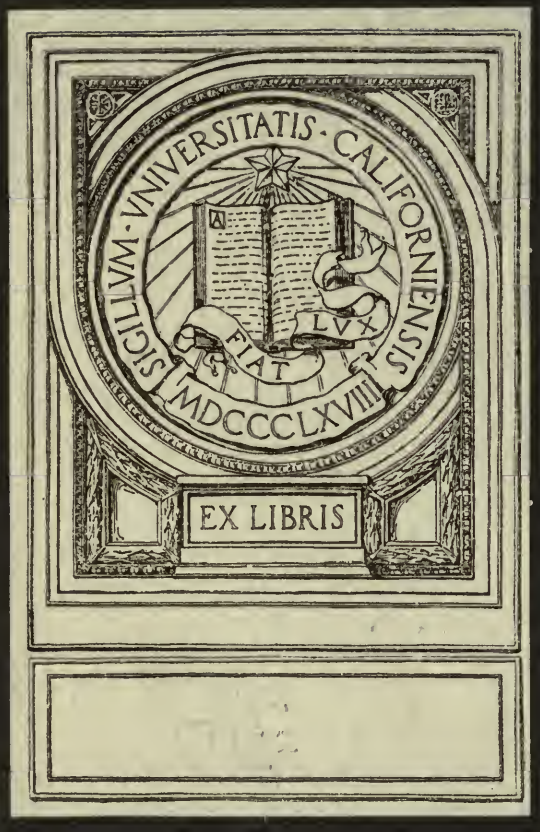
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A GUIDE FOR

LABORATORY GEOGRAPHY TEACHING

BY

O. D. VON ENGELN, PH. D.

ASSISTANT PROFESSOR IN THE DEPARTMENT OF PHYSICAL GEOGRAPHY AT CORNELL UNIVERSITY

FOR USE IN CONNECTION WITH

A LABORATORY MANUAL OF PHYSICAL AND COMMERCIAL GEOGRAPHY

BY

THE LATE PROFESSOR R. S. TARR

AND

O. D. VON ENGELN, PH. D.

New York

THE MACMILLAN COMPANY

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CONTENTS

A GUIDE FOR LABORATORY GEOGRAPHY TEACHING

INTRODUCTION

Objections to the Introduction of Laboratory Geography Instruction.—In schools where laboratory instruction in geography has never been given, a proposal for its introduction is often met by two pertinent queries, (a) Why? and (b) How?

In schools where such instruction is given, there is usually a demand, corresponding in a sense to the "why?" query, that such instruction be made more effective, more vital to the needs of the pupils and more interesting in the class room. Moreover the question "how?" is often almost as urgent in such schools as in those where laboratory geography instruction has never been attempted.

Lack of Training on Part of Teachers and Defects of Earlier Texts.—The reason for this latter difficulty is, in many instances, readily explained. The teacher has had little or no specific training in geography. Therefore, the laboratory texts, heretofore available, dealing largely with problems of technical geography have contained little that is at once interesting, suggestive, and intelligible to the teacher. Consequently, the exercises are taught half heartedly, with no originality and with no definite purpose or clearness.

Aim of the Tarr and von Engeln Manual.—It has been the aim of the authors of the Laboratory Manual, for which these pages are to serve as a teacher's guide, to produce a text which would in itself constitute a definite answer to both the "why" and the "how" queries. In other words, first, to make the purpose of each exercise so definite, concrete and practical, as to leave no doubt in the mind of either the student or the teacher as to its value from the practical, cultural and pedagogical viewpoints. Second, to provide instruction of such content and manner that its purport and method will be clear to the teacher who has not had previous training in laboratory geography; and to provide this instruction in such a form as will most facilitate the mechanical routine of class work.

Purpose and Content of this Guide.—The purpose and content of this pamphlet is, therefore: (1) to point out why laboratory geography should be taught, and on which phases of the subject the emphasis should be put; (2) to indicate how it should be taught; and (3) to give practical and particular suggestions for teaching with the Laboratory Manual, to the use of which it is a guide.

"WHY?" OR THE VALUE OF LABORATORY GEOGRAPHY TEACHING AND ITS APPLICABILITY TO VARIOUS PHASES OF THE SUBJECT

The Emphasis put on Regional Geography in the Grammar Schools.—In the lower schools the regional side of geography receives the greatest emphasis. So much time is required to give a comprehensive drill on the location and distribution of natural and cultural features, and the memorizing of place names, that only a beginning can be made in teaching the subject from the "explanatory" side, to use a simple comprehensive term. Moreover, the immaturity of the students makes it impossible to convey to their understanding the larger concepts of the subject. Only a few gain even so much knowledge of latitude and longitude as will serve for an accurate interpretation of a map.

Nature and Content of Advanced Geography Texts.—The more advanced texts endeavor to meet these needs. In general such texts are of two kinds, Physical Geographies and Commercial Geographies. In both classes of texts first consideration is given by most

modern authors to the development of the explanatory aspects of geography. Usually, also, the more difficult space concepts, natural geographic regions, and climatic relationships are quite fully developed. In some physical geographies study has been centered too exclusively on the systematic development of land forms. In commercial geographies the subject matter may consist too largely of the facts and statistics of production. Aside from these general defects, however, both types of text are well adapted to the requirements of more advanced study in geography, as indicated above, in that they dwell on the causal factors. In Professor Tarr's "New Physical Geography" the principles of physical geography are clearly enunciated and the human relations are much more extensively developed than in other books of its kind. Therefore, such references as are given in the text of the present Laboratory Manual are to pages in this volume. It needs only the consulting of an index, however, to adapt these references to almost any modern text of either physical or commercial geography.

Inadequacy of Text Book Study alone and Function of Laboratory Study.—But a personal and intimate knowledge and appreciation of geographical facts and relationships *can not be gained from text book study alone*, whether of physical geography or commercial geography. To know geography the student must himself work with the materials of geography. He must be trained to make independent geographic observations and deductions. To give such training is the purpose and the function of geography laboratories and geography manuals.

Practicability of Laboratory Geography Instruction.—The truth of the statements and conclusions of the foregoing paragraph will probably gain a ready assent from everyone interested. But to gain, or hold, a place in the curriculum of many schools, laboratory study in geography must satisfy another requirement, which may be put in the form of a double question: Is such training distinctly essential to the average student; and can it be made both practical and interesting without elaborate equipment and specially trained teachers?

The first part of the question involves two factors, (a) how closely such training meets the needs of the everyday future life of the majority of students, and (b) whether it possesses educational value greater than that of other subjects that it may displace. In other words, is such training preëminently practical (useful) and does it provide a superior kind of mental culture?

Laboratory Instruction in Geography Essential to Good Citizenship.—It is not difficult to answer these questions. A laboratory study of geography will give the general student a background and basis for intelligent future reading of current events in newspapers and magazines. It will enable him in business life to appreciate the routes, tendencies and opportunities of commerce. It will give the agriculturalist a broad knowledge of the conditions for crop production in areas outside the sphere of his own activities. It will give the future engineer information concerning the structure, forces and processes of nature, which will enable him intelligently to utilize or cope with her various conditions. That the laboratory study of geography has an intense human interest can not, therefore, be denied. This human interest appertains, in a certain measure, also, to mere textbook study of geography of the advanced sort. On the other hand, laboratory instruction in geography specifically compels a training in observation and deduction in exactly those things that constitute the immediate and ever present environment of every human being. Lack of accurate observation has been said to be at once the mark and the curse of American student habit; and this lack is necessarily accompanied by an almost complete non-use of the deductive faculties. Laboratory instruction in other subjects besides geography may be directed toward overcoming these deficiencies of American education; but in no other case can it apply so broadly to the whole future life work of the student as *to that study which teaches him to observe the phenomena of the world in which he lives, and to reason on the controlling factors of his own environment.*

Elaborate Equipment not Essential.—We may revert next to the second part of the original question: Can such training be made both practical and interesting to the average

student without elaborately equipped laboratories and specially trained teachers? It can. Laboratory geography manuals and laboratory geography teaching in general, have, in the past, suffered from *two defects; incoherent and unsystematic presentation of the various topics,* and the requirement of too much time on the part of both the student and the teacher in mastering the mechanical routine and technical detail of the experiments and exercises available. No small part of the latter was *the necessity of rewriting the questions set in the manuals* and their incorporation in the answers in order that these answers might be intelligible.

