PRACTICAL EXERCISES IN PHYSICAL GEOGRAPHY

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Practical Exercises in Physical Geography by William Morris Davis

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BY

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PREFACE

The object of this Text and the accompanying Atlas is to provide in as compact a form as possible a series of disciplinary exercises which may be assigned as "laboratory work" in connection with any of the modern text-books on Physical Geography.

The need of such exercises is generally recognized. Experience has shown that a student may fail to acquire a clear understanding of the facts and problems of Physical Geography if they are presented only through the text of a printed page; and that even the ornamentation of the page by pertinent illustrations does not always suffice to ensure a full comprehension of essential points. The student's attention must be directed to and detained upon each feature of a complicated fact, each step of a large problem, in order that the facts and problems may reach his understanding and remain in his memory; hence the desirability of combining the performance of a series of systematic exercises with the study of a text.

The topics selected for the Exercises here presented are such as are treated in greater or less fullness in all modern text-books. The Exercises may be taken up in such order as the teacher shall determine: those on the atmosphere and the ocean may follow or precede those on the lands; those on the lands may be rearranged if desired, except that it is well to place Exercise I early in the series because of its many applications, and to place Exercises VII and VIII late in the series because of the greater detail of their problems.

The method recommended for performing the Exercises is stated in the General Instructions (pp. 1 and 2). It may be here added that it will be found useful to allow students to read the Text and to examine the Atlas in a preliminary study period, and thus to

construct mental answers and imaginary diagrams in preparation for oral answers in a recitation or for written and graphic answers in a laboratory period.

The Exercises are not divided into separate lessons; they are left like the chapters of a text-book, to be divided by the teacher according to the time assigned for laboratory work and to the advancement of the pupils. The Exercises are, moreover, planned so that they may be used for a shorter or a longer course, according to the time allotted to Physical Geography in a programme of studies. In a short course all the bracketed questions and sections may be omitted without lessening the continuity of the work. For still more abbreviation, written answers in the pupil's notebook may be replaced by oral answers recited in succession by different members of a class; but it is recommended that after such a recitation the teacher should indicate certain questions for which the answers should be carefully written by all members of the class in order to secure a clear understanding of the most important points.

The Exercises may be profitably extended through a longer course by requiring written answers, carefully phrased, for all questions in the Text. Additional questions, which every teacher will inevitably invent for himself as the work progresses, may be frequently introduced. Questions concerning opportunity for human settlement and movement, conditions of human occupations, etc., may be greatly increased. Some examples of such questions are given, as in Exercise V, §§ 3 and 12; but it has been necessary to exclude them, as a rule, in order to save space. Still further extension of a very profitable kind may be made by having the pupil draw temperature and pressure gradients and generalize wind movements on selected governmental weather maps, following the methods of Exercise XII; or by calling for the preparation of maps, in hachures or contours, of selected parts of the land forms shown in the block diagrams of the Atlas; or by assigning certain parts of selected topographical maps published by governmental surveys for careful description and explanation. But in all cases, whether the work

makes part of a long or of a short course, it is advised that minute accuracy is not to be expected in the answers to questions regarding distances, altitudes, and locations, and that, in general, the answers to questions should be simple rather than elaborate.

The plates in the Atlas on which the Exercises are largely based are in most cases ideal designs and not copies of actual occurrences; but the charts of mean temperatures, prevailing winds, and ocean currents are exceptions to this statement. The reason for giving ideal examples of weather maps and of land forms is, that only in this way can the systematic progress of teaching be secured. In the daily weather maps and on the large-scale topographical maps published by our governmental bureaus, the illustrations of typical features are nearly always complicated by the addition of irrelevant details, which are distracting to the beginner. Moreover, these official maps do not and should not attempt to emphasize certain typical features and to subordinate unessential details; they are prepared for adult experts; they must present the facts of nature in all the complications of their actual occurrence. But to use such maps in the first lessons on Physical Geography would be much the same as to use pages of actual accounts taken from the books of a large commercial establishment in the first lessons in arithmetic, and thus to introduce division, interest, addition, fractions, and so on, in the haphazard order of their daily occurrence in business, instead of in a well-arranged, systematic order appropriate for a beginner's study in school.

The author is, however, aware of various imperfections in the ideal diagrams of the Atlas. Effort was made to find a professional draftsman who would prepare thoroughly satisfactory drawings, but no one could be discovered who possessed at once a sufficient knowledge of the subject and a trained proficiency of handiwork. Among the shortcomings which a redrawing might lessen are certain errors of perspective in some of the block diagrams; some unintentional disagreement of scales among the successive members of a single series of diagrams; an insufficient depth in the gorge between lakes

A and *C*, in 17 2 (for manner of reference to Plates and Figures see p. 1), and a lack of expressive emphasis in the shading of the sea cliffs in 35 1. It is hoped that these subordinate defects will not seriously interfere with the usefulness of the diagrams for the purposes of teaching.

