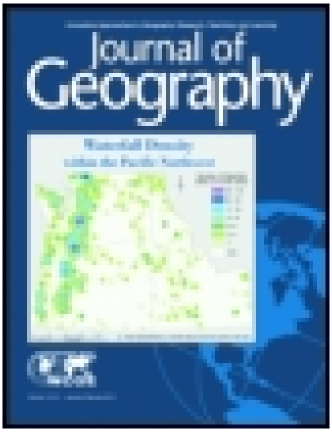

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PROBLEMS IN THE TEACHING OF PHYSICAL GEOGRAPHY IN SECONDARY SCHOOLS

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MATHEMATICS and the languages have been used as educational instruments for thousands of years. Small wonder then if those subjects are well organized and adapted to educational use. None of the sciences have been so used a century; so it is not surprising that they have their *problems*. We wonder still less when we remember that the sciences themselves have changed so rapidly that no routine of work could retain any value longer than twenty years.

The first and greatest of the problems of Physical Geography teaching is suggested by this youth and rapid development. It is the efficient organization of the subject matter,—the choice of material; its arrangement in the proper sequence; the most advantageous correlation of each topic and the *method* of the subject. We have here no reference to methods of teaching.

A second problem pertains to the place or places allotted to geographical studies in the curriculum. This is so intimately connected with the problem of subject matter that it would be difficult to treat the two independently. In fact, troubles recently arising out of this second problem are largely responsible for the chief present troubles with reference to the subject matter of the course.

A third problem relates to methods of teaching, primarily just now, to the value and possibilities of the so-called laboratory work. It may

[1] Read before the joint meeting of the American Federation of Science and Mathematics Teachers and Section L of the A. A. A. S. at Baltimore, December 29, 1908.

serve to give a setting to these problems, if we first review briefly some changes in the science itself and in the teaching of it within the past twenty years.

A generation ago the name Physical Geography stood for a fairly well recognized and rather uniformly delimited field of knowledge and scope of teaching. You all know its content. It pertained largely to nature's more spectacular phases,—volcanoes, earthquakes, tornadoes, glaciers (not the resulting topography), tides, races of men, etc. The treatment was mainly descriptive, and the subject, as taught in the schools, could only by courtesy be called a science. Even among scholars, Physical Geography could not be regarded as a very live science, since more specialized lines were gradually coming to be recognized in Meteorology, Glaciology, Oceanography, Seismology, etc.; and the contributions to these were scarcely thought of as belonging to Physical Geography.

Then began a most energetic and fruitful study of topography, involving its genesis and the classification of its forms. The new phase became known as Physiography, a term borrowed from England, where it is still used in almost the original sense which its etymology implies. It soon became evident that this new phase was something more than a mere improvement within the field of the old Physical Geography. It developed a content and methods of its own which soon entitled it to a quasi-independent position, coördinate with Meteorology, Oceanography, Seismology, etc., all of which are closely related to the more comprehensive science of Geology. For various reasons, however, the reflex influence of this new phase on the character and teaching of the parent science of Physical Geography was destined to be decidedly greater than that of the others mentioned.

At about this same time another factor became highly significant, namely, the general tendency to put all science teaching on a laboratory basis. This movement in Physical Geography was, no doubt, to some extent independent of the change in subject matter, but it must also be said that the newer phase lends itself to what may be called laboratory exercises, as the former descriptive study did not. The time had come when it was not considered respectable to teach any science without a laboratory, and if Physical Geography was to be a science, it must, of course, fall into line.

In 1894 appeared the report of the Committee of Ten, a remarkable document. The clear-sightedness of the sub-committee on Geography is the more noteworthy when it is observed that exactly in those quarters where subsequent practice has departed from its recommendations, troubles have arisen which are again giving rise to discussions, indicating a very considerable unrest in the matter of geography teaching.

The points of that report which concern us here are: (1) Both Physical Geography and Physiography are clearly recognized as distinct phases of Earth Science and of very unequal difficulty; (2) Physical Geography is to be taught to all pupils as the last geographic course preceding the high school, or in the high school if not properly finished earlier; Physiography is to be offered in the later high school or early college years; (3) Physiography is made coördinate in this respect with Meteorology and Geology, except that in neither of these latter cases is there a hint that the subject might prove too difficult for the high school.