Furthermore, the exercises of previous manuals are largely devoted to experiments in earth physics and earth chemistry, and to a study of the systematic development of land forms. These things lack human interest, often demand expensive apparatus in the school, and laboratory technique of a special kind of the teacher. It is easy to see why such work is commonly distasteful and irksome to the student, and why some schools and teachers hesitate, or find it impossible, to attempt such instruction.

The Average Teacher Competent to give Laboratory Instruction with the Tarr and von Engeln Manual.—In the present manual all these defects and difficulties have been met. The determining factor in the question of incorporating or excluding an exercise, or planning its content, has been the strength of its human interest, the "everydayness" of its application to the affairs of the ordinary citizen. Thus the knowledge gained is practical in the best sense of the word and *the interest of the student is always keen.* The exercises follow one another in a logical order and are systematically grouped under appropriate general topics. Yet, as occasion demands, exercises may be omitted, without destroying the sequence; and it is extremely easy for capable and enthusiastic teachers to change the order of the exercises, to add other material of their own devising, to infuse the work, generally, with the spirit of their own personalities. On the other hand, the directions accompanying the exercises are so explicit, that with the help of this guide, *any teacher capable of presenting an advanced text in geography, can also, with facility, conduct the laboratory work outlined in the manual.*

Cost of Equipment a Negligible Factor.—*The cost in equipment* needed by the pupil and the school *has been reduced to an extremely low minimum,* as will be seen on consulting the list of required material given in this guide, so low, in fact, as to be a negligible factor. The mechanical make-up of the manual is such that only a small fraction of the student's time is required for setting down results. By far the major part of his effort is directed to getting the results—to training in observation and deduction. *The work thus becomes distinctly laboratory work and not essay writing under the delusion that laboratory work is being done.*

Laboratory geography teaching, therefore, as outlined above, is practical, it develops the explanatory side of the subject, has a wide human interest, gives a superior and consistent training in observation and deduction, costs little to introduce in the school and requires no special training of the teacher.

"HOW?" OR THE CONTENT, MAKE-UP AND SPECIFIC METHODS OF A LABORATORY GEOGRAPHY MANUAL CONFORMING TO THE REQUIREMENTS INDICATED.

Content of the Manual.—The value of any school course depends primarily on its content, and after that on the method of its presentation.

The Exercises of the present manual are grouped under six heads:

The World as a Whole
Minerals, Rocks and Soil
Making and Interpretation of Topographic Maps
Physiography of the Lands
The Ocean
The Atmosphere

Development of a Geographic Consciousness in the Student.—In the section on the World as a Whole, the fundamental concepts of the form, size and movements of the earth, of direction and location, are made realities to the student, by proposing problems in them the solving of which is within the scope of his intellectual development. The student is also led to appreciate the ways and means of giving concrete expression and representation in miniature to concepts which are world-wide in their extension. From a good map there may be gleaned in a few minutes a multitude of facts and relationships, the presentation of which in words would require many pages. *Therefore, expertness and sureness in map reading, and a knowledge of the possibilities and limitations of map making, are first essentials to the development of a geographic consciousness.* And to know maps one must work with maps; a glance at them as illustrations in the pages of a textbook helps little. The atlas habit, acquired by a real knowledge of maps, is a mark of the successful man of affairs. In this respect the Germans, as a nation, are much in advance of us. The teacher should be sure to read Mr. Cyrus C. Adams' article in Harper's Magazine for January, 1912, p. 237, entitled: Maps and Map-Making.

Intimate Relation of Human Life to the Composition of the Earth.—The second section is devoted to Minerals, Rocks and Soil. The food we eat and the clothes we wear both have their origin in the soil. This, in turn, is derived from the solid rock which, at varying depths, everywhere underlies the soil. An appreciation of the activities of man and the natural conditions that control and direct his industries and manufactures, calls for a first hand acquaintance with the raw materials making up the structure of the earth. It so happens that *a comparatively few substances make up the great bulk of the earth's mass*, and a comparatively few ores, again, are of basic importance to industry. Every intelligent person should know, at least, these several substances of the inorganic world.

The Significance of "Scenery."—The exercises in the section on The Physiography of the Lands have a particular importance in the content of a laboratory geography manual.

Not many years ago the form and features of the earth's surface were simply "scenery," which existed in men's minds without reason or order. But, *in modern geography, scenery has been systematized*, and it is found that each hill and each valley and the broad plains have, one and all, a significance and life history of their own. The occurrences and characteristics of each type furnish clues to its past and indications of its future. Scenery is not distributed haphazard, nor are its individual forms of isolated occurrence. In readily distinguishable belts and areas, the landscape is made up of associated and related features.

Such areas and belts constitute physiographic provinces, and the boundaries of such provinces have far more influence in setting apart the various activities of men than have the boundaries of states or nations. Indeed, if a national boundary be not also of physiographic significance, it has little hope of permanence, as history has repeatedly shown. Of such physiographic provinces the United States has many types; they range over nearly the whole field of possibility. For a correct understanding of the geography of the United States, *a knowledge of these provinces, their extent, location, and characteristics, is, therefore, of much greater fundamental importance to the student than is a knowledge of state boundaries and state groups.* As the physiographic provinces vary, the pursuits, occupations and interests of men vary; and from this variation comes sectionalism as opposed to nationalism. What more significant field for study, then, than that in which facts and relationships are vital to the past, present and future integrity of the nation?

This section, therefore, (a) brings the various phenomena of the physical geography of the lands into intimate association with the regional geography background of which the student has acquired a general knowledge in the elementary schools, and (b) enables the student to see the close relationship between physiographic conditions and human activities; in other words, how man responds to his environment.

The Ocean as a Highway of Commerce.—In the section on The Ocean, also, emphasis has been put on the human relationships. *For our civilization is conditioned by oceanic phenomena in almost as great a degree as by the configuration of the land.* Civilization hinges

in large measure on transportation possibilities, and the ocean in modern times has become the great highway of commerce. Furthermore, climate is perhaps less modified by latitude than by the position, character and flow of ocean currents. For this reason it is entirely appropriate that some study of oceanic conditions be included, even though the school be remote from any coast. In many of the other exercises, also, the influence of the oceans and coast lines is touched upon, so that this section serves to amplify observations and deductions made before and after this topic is taken up.

Our Great Interest in the Weather.—The final section is devoted to The Atmosphere, and includes also a summary study of the climatic and other conditions which fix areal limitations on organic life. To indicate the significance in daily life of a knowledge of atmospheric phenomena, attention need only be called to the fact that our most common and casual conversations are given over to weather discussions. *Yet how exceptional is the person who can discuss the topic intelligently or interpret even the large facts of the daily weather maps which a national bureau sends, broadcast, over the country.* In a city environment, moreover, atmospheric phenomena are often the only tangible natural manifestations, within the ken of the student, on which the activities of men have not put a permanent mark. It is only natural, therefore, that a large part of laboratory geography study in large cities is devoted to acquiring a knowledge of the causes and consequences of atmospheric disturbances. Ample consideration is, therefore, given, in the present manual, to exercises which will promote an intelligent understanding of sunshine and precipitation, winds, temperature, and climate.

Make-Up and Specific Teaching Method of the Manual.—The manual is supplied to pupils in two distinct bindings. The inner volume is bound into the outer cover with brass staples. The teacher should note that these are passed through the folds of the cover *from the back side to the front,* and should direct students to use this method in rebinding completed exercises.

On beginning work the student should be directed to remove the inner volume from the outer cover, preserving the brass staples.

The inner volume should then be opened at the beginning of the exercise to which the period is to be devoted. The pages of this exercise are to be carefully torn out along the line of perforations, near the binding edge. (Use a ruler edge as a guide in tearing). Then the inner volume may be laid aside for the time being. The loose sheets of the desired exercise are thus freely available for the student's use without encumbrance by the bulk of the rest of the manual.

