Special Issue in Honor of Eron L Aero

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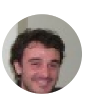

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Special Issue in Honor of Eron L Aero

This special issue is dedicated to Professor Dr Eron L. Aero on the occasion of his 80th birthday. Only a few can boast that their first published work aroused widespread interest and was highly appreciated by recognized scientists. The paper by Aero and Kuvshinskii on a model of the Cosserat continuum that appeared in 1960 [1], see also Aero and Kuvshinskii [2], was immediately noted by outstanding scientists in the field of generalized continua, such as Eringen [3, 4]. It became a pioneering work and gave rise to many studies in the field of micropolar mechanics, see Stojanović [5, 6] for the state-of-the-art in the 1960s. Let us note that the Cosserat continuum model is used for the description of solids with internal microstructure, for example, micro-inhomogeneous materials, foams, cellular solids, lattices, masonries, particle assemblies, etc.

Aero did not restrict himself to micropolar solids, also presenting a model of micropolar viscous fluids [7]. Later the model was generalized by Eringen [8] taking into account rotatory inertia. Micropolar hydrodynamics have been applied to describe the behavior of magnetic liquids, polymer suspensions, liquid crystals, and other types of fluids with microstructure, see, for example, the books by Lukaszewicz [9] and Eringen [10]. Throughout his life Aero has considered the micropolar models of solids and fluids [11-15]. Nowadays the Cosserat continuum has a significant place in Continuum Mechanics among other generalized models of continua such as micromorphic continua, strain gradient media and media with internal variables [16-19].

Aero delivered the lecture on his recent findings in generalized continua at the Euromech Colloquium 510: *Mechanics of Generalized Continua: A hundred years after the Cosserats* [20] in Paris on his 75th birthday. His outstanding contribution is widely noted in the literature, see for example Maugin [21], p. 184

'One is Eron L. Aero (born 1934) who, before even Palmov and long before anybody in the USA, produced (1960) a nice original paper on a model of Cosserat continuum. Remarkably enough Aero is still active at the moment of writing this book (2012) and he considers nonlinear effects in media that are also generalized continua.'

Aero's scientific interests were not restricted to the Cosserat continua. He has studied viscous fluids and liquid crystals [22-29]. Liquid crystals can be described by models similar to those for micropolar fluids. However, unlike the model of micropolar fluids where three unit orthogonal directors are used, only one unit director is introduced in the theory of nematic liquid crystals [30, 31]. As a result, known models of liquid crystals are called Ericksen–Leslie or Eringen liquid crystals. One of the achievements of Aero has been obtaining new dynamic equations for liquid crystals that allow us to describe their physical and mechanical features, which are important for various engineering applications.

In recent years, Aero has developed a strongly nonlinear continuum theory for crystalline media with a complex lattice, consisting of two sub-lattices [32-35]. He suggested a principle of translational symmetry that resulted in new nonlinear equations of motion. During recent years, much experimental data has been collected in the field of solid surface relief on the atomic level, crystal lattice changes, singular defects, the formation of new phases, and phase transformations under the influence of intensive outer forces, temperature or electromagnetic fields. These phenomena are observed in experiments but cannot be described within the linear theory or weakly nonlinear theory of crystalline media. The equations obtained using the highly nonlinear continuum approach by Aero predict deep structural re-arrangements of the lattice under intensive power and thermal stresses: lowering of potential barriers, switching of inter-atomic bonds, phase transitions, fragmentation of the lattice etc., thus allowing us to explain modern experimental data.

The new governing highly nonlinear equations were obtained in the form of the sine–Gordon equation and its generalizations. The generalized equations are not integrable, and new methods were needed to find their solutions. Aero and his co-authors [36, 37] developed a new procedure allowing them to obtain new solutions for multi-dimensional nonlinear equations in an explicit form. It concerns, in particular, the 3D sine–Gordon equation [36] and the nonlinear Klein–Fock–Gordon equation [37]. Recent achievements in this area may be found in their paper in this issue.

Eron Aero was born on May 14th, 1934, in the village Naryshkino near the city of Penza, located on the Sura River, 625 kilometers (388 miles) southeast of Moscow, Russia. He graduated from the Radio-Technical Faculty (now the Biophysics Electronics and Telecommunications study area) of the Leningrad Polytechnical Institute (nowadays known as St. Petersburg State Polytechnical University) in 1959. He received the degree of Candidate of Sciences (PhD) in 1975. In 1982 he received the degree of Doctor of Sciences for his dissertation entitled "Hydrodynamical theory of liquid crystals". From 1960 until 1986 he worked at the Institute of Macromolecular Compounds of the Academy of Sciences of the USSR. From 1986 to date, he has worked as the head of the Laboratory of Micromechanics of Materials at the Institute for Problems in Mechanical Engineering in St. Petersburg.

In this issue, we have tried to collect the papers that reflect recent achievements in the areas of scientific interest of Aero. Some of the contributors are working with him at the Institute for Problems in Mechanical Engineering, and their works were inspired by scientific discussions with Aero to a greater or lesser extent.

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