

CEMENTATION
OF
IRON
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STEEL

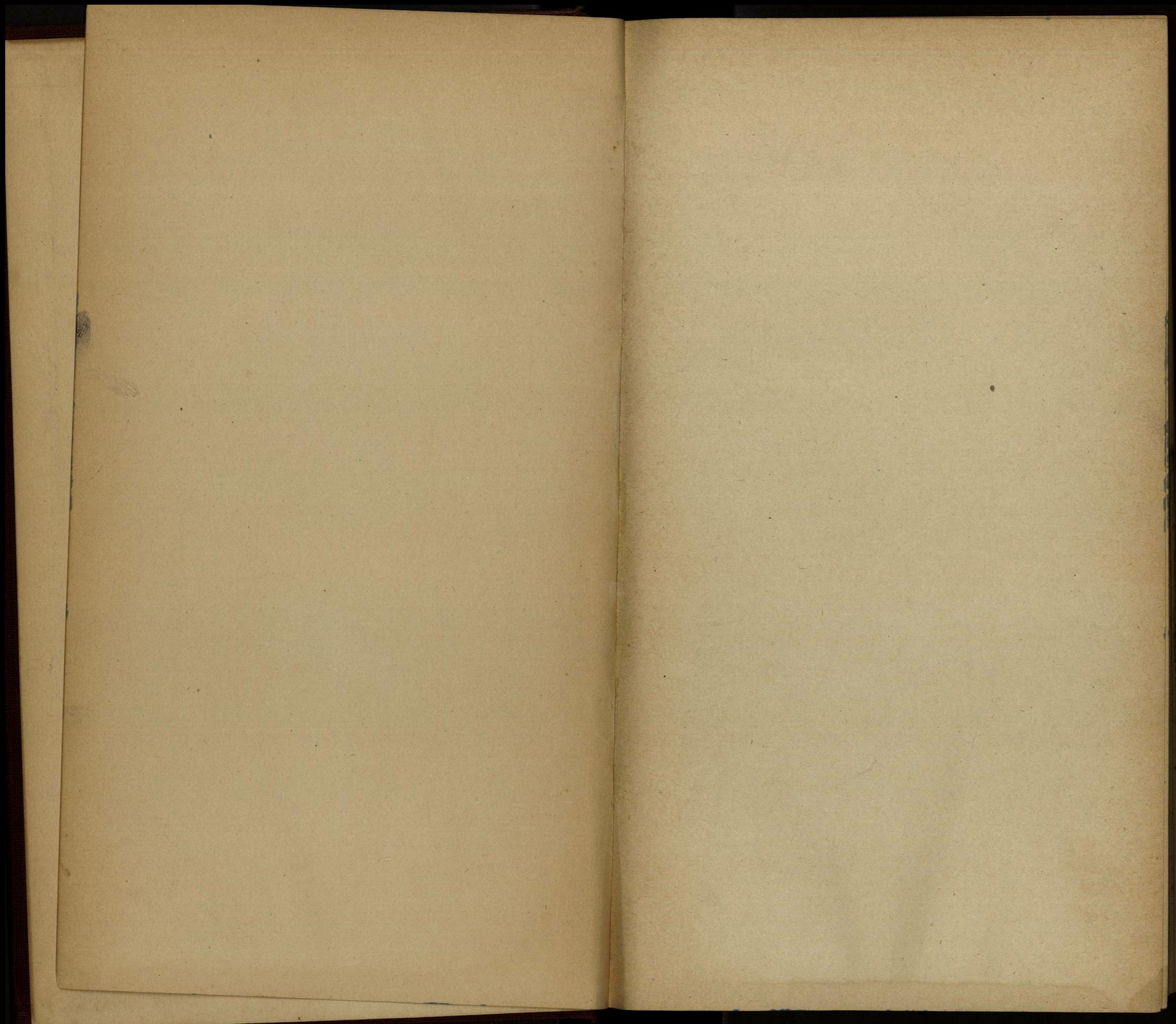
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