At the head of each exercise is a title, a list of the materials required and a specific statement as to the purpose of the study. This last is often supplemented by an introductory statement. *Thus there can be no haziness in the student's mind as to the nature of the work about to be attempted.*

The feature which will first attract attention is the leaving of space after each question in which the student is to write the answer. This serves a double purpose. It insures the student's following the argument of the outline and his appreciation of every point by personal observation and deduction. In the second place this plan very materially lightens the labor of the overworked science teacher in inspecting the work of students. *There is a place for every answer and every answer should be in its place.* Any incompleteness is readily detected, as is also the correctness of the student's interpretations. Furthermore, the time of the student is conserved for the actual observations, inasmuch as there is no need for the laborious rewriting of questions in order to make the disconnected answers coherent. Additional material presented by the teacher may easily be inserted after any exercise; accordingly, the exercises may vary considerably in different localities to insure a fuller understanding of local conditions.

Completeness of the Manual.—Another feature which we feel sure will meet with general approval is *the insertion of all maps, figures, diagrams, and tables needed, in the pages of the manual,* and in most cases at the exact place where they are to be used. An ample supply of cross-section paper is included at the back of the volume.

By allowing a space for the pupil's answer, and by providing a protractor, spaces for drawing and cross-section paper, much expense ordinarily attached to a laboratory study is saved the pupil; for *the manual is at once a manual, a note book and equipment for study.*

After the student has completed the first exercise assigned, he is to remove one of the Index pages at the front of the volume, fill in the title of the exercise and the date at which it was completed, and then bind this page with the pages of the exercise, in their proper order, in the outside cover furnished with the manual, using the brass staples provided. Thus completed and bound, the exercise is to be handed to the teacher for inspection, correction, and marking. Succeeding exercises are to be similarly indexed, and bound with the first one. *Thus the teacher is only required to lift and handle the bulk of the completed exercises* instead of the total weight of all the manuals used by the class, as is the case with many other laboratory texts.

Provision for the Introduction of Original and Supplemental Material.—*It is not expected that any one class will have time to complete all the exercises of the manual.* The teacher should make a judicious choice, selecting those which best fit in with the requirements of the State Syllabus, if one is issued; as in such instructions special emphasis is usually put on subjects which have the greatest local interest. Where no syllabus is published, the local interest, or the teacher's own special interests in the subject should be given preference. It will probably be wise in many cases to supplement exercises on certain topics by others of the teacher's own devising. The pages of the manual are punched to conform with that of the regulation 8″ x 10″ loose leaf, note book paper, in general use throughout the country. This makes it very feasible to introduce additional material.

Logical Sequence of Topics and Flexibility of the Manual.—The exercises follow each other in a logical order. They permit, however, (a) transposition of the larger sections, i. e., The Atmosphere and The Ocean may be studied before the Physiography of the Lands is taken up; and (b), in most places the omission of exercises with no essential loss of sequence.

It is not intended that each exercise should constitute the work of a single period. The length of periods varies in different schools. In certain exercises it may be advantageous to permit students to do part of the work at other than the regular class period. The average exercise will require about one and one half hours time for completion. Some are shorter, others are longer. *The object in view in planning them has not been to conform to any specific time period, but to teach each topic systematically and convincingly.*

Require the students to tear out the sheets of the exercises only as directed by you. To write neatly, with ink. To write answers as complete phrases or sentences, except where a simple yes or no, or a clear abbreviation will suffice. To answer the questions and do the work required in the sequence of the exercise. To bind each completed exercise in the cover provided, and index it with date of completion. To hand in the completed bound exercises periodically for your inspection, criticism and correction.

Require the student, after having a completed and corrected exercise returned to him, to review its content—Purpose, Questions, Answers and Diagrams, in order that he may get a definite concept of the purport of the whole.

SUGGESTIONS IN REGARD TO THE DIFFERENT TOPICS AND PARTICULAR EXERCISES.

The Earth as a Whole. Exercise I.—Shape and Size of the Earth. An apple slightly flattened at the stem and bud areas, whose surface is otherwise fairly spherical, is the most readily available object which will give students a definite conception of the form of an oblate spheroid. Their attention may, also, be incidentally called to the fact that there is an analogy between the hollows and other irregularities on the surface of the apple and the earth's surface with its continents, mountains and ocean basins.

If the school is situated near a large body of water, the curvature of the earth's surface may be convincingly demonstrated by the use of a field glass. Only the rigging of a distant ship is visible. Focus the glass on the rigging. When this is sharp and clear in the field

glass, lower the glass to the line of the water surface where this crosses the ship, and it will be noted that this line and the adjacent sea surface are out of focus. Focus on the line of the water surface, and then the ship's rigging will be out of focus. This is explained by the fact that the line of the water surface, which cuts the lower parts of the ship from view, is located at a point somewhere near half way (depending on the elevation of the observer's viewpoint above sea level) the distance between the observer and the ship. This experiment is also possible on some parts of the level Dakota plains.

Exercise II.—World Maps. This exercise is important because so few students have a definite conception as to the significance of the scale of a map. As a class room demonstration it is worth while to have a map of Europe and one of the United States of the same actual size of sheet, and contrast these maps with maps of each of these areas on the same scale. A good school globe serves even better for this latter purpose.

Exercise III.—Map Construction. If possible supplement the discussion of areal distortion on world maps, by obtaining some cheap world maps on different projections and cutting out from these certain countries. Then superimpose these cut outs on each other to demonstrate the distortion. The globe may be used to show the true shape. If maps sufficiently inexpensive to permit cutting up are not available, the same end may be attained by tracing the outlines of certain countries from wall maps of the world, or from maps in large atlases.

Exercise IV.—The Mercator Map. A large part of the value of work of this kind is in its teaching of accuracy and exactness. To insure this, students should have pencils of medium hardness and the teacher should insist on the pencils being sharply pointed. Rulers should be of good grade with fine scale divisions.

Exercise V.—Determination of Direction, of Latitude and Longitude. The teacher should secure a copy of W. E. Johnson's "Mathematical Geography", American Book Company. It is an inexpensive volume and contains many illuminating paragraphs on mathematical geography. It serves well as a volume for "outside reading" by members of the class while this subject is being taught, and for this purpose the school library may well possess a number of copies.

Among other things, devices are described which will give more accurate results in latitude and longitude determinations than the very simple apparatus utilized in the exercises. Several of these devices are simple enough to admit of construction and use by ingenious and enthusiastic teachers. A detailed discussion of necessary corrections to be applied to readings is also given.

The following construction will serve as a check on the determination of the N. and S. line by the shortest shadow. With your vertical rod as a center draw a circle with a radius approximately 3 times the height of the rod. At some time in the forenoon the end of the shadow will cross the circumference of the circle. Mark the point where it first just touches the circle. Do the same in the afternoon as the sun leaves the circle. Connect these two points by a straight line. This line will be due east and west and should cross your north and south line at exactly right angles.

Exercise VI.—Rotation and its Effects. Determine as nearly as possible the exact longitude of your school, especially if you are located at some distance to the east or west of the central meridians of the time belts.

Put special emphasis on the difference between the true, local time and the standard time in use, and the reason for the amount of difference. Call attention, also, to such possibilities as the printing of European news, in the local morning newspapers, of events which occur in the morning of the same day, possibly at the same apparent hour that the paper is being read.

In illuminating the globe arrange a shade over the source of light so that the rays come from one direction and are as nearly parallel as possible. Otherwise, it will be difficult to get sharply defined shadows. Pay especial attention to the purport of the "Notes to teacher" included in the text of the exercise.

Exercise VII.—The Seasons. In the second paragraph of this exercise a "Demonstration" by the teacher is called for. This consists in carrying a globe around a central source of light (to represent the sun), maintaining the axis of the globe at a constant inclination of $23\frac{1}{2}°$, and pointing in a constant direction, so that all positions of the axis are

parallel to each other. Carry the globe around in a *counter clockwise direction.* Special attention should be called to the Summer Solstice, Winter Solstice, Vernal Equinox and Autumnal Equinox positions.

In the latter part of the paragraph opposite the marginal topic "Summer Season", is a question—"Where will a shadow be longest when it is midsummer (June 21) in the northern hemisphere?" The answer is, Just to the north of the Antarctic Circle. At the Antarctic Circle the sun would theoretically be just on the horizon at midday, when it is midsummer in the northern hemisphere. Therefore, a shadow would be projected into space. Actually, refraction would "lift up" the sun enough so that a shadow would be cast on the earth to the south. However, just to the north of the Antarctic Circle would satisfy the question both practically and theoretically.

