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PHYSIOGRAPHY:—AN ELEMENTARY SCIENCE COURSE IN THE HIGH SCHOOL

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THE question as to the place which geography should occupy in the high school and its relation to elementary science is an important one at the present time.

By general consent the formal study of what is commonly called physical geography has been left to the high-school period. Owing, however, to the failure on the part of many teachers to understand the full significance and scope of the subject, it has not gained the recognition which it deserves. Besides this, many teachers feel the need of an elementary science course which shall precede and give some preparation for formal chemistry, physics, and biology, and they do not see in geography anything that can fill this need.

In the following paper I hope to show that physical geography, or physiography as I prefer to call it, when viewed from a broad and rational standpoint, can be made to include not only all of geography that is needed in the average high-school course, but also all that is important in an elementary science course. I hope to show further that physiography has a great advantage over an elementary science course in that it presents the subject matter from an intelligent and comprehensive viewpoint.

A course in merely elementary science, adapted to the first year of the high school, would group in a disorderly jumble unrelated facts from many widely different fields. If these same facts were taken up from the geographic viewpoint they would naturally fall into an organized whole or cosmos, giving the student an intelligent outlook on nature. The geographic concept alone can form the binding cement. It looks at all

facts according to the part which they play in the activities of the world as a whole.

While it matters little whether we call this subject physical geography or physiography, yet it is important that there should grow up a common usage so that we shall know just what is intended to be conveyed when the matter is mentioned. By many teachers these terms are used synonymously. Some understand physiography to apply to land forms alone, and physical geography to be of wider application but without any emphasis upon life. Still others are inclined to use the term physiography in the sense in which Huxley introduced it, that is, a study of nature based upon observation.

To my mind the term physiography seems to designate more fittingly than any other that newer conception of our subject which leads us to take up a study of the phenomena of the world about us, not for their own intrinsic values, but for those far more valuable results which can be obtained only when they are considered in the light of their relation to each other and to the world as a whole.

Physiography is then more than the study of land forms. It is more than physical geography with its formal laboratory work. It includes in short the elements of all the sciences from the geographic viewpoint, the work being based at every step upon the observation of real things.

The study of physiography as thus defined leads to a broad, intelligent outlook upon nature, fits the stage of development of pupils entering the high school, is introductory to much that follows, and for these reasons should be made a required study for every one.

Geography is the mother of the sciences. It once included all that was known of nature, and was purely descriptive until very recent times. Its boundaries have always been ill-defined, and are so to-day in the minds of most teachers. With the growth of inquiry into cause and effect and the growing recognition of the individuality of the subject, geography is rapidly becoming a science. It offers wide fields of research to the university student, as well as a fundamental insight into nature for both grammar and high-school pupils.

There is nothing that can fill the gap between the geography and nature study of the grades and the sciences of the later years of the high school so well as physiography. Its outlook is comprehensive, and, if properly taught, so interesting that the pupil is placed in the best possible attitude toward formal science.

We must constantly bear in mind in this elementary science course that it is the geographic concept which is the important thing, and that this must be placed foremost at all times. Now let us see in detail the advantages which physiography possesses over every other science as an introductory course in the high school.

Physics has been emphasized in high schools because of university requirements. It is a formal laboratory course in which the practical side, so important from the standpoint of young pupils, is not brought out.

A course in elementary physics has been suggested for the first year in the high school, as filling the need of an elementary science course. The same objection can be raised to such a course as to a similar course in each of the other sciences, and this objection is that it introduces formal specialized work when a broader treatment of science as a whole is much more fitting. The knowledge gained by taking up the facts of science from the standpoint of their geographic relations is infinitely more valuable at this period than when these facts are studied for their own sakes.

Physiography takes up the elements of physics as illustrated in the behavior of the earth, the water, and the air, and their relation to living things. It may be argued that this is not geography, but physics. I will say in reply that physical conditions enter into geographical problems, and we can not separate them without destroying the content of geography. The pupil should have become familiar with many simple physical problems in the last years of the grammar school, but if he has not it is perfectly right as well as necessary to introduce them whenever by so doing we make the meaning of the geographic facts clearer.

