



# **The Screw Propeller: An Investigation of Its Geometrical and Physical Properties, and Its Application to the Propulsion of Vessels**

*Robert Rawson*

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An excerpt from the PREFACE:

THE increasing national importance of the subject discussed in the following pages, the limited information to be obtained from English publications on the purely scientific part, and the more limited mathematical investigations which have been made in the theory, must apologize for my presuming to lay the following pages before the public.

I cannot flatter myself that the following exposition of the subject of Screw Propulsion is complete, or that the arrangement is the best that might have been adopted; being the results of my consideration of the subject, in the order in which they presented themselves to my own mind, rather than according to a preconceived arrangement; but, although the investigations are not so complete as I could have desired to make them, still I trust that the Mathematician, Naval Architect, and Engineer will find in them much that is new, and at the same time capable of standing the test of accurate mathematical examination.

The following are some of the more important conclusions arrived at:

The discovery of the surface of vanishing pressure, detailed in the second chapter, is important, as it affords an explanation of some curious phenomena which have been observed in the practice of Screw Propulsion. The investigation of the moment of inertia of the screw blade, as given in problem (5), chapter h., and its application to the determination of the accelerating forces acting on the blade of the Screw Propeller, are entirely new, as well as the results obtained, in the notes at the end of the second chapter, on a subject highly interesting both to the practical Naval Architect and the theoretical inquirer. The formulae for the area, pitch, radius of gyration, and moment of inertia of the screw propeller blade, and the table, computed at considerable labour, for their application in practice, will, it is hoped, be found useful to practical men.

Among the results which have been brought out in the following investigation of the properties and action of the screw propeller, the singular and important relation which is expressed by equation (7), page 33, will be found very useful in determining the quality of the screw, and of the engine which is used to turn it; as it is not always the case that the largest and most powerful engine is the best adapted to the Screw Propeller.

The engineer will readily see the importance of the fact, that a moment of force is absolutely necessary to produce a motion of rotation, and that this moment of force consists of two independent elements, the force, and the distance from the point of its application to the centre of rotation; therefore, the moment of an engine should be regarded, in the estimating of its quality for this purpose, and not the absolute force as measured by the indicator, or the pressure on the piston. An engine which may have a large force on the piston, and a small moment, is not advantageously adapted to give rotatory motion to the Screw Propeller.

The peculiar form of the Screw Propeller blade gives rise to the resolution of the forces acting upon it into two directions; one the direction of the vessel's motion, and the other to turn the screw round its axis. These two resolutions give two equations, each of which contains the same indeterminate integral, which depends on the (at present) unknown law connecting the accelerating resistance of the water with the normal velocity of the screw blade; by means of these two equations the unknown integral can be eliminated, and the result is an important relation between the pressure of the water on the blade of the screw in the direction of its axis, and the moment of force which is exerted by the engine when the screw and the vessel have obtained a uniform motion....

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#### **Michele Fernandez:**

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#### **Nancy Brown:**

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