Summary.—*The subject of mathematical geography is difficult even when put in the simple terms of the above exercises.* Yet these phenomena play so great a part in governing the large and small concerns of all life that the teacher should *make a heroic effort* to impart to each student definite, clear-cut, conceptions of at least the few, fundamental facts given in these exercises on *The Earth as a Whole.* The paragraphs in smaller type may, however, well be omitted where time is limited; or where it is felt that the students are not sufficiently mature to profit by a longer study of these topics.

Minerals, Rocks and Soil. General.—This subject has a place in geography study in so far as it helps to an understanding of the materials composing the earth's outer shell, and their behavior under the various alteration processes to which they are subjected and the uses to which the substances, in bulk, are put by man. *An extensive treatment of individual mineral and rock species and types would not be apropos.* Therefore, only those substances which comprise a large proportion of the earth's surface material, and such as have had the greatest bearing on the human occupation of the land receive attention in this manual. In regions where mining or smelting is a dominant industry, it is suggested that in addition to the minerals used in the exercises, others, peculiar to the region, be studied, along the same lines. Additional blank pages may readily be inserted in the manual for a record of the student's study of such additional material.

Mineral Collections Made by Students.—The students should be encouraged to become thoroughly familiar with the different specimens by frequent handling of them. This is the only way in which a permanent, interesting acquaintance with them can be acquired. If possible permit the specimens to be carried home for further examination. Often students are willing to pay the cost of sets of small specimens as nuclei of personally owned collections. *The collecting habit is strong in youth* and the possession of a small set of representative specimens may lead to an extended, independent, personal study of minerals and rocks by some students. A copy of the volume Rocks and Rock Minerals by L. V. Pirsson, Wiley and Sons, Publishers, ought to be in the school library.

Exercises VIII, IX, X.—Minerals. During the study of these exercises the teacher should conduct a demonstration and experiments at the lecture desk, to illustrate crystallization from solutions. Make a saturated, hot solution of salt, in a glass beaker, suspend a cotton string in it and allow the solution to cool very slowly. Fairly large crystals should form. Cool a similar solution suddenly. The fine powder resulting illustrates the tendency to develop an amorphous mass. Evaporate, slowly, a cold solution of alum and salt and note the differences in the shapes of the crystals of the different substances. The chemistry teacher will no doubt be able to suggest and provide a little material for similar experiments; possibly with salts which will give more spectacular results than the common ones suggested above. From such visible demonstrations of crystallization the students will be able to carry the conception over into the larger realm of the mineral world.

Exercise X.—At the conclusion of this exercise, the teacher should distribute to each student three, or more, unnamed and unnumbered specimens and require the student to identify them. A written test is best, in which should be required reasons for the identification, what other minerals the specimen resembles, and how it can be distinguished from them.

Exercises XI, XII, XIII.—Rocks. *Perhaps the most generally practicable excursion*

for classes in laboratory geography is one to study minerals, and, more particularly, rocks, either in their natural outcrops or in structures erected by man. Such an excursion, moreover, evokes keen interest on the part of the class. Identification of the substances seen, uses to which they are put, their relative desirability, their local source, are some of the topics which may be taken up. Especially worth while is a study of the effects of weathering on different rocks. Weathering phenomena teach convincingly that the rocks of the earth's surface are constantly crumbling and that, therefore, the "eternal hills" are far from eternal. Unless one has prejudices, a cemetery, especially an old one, is a particularly favorable place to make such a study of weathering; as the dates on the headstones give fairly accurate data as to the time period the stones have been exposed. Quite a variety of rocks will be found.

Exercise XIV.—The Soil. This is one of the subjects of which a more extended study may be desirable; as e. g. in an agricultural district or with a class of students in agriculture. Suggestions for additional laboratory work along this line may be secured from Lyon and Fippin's volume entitled "The Principles of Soil Management" — Macmillan Company, 1909.

Making and Interpretation of Topographic Maps. Exercise XV.—Construction of an Areal Map. There should be available for use in this exercise a large rectangular table. Or there may be substituted a platform of boards laid on two carpenter's trestles. A basement room may be utilized, especially if it has a cemented floor. If the weather is suitable the exercise may well be conducted out of doors.

On the top of the table, or platform, an ideal land form of some topographic diversity should be modeled, of molder's sand, preferably, though sand, or a mixture of sand and clay, will serve the purpose.

Include a conical mountain (volcanic cone) occurring in a trough between two mountain ridges, whose average elevation is lower than that of the conical mountain. The conical mountain should rise some 12 to 18 inches above the level of the table top. The elevations and size of the other relief features should be proportioned to the size of this cone. Model the mountain ridges at one edge of the land form. From their inland face model a plateau-plain. Let this be slightly varied in feature by the introduction of slight escarpments, canyon valley trenches (near the mountains), open valleys, mesa forms, low hills, etc. As the table top represents the ocean level of the land form, fashion bays and capes where the plain meets the ocean level.

Give suggestive names to the more prominent points, features and areas. These names may be lettered on the wooden markers used by florists to label potted plants. It may help the realism to locate rivers, a city site, roads, railroads, etc. Avoid, however, attempting anything too elaborate for the time at your students' disposal. At best, it will be possible to locate only a few points accurately. From the location of these, others can be *sketched in*. Indeed, this corresponds to actual field mapping procedure. In every class there will be found a few students who take delight in such work as this, and who will devote extra time of their own to make their maps distinctive and individually complete. Such students should be encouraged, as a natural talent for a future life work may be given stimulus by such practice.

Encourage, also, such students as show a natural aptitude for lettering, to "print in" the various place names, etc., on the map. Let the others write them neatly, in small script.

If this exercise is omitted special stress should be laid in other parts of the work on teaching the reading of scale, orienting maps, etc.

Exercise XVI.—Construction of a Contour Map with Land Model. One of the blocks or boxes used in this exercise should be so much lower than the contour interval adopted, that, when the rectangular pointer is laid upon it, the tip of the pointer will be exactly the space of the contour interval above the platform. *If the room and materials for Exercise XV are not available, the following scheme may be substituted for Exercise XVI.* Use the blank sheet of paper preceding Exercise XV. Draw on the board an areal map essentially like Fig. 13 (Exercise XVII) of the manual, but omit the contour lines. In their place substitute figures giving the elevation of the land at a number of points in the area. Instead of one

inch, as in Fig. 13, call the contour interval one hundred feet, and assume the horizontal scale to be one foot to the mile, or whatever may seem most suitable. Do not give all the elevations in multiples of the contour interval, but put in some as 270 feet, 330 feet, etc. Have the students copy the areal map and these figures on the blank sheet of paper and then direct the drawing in of the contour lines. The horizontal scales of their maps will necessarily be reduced, and the contours they draw correspondingly more closely spaced. Most of the questions of Exercise XVI, as given, will be pertinent to this substitute plan also, and should be answered by the pupils.

Exercise XVII.—Making a Cross Section of a Contour Map. *The teacher who has not had experience in making such cross sections should very conscientiously study and complete this exercise, personally, before the class attempts it.* A second's demonstration of method, on some little point, will help a pupil more than pages of printed directions. Therefore, the teacher should be alive to the little technical details which make all the difference between characterless and admirable results.

Turn to the examples of cross sections reproduced at the back of this pamphlet, for suggestions as to details of finish, and require like neatness of completion on part of the students.

Physiography of the Lands. Exercise XIX.—Processes of Erosion and Deposition. To carry out this exercise a rather large sink (= a rectangular tank) should be available. One 3 x 4 feet is a minimum size, while one 8 feet square is very desirable. It should be lined with galvanized iron, and should be from 6 to 12 inches deep. An outlet for the water should be provided at the bottom, and others, at various depths, at one side, so that by the use of wooden plugs the water level can be held at a certain depth.

In this sink a land form of simple topography should be built up. On one side it should have a plain of considerable area sloping down gently into the water, and the whole form should be so built up that the drainage from its surface will almost all flow over this plain. Allow a considerable width of water in front of the plain, between it and the end of the sink, so that there may be room for the formation of a delta. Beyond the shore line, the front of the plain should slope off to the bottom of the sink with some steepness, but not fall off too abruptly, else too great an amount of material will need to be brought down by the streams before deltas can form typically.

The surface portion, 4 or 5 inches in thickness at least, of the land model, should be built of molder's sand and powdered clay in alternate layers. The powdered clay may be obtained from a pressed brick manufacturing plant. Have it shipped by freight if necessary. Have the clay layers quite thin, one half inch deep on the average, or even less.