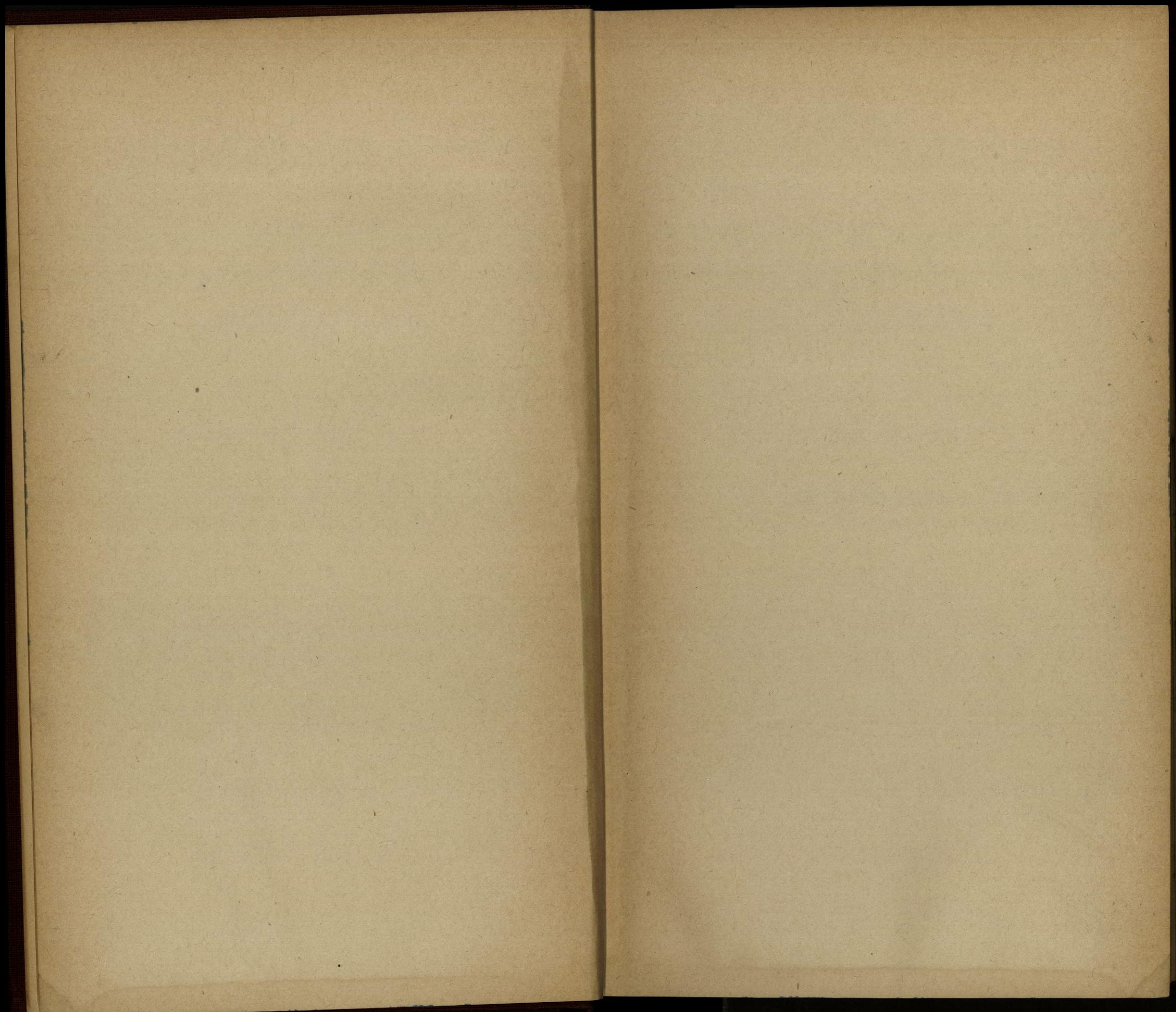
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THE CEMENTATION OF IRON AND STEEL

