Mega-kink folds and related structures in the Upper Devonian Merrimbula Group, south coast of New South Wales. M. J. Rickard, Department of Geology, Australian National University, P.O. Box 4, Canberra, A.C.T., Australia, 2601.

Interbedded sandstones and red mudstones of the Upper Devonian Merrimbula Group were mildly deformed during the Carboniferous in a 'transitional' tectonic regime. A remarkable variety of structures was developed. Tectonic shortening of about 10% was accommodated by the development of kink-like monoclines and box folds with a very wide-spaced (few cm) cleavage in sandstones, spaced (few mm) 'reticulate' cleavage in siltstones, and a penetrative slaty cleavage in mudstones. Solution transfer played an important role in cleavage formation. Faults and conjugate shear zones succeeded by regional joints were developed in competent beds. Abundant quartz veins occur along bedding planes, faults and shear zones. The low strain allows certain kinematic and dynamic conclusions; the structures are geometrically congruent and were developed under high fluid pressures at a high level in the crust and are related to a single, long deformational episode under essentially horizontal E–W compression possibly accompanied by shearing along bedding planes associated with local décollement. The stress configuration contrasts with that necessary for the extensional rifting postulated for the period immediately prior to the deposition of the Merrimbula Group.

The structure of the coastal Ordovician rocks south of Bermagui, New South Wales, Australia. M. J. Rickard, Department of Geology, Australian National University, P.O. Box 4, Canberra, A.C.T., Australia, 2601.

Meridional upright F_1 folds with wavelengths of a few tens of metres are uniformly developed throughout the coastal strip. There are no consistent vergence zones related to a major structure so that the gross enveloping surface is approximately horizontal. The folds have well developed 'slaty' cleavage or 'stripy' spaced cleavage, and in places both fan about the hinge planes. The 'slaty' cleavage is the earlier surface but no evidence for associated early folds can be found and, although the spaced cleavage fans asymmetrically on one limb, there is no evidence that it transects the folds. It is argued that both slaty and spaced cleavage form successively during the same phase of folding.

F_2 folds with crenulation cleavage locally distort the F_1 folds, and the steep F_3 crenulations, minor folds and kinks are developed in wide-spaced SE-trending zones. The latter are parallel to folds in the Bunga Beds, which lie unconformably above the Ordovician turbidites, and therefore F_3 may be younger than Late Devonian.

Mechanisms of crystal growth in relation to deformation in the aureole of the Tinaroo Batholith, North Queensland. M. J. Rubenach, Department of Geology, James Cook University, Townsville, Queensland, Australia, 4811.

Following a mylonitic event (D_m) the earlier-phase muscovite–biotite adamellite of the Tinaroo Batholith was emplaced synchronously with a regional deformation event which produced F_2 folds and tight crenulations. The syn-D_2 metamorphism produced a biotite zone, an andalusite–staurolite zone, and a narrow inner sillimanite–K-feldspar–muscovite zone.

Where they have not suffered hornfelsic overprinting or retrogression during subsequent biotite adamellite emplacement, well-preserved microstructures in the andalusite–staurolite zone provide timing criteria for the reaction and growth sequence and elucidate porphyroblast-growth mechanisms. Large skeletal porphyroblasts of andalusite grew from the dissolution of staurolite, the reaction involving matrix micas and quartz and exchange of ions (including Al) between sites of dissolution and growth. Quartz dissolved from domal-shaped solution seams, now marked by graphite accumulations, in front of advancing andalusite faces, and replaced strained muscovite to form a muscovite-depleted halo 2–7 mm wide around andalusite porphyroblasts. The dissolved muscovites supplied Al for the growing andalusite grains, and components both for the growth of unstrained muscovite and biotite in the matrix and replacement of staurolite by these minerals. The preferential growth of skeletal andalusite arms along graphite/muscovite-rich layers is interpreted as being due to the ease of dissolution of strained muscovite grains and/or more rapid diffusion in such layers relative to adjacent polygonal quartz–muscovite layers.

Although the growing porphyroblasts form the domal patterns adjacent to crystal faces because of a growth/strain effect, they do not in any way deflect the pre-existing mylonitic foliation. The axial planes of the D_2 crenulations deflect around the porphyroblasts, demonstrating that they grew syn-D_2. These observations also confirm the hypothesis that deflection of foliations is due to flattening of the matrix around relatively rigid porphyroblasts rather than the latter shouldering the foliation aside by 'force of crystallization'.

Strain history and the development of transecting cleavage, with examples from the Caledonides of the British Isles. D. J. Sanderson, T. B. Anderson and D. Cameron, Department of Geology, Queen's University, Belfast, U.K.

Many models for the development of transecting (or non-axial planar) cleavage consider the two-dimensional finite strain within a plane through a three-dimensional strain ellipsoid. By assuming that cleavage approximates to the XY-plane and that fold axes develop normal to the minimum stretch within layering, it can be easily demonstrated that fold axes need not be parallel to cleavage. Such models do not consider the strain history. Even in an irrotational three-dimensional strain (i.e. principal axes do not rotate through the material) the two-dimensional strain history of the layer may be rotational. Clearly in a rotational three-dimensional strain a wide variety of strain histories is possible.

Various simple strain models are used to illustrate the potential development and geometry of transecting cleavage. Transection is shown to be fairly common in models involving wrench-type strain, due mainly to the large component of rotation within an initially sub-horizontal layer. The geometry of transection can be related to the strain history in many cases.

The inverse problem of using transection to deduce strain history is considered in the Lower Palaeozoic rocks of Ireland and South Scotland. Regions of transected folds show a consistent pattern of steep cleavage trending clockwise of steep fold axial planes, with an associated sub-horizontal stretching lineation. In regions of non-transecting folds the stretching direction pitches steeply in cleavage. These features, combined with evidence from other minor structures and the regional setting of the deformation, are used to argue for a strong component of left-lateral strike-slip movement during the Caledonian orogeny.

Microfabric development in Proterozoic schists, North Mt. Painter Block, South Australia. G. P. Scales and P. R. James, Department of Geology and Mineralogy, The University of Adelaide, Adelaide, South Australia, Australia, 5000.

In the Lower to Middle Proterozoic schists and gneisses from the North Mt. Painter Block, a mylonite-forming event has been superimposed on a multiply-folded layer-parallel foliation, S_1, which formed during amphibolite-facies metamorphism.

The development of the mylonitic foliation and associated elongation or stretching lineation, and consequent modification of S_1 can be observed in a number of different lithologies ranging from competent garnet–quartz rocks through 'granitic' augen and layered gneisses to biotite–chlorite–quartz schists and amphibolites.

The well-documented processes leading to grain refinement with increasing strain rate followed by the progressive development of the mylonitic foliation, S_m, and lineation, L_m, can be compared in these lithologies using the nature and intensity of the quartz petrofabrics and the formation and dimensions of subgrains and new grains.

By measurement of the location, area and aspect ratios of subgrains and new grains of quartz through zones showing different grain size and morphology, it is apparent that there is a common subgrain size in all specimens indicating that subgrain formation may be independent of strain rate, temperature and presence of impurities. However, new grains do show a direct relationship between their dimensions and the mineralogy and strain rate. Thus, the processes leading to subgrain formation must be of a different nature from those of new grain formation, at least until the subgrain reaches a critical size.

Subsequent to the development of the mylonitic fabric, S_m, a weaker