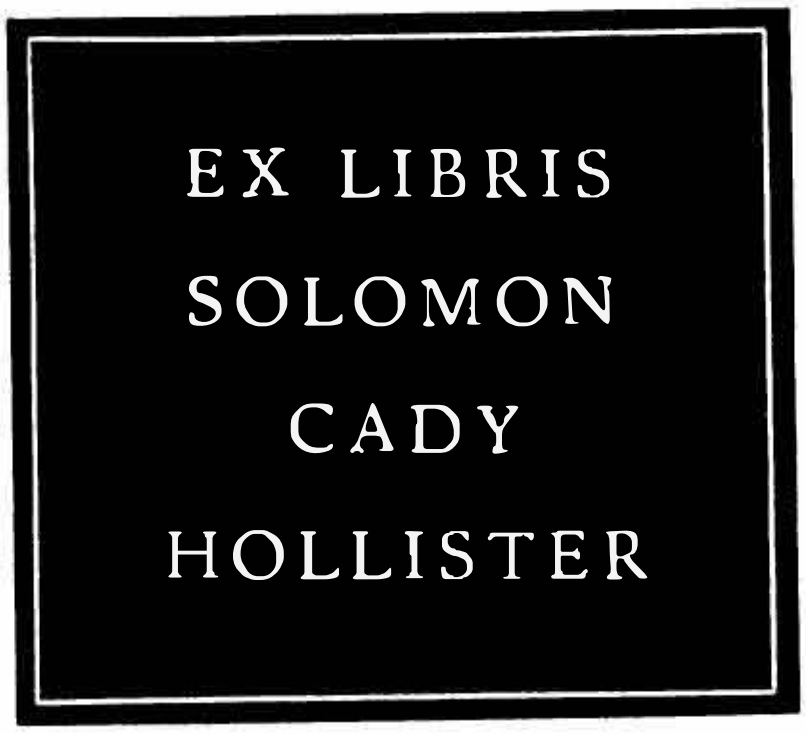
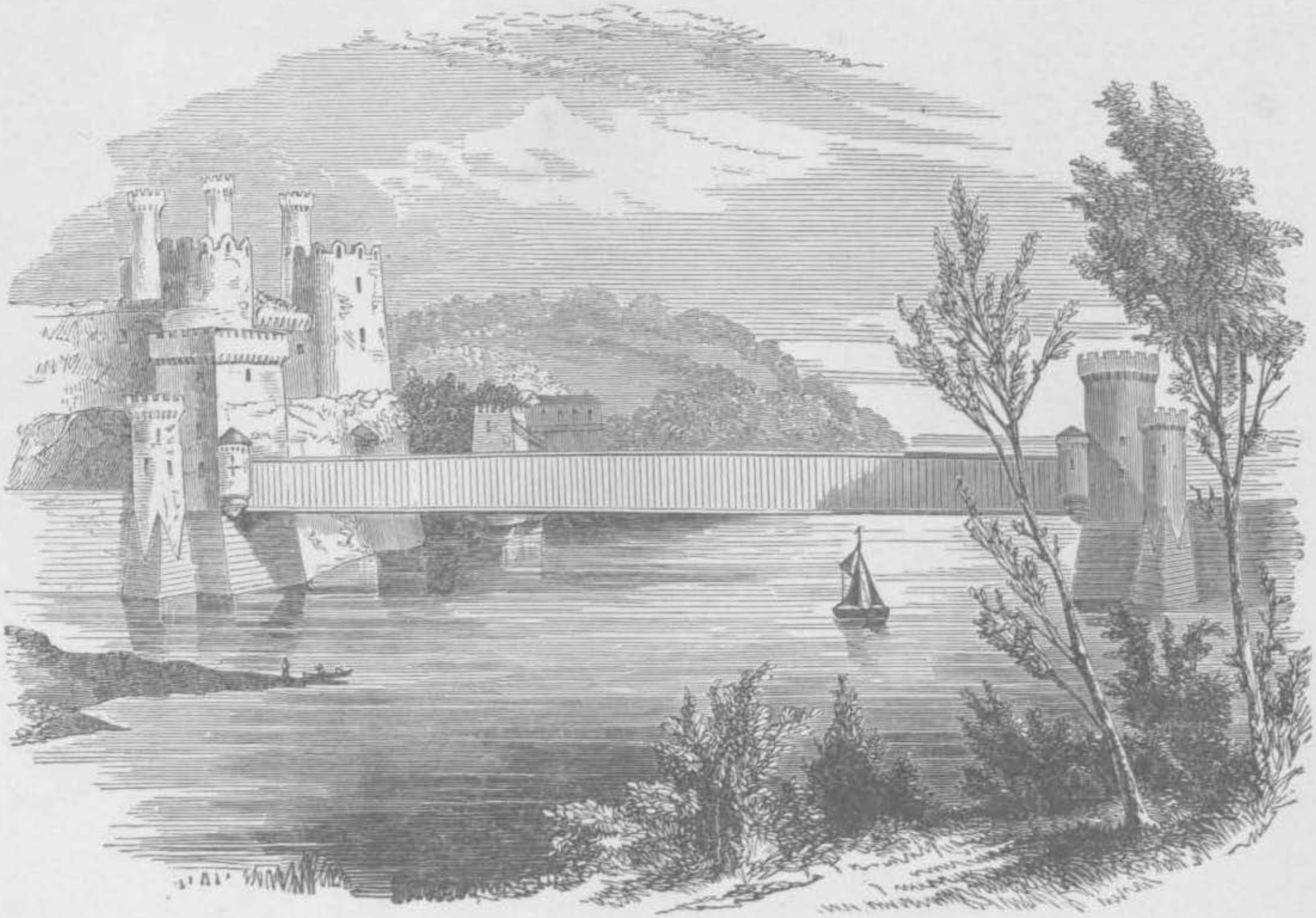

