



# STEEL

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ITS SELECTION  
ANNEALING  
HARDENING  
AND  
TEMPERING

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MARKHAM

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TS 320  
M3

The  
Norman W. Henley  
Publishing Co.

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New York

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# STEEL

## ITS SELECTION, ANNEALING, HARDENING AND TEMPERING

This Work was Formerly Known as "*The American Steel Worker.*" It is the Standard Work on Hardening, Tempering and Annealing Steel of All Kinds, Being Comprehensive and Giving Specific Instructions as well as Illustrations of the Methods of Hardening a Large Number of Tools. All Kinds of Annealing and Muffle Furnaces, Blast Ovens, Open Flames and the Use of the Lead and Cyanide Baths are Fully Described. Case Hardening and Pack Hardening are Treated in a Comprehensive Manner. A Practical Book for the Machinist, Tool Maker, Blacksmith, Tool Hardener or Superintendent.

By E. R. MARKHAM



FOURTH EDITION. FULLY ILLUSTRATED.

New York:  
THE NORMAN W. HENLEY PUBLISHING CO.  
132 Nassau Street  
1913

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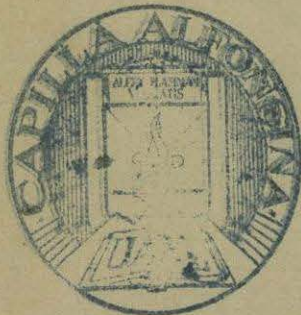
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Words are not adequate to express the debt I owe one, who, more than all others, has been instrumental in instructing, advising and assisting me along lines that have led to whatever success I may have attained.

As an humble acknowledgement of my gratitude, I dedicate this work

To My Father,

RUSSELL MARKHAM.



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## Preface to Fourth Revised Edition.

The rapid progress made in American steel manufacture and treatment with the constant improvement and invention of new processes and special steels has necessitated a revision of the present volume with numerous additions regarding the most recent methods of special-steel treatments. The advent of the automobile, the modern gas engine and aeroplanes has brought about a demand for extremely tough, strong, high grade steels of various kinds known as Alloy Steels. The exact composition of these new steels is held as a trade secret by the manufacturers and in fact it is very doubtful if the makers themselves know exactly what the steels contain. In a general way analysis will show the various proportions of the different metals and chemicals entering into their composition but doubtless the rare gases, metals and chemicals, which to great extent influence the final quality and grade of these alloy steels, are consumed or altered in the process of manufacture and do not appear in the ultimate product. Although known to the trade as "Tungsten steels: Vanadium steels, Chrome and Nickel steels," etc., yet nearly all are complex alloys and practically every manufacturer has a different method or process of producing them. For automobile and other special uses these alloy steels have proved of inestimable value and several manufacturers, notably the Ford Company, have carried on expensive and exhaustive tests of such steels and in fact in this line of work have outdone the steel manufacturers themselves, as well as the U. S.

## Preface to Fourth Revised Edition.

Government experts. Space will not permit of a full discussion or account of the modern alloy and high-speed steels or their treatment and all that can be done in a volume of the scope and size of the present work is to give a brief account of the more important points of annealing, hardening, tempering and case-hardening of modern steels with such data and specifications of their strengths, compositions and properties as can be ascertained. While the majority of users of modern steels guard their methods of treatment as carefully as do the steel manufacturers, yet there are notable exceptions to this rule and my thanks are especially due to the Bantam Anti-friction Company of Bantam, Conn., for information furnished regarding the heat and hardening treatment of their world-famous ball- and roller-bearings as well as to the C. S. Mersick Company, the Malleable Iron Fittings Company, and others for data and information furnished.