General introduction

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This symposium took place in Davos, together with the 161st annual meeting of the Swiss Academy of Sciences. The Central Committee of the latter had proposed to place all discussions under the very broad theme of the 'Origin of Things and Beings' (vom Ursprung der Dinge) and for us astronomers, this reflects itself on the origin of the different bodies which populate the cosmic universe.

The six lectures delivered at this symposium deal successively with the origin of planets, of the solar system, stars, galaxies and finally of the universe itself. This ordering is thus correlated with increasing distance scales, starting with close objects like planets and meteorites, about which we have a precise knowledge, even if incomplete. Reversing this order should have meant first laying the stage for the universe at large, of which we can draw today an improved picture, but still controversial in many respects however. Another ordering of the cosmic objects reviewed here could have been chronological, but this ordering appears to be questionable for reasons connected to the conditions prevailing at the formation of celestial bodies or of systems of such bodies.

In the first lecture, by I.P. Williams, the most recent data on the planets and meteorites of the solar system are reviewed, with the purpose of reaching a better understanding of planetary formation and of describing the 'best' current model.

Now it appears that many chemical elements in planetary bodies and in the sun contain isotopic anomalies, often uncorrelated. Going through recent investigation in the field of isotopic research, P. Bochsler points, in the second lecture, to some implications of new observations about several of these elements, on the early history of the solar system.

In the third lecture, P. Bouvier summarizes the successive stages of stellar evolution as we know them today, from the protostars forming of diffuse stellar clouds, to the stars in which thermonuclear reactions ignited inside the central regions provide the main source for the energy radiated away. The great majority of the chemical elements building the matter of our world appears to have originated inside stars, while some of the lighter elements presumably formed in interstellar spallation reactions or during the first quarter of an hour of the early universe, according to the standard Big Bang picture.

It has been customary to think of galaxies as being born from gravitational instabilities in an initially more or less uniform universe, although the growth of such perturbations in time appears to be too low in the case, suggested by the observed baryon density, of an open universe.

At present the recent measurements of the electron neutrino rest mass opens new perspectives in cosmology and several authors have pointed out that massive neutrino condensations may trigger the formation of baryonic matter condensation in the universe at large, probably on the scale of clusters of galaxies. This work is being reviewed in the fourth lecture by F. Occhionero who gives also some new results on the linear growth of baryon condensations, from decoupling onwards, when self-gravitation has overcome the gravitational coupling to preexisting neutrino condensations.

In the fifth lecture, R. Buser alludes to recent work on the spectral evolution of galaxies, using models which allow the calculations of galaxy magnitudes, k-corrections, evolutionary corrections and colours as functions of red shift, to be carried out in a variety of photometric systems. These results are used to interpret the observed colours of faint galaxies, thus providing a test for the deceleration parameter and for constraints on the

ages of galaxies and the history of star formation inside galaxies.

The Hubble discovery of the recession of the galaxies (1929) is a far-reaching observational fact, although not a proof for an expanding universe starting from a singularity (Big Bang); there was still no definite agreement, two decades ago, on whether the expanding universe had a beginning or whether it remained eternally in a steady state.

The present observational evidence, revised by G. Tammann in the sixth and last talk of this symposium, strongly indicates that the universe is indeed evolving and, in addition to the Hubble recession, the colour distribution of galaxies and their counts at different wavelengths require cosmological evolution. Moreover, the universal helium content of celestial bodies and the discovery (in 1965) of the cosmic background radiation can only be explained if we assume that the universe started in a 'Big Bang' some 18 billion years ago.

Such were the topics treated in these six lectures, outlining in a fairly coherent way the state of knowledge reached today about the origin of the physical world.

Pierre Bouvier
Chairman