At the time of this report there were no text-books corresponding to the Committee's ideas of Physiography. Within the next four years there appeared two books representing the newer phase and *suited to the later years of the high school.* Those books were, however, called Physical Geography and not Physiography. They carefully included all the traditional divisions of the older subject, as if intended to enter the field in competition with the old-style books, instead of presupposing the study of Physical Geography and offering a distinctly advanced course in Physiography as contemplated by the Committee of Ten. Whatever may have been the original intention of the authors, competition did occur; the new books began to displace the old in the first high school year, and the advanced course was lost sight of, though these books were suited to more advanced students and not to first-year pupils. More books appeared, the later ones frankly accepting the conclusion that the place of the subject is in the first high school year and being simplified accordingly. Among these are entirely new books written by the authors of the first two. With perhaps one exception, these later books do not, however, give up the classification of land forms based on life histories (thus making the subject preliminary to Physiography), but cling with more or less compromised purpose to the idea of presenting the subject of Physiography, with apparently no expectation of an advanced course within the high school. The result is, generally, an attempt to present an unsuitable subject by means of consciously simplified language. The outward forms of laboratory work are an attempt to make the teaching consistent with the subject matter, while the driveling character of the work is largely a result of its misplacement in the course. The present situation has come about by drifting. It lacks clear purpose, or rather it mixes several purposes which are inconsistent.

It is but just to add, however, that the trend of text-book making shows a marked dwindling of the distinctly physiographic phases. With further clarification of purpose, this tendency may be expected to continue.

The situation since the Committee of Ten's report may be summarized as follows: (1) The plan of giving a broad, unspecialized but vivid course in Physical Geography just below the high school has dropped out of mind; (2) the idea of an advanced and more specialized course in the later years of the high school has been lost; (3) events have brought about an illogical combination of these two purposes, with a result which fails to satisfy either purpose; (4) much of the present course is better suited to more advanced pupils than to those who study it; (5) the subject is probably less universally liked by pupils than formerly; (6) the success of the laboratory is still problematical.

Having reviewed the developments of the past fifteen years, let us examine more closely the two main problems of the present; the first, pertaining to the subject matter and its place in the curriculum; the second, to methods of teaching, primarily to laboratory work.

There seems to be a plain need for a broad, interesting, unspecialized *introduction to earth science,* to be given not later than the first high school year. Probably good organization of the work of the grades would make it possible to give this course in the last year previous to the high school. It should also be quite as apparent now as it was fifteen years ago, that there is need of an advanced course to be given late in the high school course at a time when the pupils' minds have become distinctly more mature, and their intellectual horizon distinctly broader.

To the possible charge that this is asking too much high school time for the earth sciences, it may be answered that (1), the opinion has already been expressed that the elementary course should ultimately be mastered in the 8th grade. (2) The advanced course may be elective. (3) It should not have the same scope as the elementary course, but may be in a different line of earth science, say Meteorology or Geology or Regional Geography or even Commercial Geography rationally taught. (4) If the course be in Regional or Commercial Geography, it should not be charged up to science any more than to the humanities. There is no reason whatever why the study of one of these should preclude the study of Physics or Chemistry at the same time. It is not customary to limit the so-called humanities to a single year in the high school.

The introduction of this advanced course is desirable for more reasons than can be stated here. It should be made the subject of a special plea.

But the more elementary course is already represented in our schools, and it is with its problems that we are especially concerned.

In view of these observations and of the recent and rapid development of the science, it seems fair still to treat the choice of subject matter of the elementary course as an open question. We believe it is not too late to examine into the merits of different topics, and to look critically at the grounds on which a choice of subject matter is to be made.

