FOREWORD

The present issue of the Journal of Engineering Physics and Thermophysics (Inzhenerno-Fizicheskii Zhurnal) contains the main results of research carried out in 1997-1999 by a team of staff members (about 30 in number) of the Academic Scientific Complex "A. V. Luikov Heat and Mass Transfer Institute" of the National Academy of Sciences of Belarus, Belarusian State University, and Moscow Engineering Physics Institute within the framework of the project of the International Science and Technology Center (ISTC) "Mathematical Simulation of Natural and Human Activity Accidents and Their Influence on Environmental Conditions and Ecology" (project B23-96).

Large-scale catastrophes caused by the fall of large extraterrestrial bodies, volcanic eruptions, inadvertent explosions of ammunition warehouses, accidents at petroleum storage depots, oil and gas pipelines, and nuclear power stations, etc. have a number of common characteristic features. To a certain extent they represent a combination of such physical processes as intensive flow of compressible and incompressible media, molecular, convective, and radiative heat exchange, plastic flow and breakup of the condensed phase of matter, melting, evaporation, and condensation, ejection of large quantities of matter and heat into the atmosphere; complex chemical transformations of initial products, etc. Frequently the consequences of such events exert a substantial effect on the ecological situation and the environment. Existing methods of mathematical simulation and ones being developed allow prediction of the dynamics of these complex processes and the ensuing consequences in various time, space, and energy scales. Therefore, it is difficult to overestimate the immediate importance of this approach.

The objective of the project was to develop a unified approach to the solution of a wide range of large-scale energy catastrophes by the methods of mathematical simulation. For this purpose new physical–mathematical models of the phenomena that accompany large explosive- and impact-type energy catastrophes were improved and developed, new physical–mathematical models of the properties of matter at high energy densities were developed, the numerical algorithms for their realization were constructed, software was created, and numerical experiments on simulation of the above phenomena were performed.

The problems considered in the papers presented in what follows cover a wide range of kinetic, gas-dynamic, hydrodynamic, and thermophysical phenomena that accompany the entry of large meteoroids into the earth's atmosphere (hypersonic flow and thermal destruction of bodies, radiation of gas heated in shock waves, chemical reactions in air and vapors, etc.), impact on solid and water surfaces, formation of craters, tsunami, etc., and the processes of volcanic eruption and evolution in the atmosphere of the products of volcanic ejection of explosive and jet type. Study of the above-indicated processes is impossible without the creation of appropriate databanks on the optical–physical characteristics of heated gases and plasmas and condensed media in the range of high temperatures and pressures.

In our opinion, these articles can be of interest to a wide range of specialists who work in the field of studying fundamental problems of high-temperature thermophysics, radiative plasmodynamics, and the behavior of matter at high energy densities.

The papers presented can be grouped into the following categories:

1. Properties of media (equations of state, optical characteristics), problems of transfer of radiation and matter.
2. Hypersonic flow, high-velocity impact, and the consequences caused by these processes.
3. Mathematical simulation of water waves caused by high-power external perturbations.
4. Simulation of processes in the atmosphere caused by high-power volcanic ejections.

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It should be noted that a number of results obtained in the course of carrying out the project were published in other issues of the Journal of Engineering Physics and Thermophysics and other publications. Detailed information about these articles can be found on the Internet (URL: http://www.itmo.by/devision/rgd/ists-b23-96.html).

We realize that the announced claims exceed the factual material contained in the works presented. Therefore we are ready to acept with gratitude any comments. At the same time, we hope that the readers' criticism will give us the impetus to do something better or something differently. We will believe that the primary purpose has been achieved in that case.

For a long time the authors of the papers published below have worked to obtain the end result. The possibility of being involved in solving problems that are far from applied ones has appeared almost for the first time. In these works we actually tried to follow the spirit of conversion in essence, and therefore our approaches can appear unusual in some way to those experts whose fields we have unintentionally intruded upon.

The project has given us the possibility of perceiving ourselves in a different quality, making no claims to specialized knowledge in areas new to us. We recognize the insufficiency of our experience. This is only the beginning. We wish to develop the possibility presented to us and to obtain more significant scientific results. An important point is that we wish to improve what we have achieved. We believe that the ISTC has given impetus to our work and has opened for us the possibility of participating in international cooperation.

In this connection we are deeply grateful to the administration and staff of the International Science and Technology Center, whose kind attitude and support were felt by us throughout our work.

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