
**A Manual of Field and Office Methods for the Use of
Students in Surveying**

Pence William David

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Author: Pence William David

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A MANUAL OF
FIELD AND OFFICE METHODS

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FOR THE USE OF

STUDENTS IN SURVEYING.

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PREFACE.

In preparing this manual the following points have been kept especially in view: (1) To provide a simple and comprehensive text designed to anticipate and supplement, rather than replace, the usual elaborate treatise. (2) To bring the student into immediate familiarity with approved surveying methods. (3) To cultivate the student's skill in the rare arts of keeping good field notes and making reliable calculations.

It is believed that the discussions of the different instruments, their use and theory, at the beginning of the several chapters is unusually simple, especially in the relations of the elementary lines.

The several series of practice problems at the conclusion of the respective chapters are arranged so as to give the student familiarity with the use of the instrument before taking up its theory and adjustments, this order being more effective than the reverse. The interest of the student may be stimulated and his gain in skill promoted by giving him practice with level and transit very early in the course, after which the scope of the work may be much more flexible both for student and instructor.

Since the list of problems is more extended than can be covered in the time usually available for surveying field practice, some range is permitted in the choice of work from year to year and under varying local conditions. By using some discrimination in selecting the more important problems for actual field work, the others may be covered sufficiently by class room discussions.

The consistent treatment of errors of surveying receives attention throughout the book. The methods of work both in the field and office are designed to reveal and, as far as possible, to eliminate blunders and errors, and the tests of precision are borrowed from the most rational current practice. The distribution of residual errors falling within the permissible limits likewise receives due consideration.

An important innovation in this manual is the liberal use of field note and other forms executed according to the standard required of the student in like work. The high

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PREFACE.

value of such samples in developing the student's skill in this important detail of field work has been well established. It will be seen that the forms are prescribed in liberal number in the earlier stages of the work while the student is engaged in fixing a standard of quality, but that farther on he is required more and more to devise his own forms. A valuable feature of this system is the liberal amount of practice obtained in freehand lettering which has marked effect on the drafting and other work.

It is suggested that the student should be trained to be self-reliant by requiring him to verify his own results before submitting them for criticism. Likewise he should be encouraged to be genuine by placing him on his honor.

This somewhat informal guide to field and office methods is issued primarily for the use of the authors' classes, but it is hoped that others as well may find it of value in presenting principles to the beginner, and in cultivating his spirit and manual skill.

September, 1901.

W. D. P.
M. S. K.

SPECIFICATIONS FOR A GOOD ENGINEER.

"A good engineer must be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment, must have command of his temper, must have courage to resist and repel attempts at intimidation, a firmness that is proof against solicitation, flattery or improper bias of any kind, must take an interest in his work, must be energetic, quick to decide, prompt to act, must be fair and impartial as a judge on the bench, must have experience in his work and in dealing with men, which implies some maturity of years, must have business habits and knowledge of accounts. Men who combine these qualities are not to be picked up every day. Still they can be found. But they are greatly in demand, and when found, they are worth their price; rather they are beyond price, and their value can not be estimated by dollars."—*Chief Engineer Starling's Report to the Mississippi Levee Commissioners.*

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CHAPTER I.

GENERAL INSTRUCTIONS.

FIELD WORK.

Habitual Correctness.—Habitual correctness is a duty. Error should be looked upon as *probable*, and every precaution taken to verify data and results. Unchecked work may always be regarded as doubtful. A discrepancy which is found by the maker in time to be corrected by him before any damage is done is not necessarily discreditable, provided the error is not repeated. However, *habitual error* is not only discreditable but dishonorable as well, and nothing except intentional dishonesty injures the reputation of the engineer more quickly or permanently.

Consistent Accuracy.—The degree of precision sought in the field measurements should be governed strictly by the dictates of common sense and experience. Due consideration of the purposes of the survey and of the time available will enable one to avoid extreme precision when ordinary care would suffice, or crudeness when exactness is required, or inconsistency between the degrees of precision observed in the several parts of the survey. It is a very common practice of beginners, and of many experienced engineers as well, to carry calculated results far beyond the consistent exactness.

Speed.—Cultivate the habit of doing the field work quickly as well as accurately. True skill involves both quantity and quality of results. However, while the habit of rapid work can and should be acquired, the speed attempted in any given problem should never be such as to cast doubt upon the results. Slowness due to laziness is intolerable.

Familiarity with Instructions.—The instructions for

the day's work should be read over carefully, and preliminary steps, such as the preparation of field note forms, should be taken so as to save time and make the work in the field as effective as possible. The ability and also the desire to understand and obey instructions are as essential as the skill to execute them.

Inferior Instruments.—Should a poor instrument or other equipment be assigned, a special effort should be made to secure excellent results. In actual practice, beginners often have to work with defective instruments, but they should never seek, nor are they permitted, to justify poor results by the character of the field equipment. The student should therefore welcome an occasional opportunity to secure practice with poor instruments.

Alternation of Duties.—The members of each party should alternate in discharging the several kinds of service involved in the field problems, unless otherwise instructed. Training in the subordinate positions is essential whether the beginner is to occupy them in actual practice or not, for intelligent direction of work demands thorough knowledge of all its details.

Field Practice Decorum.—The decorum of surveying field practice should conform reasonably to that observed in other laboratory work.

THE CARE OF FIELD EQUIPMENT.

RESPONSIBILITY.—The student is responsible for the proper use and safe return of all equipment. All cases of breakage, damage, loss or misplacement must be reported promptly. The equipment should be examined when assigned and a report made at once of any injury or deficiency found, so that responsibility may be properly fixed.

PRECAUTIONS.—Careful attention to the following practical suggestions will save needless wear to the equipment and reduce the danger of accidents to a minimum, besides adding to the quality and speed of the work.

Tripod.—Inspect the tripod legs and shoes. The leg is of the proper tightness if, when lifted to an elevated posi-