The first of these grounds is *logical order,* a watchword under which all sorts of educational sins have been committed from the time when it was considered illogical to teach "b" before "a", or words before letters, or weights and measures before fractions. Children used to study grammar in order that they might "speak and write the English language correctly." Now they learn to use the language first; *but,* it is recognized that there can be no *advanced* scholarship in literary lines without the study of technical grammar. It may now be urged by some that pupils must have a classification of land forms before they are ready to receive and understand a description of the earth's surface. It seems to me that this is exactly analogous to the grammar question, and that it will ultimately be found wise, if not logical, first to fill the mind with pictures of the earth's surface, then to analyze and classify them, remembering that no *advanced* study of Physical Geography is possible without such a scientific classification of forms.

The question whether college entrance requirements are a suitable criterion for the selection of subject matter in secondary schools has been fought over until nothing new can be said. Any new expression can be little more than an announcement of one's sympathies, but such announcements have their influence. The sooner colleges give up the idea of controlling high school courses, the better it will be for the colleges.

There remains another basis of choice which has sometimes been consciously adopted, sometimes unconsciously, but has, perhaps, never been without its influence. On this basis all subject matter is judged according to the ability and normal interest of the pupils, not, of course, the likes and whims of the individual pupil, but the bent of the average pupil at a given age or stage of advancement.

It is undeniable that Physical Geography as now taught embraces elements of very unequal difficulty, some of them easily grasped by children in the grades, others requiring skilful presentation and abundant drill for good high school pupils. If the subject matter now given in Physical Geography be ranged in the order of difficulty beginning with the easiest, it would probably divide itself somewhat as follows: (1) common rocks and simple dynamics, subject to direct observation and experiment; (2) unobserved but spectacular forms and processes, the descriptive material such as constituted the bulk of Physical Geography twenty years ago; (3) genesis and classification of land forms.

The subject of common minerals and rocks is not only relatively easy of comprehension, but calculated to hold the interest of children. The subject is eminently concrete and needs little imagination. The facts need pointing out rather than explaining. The ease of making and keeping simple collections adapts this subject to the work of Nature Study or Primary Science. But even in the grades, the work in this line can easily and economically be made to cover as much or more than is given in any high school text-book of Physiography or probably of Geology. Certainly this subject is distinctly easier than the systematic genetic study of land forms, and is adapted to younger minds.

There seems to be no reason, except custom, for deferring until college years the study of what a sandstone really is,—sand grains cemented together. The descriptive study of sandstones with reference to size of grain, shape of grain, nature of cement and even coloring matter is also easy, being subject to direct observation and simple experiment. Whether considered with reference to difficulty, interest to pupils, logic or any other standard except tradition, this is an elementary study. It certainly is easier and more in line with children's interests than the changing cross-section of a valley, the shifting of a divide or the maturity of a coast line. The elementary study of rocks may not be Physical Geography, but it does belong to a general introduction to earth science.

Probably a little more difficult than the study of rocks is that of those processes which may be subject to direct observation or experimentation. It is assumed here that, in the main, each process can be watched while it makes appreciable progress, as for example, evaporation, or the solution of limestone in water carbonated by the breath, or transportation along a beach; or the process, if not watched, may be one which appeals to the imagination as a single act, as the breaking of a rock by frost; or one whose evidences are vividly concrete, as the oxidation of a rock with change of color. Of this nature are most of the weathering processes. Consider the natural sand blast, the making of caves, the work of plant roots, of earth worms, etc.; the issuance of spring waters, etc.; the rounding of stones and the production of sand and mud by attrition; the undercutting of stream banks; transportation in solution, in suspension and at the bottom of the streams, etc. All these and many others are so simple that they need pointing out rather than explaining, and once consciously observed, they will offer a constant allurement to the observation of natural processes, preparing the mind for more technical studies. It is not meant that these should be given in the diluted form commonly called Nature Study, but as a serious study, going into the matter quite as fully as is done in high school text-books of Geology, and more systematically than is done in high school text-books of Physical Geography. It certainly is easier than the study of land forms, and fitted to interest younger minds. The strain on the imagination begins when the topographic effects of these processes are considered. That much of this study of processes is commonly called Geology, and left to be taught under that name, can not be considered as a matter of weight.

Consider also the glowing and interesting descriptions which formerly made up the bulk of Physical Geography. These pertained to volcanoes and earthquakes, especially narrative and descriptive, crustal movements, and much about glaciers, etc. All this must be given somewhere and it seems to demand less maturity of mind than systematic Physiography.