The importance of associating actual phenomena, as they occur in nature, with the ideal types given in the Atlas is fully recognized. A step towards such association is made by introducing in Plates 35-39 a number of maps, reproduced with more or less simplification from parts of selected topographical sheets of different areas in the United States, published by the National Geological Survey (see explanation of plates, page 3 of Atlas), and by calling for the location of these actual examples, as well as of a number of other examples indicated by name in the Text, on the outline maps of the United States and the continents, Plates 40-45. All these actual examples should be carefully learned by name and location in order to give reality to the Exercises. Just as the condensed statements of a text-book should be elaborated by the teacher and illustrated by the exhibition of appropriate maps, pictures, and specimens, so this Text and its Atlas may be profitably supplemented by the exhibition of selected weather maps, published by the Weather Bureau, Department of Agriculture; by the study of full-sized topographical maps published by various governmental bureaus; and by the examination of such photographs and lantern slides as may be available to illustrate the problems in hand. If experimental illustrations of the formation of valleys, deltas, shore cliffs, volcanoes, etc., can be given in what has been called the "wet laboratory," following the suggestions that have recently been made by some expert teachers, so much the better.

Field excursions are also to be strongly recommended as a means of giving reality to problems that might otherwise be regarded as abstractions. It is particularly urged that the Exercises here presented should not be taken to replace field excursions; but rather that the principles illustrated in the Exercises should, as far as

possible, be given additional illustration by systematic excursions in the school district. It is in connection with such excursions that the teacher may to best advantage first teach something of different kinds of rocks, taken from their actual outcrops and selected to illustrate varying degrees of resistance to weathering. Alluvial deposits of gravel, sand, and clay should also be examined in field study. Similarly, local weather observations should be undertaken for the determination of temperatures, wind directions, changes from clear to cloudy sky, rainfall, and so on. It will be of decided advantage if the chief facts concerning the sun's seasonal change of altitude and the associated changes in the points of sunrise and sunset, and of the length of day and night, can be introduced in an earlier year than the one in which these Exercises are studied. If this is not conveniently possible, then the most important observations on the sun, as referred to in Exercise X, §§ 4, 5, should be made while the Exercises on land forms are studied; and the Exercises on the atmosphere should come near the close of the year.

It would truly be vastly better if, in the study of land forms, actual examples of all typical features could be made the subject of systematic observation and description in the field by every pupil, and if in the study of the temperatures, winds, and ocean currents of different parts of the world, the class could visit the regions where the actual phenomena are observable; but this is manifestly impossible. Even the most favored school district does not include a complete and well-ordered series of all the different kinds of land forms which every student of Physical Geography should learn to know; indeed, such forms as it includes are often imperfect or complicated examples of their kind, and it is not always possible for a class to visit them on the day and hour when they are reached in the regular progress of class work. Hence the necessity of presenting the facts of our science largely through descriptions and imitative illustrations. Nevertheless, so great is the power of the constructive imagination on the part of young students that no serious difficulty should be found in giving sufficient reality to the charts

of temperatures, winds, and currents, which graphically represent average values of observed phenomena in Exercises X, XI, and XIII; or to block diagrams such as illustrate the series of volcanic forms in Exercise VI; or to maps such as illustrate the series of shore-line forms in Exercise IX.

It is believed that great progress can be made when imitative ideal illustrations are used as the basis of practical work under the direction of a good teacher and in association with an appropriate text-book. It goes without saying that, as already noted above, supplementary illustrations are useful and helpful; but the effort has been made to provide so much of the essential material in this Text and its Atlas that the labor of the teacher in supplementing it shall be as light as possible. The careful performance of the Exercises will lead the pupil to observe, to describe, and to generalize; to make inferences, to invent explanations, and to test theories; to express new ideas verbally and graphically. If the teacher is patient and does not infringe too often on the pupil's right of discovery, the pupil may make so much progress in these various processes, and at the same time acquire so good a knowledge of a great group of natural phenomena, that he will really be led to make a beginning in the formation of scientific habits of thought.

The value of practical exercises in association with text-book lessons may be illustrated by comparing the impression made upon a student by the study of the important generalization, found ready-made on a printed page, concerning the slopes of rivers and the accordant junctions of branch and main streams, with the impression made upon him by having to develop the generalization himself on the basis of a diagram of river profiles that he has constructed with his own hands, as in Exercise I, § 4. There can be little question that the reality of the facts involved, and the truth of the generalization that represents the relations of the facts, are best apprehended through practical exercises; but at the same time it may well be that the wording of the generalization is not so clearly given in the student's notebook as in the text-book, where it should