Van der Waals equation of state one and a half centuries

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This year marks the 150th anniversary of the van der Waals equation of state (EOS). He is considered the founder of a big problem of three components: obtaining new EOS, improving the known ones and choosing the optimal ones among them. All directions are still relevant, including for a variety of low-parameter (from 2 to 5) EOS of the vdw-type. Many questions have accumulated to them, the answers to which cannot be obtained with the standard approach, when new modification equations are associated with the van der Waals molecular model, where only two parameters make sense. And only a systematic approach as the basis for the development of molecular thermodynamic models opens up such possibilities. The simplest variant, the model of interacting point centers, makes it possible, among other things, to reveal the connections between the vdw-type EOS and the microlevel. In this case, analogs of the known vdw-equations are among the physically substantiated EOSs, all of whose parameters make sense. This allows us to introduce a comparative factor that reflects the nature of the intermolecular interaction, which, by determining a set of parameters, forms a specific EOS. It turned out to be the governing parameter of the model at the thermodynamic level, turning a set of separate unrelated EOS into a one-parameter family. This applies not only to EOSs of the new model, but also to equations vdw-type. The results obtained [1], including the latest ones, refine and deepen the connection between models of two levels (EOS parameters and molecular characteristics). Being our contribution to solving common problems, the results are of particular interest due to the fact that the research for the keys to the success of the famous EOS continues to this day.

[1] Petrik G G 2020 *Sbornik nauchnych statej* (Makhachkala: CSMOSiPR)