It can be said of chemistry also that many of its phenomena are illustrated in the experiences of every-day life. These experiences have their geographical aspect which ties them up to life and chemical changes viewed in their relation to the earth as a whole.

In biology we take up the development, structure, and classification of living things. We study them for their own sakes. In physiography we study life from a wider and more comprehensive standpoint. We look at it from its relation to the physical world. We study the factors governing the distribution and modification of living things, how they have been affected by climate, the food supply, and the relief of the earth's surface.

We have been subject to the influence of physical forces as well as the plants and lower animals. Everything we do is more or less com-

pletely determined by our environment. In our racial as well as our individual histories it was the *tout ensemble* of the phenomena about us, as they were related to our ill or well-being, that first attracted our attention rather than the facts arrived at in later years through analysis. This should aid us in arranging our scientific studies in their proper order.

Physiography is simpler and in every way more suitable for high-school pupils than is geology. The study of the origin and changes of land forms offers a good foundation for geology both through its actual content and through its training of the observational powers. While it is true that geological problems enter into a complete understanding of the meaning of land forms as illustrated particularly in movements of the earth's surface and the formation of rocks and minerals, yet these can be made simple and easily understandable for the purpose in hand.

In geology we study a volcano as an end in itself. We inquire into the causes of its origin, its materials and its physical history. In physiography these things are gone into only in sufficient detail to make plain the relation of volcanoes to climate, soil, distribution of plants and animals, and finally man and his activities.

Meteorology forms an extremely important part of physiography. Through its study many problems in physics and chemistry find practical application. Man can overcome to a considerable degree obstacles presented by land and water, but he is almost completely at the mercy of the air. The climates of the earth are in large measure dependent upon its movements.

Oceanography also enters into our subject. The currents and tides of the ocean, together with its influence upon climate, and the living things which it supports, round out our study of the earth.

Astronomical geography introduces us to the earth as a member of the solar system. That part, however, which is of especial importance to physiography has to do with climate as related to daily and seasonal changes.

The dependence of man upon all of the above-mentioned physical conditions, how in every place and at all times he is more or less at their mercy, should be made most emphatic in a properly arranged course in physiography. Man is the highest product of the cosmic forces, and while there can be a real geography without him, yet his presence makes possible a knowledge of its meaning.

The geography of agriculture is more important to the average high-school pupil than is agriculture undertaken for its own ends. It introduces him to an elementary study of rocks and how they decay to form soil. It takes up the distribution of different kinds of soil as related to rocks, to slope and to climate. It finally brings out the intimate connection which exists between the soil and the industries of man and his spread over the earth.

The formation and distribution of mineral substances should be taken up in connection with physiography, for they exert a powerful influence upon commerce and industries.

The net result to the pupil from a course in physiography made as comprehensive as has been outlined above, will be small if the work is based upon a text-book. If we go to the other extreme and base it upon in-door laboratory work the result is almost as bad. In either case he is lacking in ability to apply his knowledge to the world of real things. That kind of geographic knowledge which possesses practical utility finds its first and most important elucidation in the phenomena open to observation all about us. The ideal course in physiography being based largely upon observation must vary more or less with the materials at hand in different places, and its laboratory is preëminently out of doors. Laboratory work in physics, chemistry, and biology deals with practically the same principles and illustrations everywhere. It is more formal and pays little attention to the surroundings of the pupil.

The main aim in a course in physiography should not be the acquirement of book facts, or of the so-called laboratory methods, but rather to so familiarize the pupil with the phenomena of the land, the water, and the air in their relation to each other and to living things, that he can at any time, and wherever he may be, interpret them with a reasonable degree of certainty. For example, training in the principles and use of meteorological instruments is physics, and has no geographic content. Most pupils leave school and never have anything to do with such instruments in after years. Such training must be supplemented by observations made out of doors upon actual weather phenomena. The ability to interpret the signs of the sky gained through observation, and aided when possible by meteorological instruments, is the thing that will prove of importance in life. This knowledge is strictly geographic in its nature, and when once acquired can be made of use in any part of the earth.

