Preface

Since earliest recorded history, man has sought an understanding of natural phenomenon. Some sought understanding as a way to control phenomenon like flooding in areas vital to agriculture. Others sought understanding as a way to join in the phenomenon that intrigued them. For both those seeking to control the movement of water and those seeking to move through the air with the birds, the close observation of fluids in motion was a natural place to begin.

By the time of Aristotle, theorists had begun to record their investigations. As the years passed, observers also began to experiment with the effects of these properties on objects moving through the fluids. Each early theorist pursued the aspect of fluids that interested him, generally unaware of the work of others. Although these investigations were performed without the tools that are available today, the conclusions formed by many have proven over the centuries to be correct. By the sixteenth century, most investigations were conducted by enthusiastic amateurs or those who were to become the first in what are now established fields such as engineering. It was at this time that theories proven by replicable investigation began to take the place of long-held but unproven beliefs.

But observations and theories were one thing. The systematic application of these theories to matters of national importance was another. Even in a discipline so vital to the interest of emerging nations, it wasn't until the late nineteenth century that shipbuilders first looked to apply science to the design of ships. Prior to this, shipbuilding had been more art than science with ships built according to what had worked before and what "should" work going forward. As navies and industries exerted greater control over the design and construction process of increasingly complex and expensive vessels, there was an increased demand to demonstrate that the completed ships would satisfy a specific level of performance (e.g., speed) before governments and private owners were willing to invest the enormous money and resources needed to build these ships.

It was this dual focus on the application of science and the demand for accurate estimates of future performance that led to an examination of scale model testing as a viable method for achieving these objectives. The time was right for English engineer William Froude to champion and prove that the testing of designs on scale models in a controlled environment as a precursor to construction would yield results that were superior to those that could be achieved through a reliance on historical precedence having scant relationship to the new ships being called for. Since this time it has been accepted practice to use scale model testing to perfect the designs for new vessels before construction begins.

Scale models are used today for more than the design of ocean-going craft. They are also used for the design of aircraft and spacecraft. In areas where exact scale models are not used, prototypes often are because the value of small-scale tests in the design phase is no longer questioned. Even the sophisticated computational fluid dynamic models used to generate many vessel components in production today are based upon physical scale model testing that was completed in model basins.

All of these models predict future performance by way of the application of the fluid dynamic principles that will be in effect around the full-sized versions of these craft. This is because water, air, and gasses are all considered to be fluids. When you float a boat, fly a kite, or launch a rocket, you are putting the principles of fluid dynamics to work. Today as fluid dynamic principles are applied to problems encountered in the design of ocean vessels for best performance, to decisions about the optimal configuration of an airplane wing, and to considerations about the most efficient design for rockets and launch vehicles, the process represents the effective melding of science and innovation. This combination has now facilitated the economical and reasoned design of scores of vessels for more than 100 years.

As an appreciation for the economies linked to the use of scale models grew, the scope of their use increased greatly. An exploration of the application of scale models to the design of ocean-going vessels, aircraft, and spacecraft—along with a look at the scientific principles in action in nature and the testing facilities—will be found in the chapters that follow.

Rockville, MD, USA Gina Hagler

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