

Preface

Once upon a time, about 30 years ago, at the summer school on theoretical physics, lying on the beach of a gentle Black Sea in the sport camp of the Odessa University together with the well-known throughout the physical world scientists Valentin Pokrovsky and Alexander Patashinskii, who wrote a famous book “Fluctuation Theory of Phase Transitions” (Pergamon Press, Oxford, 1979), one of the editors (A.Ch.) of the Springer book “Modern Problems of Molecular Physics: Selected Reviews” heard from them such words: “Our great teacher Dau told us that there is nothing to consider the density of a liquid is different from the unit!”.

Should we explain the meaning of this sacramental phrase for respected readers, which seems to be an “error” by the Nobel Prize Laureate Lev Landau? In fact, a genius physicist L. D. Landau did not make mistakes in his physical works. Indeed, the density of the most common in nature, simultaneously so unique and mysterious, liquid water is equal to 1 in grams per cubic centimeter under normal conditions at room temperature and at atmospheric pressure. Then, what is a reason to use the word “error” even in quotes? As is known, Landau did not consider the physics of the liquid state of matter was equally interesting and promising area for building a successful physical theory, as, say, the solid-state physics or the physics of elementary particles. There is a well-known statement: “Theoretical physics is the physics of limiting cases”. In this sense, it is difficult to introduce small parameters for liquids, and the water density is not such a small parameter.

It is interesting to note that Landau made many of his outstanding work in Ukraine, being a Head of the Theoretical Physics Department at the Kharkov Institute of Physics and Technology. Here, in 1934 at the age of 26, he became a Doctor of Physical and Mathematical Sciences, and a year later received the title of Professor. Thus, the theoretical physics in Ukraine (and not only in Ukraine, and not only the theoretical physics) has received a tremendous impact for its further development, thanks to the Kharkov period of Landau scientific activities.

Unfortunately, the great physicist died very early-at the age of 60, in April 1968. One may say, paraphrasing one of our bards of that time: “60 is the time of achievements! 60 is the age of the tops!...60 seems like a lot, 60 is still not enough!”.

We are sure that L. D. Landau, who received the Nobel Prize on physics in November 1962 for his outstanding work on superfluidity of quantum liquids, or more precisely, “for his pioneering theories for condensed matter, especially liquid helium”, could make much more enlightening discoveries, including the field of classical liquids, did not be that fatal car accident on January 7, 1962.

In more than half a century since that time, the physics of liquids has leaped forward. It is sufficient to list the main directions of development of these advanced knowledge areas: nanophysics of liquid systems, medical applications of liquids; water and aqueous solutions in normal and metastable state; ionic and ionic-electronic liquids; magnetic liquid systems; phase transitions and critical phenomena; surface phenomena and liquids in confined geometry; quantum liquids; radiation physics of liquids; etc.

All these areas were presented at the 7th International Conference “Physics of Liquid Matter: Modern Problems” (PLMMP-2016) which was held during May 27–31, 2016, in Kyiv, Ukraine. The PLMMP-2016 International Conference was organized by the Taras Shevchenko National University of Kyiv and Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine. The scientific program of the conference comprised invited lectures, oral presentations, and posters contributed by hundreds of scientists from many countries all over the world (Austria, Brazil, France, Germany, Great Britain, Hungary, Italy, Poland, Portugal, Romania, Russia, Slovakia, Turkey, Ukraine, and United States of America).

Of course, the realization of the PLMMP-2016 International Conference is an important event in the scientific life of Ukraine, whose role cannot be overestimated. After all, the state of science and education largely determines the economic independence of any country and its ability to provide adequate answers to the challenges of modern civilization processes.

The book “Modern Problems of Molecular Physics: Selected Reviews” represents the collection of selected plenary and invited lectures of the PLMMP-2016 Conference and is aimed at elucidation the most important and modern aspects of the molecular physics, condensed and soft matter physics. The unification of experimental, theoretical, and computational methods allow to receive significant results in such four directions: (a) *Liquid Systems with Nanoparticles*, (b) *Ionic and Ionic-Electronic Liquids*, (c) *Magnetic Liquid Systems*, and (d) *Phase Transitions and Critical Phenomena*. This book is written for the scientific researchers as well as for teachers, engineers, students, and all those readers interested in modern problems of the physical sciences.

On behalf of the Organizing Committee of the PLMMP-2016 Conference and editors of the book “Modern Problems of Molecular Physics: Selected Reviews”, we would like to thank all the plenary and invited speakers as well as all the participants for their valuable contributions and brainstorming discussions, the International Advisory Board and Local Organizing Committee for assistance in

organizing and realization the scientific program of the PLMMP-2016 Conference, and the Springer International Publishing AG Switzerland for helping to organize the publication of the book “Modern Problems of Molecular Physics: Selected Reviews” in Springer Proceedings in Physics.

Kyiv, Ukraine

Leonid A. Bulavin
Alexander V. Chalyi

<http://www.springer.com/978-3-319-61108-2>

Modern Problems of Molecular Physics

Selected Reviews from the 7th International Conference

"Physics of Liquid Matter: Modern Problems", Kyiv,

Ukraine, May 27–31, 2016

Bulavin, L.; Chalyi, A.V. (Eds.)

2018, XIV, 374 p. 156 illus., 100 illus. in color.,

Hardcover

ISBN: 978-3-319-61108-2