Let there be some variety to the topography of the more elevated parts of the model. But do not attempt too great complexity. Shallow depressions on the plain surface will give rise to consequent lakes. If the clay layers are not sufficiently resistant to cause waterfalls, plaster of Paris in *extremely* thin layers, put on dry, over scattered areas, will give the desired result. Plaster of Paris may also be used to advantage, in combination with sand, to give firmness to the foundational parts of the model,—*preventing it from slumping where it extends under water.* As the model is being built sprinkle the layers with sufficient water to make them compactly moist.

Since the various processes will be in progress simultaneously, while the record of them needs to be made in sequence in the manual, it will be well to have the pupils read through the whole exercise before the experiment begins, so that they may be on the alert for the occurrence and progress of the various phenomena.

Let the spray have considerable volume, but let it be very fine, so that little or no direct blow is given by the water particles as they strike on the land surface. Distribute the pseudo rainfall primarily on the highlands of the model, but let a considerable portion fall, also, on the inner, plains area.

Further details about conducting such experiments as this will be found in an article by Tarr and von Engeln, Journal of Geography, Vol. VII, 1908, pp. 73–85. (Published at Madison, Wisconsin, by the University of Wisconsin).

Exercise XX.—Introduction to the Study of Land Forms. This is a recitation exer-

cise, and a thorough drilling in it will greatly enhance the value and the student's appreciation of the exercises which follow.

Physiographic Provinces and Human Occupation of the United States.—Exercises XXI to XXXIX, inclusive. These exercises constitute a laboratory study of the geography of the United States from a very broad viewpoint. The regional, physiographic, commercial and industrial aspects of the subject are all given attention. Physiography is made the structural basis of the study, inasmuch as it is foundational to the other phases, and largely conditions the general environment and activities of man. Specialized study of the development of land forms is avoided. It will be better to complete only a part of each one of these exercises than to omit any.

The teacher should have at hand a copy of "Forest Physiography" by Professor I. Bowman, Wiley and Sons, New York City, Publishers. In this are described in detail the various physiographic provinces of the United States. In fact a more descriptive title for this book would be "Physiographic Regions of the United States, with especial reference to their forest features." It will, therefore, serve as a reference volume for both teacher and students, and give the clue to answers for any questions whose purport may not be understood at once.

Briefly, the scheme of the exercises is this. The basis of the whole study is a series of carefully selected United States Geological Survey topographic maps. These have been chosen to show typical conditions in each of the larger physiographic provinces of the United States. The student accurately locates and outlines the position of each sheet on a map of the United States. Then he outlines, on the same map of the United States, the physiographic province of which the sheet shows typical conditions. By this device he gains a definite idea of the location and extent of the area under consideration. And what he learns later of the physiographic features, from a detailed study of the topographic sheet, has then a particular and direct meaning; for in his previous regional study of the states he has become familiar with these physiographic areas as political divisions.

Next, taking up the topographic sheet itself, he is led to consider, by a series of suggestive questions, the topographic features, the physiographic history, the climatic condition, and finally the human responses of the area, the last indicated by the cultural features. The answers required can almost all be simply and directly inferred and deduced from a study of the maps. The exercises are a supplement to, rather than a review of the text. *The student finds himself eager to see in what degree the physiographic and climatic conditions have affected or influenced the human occupation of the region.*

On the purely physiographic side, also, a distinct advance in pedagogical method has been achieved. *Instead of jumping from the study of a young river to, say, that of a volcanic cone,* as has been the case in other manuals, a systematic plan has been carried out. Young rivers are studied in connection with young plains, old rivers on old plains, and plains in turn are considered in successive stages in their cycle of development from youth to old age.

Only a few general suggestions need be made in regard to the teaching of these exercises. It will be found that students are able to go from one to the next without special instructions, as the directions given are clear and specific.

Reproduction of Cross Sections as an Aid to the Teacher.—*The teacher should himself answer all the questions of an exercise before assigning it to the class.* On succeeding pages of this Guide are reproduced the series of cross sections which are to be drawn. The students' productions may be compared with these for correction.

Use of Lantern Slides in Geography Instruction.—If lantern slides are available, pictures of the region studied may be thrown on the screen and a quiz recitation held. *In the opinion of the writer, this use of lantern slides, for this subject, is by far the best purpose which they serve in the schools.* In this particular topic it leads to a correlation between the conceptions gained by the students from their map studies of the different regions of the United States and the actual scenes as visible to the eye. Forests, for example, are not indicated on the maps. A livelier interest is aroused in the regions later studied, as there will be a striv-

ing on the part of each pupil to form in the mind's eye a true picture of the region, which he may later confirm or find incorrect when viewing the pictures on the screen.

Optional Use of a Relief Map of the United States.—Some teachers may wish to use the 18″ X 28″ Relief Map of the U. S., 1911 edition, for each student, in preference to the 18″ X 28″ Contour Map. The colors of the Relief Map interfere with the student's coloring of the physiographic provinces, but, on the other hand, they are a great aid in rapidly outlining these provinces on the map. A few of the Relief Maps should, in any case, be available for general class use.

Practical Details.—*Have a set of the topographic sheets that have been studied to date, hanging along the wall of the laboratory, arranged in the order in which they were taken up.*

A couple of rubber stamps printing "Vertical Scale" and "Horizontal Scale" will save the students labor in connection with the cross sections. The exercises are designed to put a premium on thinking and to reduce manual labor to a minimum.

Put three cross sections on a page of the cross-section paper. See examples in this Guide.

Impress upon the students that they are not to color the area on the map until directed in the text of the manual to do so. In coloring, hold the pencil loosely in the hand and color lightly. A heavier line of the same color may be run over the original outline (which should be made with black pencil) of the boundaries of the province.

Mounting Maps on Cloth.—The topographic sheets should be mounted on cloth to save wear and tear. This is a very simple process. Secure some thin muslin. Thoroughly wet it. Then spread it on a flat surface, preferably a smooth table top. Carefully smooth out all wrinkles and squeeze out surplus moisture. You have then a quite damp sheet of cloth closely and smoothly adhering to the table top. On this place, side by side, *face down*, as many of the topographic sheets as the area will allow. Now spread stiff, book-binder's paste uniformly over the whole of the back of one map. Then turn it over and rub it down firmly, from the center of the map outward, on the cloth. Repeat this with the other maps on the sheet. Allow them to dry. It will be found that sufficient paste has passed through the meshes of the cloth to make it adhere to the table top. This obviates the need of using thumb tacks to stretch the cloth. When dry the sheet of maps can readily be removed from the table by pulling up on one corner of the cloth. Then the maps should be neatly trimmed, using a sharp knife and straight edge.

The Ocean. Exercise XL.—Ocean Currents. Exercise XLI.—Tides. The consideration of the ocean has been curtailed to these two exercises for several reasons. A great majority of our schools are inland. Some other exercises which might profitably be introduced, where the local interests of the school are centered on the sea, would require a large amount of special material. Exercises on the oceanic topic of most general interest, oceanic routes of commerce, can readily be devised by the teacher of classes where special emphasis is placed on this subject.

Exercise XXXIX.—Coast Line Correlation belongs as much under this topic as under Physiography of the Lands. The same might be said of other exercises dealing with physiographic provinces which border on the coast.

Supplemental Study of Harbors and the Development of Navigation.—Special studies, requiring material of local interest, would be a study of various types of harbors. Charts for such a study may be obtained from the United States Coast and Geodetic Survey, Washington, D. C. A special study of New York City harbor would be of interest in that locality. The Geologic Folio of New York City, No. 83, U. S. Geological Survey, Washington, D. C., price 50c, would serve as a basis for this.

Teachers who are versed in history will be interested in having the class trace the course of navigation development, first along the coast of the Mediterranean, then among the islands of the Grecian Archipelago, then to the remoter peninsulas, out of the gate of Gibraltar, etc. Or as developed from the Norse center. This could be done with a series of charts.

It is worth while to have students trace ocean steamship routes on outline maps even

though such maps, completed, occur in the text used. By means of the globe teach the significance of great circle sailing.

The Atmosphere. Exercises XLII to LVI inclusive. The causes of atmospheric phenomena are largely problems of physics, and many of them are, as yet, only imperfectly understood. On the other hand the various characteristics of the atmosphere and the distribution of its phenomena have very direct effects on the activities of men. Therefore, the emphasis in these exercises is put on the latter phase of the topic.