EX LIBRIS
SOLOMON
CADY
HOLLISTER



THE CONWAY TUBULAR BRIDGE.

PRINCIPLES

OF

THE MECHANICS

OF

MACHINERY AND ENGINEERING.

BY JULIUS WEISBACH,

PROFESSOR OF MECHANICS AND APPLIED-MATHEMATICS IN THE ROYAL MINING ACADEMY OF FREIBERG.

FIRST AMERICAN EDITION.

EDITED

BY WALTER R. JOHNSON, A.M., CIV. & MIN. ENG.

WASHINGTON, D.C.

FORMERLY PROFESSOR OF MECHANICS AND NATURAL PHILOSOPHY IN THE FRANKLIN INSTITUTE, AND OF CHEMISTRY AND NATURAL PHILOSOPHY IN THE MEDICAL DEPARTMENT OF PENNSYLVANIA COLLEGE. AUTHOR OF A REPORT TO THE UNITED STATES NAVY DEPARTMENT ON AMERICAN COALS, &C. &C.

IN TWO VOLUMES.

ILLUSTRATED WITH EIGHT HUNDRED AND THIRTEEN ENGRAVINGS ON WOOD.

VOL. II.

APPLIED MECHANICS.

PHILADELPHIA:
LEA AND BLANCHARD.
1849.

PHILADELPHIA:

T. K. AND P. G. COLLINS, PRINTERS.

PREFACE BY THE AMERICAN EDITOR.

In submitting to the American reader the second volume of Weisbach's Mechanics of Machinery and Engineering, we cannot, perhaps, better express our own appreciation of the value of this part of his labors, than by citing a passage from the advertisement of the English translator, Prof. L. Gordon.

"The usefulness of this second volume will be manifest from the practical interest and importance of the subjects treated. The first part of the volume, though far from giving a complete theory of engineering and architectural construction, brings many important questions of practice before the student in a simple form, and in a light by which he will more readily recognize the bearings of the mathematical calculations on this subject, than has been usually the case in English works. The second part of the volume contains the only Theoretical Treatise on Water Power of the least practical value hitherto printed in the English language. The real *importance* of such a treatise will be variously estimated; but as it is the first publication in which a systematic attempt is made to familiarize English Machinists with the application of exact reasoning in developing the theory of the machines treated of, it is believed that it must be interesting to them, and if so, it cannot fail to be useful likewise."

The most available treatise on the numerous forms of reaction wheels, and other turbines to which the American student has access, is believed to be embraced in this volume. The author, it may be observed, has not contented himself with giving a general theory on that subject, but by skillfully analyzing the several effects produced, and computing separately the prejudicial and the useful resistances

to the action of the water, has presented conclusions challenging the highest confidence, especially as they stand confirmed, in most cases, by the results of numerous direct experiments.

In reference to the water-pressure engine, also, it may be said that the present volume will afford to the American student the most direct and positive information as to the useful application of water in that species of motor.

In the original work of Prof. Weisbach, the second volume embraced the science applicable to the steam engine, but as that subject has now assumed so distinct an importance, and as its numerous topics and improvements could scarcely be presented with sufficient clearness, in a less space than an entire volume, it has been deemed expedient, in imitation of the English translator, to reserve that branch of the mechanics of engineering for a separate treatise.

In assigning to their appropriate chapters the additions of the translator, which had in the English edition been thrown into the form of an appendix, we have been guided by a desire of rendering the work more serviceable to the student, by placing before him the whole matter pertaining to each branch under its appropriate head.