The systematic study of land forms is last in the order of difficulty. Its main difficulties are two: first, the largeness of the features produced, so that most of them can not be seen in a single view; and second, the slowness of topographic changes so that process must generally be inferred from form. These features, which are among the chief attractions to the initiated, are serious matters to immature minds. The subject is full of semi-geometrical conceptions and makes heavy drafts on the student's ability to picture space relations from descriptions.

It is, of course, obvious that many simple physical processes involve an element of topographic change, such as stream corrasion, wave erosion, land slipping, weathering, etc.; but the apprehension of these elementary results is not a systematic study of land forms. Such a *system* has been well described as based on three things: structure, process and stage. In other words, a land form is classified by answering the questions: (1) What is it made of or made *from* (implying the original form)? (2) What are the agents or processes at work? (3) What stage has it reached in that long series of forms through which it must pass before it is reduced to base level? The elements involved in the first two questions lend themselves to elementary instruction, but those of the third question, involving stage, are of distinctly advanced grade, neither easy nor interesting to young pupils just entering the high school. Yet such elements stand at the doorway of all accurate and up-to-date knowledge of the earth's surface, and all teachers, at least, should know a part of the earth's surface from that standpoint.

The scope of study here suggested for the first course in the high school may not exhaust the science of Physical Geography, and it may contain some things which tradition associates more closely with Geology. It is avowedly an *introduction to earth science,* and does not cover the ground of Physiography any more than it does that of Meteorology, Oceanography, Geology, or Regional Geography. Technical Physiography takes its chances of later study as do the others named.

The above crude suggestions are not a syllabus, but are intended to illustrate the lines along which selection of material should be made. The point is insisted on that the basis of selection for immature pupils should be *fitness as an educational instrument,* and not the theoretical limits of the science. The usability of each and every topic must ultimately be settled by experience. In this way natural selection will do much in the next few years toward determining what should be given in this introduction to earth science.

What shall be done about laboratory work? The name itself smacks so much of good scientific teaching that the very sound of it is at least alluring and may even be deceptive. The essence of laboratory work is the giving of concrete ideas on which generalizations may be based. This is an educational principle which must in some way be satisfied. The laboratory is only one application of this principle. In other words, laboratory work is a *method.* The *principle* must be followed, but this *method* may or may not be the best one. Of course, if the words "laboratory work" are made to stand for any and every exercise which gives concrete ideas, the discussion is at an end, for some such exercises there must be. Commonly, the words *laboratory work* are accepted as indicating systematic exercises carried on under the direction of, and generally in the presence of, an instructor, with materials and equipment designed for the purpose, the observations being systematically recorded in a note-book. There are universities second to none in the world in the matter of high standards for physiographic work, where the word laboratory is not used in connection with Physiography; where there is no room set aside for such work, and no special periods; where no objective work is done in the presence of the instructor, though map studies are reviewed in conference between the instructor and very small groups of students. But it must not be inferred that the principle demanding concrete ideas as a basis is either ignored in these institutions or followed in any half conscious way.

The problem of laboratory work presents two phases: (1) What shall it be where the scientific classification of land forms is undertaken, and (2) what shall it be where the work is a general introduction to earth science on the basis mentioned above?

We have already indicated our agreement with the Committee of Ten in the belief that the first-named phase should not be undertaken before the later high school years, and then only after a preliminary course in Physical Geography. There would seem to be little room for difference of opinion, that where the systematic study of topographic forms is the chief thing in the course, there should be much concurrent study of topographic maps, some of pictures, and at least a little at the start, of models. Field work is, of course, presupposed; but the burden of the collateral work indoors must probably still be with the topographic maps. As pictures come to be more carefully selected, and diagrams drawn specially for the purpose become more numerous, the use of the map may become less and less exclusive.

Some such work, suited mainly to advanced grades, is being done in many high schools, where distinctly physiographic work is undertaken in the first year. It would be difficult to give a proper rating of the work thus done; but it may be safe to say that those who judge of it from college entrance examinations do not rate very highly the work done thus far in this line.