BY

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PREFACE

The cementation of iron or steel is perhaps, of all metallurgical processes, that which to-day is still applied industrially with the greatest empiricism, and it may be asserted that what the English so effectively denote by the expression "rule of thumb" is the only rule followed in the greater part of cementation establishments.

Now, while this might have been justified, a few years back, by the lack of precise scientific data on the process of the carburization of iron or steel, this is no longer so, since numerous investigations which have been carried out have furnished abundantly the information necessary to carry out any cementation under the simplest and most easily controlled conditions, with less expensive materials, and in such a way as to obtain, certainly and logically, exactly predetermined results. It would therefore be desirable, since it is now possible and even easy, that cementation establishments should begin to use only cements whose composition and manner of acting are known exactly, and that the persons who direct them should realize that it is very easy to prepare for themselves cements which are much more simple, efficacious and certain—and, above all, by far much less expensive—than those which they now buy at very high prices without knowing even approximately what is concealed under the mysterious names which dealers in cement powders usually give to their humble products.

I believe that such an evolution can and must soon come to pass as, for example, that which has almost completely stopped the very lucrative trade in those mysterious powders which, thrown in small quantities into the molten steel, before casting, were supposed to relieve the steel founder of all his ills.

It has seemed to me that, to facilitate such an evolution (at least in small part) I could usefully contribute a résumé of the results to which the scientific investigations carried out on the process of the cementation have led.

Of the criteria which I have thought fit to observe in the compilation of such a résumé I will say here, to prevent any one from seeking in this volume that which I have not thought I could include, that it is neither an organic or systematic treatise on the physico-chemical theory on which the study of cementation may be based nor a recipe book intended to reveal the secrets of the dealers in cement powders.

In the first part of this volume I have tried to summarize the results of the scientific investigations carried out up to the present on the process of the cementation.

Many of the fundamental questions—especially theoretical—regarding

cementation have not yet been completely, certainly, and definitely solved, so that, for a useful practical application of the researches carried out up to the present, a few synthetic rules are not enough, but we must also take into account a large number of data which are insufficient (because they are not sufficiently coordinated experimentally) to constitute complete and organic theories.¹ It follows that, lacking the possibility of collecting systematically the data thus far acquired so as to establish well-defined theories, and it being necessary, on the other hand, to summarize *all* these data, the chronological order had to be followed in this first part of the treatise.

I have thought it well, however, to show—in the fifth chapter of the first part—how the data collected in the first chapters, besides constituting a most useful basis for the rational technical application of the processes studied, can even now be gathered logically into groups in such a way that, without being adequate to furnish the material for satisfactory theories, sufficient conclusions can be drawn from them to clear up many of the more important theoretical questions and to point out clearly the surest and shortest way for further studies and researches.

In this first part I have tried to collect all the data at present at our disposal for the rational technical application of the processes of cementation, data which should already be amply sufficient to emancipate workers in this art from the purchase of cementation powders of unknown composition.

The necessity of avoiding long digressions has constrained me to presuppose in the reader a sufficient knowledge of metallography and metallurgical chemistry.

In the second part of the volume I have tried to bring together some examples of the means to which recourse may be had to realize in practice the conditions which the data in the first part indicate as being best suited, in any given case, to obtain a predetermined result, and of the means for controlling the results obtained.

I repeat, however, that the rules for carrying out the cementation proper in such a way as to obtain given results are those contained in the first part of the volume.

In the choice of examples of apparatus and of technical processes cited in the second part, I have tried to limit myself, as far as possible, to those forms of apparatus and to those processes which I have had occasion to use and study personally.

¹ Among the many examples which might be cited to prove the justice of this assertion, I will mention only the aggregate of experimental data relating to the phenomena of oxidation which under certain definite conditions accompany the carburizing action exercised by carbon monoxide on chrome steels and the rules which enable us to establish the conditions under which such phenomena do not take place. I will mention also the aggregate of the data on which are founded the rules for obtaining predetermined concentrations of carbon in the cemented zones, working with mixtures of carbon monoxide and hydrocarbons.

TRANSLATOR'S PREFACE

When Dr. Giolitti's work appeared in Italian, in 1912, it was clear to metallurgists that this was an epoch-making contribution to the literature of iron and steel. For several years the scientific papers on cementation coming from Prof. Giolitti's laboratory have been numerous and important, and his industry and brilliant investigations have practically cast new light upon the whole subject. While regretting that the author's commercial connections prevent him telling all he knows on several important questions, such as the carburization of armor plate, yet he has nevertheless made the industrial and scientific worlds his debtors by the vast amount of detailed information he has given with regard to the scientific investigation and control of cementation processes.

Regarding the translation, it may be remarked that the Italian language is much less direct than English, and that a nearly literal translation would have made tedious reading. Without entirely deviating from the form of the original, we have striven to render the sense and the ideas in the nearest acceptable English form. Professor Richards is responsible for the metallurgical accuracy of the translation, while Dr. Rouillier shouldered the bulk of the task of rendering the original into English.

LEHIGH UNIVERSITY AND
JOHNS HOPKINS UNIVERSITY.
May 22, 1914.

JOSEPH W. RICHARDS.
A. ROUILLIER.

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