The only regional geography that should be introduced into a course

in physiography is that which helps the main thought of the subject, which is the gaining of a working knowledge of the geographic relations existing in all phenomena.

All the commercial geography which will do the first-year high-school pupil any good is that which can be worked in similarly to regional geography. When the main conceptions of physiography are recognized by teachers, the question as to what should be included and what excluded will no longer give any trouble.

We may say, then, that a course in physiography or physical geography fails of accomplishing its main ends if the pupil goes out from school unable to interpret the facts of his physical and vital surroundings in relation to himself and to the world as a whole. The memorizing of facts from a text-book, whether in the grammar school, high school or university, is largely useless, for the most of them will be forgotten. The ability to interpret nature is no more going to be forgotten than is the ability to swim when once acquired, though it be not practised for years.

From the standpoint of geography the earth may be considered an organism upon whose surface multitudes of living things carry on their activities subject to physical laws. Latitude, direction of the wind and ocean currents, distance from large bodies of water and elevation are all concerned, bringing in an infinite variety of physical problems. The manner in which the sciences have developed, from the general to the particular, should teach us, if nothing else does, that this broad geographic view of nature should come before any specialized science. We should learn something about the organism as a whole before we dissect and analyze it.

Physiography as I view it is a true science of wonderfully wide adaptiveness. In its simple interpretation it is more suited to immature minds than formal analytical science, for it sees things in their large relations and in wholes. In its deeper aspects physiography offers unlimited opportunities for advanced students through its world-wide inclusion of all physical and vital relations. It might be called a universal science, and thus viewed approaches philosophy. Thus the subject may be made of the highest advantage both to the pupils who leave school at an early age, and to those who expect to continue its study in later years.

Let us now consider the relative importance of the different factors entering into a course in physiography. Geography is not a heterogeneous aggregate of facts about the earth. It is no longer purely descriptive, but seeks for causes and effects, and the inter-relations between all

phenomena. It seems irrational to speak of geography as the "study of the earth as the home of man." This statement seems to imply that there could be no geography without man. If a rational being were examining the earth from an exterior point, the presence or absence of man could in nowise affect the development of a science of geography.

Many teachers are of late coming to hold that too much attention has been given land forms to the neglect of other and more vital phases of the subject. There can be little doubt that much of the modern teaching of physical geography, although showing a great advance upon earlier years, is open to serious criticism. In the reaction from the purely text-book methods and the introduction of laboratory work, much of the latter following after physics has become *too formal*.

The study of land forms in the newer teaching has not been properly adapted to the needs of high-school pupils. It has been made an end in itself rather than a foundation for the wide field of geographic influences and relations.

When, however, we call to mind the dependence of living things upon the character of the land and its relation to the water, we can not, if we go at it rightly, emphasize that side of our subject too strongly. Except in regions of low relief and wide extent of similar physical conditions, the influence of slope and elevation is so marked that we can not escape it.

There can be little question that in most courses of high-school physiography the life side is neglected. The text-books generally slight this phase, and it is little wonder that the teachers follow them.

We should interweave with our study of land forms the definite relations which exist between them and living things. Each successive stage in the development of the land has its own particular influence upon climate and life. The elevation of a mountain range may completely change the climate of an interior region, and with this change come modifications of the fauna and flora.

A worn-down range will cease to condense much of the moisture of the passing storms, and a well-watered region becomes uninhabitable. Such great changes as these are illustrated in some of the features of California, and taken together with the almost infinite number of important but less striking influences which are observed everywhere, the lands and their evolution form one of the most important branches of physiography.

It is only through an understanding of the effect of the relief of the

land upon life that the history of the human race can be understood. We should not let the thought that man is the most important product of the earth minimize the importance of a knowledge of the physical conditions under which he has gained his present position.

If we make physiography an elementary science in which the underlying principle is geographic, the work must be based upon observation and experiment. A knowledge of the physical relations existing in the home region must form the basis of any extended study. The ability to interpret the surrounding physical and life conditions is the essential thing, and from this we can extend the work to our own country and the world at large.

