Preface to the second Russian edition

The general structure of the book and the major part of the text in this second edition were retained without change. At the same time, certain chapters were thoroughly revised and a considerable amount of new material was added. Chapter V now contains a part devoted to breakdown (high-intensity ionization) processes and to the heating of gases by a focused laser beam. This is one of the most interesting phenomena connected with the interaction between an intense light beam and a medium. It was discovered experimentally several years ago, shortly after the development of lasers, which produce high pulse intensities measured in tens of megawatts and higher, and immediately attracted the attention of many physicists (including the authors of this book, who have published works on the theory of this phenomenon).

In connection with problems of gas ionization by laser radiation we have added sections to Chapter V in which emission and absorption of light by free electrons on collision with neutral atoms is considered. The lively interest which is now shown toward lasers has induced us to write a special section (in Chapter II) devoted to the semiclassical treatment of induced emission and of the laser effect.

Extensive changes were made in Part 3 of Chapter VI, in which we consider problems of ionization, recombination, and electronic excitation. This part has been virtually rewritten and extensively expanded in order to take into account modern views on these processes. According to these views an important role is played by stepwise ionization of atoms (first excited and then ionized) and electron capture into upper atomic levels through three-body collisions with subsequent deexcitation of the excited atoms through electron impact and radiative transition. Ionization in air has been considered in more detail. The presentation of the closely related problem of ionization of a gas in a shock wave (in Chapter VII) was also changed.

Sections of Chapter VIII, pertaining to the rate of change in the degree of ionization and of the "freezing" accompanying a sudden expansion of an ionized gas into a vacuum have been rewritten. This problem has been recently reexamined with account taken of electron capture into upper
atomic levels as a result of recombination through three-body collisions.

On the basis of material which was contained in the first edition and of more recent results we have added in Chapter XII a part dealing with the propagation of shock waves in an inhomogeneous atmosphere with an exponential density distribution. We have added an appendix wherein are collected certain constants, relations between atomic constants, and relations between units and formulas which are frequently encountered in practice when dealing with the subject matter of this book.

We have here mentioned only the principal, but by far not all of the changes and additions which were made (we also note that mistakes and printing errors which were found in the first edition have been corrected).

Topics of physics and mechanics which were touched upon in the book are developing at an extremely rapid rate, with the consequent discovery of more and more new fields of application (an example of this is the phenomenon of breakdown and heating of gases in the focus of a laser beam).

As an evidence of the interest shown toward these scientific disciplines we cite the fact that immediately after publication of this book, an English translation was undertaken in the United States, and a need for a new edition very soon arose. We hope that this second revised and supplemented edition will be of use to specialists already working in the above fields of science and engineering and to those who are about to enter these fields.

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