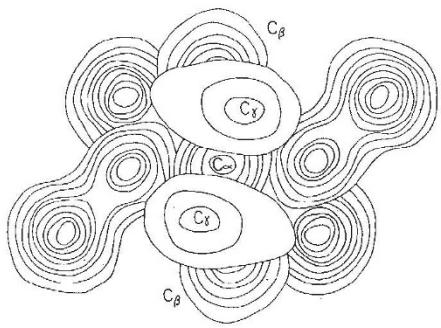
from our Structural Geology Correspondent

IT is seldom that cross-fertilization between different scientific disciplines is as successful as that demonstrated by Friend and Moody-Stuart (*Skr. Norsk Polarinst.*, **157** ; 1972) in their intricate analysis of Devonian palaeogeography in Spitsbergen. They chose for their analysis the Wood Bay Formation, the most extensive formation in the 8 km thick late orogenic Silurian and Devonian red bed succession in Spitsbergen. The formation is 3 km thick, outcrops over an area 150 km by 75 km, and represents deposition in river channels and clay flats (playa lakes). They collected field data relating to river palaeocurrents, the sandstone composition and the variation in grain size and plotted contours for these variables by means of a computer-based iterative-fit quadratic trend surface analysis. The results of this initial analysis showed that, in the east, rivers flowed into the alluvial area from the south-east carrying a high proportion of bed-load cross-stratified sands characteristically containing orthoclase feldspar, whereas in the west the rivers flowed from the west depositing a significant proportion of suspended-load sediment characterized by flat-laminated siltstones.

Having reached this stage in the analysis of the alluvial areas Friend and Moody-Stuart attempted to extend the palaeogeography by reconstructing the situation in the source areas. They used laboratory studies of water flow and knowledge of present rivers to interpret the characteristics of the Wood Bay

Structure of 1,1-Cyclopentanedicarboxylic Acid

IN an article in next Monday's *Nature Physical Science* (April 9) Margulis *et al.* report how many physicochemical techniques—X-ray diffraction and several kinds of magnetic resonance—have been brought to bear on a study of the problem of molecular motion in the solid state. They have examined crystals of 1,1-cyclopentanedicarboxylic acid ($C_5H_8(COOH)_2$) and also the cyclopentyl-1-carboxylic acid radical and have come to the conclusion that at room temperature the radical undergoes "pseudorotation". The five-membered ring of the molecule also turns out to be disordered, probably as a consequence of pseudorotation.



The basic ring of cyclopentane, C_5H_{10}, has been known for many years to consist of two puckered formations which have about the same energy, about 5 kcalorie mol^{-1} smaller than that of the planar formation. And it is also a well established idea that the puckering can be thought of in terms of a rotation of the phase of the puckering around the ring, "pseudorotation".

The electron density map produced by Margulis *et al.* of 1,1-cyclopentanedicarboxylic acid, viewed along the molecular and crystallographic two-fold axis, is shown in the diagram.