

**WATER RIGHTS
DETERMINATION
FROM AN ENGINEERING
STANDPOINT**

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Water Rights Determination from an engineering standpoint by Jay M. Whitham

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WATER RIGHTS DETERMINATION

From an Engineering Standpoint

BY

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Author of Steam Engine Design, Constructive Steam Engineering, etc.*

"I don't think much of a man
who is not wiser to-day than
he was yesterday."

—Lincoln

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TO THE MEMORY OF
Caroline A. (Rowe) Whitham

MARCH 1, 1826-DEC. 28, 1916

"God never made anything that so
reflected the attributes of love as
the heart of a Mother."

—H. A. Mooney

384947

PREFACE AND INTRODUCTION

"The wisdom of the wise and the experience of ages may be preserved by quotation."
—BENJ. DISRAELI.

THIS book is intended to assist an owner of an indefinite water right in determining:

1. The meaning of his right as expressed in horse-powers, and
2. The number of cubic feet of water per second to which he is entitled.

The Author has had much experience, during the past twenty-seven years, in interpreting such water grants. It was necessary to view the site, ascertain the head possibilities upon the property, study the state of the particular art referred to in the grant, as applying to the time and place, and then learn the types and efficiencies of wheels known and available for use.

In pursuing such studies the Author has collected the various books relating to milling, millwrighting, tanning, saw mills, paper making, blast furnaces, rolling mills, mechanics, science, water wheels, etc., referred to in the bibliography appended, and others; has digested their contents into some 1800 pages of typewriting, and prepared an extensive topical index thereof; has visited remote localities, examined and tested many existing and operating examples of the early days, as well as ruins of abandoned mills; has conversed or corresponded with scores of millers, millwrights, and operatives in the old

mills; and has studied many judgments of courts determining the meanings of water grants, and abstracted the printed records thereof, after visiting the properties referred to in the judgments.

A book of this nature is necessarily a compilation. With the wealth of data obtained it is impossible, in a work of this size, to give more than citations from some of the representative writings. Many tests and power determinations by the author are here published for the first time.

At sundry times from before 1800 to even after 1900, owners of water powers have granted rights as measured by specific uses, such as to operate "a run of stones," or "one saw," etc., and an equally large number of grants do not have even this restriction, but simply allude to the nature of the industry to be driven. Thus, on one dam in New York, at times from 1808 to 1850, separate water grants were sold for a saw mill, a woolen mill, a machine shop, nail works, a paper mill, a tannery, a force pump, a trip hammer, a carding mill, an oil mill, etc., all being subordinate to an undefined cotton mill. There was no mention of the number of saws, the sets of woolen machinery, the mechanisms in the shop, the number of nail cutters, the equipment or product of the paper mill, the number and kind of hides tanned per day, etc. No one is living who worked in the mills as constructed. None of the original mills are in existence. The water rights have been absorbed by some half dozen industries. The industrial character of the locality has changed.

Should the owners, or the courts, endeavor to measure

these rights it will be necessary to consult some of the old books referred to in this work, to study old local histories and even old local newspapers, to take the opinions of old millwrights and operators of old saw mills, oil mills, tanneries, etc., gathered from nearby localities, and of engineers familiar (by research) with the state of the arts and with water wheels of from 1808 to 1850. It will, of course, be necessary to examine the sites and form a judgment as to the heads which could reasonably be developed for the wheels available for use at the times.

Too much reliance should not be given to the various old books on millwrighting. Evans' book for its time (1795) was probably an authority. The flour milling art quickly outgrew that work. Subsequent editions were rearrangements of the old book. Jones, a teacher of mechanics in a night school, could add no milling value by his revisions. The works of Hughes and Pallett were prepared by men of grist mill experience, and were largely compiled from older books representing English practice. Craik, "a hard-working, practical millwright and miller" wrote an excellent book, but omits all allusions to power except for saw mills. None of these writers were engineers or knew much about horse-power and accurate water measurements.

It is to be remembered that when most of these early grants were made there were neither mechanical engineering schools nor professional hydraulic and mechanical engineers. The engineering was done by millwrights—men clever with their hands in fashioning water wheels, mill buildings, dams, etc., and generally possessed of a

fairly clear knowledge of stream possibilities and hydraulic principles. They were not gifted in writing, were secretive and jealous of their knowledge, and passed it on to apprentices. The writers were either inventors, owners of small mills, or mathematicians and professors.

There were growths in every industry from time to time. Evans' mill of 1795 was not the flour mill of 1830. "Flat milling" was succeeded by the new "half-high" system, only to be replaced by the "combination" system of rolls for breaking down the wheat and buhrs for grinding its product. Then came the "roller" mill. The old upright saw, with its single blade, gave way to the gang saw. Next the circular came and finally predominated. The time for tanning a hide was greatly reduced by chemical treatment. The hand-formed was replaced by the machine-made sheet of paper. Rags largely gave way to wood for paper stocks. Improvements were made in textile machinery. The tendency all along was to "speed up" and get a larger volume of product, thus using more power. It is, therefore, evident that the state of the art for the time of the grant should be known. This work may be of some service in this respect.

When the earlier grants were made, wooden flutter, undershot, breast, overshot, and tub wheels predominated, one or the other being used as the head at the property and the volume of flow in the stream would justify. Then came the flat-vaned, central-discharge, scroll-cased, wooden wheel and the turbine. Finally, towards the end of the 1840's and through the '50's there was an epidemic of turbines. Every foundryman near a rapids in