

**FIELD-BOOK FOR RAILROAD ENGINEERS:
CONTAINING FORMULÆ FOR LAYING OUT
CURVES, DETERMINING FROG ANGLES,
LEVELLING, CALCULATING EARTH-WORK,
ETC., ETC., TOGETHER WITH TABLES OF RADII,
ORDINATES, DEFLECTIONS, LONG CHORDS,
MAGNETIC VARIATION, ETC., ETC.**

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Field-Book for Railroad Engineers: Containing Formulæ for Laying out Curves, Determining Frog Angles, Levelling, Calculating Earth-Work, Etc., Etc., Together with Tables of Radii, Ordinates, Deflections, Long Chords, Magnetic Variation, Etc., Etc. by John B. Henck

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JOHN B. HENCK

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F I E L D - B O O K

F O R

R A I L R O A D E N G I N E E R S

FIELD-BOOK

FOR

RAILROAD ENGINEERS.

CONTAINING

FORMULÆ

FOR LAYING OUT CURVES, DETERMINING PROG ANGLES, LEVELLING,
CALCULATING EARTH-WORK, ETC., ETC.,

TOGETHER WITH

TABLES

OF RADII, ORDINATES, DEFLECTIONS, LONG CHORDS, MAGNETIC VARIA
TION, LOGARITHMS, LOGARITHMIC AND NATURAL SINES,
TANGENTS, ETC., ETC.

BY

JOHN B. HENCK, A.M.,
CIVIL ENGINEER.

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1871.

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P R E F A C E .

THE object of the present work is to supply a want very generally felt by Assistant Engineers on Railroads. Books of convenient form for use in the field, containing the ordinary logarithmic tables, are common enough; but a book combining with these tables others peculiar to railroad work, and especially the necessary formulæ for laying out curves, turnouts, crossings, &c., is yet a desideratum. These formulæ, after long disuse perhaps, the engineer is often called upon to apply at a moment's notice in the field, and he is, therefore, obliged to carry with him in manuscript such methods as he has been able to invent or collect, or resort to what has received the very appropriate name of "fudging." This the intelligent engineer always considers a reproach; and he will, therefore, it is hoped, receive with favor any attempt to make a resort to it inexcusable.

Besides supplying the want just alluded to, it was thought that some improvements upon former methods might be made, and some entirely new methods introduced. Among the processes believed to be original may be specified those in §§ 41 - 48, on Compound Curves, in Chapter II., on Parabolic Curves, in §§ 106 - 109, on Vertical Curves, and in the article on Excavation and Embankment. It is

but just to add, that a great part of what is said on Reversed Curves, Turnouts, and Crossings, and most of the Miscellaneous Problems, are the result of original investigations. In the remaining portions, also, many simplifications have been made. In all parts the object has been to reduce the operation necessary in the field to a single process, indicated by a formula standing on a line by itself, and distinguished by a \square . This could not be done in all cases, as will be readily seen on examination. Certain preliminary steps were sometimes necessary, and these, whenever it was practicable, have been indicated by *words in italics*.

Of the methods given for Compound Curves, that in § 46 will be found particularly useful, from the great variety of applications of which it is susceptible.

Methods of laying out Parabolic Curves are here given, that those so disposed may test their reputed advantages. Two things are certainly in their favor; they are adapted to unequal as well as equal tangents, and their curvature generally decreases towards both extremities, thus making the transition to and from a straight line easier. Some labor has been given to devising convenient ways of laying out these curves. The method of determining the radius of curvature at certain points is believed to be entirely new. Better processes, however, may already exist, particularly in France, where these curves are said to be in general use.

The mode of calculating Excavation and Embankment here presented, will, it is thought, be found at least as simple and expeditious as those commonly used, with the advantage over most of them in point of accuracy. The usual Tables of Excavation and Embankment have been omitted. To include all the varieties of slope, width of road-bed, and depth of cutting, they must be of great extent, and unfitted

for a field-book. Even then they apply only to ground whose cross-section is level, though often used in a manner shown to be erroneous in § 128. When the cross-section of the ground is level, the place of the tables is supplied by the formula of § 119, and when several sections are calculated together, as is usually the case, and the work is arranged in tabular form, as in § 120, the calculation is believed to be at least as short as by the most extended tables. The correction in excavation on curves (§ 129) is not known to have been introduced elsewhere.

In a work of this kind, brevity is an essential feature. The form of "Problem" and "Solution" has, therefore, been adopted, as presenting most concisely the thing to be done and the manner of doing it. Every solution, however, carries with it a demonstration, which is deemed an equally essential feature. These demonstrations, with a few unavoidable exceptions, principally in Chapter II., presuppose a knowledge of nothing beyond Algebra, Geometry, and Trigonometry. The result is in general expressed by an algebraic formula, and not in words. Those familiar with algebraic symbols need not be told how much more intelligible and quickly apprehended a process becomes when thus expressed. Those not familiar with these symbols should lose no time in acquiring the ready use of a language so direct and expressive. It may be remarked that it was no part of the author's design to furnish a collection of mere "rules," professing to require only an ability to read for their successful application. Rules can seldom be safely applied without a thorough understanding of the principles on which they rest, and such an understanding, in the present case, implies a knowledge of algebraic formulæ.

The tables here presented will, it is hoped, prove relia

ble. Those specially prepared for this work have been computed with great care. The values have in some cases been carried out farther than ordinary practice requires, in order that interpolated values may be obtained from them more accurately. *For the greater part of the material composing the Table of Magnetic Variation the author is indebted to Professor Bache, whose distinguished ability in conducting the operations of the Coast Survey is equalled only by his desire to diffuse its results. The remaining tables have been carefully examined by comparing them with others of approved reputation for accuracy. Many errors have in this way been detected in some of the tables of corresponding extent in general use, particularly in the Table of Squares, Cubes, &c., and the Tables of Logarithmic and Natural Sines, Cosines, &c. The number of tables might have been greatly increased, but for an unwillingness to insert any thing not falling strictly within the plan of the work or not resting on sufficient authority.

J. B. H.

BOSTON, *February*, 1854.