We have added a few articles particularly relating to the strength of materials, which, we hope, may not be found uninteresting to the student. Indeed, when we take into view the lamentable, and often wilful and obstinate disregard of the truths which science has elicited relative to this department of our subject; when we see machines and engines intended to perform the most powerful operations, and edifices, or monuments, designed to endure for ages, constructed of materials, either utterly worthless, or, at best, of very inferior character and durability, or containing in their composition the elements of weakness and decay, we may estimate, with some justness, the importance of those researches and computations, which prove what may be expected from the employment of good or bad materials respectively, for any of the purposes of the architect and engineer.

The fact that the public has often been basely imposed upon by reason of employing as architects and engineers those who would pander to the cupidity of contractors for materials and labor, and

erect public works wholly discreditable to the nation, is an additional reason why works, written for the purpose of imparting correct information on the physical properties and the relative values of materials, ought to be diligently studied by those who desire correct and reliable knowledge.

The list of illustrations which we have added will much facilitate reference to the several topics to which they relate, and the execution of the cuts, with the creditable manner in which they have been used by the printer, will be sufficiently apparent to the most casual observer.

WASHINGTON, *August*, 1849.

AUTHOR'S PREFACE.

In writing this, the second volume, I have adhered as closely as possible to my views of what the work should be, as explained in the preface to the first volume.

I am aware that these views are not adopted by all who are capable of judging in the matter, and that a more general and mathematical treatment of the subject would have been preferred by many. But I have now long experience in teaching to fall back upon, and am thereby convinced, that the comparatively elementary style adopted as it can be followed by those who have not made extensive mathematical acquirements, will more surely lead to the introduction of applications of Mechanical Science in the routine practice of engineers, than the more general methods of treating these subjects have done.

A basis on true principles and established facts, and simplicity in the method of analysis, are the main requisites in a work intended for the instruction and guidance of practical men. And it is chiefly the want of these, in technical literature, that has retarded the introduction of science amongst those engaged in the execution of works, and the erection of machinery. If in evolving rules of art, imperfect facts be assumed, or unwarranted hypotheses be adopted—if the essential be not distinguished from that which is merely collateral, and if important considerations be neglected, it cannot be expected that the rules deduced, however correct the process of deduction, will be available for any useful application. But this is no uncommon fault. Authors forget that the mathematics can only *guide* our ideas, and not *give* us any: and thus, in admiration of their analytical processes, they often overlook the worthlessness of the premises. Hence it arises that practicians not unfrequently reproach *theory* as valueless, whilst it is, in reality, the facts of the case that have been erroneously stated or applied. Besides, it is not an easy matter to deduce rules of art by the principles of

science; for this requires not only an intimate acquaintance with the subject investigated, but generally requires special observations or experiments to be made, in order to *create the facts*, so to speak, that are to be reasoned upon and reduced to a theory which shall interpret them.

In this second volume of his work, the Author has done his utmost to develop theories that will be found applicable in practice—to furnish the guide above alluded to—well aware, however, that his endeavors have only imperfectly succeeded.

This volume is divided into two parts; the first, the application of Mechanics in Construction, and the other to the theory of Machines recipients of Water and Wind Power. The Author regrets now his not having entered more at large into a discussion of the theory of the construction of wooden and stone bridges, and more particularly not to have been able to avail himself of the information contained in Ardant's *Etudes sur l'établissement des charpentes à grande portée*, as this subject is, in these times of railway extension, of especial importance (in Germany).

The second part of the volume is as concisely written as was consistent with the object I had in view. I now regret having been so brief on the important subject of Dynamometers. The chapter on Turbines may appear to some to err in excess, from my having given the details of the theory and construction of the old impact and pressure turbines; but I consider that it is important to be aware of the faults or imperfections of one construction of a machine, in order fully to appreciate the improvements introduced in a more perfect one. Again, the application of Water-pressure Engines, being almost entirely confined to the Mining Engineer's province, the fullness with which I have treated this engine may appear to exceed its relative importance. The circumstance, however, that there is no work in any language, that I am aware of, treating of these engines, must be my apology for attempting to fill that gap in technical literature.

I hope soon to preface a volume, containing a Treatise on Mechanism, and on the principle *Operators*, or machines performing various mechanical operations.

JULIUS WEISBACH.

FREIBERG, *December*, 1847.

TABLE OF CONTENTS.

PAGE

SECTION II.

OF MOVING POWERS, AND THEIR EFFECTS.

LIST OF ILLUSTRATIONS.

Please note:
These pages were scanned
as they appear in the original
(no pages were skipped
in the scanning process)