In secondary schools, where the systematic classification of land forms is not a prominent part of the course, and where the course is such a general introduction to earth science as is indicated above, the topographic map becomes a less essential piece of apparatus. There may or may not be a laboratory room, a laboratory period, or even note-books. These may either foster or kill interest, according to the manner in which they are used. But there must be *some first-hand dealings* with the materials, phenomena and forms discussed. To give a few illustrations and not a syllabus:

The general types of rocks should be known wherever seen. This knowledge should include not only their names, but such points of interest as make the names worth knowing, namely, their origins and habits. A few processes may be watched in nature and a few others illustrated by simple experiments, such as the solution of limestone and the settling of sediments. But the great thing is to learn to trust one's own eyes in matters where *process is revealed by form,* and when the under-cutting of a cliff is revealed by its steepness, or the splitting of a ledge by frost is known by the presence of a talus, or the weathering of a limestone is shown by a yellow shell surrounding a blue interior. It is easy to find many illustrations in almost every locality. It is practicable to bring indoors many specimens to be used in a similar way, and when a start is thus obtained by observing nature itself, pictures may be used for the same purpose.

Whatever may or may not be done in the scientific classification of land forms, the mere descriptive interpretation of topographic maps demands early attention. Exercises should be given which involve the formation of a mental picture from a contour map, whether the forms thus pictured be genetically explained or not. Unfortunately, the latter is often attempted before the former is learned.

The matter of an elementary course in Physical Geography can never be regarded as properly settled without considering advanced courses at the same time. This is partly because the high school will, for years to come, be the finishing school for many teachers, and the subject must continue to be "dead at the top" unless teachers have a wider outlook than could be obtained at the age of thirteen. Then, too, so long as the earth sciences get but a single half-year course, and that in the first year, it can not be expected that teachers will spend much time in preparing along those lines. Physics, Chemistry and Biology are coming to be taught in many high schools by very good students of those lines, largely because there is enough teaching in each of those lines to justify preparation. But Physical Geography is still thrown to almost any one as a matter of convenience. This will be changed when advanced courses are offered in the earth sciences.

A generation ago many high schools gave Geology in the last year. Why this claim should have been allowed to lapse is among the mysteries. It occupied just that place in the curriculum which is now coveted for an advanced course in earth science. It is true that Historical Geology did not vindicate itself as a high school study, but not all Geology is historical. There is no use crying over spilled milk, but it is clear to many people *now* that if Physiography had wedged its way in as Geology instead of as Physical Geography, it would in the end have won and held its rightful place at the end of the high school instead of at the beginning. It might not have come so rapidly, but it would now be coming in instead of going out. To have called the new child by its father's name instead of its mother's would have been the merest elementary diplomacy. It could then have inherited the estate which has now gone to strangers. How the

Sub-committee of Ten, which was so wise in education, could have made such a mistake in diplomacy remains to be explained.

The problem which now confronts the earth sciences is how to get in again to the game with an advanced course, and this not merely for the pleasure of expansion, but for the well-being of the more elementary courses. It will probably be agreed that in most cases the new study must come in as an elective. It is also probable that the place will be taken by different courses in different schools, or that in large high schools several advanced courses will be offered. That serious study of sciences in high schools should be by one-year courses is almost a matter of common consent. The various possible courses may be briefly reviewed:

(1) Geology is not yet fully banished. To be sure, if it regains its place it must not be a mere abbreviation of a university course couched in offensively simple language. The historical phase must be touched very lightly. Dynamic Geology, especially surface agencies, must be emphasized. Here is a good place for the origin and classification of topographic forms. The case of high school Geology is by no means hopeless. There are several good modern text-books which are largely physiographic. Their treatment of systematic Physiography would bear further elaboration, and we may hope that this will come about in the near future since the tendency of elementary Geology to become more physiographic is quite as marked as that of Physical Geography to give up the phase of pure Physiography.

(2) Meteorology has met little favor as an independent study in secondary schools, probably because of the narrowness of its field. In all other respects it seems admirably adapted to use as an educational instrument.

(3) Almost the same thing can be said for Astronomy (if that can be called an earth science). To this branch there is the additional objection that the equipment for first-hand laboratory work is beyond the reach of most high schools.

