Preface

Great progress has been made in recent years in the areas of galaxy formation and evolution, triggered by a wealth of new high spatial and spectral resolution observations from space, by the large increase in sensitivity of ground–based 10m–class telescopes, by the availability of deep and/or large radio surveys and by substantial increases in computing power available for numerical simulations. In particular, the processes of structure formation at large redshift and subsequent assembly of galaxies are being actively investigated. However, in all these studies an important and perhaps critical aspect of galaxy evolution has been much ignored: the transformation and recycling of gaseous and stellar material both within galaxies as well as that surrounding them, such as gas consumed by star formation and subsequently ejected by supernovae or superwinds into the inter–galactic medium (IGM), injection in the IGM of metal-enriched material via AGN–driven jets, material ejected from galaxies through interactions and mergers, and gas stripped from galaxies by ram–pressure of the intracluster medium (ICM). Numerical simulations are now able to follow in detail the evolution of the gaseous medium in galaxies throughout these violent events.

At the same time, our knowledge of the IGM has improved dramatically. In clusters of galaxies, the nature of the ICM can now be constrained more tightly through observations with the latest–generation X–ray satellites. These data have revolutionised our understanding of the cooling/heating processes in the intracluster medium and allow us to measure its elemental abundances with unprecedented precision. The intergalactic medium at high redshift is investigated using absorption lines detected in high resolution spectra of background QSOs. In the local Universe, molecules in low–density gas clouds are observed well outside galactic disks by means of the detection of absorption lines against background UV sources. Strangely enough, no pristine hydrogen clouds, devoid of heavy elements, have yet been found, neither locally within the population of High Velocity Clouds nor at high redshift. All observations to date suggest a general "pollution" of the intergalactic medium by the products of stellar nucleosynthesis, even at the highest redshifts. Even more surprisingly, surveys of planetary nebulae and RGB/AGB stars in 'empty' fields of nearby clusters confirm that a large (10 to 50%) fraction of the total stellar population lies between galaxies. Various models of galaxy mass–loss via dynamical processes or superwinds have attempted to account for these observations but they still disagree on the efficiency of IGM enrichment mechanisms and on the nature of the progenitors.

What is the fate of the material lost by galaxies during their evolution that is currently observed in the IGM? Some of it is dispersed to such an extent that it is apparently lost for future recycling, whereas a substantial fraction may fall back onto the galaxy or galaxies from which it originated. This is in agreement with numerical experiments which predict the re–accretion of tidal debris as well as the gas that was stripped by ram–pressure. This reservoir of expelled material can fuel new star–formation episodes in the parent galaxies with a time delay depending on how far the gas clouds have drifted away from their origins.

Instead of falling back, observational evidence has emerged that galactic material may be recycled in the space between galaxies, forming a new generation of objects known as Tidal Dwarf Galaxies (TDGs). These fashionable objects are young galaxies assembled from the gas and stars pulled out by tidal forces from interacting galaxies. Although some numerical models are able to reproduce the formation of such objects, the precise conditions for their formation have not yet been fully investigated. Observationally, their identification in maps of interacting galaxies may not be as straightforward as first thought, due to projection effects mimicking a TDG. Also, despite the expectation that they were created in large numbers in the early Universe when interactions were more frequent, their survival rate and hence cosmological importance is still a matter of debate. Having said that, TDGs are excellent laboratories to study the process of galaxy formation as it might have proceeded at large look–back times but with a resolution and sensitivity only available in the local universe. Moreover, because of their formation history, TDGs can also be used to set constraints on the nature of Dark Matter.

IAU Symposium 217 addressed all of the issues touched upon above, following matter of galactic origin through the different stages of its grand journey: its removal from a galaxy, its sojourn in intergalactic space, and its final recycling within and outside galaxies. The organisation of these proceedings reflects these stages. First a **census** is presented of the constituents of the intergalactic/intracluster medium revealing the presence of pre–enriched material. This is followed by a section on the **origin** of this material, in particular regarding the outskirts of galaxies, and the parent galaxies in the case of interactions (the same environments where re–accretion processes take place as well). Subsequently, the proceedings deal with **ejection** and **outflow** mechanisms and, finally, the **recycling** in intergalactic space of expelled galactic material via the onset of star formation and formation of **Tidal Dwarf Galaxies**.