Coöperation of the Physics Department.—Where a course in physical geography is being given, and causal relations are considered the more important phase, these exercises may well be amplified by the introduction of a series of demonstrations, with apparatus from the physics laboratory of the school. In this connection the geography teacher should secure the coöperation of the physics teacher, and the use of the physics laboratory. The physics and geography classes may, with profit, be combined for several periods while such studies are being made.

Reproduction of Diagrams as an Aid to the Teacher.—The first of the cross-section diagrams required in Exercise XLV (of monthly mean temperatures at a number of places in different parts of the world) has been filled in by the writer, and is reproduced on page 16 of this Guide, as a suggestion to teachers, of the sort of results which such work gives; and also to show a series of symbols which may be used, instead of colored pencils, to make the different curves stand out clearly.

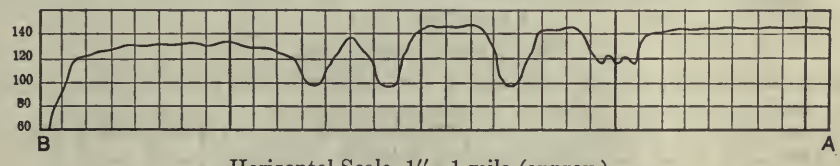
There is reproduced, also, on page 17, a filled in copy of Fig. 25, Map of Temperatures on a Winter's Day in Exercise XLVIII. This is inserted to show that, while such maps are not difficult to complete, they nevertheless give a very intelligible and striking conception of the temperature conditions of the United States at different seasons. While this is reproduced in black and white, the effect is much more striking if blue pencil and red ink are used, as directed in the exercise.

REPRODUCTIONS OF CROSS SECTIONS AND DIAGRAMS

EXERCISE XVIII

MONTROSS SHEET, MD.—VA.

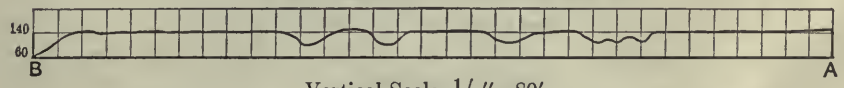
CROSS SECTION BETWEEN TEMPLETON (A) AND SOUTH END OF LAKE TO N. W. (B)



Horizontal Scale, 1″=1 mile (approx.)
Vertical Scale, $^1/_8$″=20′

EXERCISE XVIII

AS ABOVE EXCEPT VERTICAL SCALE

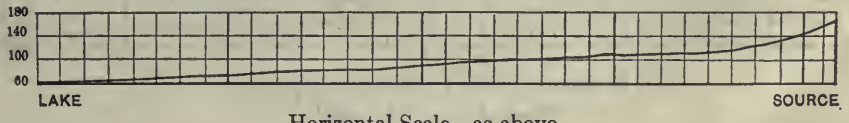


Vertical Scale, $^1/_8$″=80′

EXERCISE XVIII

MONTROSS SHEET, MD.—VA.

PROFILE OF STREAM BETWEEN CHILTON AND STRATFORD

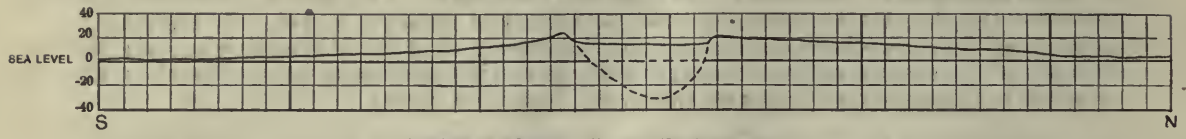


Horizontal Scale—as above
Vertical Scale, $^1/_8$″=40′

EXERCISE XXI

Donaldsonville Sheet—La.

Cross Section of Miss. R. on N. and S. Line (Approx.) Between the Letters R and I of the Word River



Horizontal Scale, 1″=1 mile (approx.)

Vertical Scale, $^1/_8$″=20′

EXERCISE XXII

Fargo Sheet, N. D.—Minn.

Cross Section from W. to E. along Road South of Wild Rice

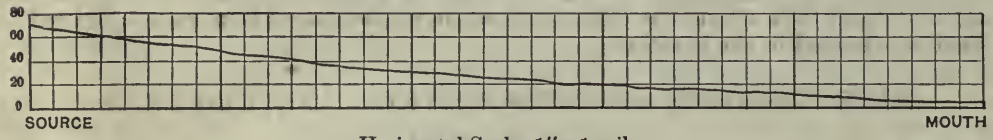
Horizontal Scale, 1″=2 miles (approx.)

Vertical Scale, $^1/_8$″=40′

EXERCISE XXIII

Winterville Sheet—N. C.

Profile of Hardee Creek



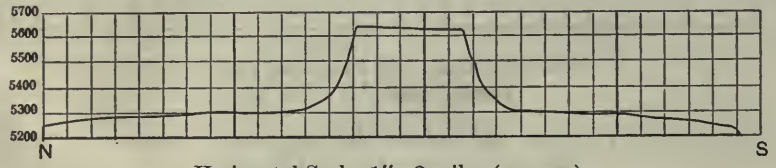
Horizontal Scale, 1″=1 mile

Vertical Scale, $^1/_8$″=20′

EXERCISE XXIV

Mt. Carrizo Sheet—Col.

Cross Section on a N. and S. Line S. W. of Mount Carrizo Showing Mesa Form



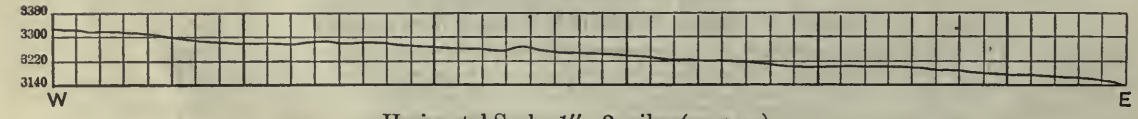
Horizontal Scale, 1″=2 miles (approx.)

Vertical Scale, $^1/_8$″=100′

EXERCISE XXIV

Syracuse Sheet—Kan.

Cross Section from Johnson to Gognac



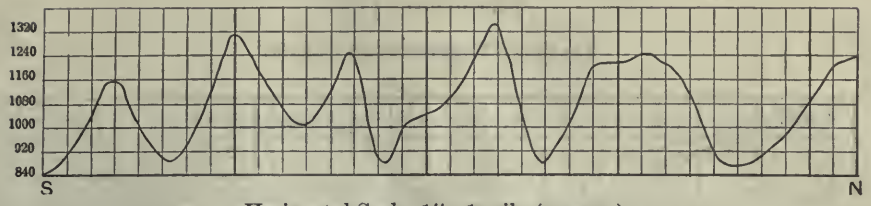
Horizontal Scale, 1″=2 miles (approx.)

Vertical Scale, $^1/_8$″=80′

EXERCISE XXV

CENTERPOINT SHEET—W. VA.

CROSS SECTION ON LINE N. FROM SEDALIA



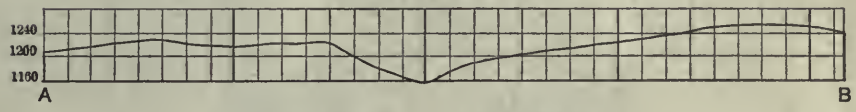
Horizontal Scale, 1″=1 mile (approx.)

Vertical Scale, $^1/_8$″=80′

EXERCISE XXVI

CALDWELL SHEET—KAN.

CROSS SECTION OF FALL CREEK VALLEY FROM S. W. TO N. E.



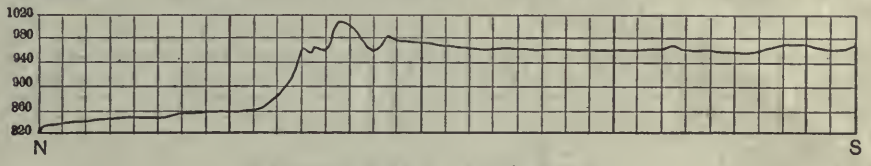
Horizontal Scale, 1″=2 miles (approx.)

Vertical Scale, $^1/_8$″=40′

EXERCISE XXVII

WHITEWATER SHEET—WIS.