(4) The present rise of Commercial Geography may have large possibilities. True, there is not much to be said for the barren recital of statistics commonly called by that name, but it is preëmpting a place in the course for earth science which may be better used in the future. Good teachers will find out that the commercial conditions of a region can not be treated rationally without an all-round knowledge of its physiography and physical conditions of habitation. The treatment will then be so broad that it matters little whether it be called commercial or not. If

that word is soothing to the public it can do no harm. There are some good text-books of Commercial Geography, but they should not be in the hands of those who are not already well instructed in Geography that is not commercial. It has come to be a favorite dictum with some that Geography should be "approached through its commercial aspects." There can be no objection to this. So far as we are here concerned, the crops of a country can be mentioned either first or last. The treatment may be inductive or deductive according to the teacher's habit of mind. The real thing is to do something with a theme after it has been "approached". Whether the trade of a country be mentioned first or last, there remains an equal necessity of studying the other conditions of that country, or the study of the trade is not a rational exercise and has no place in the high school.

(5) The study of Regional Geography is practically dead in American secondary schools. It seems scarcely even to enter into the theory of American education that Regional Geography is a thing for mature minds, and no one who has ever asked university students to locate the Wasatch mountains (or even the Rocky mountains outside of Colorado), will deny that it is outside of our practice. The points in favor of Regional Geography as an advanced high school study are many. First, it is in very close touch with later life, probably more so than any other course mentioned. Second, its reflex influence on elementary teaching would be very great, partly because many prospective teachers would study it in the high school, partly by introducing among teachers a semi-specialist class of geographers, largely by the new ideals which it would foster among teachers, pupils, school boards and communities. Lastly, it may well be claimed for Regional Geography, that, of all phases of earth study, it is best fitted to be a basis for entrance to college. Perhaps no study outside of the mother tongue is vitally connected with so many college studies. Consider its relations to History, Economics, Literature, Sociology, Political Science and the biological sciences, beside its central position among the earth sciences.

Even though it should never be possible to complete elementary Physical Geography before the high school, the introduction of Regional Geography or rational Commercial Geography into the high school course can not be objected to on the score of too much science, for such Geography is no more a science than a humanity. Whether judged by the tastes it satisfies or by the habits of mind induced by the study, or by its relations to other studies in the course, there is no reason why the study of Regional

Geography should preclude the study of a natural science at the same time.

There are no high school text-books of Regional Geography, a fact which further goes to show that its suitability as a study for any except children is not vitally a part of our American creed.

While teachers generally and rightly stand for one-year courses in the high school, it is quite probable that a very well unified year's work might include several of the branches here given as among the possibilities for advanced work. Regional Geography might share the year with Geology or Physiography, or with Commercial Geography. Or pure Physiography may be unified with Meteorology. In such combinations each phase may be given a part of the year for its independent treatment or the treatment may involve both phases simultaneously. Either plan should be considered with great caution for fear of dissipating both interest and effort, and making of the course a hodge-podge.

Physiography in the college or university is, considering its youth, on a sound basis both as to subject matter and as to methods of teaching. Its outlook is a little one-sided, being almost exclusively geological, but this will change as Regional Geography is developed. It is also embarrassed and loses dignity by being obliged to include material which has been spread out over the public school course from the kindergarten up, but this will be improved also as the public schools improve to the extent of furnishing certain things so that the university may confidently build upon them without repetition.

The great and conspicuous gap in earth sciences in the American university is in Regional Geography. Things are, however, moving so rapidly that this statement must be made with care and applied to the past rather than to the future. A considerable number of good American universities are now giving space to Geography either as a separate department or in connection with Geology. True, the work is still largely on the geologic side, but this is changing, not by the elimination of the physical but by the expansion of regional and humanistic treatment. We may expect in the immediate future a very great expansion along these lines. We may even hope that ten years hence the selection of a professor for his knowledge of Regional Geography will be quite as common as is now the selection of professors primarily for Physiography. The first great effect of that will be to dignify all geographic studies in the public school. More and better teachers will be provided. There will be a distinctly human geography which will be fostered by high school teachers in the so-called humanities instead of being resented as merely one more intruding science.