In arranging a course in physiography emphasis should be laid upon what is at hand and open to investigation, while those phases of the subject of which little illustrative material can be had should be put in the background. For example, it would not be wise in such a course as I have in mind for a school situated in the heart of the Mississippi Valley, far from any volcanic phenomena, to make a special study of volcanoes.

The pupils can gather something from specimens, from pictures, and descriptions, but not a fundamental working knowledge which comes from contact with the thing itself.

For a school situated as above, much time should be devoted to stream erosion and sedimentation, to the formation of the rocks and their decay to soil; the relation of plant life to the uplands and the lowlands, and human industries as dependent upon all these conditions. The skill acquired in working out simple geographical problems of this kind can be carried over into the wide field of geographical relations, so that wherever the pupil goes he is better fitted to interpret what he encounters.

The memory work in a course in physiography should be reduced to a minimum. Everything should be made as real as possible through constant appeal to experience, to specimens, to pictures and descriptions of the earth brought by travellers and explorers.

A course in physiography as outlined above gives a good foundation for commercial geography, economics, and the formal sciences. In addition it gives an outlook, places things in the proper perspective, and increases wonderfully the pupil's efficiency. The subject is better adapted to the immature minds of pupils at the beginning of their high-school course than is any one of the formal sciences, and has the additional value that it awakens interest and thus leads to the taking up of the later specialized work in the proper spirit.

There is constant danger that the laboratory work in physiography will become a matter of cold, formal routine. A prolonged study of maps, diagrams, and instruments is particularly to be guarded against. The ability to read and make use of contour maps is one of the essential things, but when students are kept for days examining them and discussing their significance, that spontaneous interest which sees in the maps a country which they may sometime visit and explore, the interest, and with it the value of the work, is lost.

Methods suited to university investigations are not the thing for first-year high-school pupils, and yet how frequently do we see this self-evident truth violated. One of the most serious defects of high-school teaching as well as that of the grammar school is the attempt to teach facts and use methods far beyond the pupil's interest and comprehension.

Physical geography or physiography is not taught in a large number of high schools. In many where it does appear in the curriculum the subject has no standing, but is taken as an easy and handy thing to fill up a course. In only a few schools is it made a required study for all pupils. The efficiency of the work is further handicapped by the current idea that anybody can teach physical geography. The old notion that all that is needed is the hearing of recitations from a text is still too prevalent, and so we find the work often turned over to the teacher who has the most time, without regard to whether he has any interest in, or qualifications for, the subject.

The lamentable lack of any work in nature study or physical phenomena in the seventh and eighth grades of most grammar schools leaves the pupils entirely unprepared for physiography, so that it is necessary to unduly emphasize the purely science side of the subject. This lack in the grammar school is bad enough, but the failure to recognize the importance of a broadly cultural subject like physiography as an introductory course in the high school is inexcusable. Physiography should fill the gap between nature study and science. Nature study is closely related to the geography of the grades, and science is but specialization applied to the materials entering into the all-inclusive subject of geography.

Geography has become a thoroughly organized science with definite content and definite objects to be accomplished. Beginning with nature study in the primary school we differentiate geography in the grammar grades. In the beginning of the high-school period we apply the enlightenment gained in nature study to the broad subject of geographic relationships, or in other terms physiography, and in the science of later years

we take up the various classes of earth phenomena entering into geography and study each for its own sake.

Let us forever clear our minds of the notion that there is any truth in the assumption made by some that physiography is merely science in disguise. It is neither geology, nor physics, nor chemistry, nor biology, nor a combination of them all. No one can be rationally substituted for it, since with a wide and comprehensive outlook physiography includes materials from every one.

Physiography has further the great advantage of being adaptable to the needs of pupils of different degrees of advancement, so that no one need leave school without getting some of its culture, or feel that he has learned all that there is in it when he has completed his university course.

I trust that the main points in the analysis of the subject of physiography as given above may meet with the approval of teachers, and that the ideas brought out will aid in placing it in the position of importance which it should occupy in the high-school curriculum.

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