CROSS SECTION OF TERMINAL MORAINE FROM N. TO S. S. W. OF TOWN OF WHITEWATER



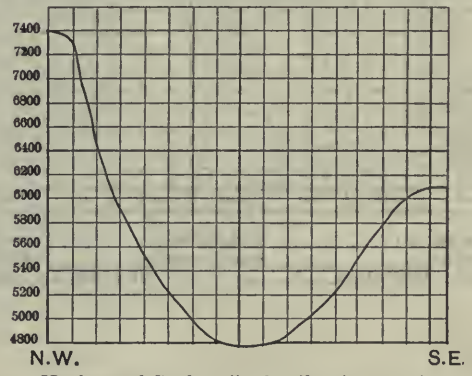
Horizontal Scale, 1″=1 mile (approx.)

Vertical Scale, $^1/_8$″=40′

EXERCISE XXXIII

CHIEF MOUNTAIN SHEET—MONT.

CROSS SECTION OF VALLEY OF SWIFTCURRENT CREEK FROM N. W. TO S. E.

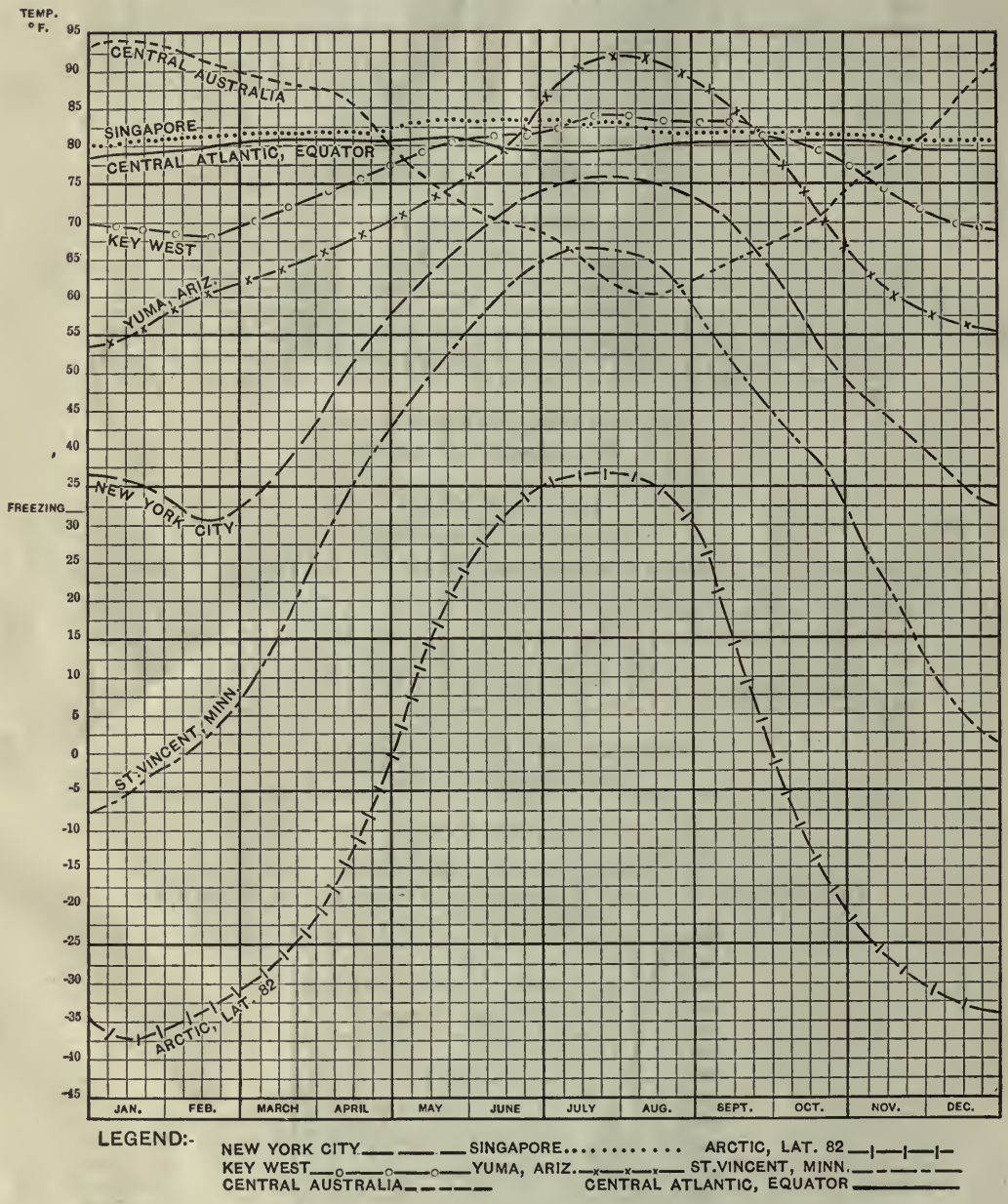


Horizontal Scale, 1″=2 miles (approx.)

Vertical Scale, $^1/_8$″=200′

EXERCISE XLV

Seasonal Temperature Curves



LEGEND:-

NEW YORK CITY _ _ _ _ SINGAPORE . . . . . ARCTIC, LAT. 82 —|—|—|—

KEY WEST —o—o—o— YUMA, ARIZ. —x—x—x— ST. VINCENT, MINN. — — — —

CENTRAL AUSTRALIA — — — — CENTRAL ATLANTIC, EQUATOR ————

EXERCISE XLVIII

FIG. 25. MAP WITH TEMPERATURES AT 8 A. M., ON A WINTER'S DAY

LIST OF MATERIALS NEEDED FOR EXERCISES

With information as to costs, place to purchase and other suggestions. The Roman numerals following the name of the article are the numbers of the Exercises in which it is used. Cost estimates of material needed by school are made on the basis of a class of ten students.

Materials to Which No Cost Is Attached

To be supplied by the teacher or by the pupils.

For Each Student.—Apple—I; Pin—I; Knitting Needle—I; Window Glass, small piece (may be had from local paint and glass store)—VIII; Piece of Coal—XIII; Field Soil from beneath sod (if in city go to local park and secure a quantity)—XIV; Soft leather disk, 3 to 5 in. in diameter (patching, upper leather from local shoe shops)—XLII; Wide mouthed drinking glass—XLII, XLIII; Watch (optional with student)—V.

For General Class Use.—Pair of shears—II; Chalk boxes, or wooden blocks—XVI. Chart No. 14, Mississippi River Commission, Liggett Building, St. Louis, Mo. (Several copies will be supplied to schools free of cost, additional copies 10 cents each)—XXI. Daily Weather Map—LI. On application to the United States Weather Bureau, Washington, D. C. this map will be mailed daily to the school without cost. The Bureau will also supply blank maps of larger size for recording original data.

Materials of Small Cost to Be Supplied by Each Student

Pen and pen holder, pencil, ruler.

Colored pencils—VII, XVI, XXI to XXVI inclusive, XXIX to XXXV inclusive. Dixon's Colored Crayons, Set No. 337, Jos. Dixon Crucible Co., Jersey City, Mnf. Sold by stationers generally. Cost 10 cents per set of six different colors.

Contour Map of the United States 18″ X 28″—XXI to XXXIX inclusive. Cost 15 cents each. If 35 of these maps are ordered at one time, or if total order for topographic maps amounts to $3.00 or more, these maps are supplied at 9 cents each. United States Geological Survey, Washington, D. C. Send money order with order.

Material of Special Design to Be Supplied by School

Rod and Cardboard Apparatus—V, VI. Can be set up by teacher. Directions given in Manual. Cost	$ .10
Table or Platform for Miniature Land Surface, XV, XVI. To be made by local carpenter. Cost may vary from $3.00 to $7.00 according to locality. Cost, approximately	5.00
Tank for Land Model in Erosion Experiment, XIX. Made by local tinner or roofer. Cost approximately	5.00
Wooden pointer with sharp metal tip, XVI. Made by local carpenter. Cost	.25

Material of Small Cost, Obtainable from Local Stores Everywhere. To Be Supplied by School

Sheets of blank paper—II, XVII, XVIII. Cost	.25
Sheets of wrapping paper—II. Cost	.05
Base balls—II. Cost	.25
Cotton string—VII. Cost	.05
Steel knives or scratch points—VIII to XI, inclusive. Cost. (A household paring knife or shoe maker's pegging awl best serves the purpose.)	1.00
Hydrochloric acid, 4 oz.—VIII to XIV, inclusive. Cost	.10
Glass plates—XIV. Cost. (Discarded negatives, cleaned, from local photographer.)	.10
Yard sticks—XV. Cost. (Often distributed by merchants for advertising purposes, gratis.)	.50
Garden hose—XIX. Cost	2.50
Twine—XLII. Cost	.10
Cheese cloth—XLVI. Cost	.10
Fruit jar, 1 quart—XLVI. Cost	.10
Alcohol, 4 oz.—XLVI. Cost	.10
Muslin—XLVI. Cost	.10
Ice—XLVII. Cost	.10

Materials Not Readily Obtainable in Many Localities. To Be Supplied by School

For Each Student.

Desk Globes—I to VII inclusive. Cost. Six inch diameter, wire stand. Cost each 30 cents, per dozen, $3.00. Rand, McNally and Co., 142 Fifth Ave., N. Y. C.	$3.00
Compass Dividers—III, IV, VI. Cost. Eagle Compass and Divider, No. 569. Eagle Pencil Co., N. Y. C. (Steel dividers give more accurate results, and may be obtained from local hardware dealers.)	2.50

For Each Student.

Test tubes, 6 in. by 5/8". Cost. ..... .30
Eimer and Amend, 205 Third Ave., N. Y. C. No. 4872 of their 1910 catalog.

Minerals and Rocks—VIII to XIV inclusive. Cost 4.80
The Geography Supply Bureau, Ithaca, N. Y.
Cheapest set, Catalog No. 9, Set No. 1, One dozen sets, $4.80. Better set, larger specimens, packed in wooden case, Catalog No. 13, Set No. 5. Ten sets, $20.00.

Topographic Sheets, U. S. Geological Survey, XVIII to XXXIX inclusive. Total cost. 18.60
In lots of 50 or more these sheets (with exceptions as noted below) cost 6 cents each when obtained directly from the United States Geological Survey, Washington, D. C. Less than 50 sheets cost 10 cents each. Money must be sent with order. 25 different 6 cent sheets are needed, making 250 in all for class of 10, or $15.00.

Names of 6 cent sheets, and numbers of Exercises in which they are used:

XVIII—Montross, Md.-Va.
XXI—Donaldsonville, La.
XXII, XXIII, XXVI—Fargo, N. D.-Minn.
XXIII—Winterville, N. C.
XXIV, XXV—Mt. Carrizo, Col.
XXIV, XXV—Syracuse, Kan.
XXIV—Kearney, Neb.
XXV, XXVI—Centerpoint, W. Va.
XXVI, XXVII—Caldwell, Kan.
XXVII—Whitewater, Wis.
XXVIII—Cleveland and Vicinity, Ohio.
XXIX, XXX, XXXII—Monterey, Va.-W. Va.
XXIX—Delaware Water Gap, Pa.-N. J.
XXX, XXXI, XXXII—Mt. Mitchell, N. C.-Tenn.
XXXI—Farmville, Va.
XXXII, XXXIII—Lake Placid, N. Y.
XXXIII—Chief Mountain, Mont.
XXXIV—Spokane, Wash.-Idaho.
XXXV—Granite Range, Nev.
XXXVII—Cucamonga, Cal.
XXXVIII—San Francisco, Cal.
XXXVIII—Tamalpais, Cal.
XXXIX—Boothbay, Me.
XXXIX—Barnegat, N. J.
XXXIX—Port Orford, Ore.

The following sheets are double size and cost 12 cents each when 50 or more sheets (of any kind) are ordered at the same time. When a lesser number is ordered the cost is 20 cents each. 3 different sheets, 30 in all, are needed for a class of 10 costing $3.60 if ordered at same time as the 6 cent sheets.

XXVIII—St. Louis, Mo.-Ill.
XXVIII—Denver, Col.
XXXVI—Bright Angel, Ariz.

If ordered of dealers the 6 cent and 12 cent topographic sheets cost 10 and 20 cents each, respectively, regardless of the number ordered.

Note: On Jan. 1, 1913, the United States Geological Survey doubled the prices on most of its map publications. The prices quoted above are the new prices.

For General Class Use.

Wall Maps of Different Scale—II, III. Cost. $4.00
Write: John W. Iliff & Co., 171 E. Randolph St., Chicago, Ill., or J. M. Olcott, 63 Fifth Ave., N. Y. C. Ask for catalogs. Select maps of interest to whole school.

Minerals and Rocks—VIII to XIV inclusive. Cost 15.00
For General Class Use. In this classification come such specimens as "Rock with Lichens Attached," etc.
Geography Supply Bureau, Ithaca, N. Y. Their "Science Sense Set". This contains all the specimens used by each student, 3 in. x 4 in. in size; also 7 additional specimens of special kinds used in the Exercises.

Acid Dropping Bottles—VIII to XIV inclusive. Cost. 1.00
"Ranvier's", .35 each, 3 for $1.00.
Eimer and Amend, 205 Third Ave., N. Y. C. Their 1910 catalog No. 2433.

Spray Nozzle—XIX. Cost 4.00
The "Vermorel" Nozzle and Coupling for one half inch hose.
Goulds Manufacturing Company, Seneca Falls, N. Y. Their catalog numbers 1310 and 67.

Relief Map of the United States 18" X 28"—XXI, XXXIX, inclusive. Cost, 3 copies .... .45
1911 Edition United States Geological Survey, Washington, D. C. 15 cents per copy. Some teachers prefer to use this instead of the contour map of the United States for each student. Where 35 or more maps are ordered this Relief Map costs only $.09 each.

Wall Map of the United States, showing Railroad Lines—XXXIII. Cost 1.25
National Railway Publication Company, 24 Park Place, N. Y. C. (Ask for latest edition.)

Glass Tube, sealed at end, 35" long—XLII. Cost ..... .35
Eimer and Amend, 205 Third Ave., N. Y. C. 1910 Catalog No. 2231.

Bottle of Mercury—XLII. Cost, approximately. 3.00
Costs 90c an oz. approximately. May be borrowed from physics or chemistry laboratory in many schools.

Glass Funnel—XLII. Cost. ..... .10
Diameter 1 inch. Eimer and Amend, 205 Third Ave., N. Y. C. 1910 Catalog No. 3347.

For General Class Use.

Thermometer, Weather Bureau Pattern—XLIII, XLIV, XLVI, LI. Cost 4.50
Geography Supply Bureau, Ithaca, N. Y. Catalog No. 29.
Cheaper thermometers may be used. These may be had locally at prices as low as 25c each.

Barometer, Mercurial—XLIV and LI. Cost 20.00
Geography Supply Bureau, Ithaca, N. Y. Catalog No. 26.
A better instrument, the Weather Bureau Pattern, costs $45.00. Catalog, No. 27.

Rain Gauge—LIV. Cost 4.25
Geography Supply Bureau, Ithaca, N. Y. Catalog No. 31.

Supplemental Material

Ores of Different Metals.
Write Ward's Natural Science Establishment, Rochester, N. Y., for catalog.

Lantern Slides for Quizzes.
Write Geography Supply Bureau, Ithaca, N. Y., for catalogs.

Large Globe for Class Room.
Write J. M. Olcott, 63 Fifth Ave., N. Y. C., for catalog.

Summary. Low Total Cost of Equipment

From these figures it will be seen that a geography laboratory for a class of *ten students* need, at the maximum, cost only $165.00. This sum will provide, in addition to the articles and permanent equipment noted above, for the purchase of tables and chairs and an inexpensive closet for storing maps and apparatus.

If the seating equipment and permanent fixtures of the laboratory are omitted from the estimate, a maximum figure of $115.00 will suffice for material. This may be reduced to as low a minimum as $40.00, especially if not all the exercises are taught and only a very few schools will have the time necessary for completing them all.

Once equipped, additional units of ten students may be provided for at an expense of about $30.00 per unit.

Schools which already possess a physics or chemistry laboratory will find that many expense items on these lists can be eliminated by using part of the equipment of such laboratories.

Where every dollar counts it will be found that a major portion of the exercises in the manual may be successfully taught with a single appropriation of from $30.00 to $40.00.