

THE NEED OF EARTH SCIENCES IN THE PUBLIC SCHOOLS

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1. VOCATIONAL BEARINGS (ABSTRACT ONLY)

This paper discussed the bearing of earth sciences on the many vocations in which knowledge of the earth plays an important part. The value of the knowledge of geology to farming, mining, oil production, and all industries concerned with the production of building materials and road "metal", was pointed out. A large proportion of the active men of our country are engaged in industries which have to do with soils, ores, fuels, and structural materials. In view of this great fact, it clearly is not right that boys be placed under a heavy handicap at the outset, by having the knowledge which affects their future productivity, withheld from them. Manifestly they should have a chance to gain the knowledge which will stand them in good stead, in all their future work.

In commercial life, knowledge of geography is as important as knowledge of geology. Where commodities are, where they are or are to be needed, how they are to be transported from the one place to the other, are primary matters of geography and fundamental matters in commerce. The location of power, of fuel, of raw materials, are parts of geography, and knowledge of them is a part of the equipment of every successful factory. These are but illustrations of the general fact that knowledge of geology and geography is of vital importance to the industrial life of most men. This being the fact, public schools cannot justify their action, if they do not make adequate provision for these subjects.

2. NON-VOCATIONAL ASPECTS

There is quite another aspect to geology, which does not concern itself immediately with income or with industry. The study involves the contemplation of things which are enlarging and ennobling, in a spiritual sense. No education which leaves out training of the imagination is properly enlarging or ennobling; and where, outside of science, is there such opportu-

nity for developing and training the imagination, and where in science, a better field than geology? The time conceptions involved, the force conceptions involved, the results involved in the operations of time and force, are among the greatest with which the student has to deal. They strengthen the mind by exercise of a sort which few other subjects afford. In space conceptions, astronomy surpasses it; in their appropriate spheres, physics and chemistry are equally effective for the educational ends here emphasized; but on the whole, no science surpasses it.

No subject affords a better field for the development of that sort of attitude of mind which seems especially to fit men for life. While there are phases of the subject which deal with facts and principles which lead to inevitable conclusions as certainly as mathematical reasoning does, there are other phases in which reasoning of another sort is called for. In most of the affairs of life, decisions are based on a preponderance of evidence. In few momentous decisions is the evidence so clear that there is but one side to the question. Rarely is the evidence 100:0; it is 75:25, or 60:40, or 51:49. And training in weighing evidence which is not overwhelmingly one-sided, is one of the most important functions of education, for most of the important decisions of life are reached by the balancing of conflicting evidence. Thorough training in geology must lead to the balancing of seemingly conflicting evidence, for there are multitudes of questions to which the student of even the elements of the subject is introduced, concerning which evidence must be weighed, and a tentative decision reached, with a full recognition of its tentative character. The recognition of this character of a conclusion opens the way to a revision of judgment when additional facts warrant, and this attitude of mind is the attitude to which good education should lead, in connection with all questions where evidence is inconclusive, and this means in connection with many of the affairs of life.

No claim is set up that no other subject does the same thing. As a matter of fact, some do and some do not; but the claim is set up that the type of subject which works on strictly mathematical lines cannot, by itself, afford the best preparation for the solution of the average problems of the average man.

Neither can other types of subjects which do not involve the balancing of evidence, and the development of the power to separate what is weighty and relevant, from that which is light and irrelevant.

One of the great lessons which the world needs most to learn, is that progress comes from cumulative achievement. If every individual could be made to realize that even his tiny contribution to the sum of useful work is really moving the world along, it would add grandeur to life and dignity to all human endeavor. This is a frame of mind that should be developed in every young person, and cultivated till it becomes a habit. Where can this be done better than in connection with such a subject as geology, where the stupendous results of processes which, day by day, seem insignificant, are constantly under consideration? Nowhere else in the whole range of subjects in our ken, is the majesty of the cumulative results of seemingly slight processes more sharply emphasized, and more constantly reiterated.

Processes are at work on the land which, by themselves, would in time destroy it utterly. They have been in operation so long that they would have accomplished this result eons ago, if nature had not provided counter activities which defeat this end. Nowhere is the inter-play of constructive and destructive forces, using these terms in their bearings on man's life and welfare, more pointedly studied.

One of the chief functions of education is to put man into sympathetic and appreciative touch with his surroundings. His physical surroundings are an important part of his environment, always and everywhere, and he who does not understand, is cut off from one of the great resources of life. It is of course true that one may enjoy a landscape, even if one does not understand geology; but he will enjoy it more if he does. A man may enjoy pictures and music without understanding much about them, but he will enjoy them more if he understands. And just as some education in music and art is to be desired because it increases a man's capacity for enjoyment of the things which he sees or hears occasionally, so education with reference to the landscape, which the average man sees much more than he sees works of art, and much oftener than

he hears music, is a desideratum. To go about the earth blindly, unintelligent as to the meaning of its surface configuration, is to cut off one of the great pleasures of life, and especially one of the great pleasures of travel.

Since all men are always in touch with at least a limited part of the land surface, and most of them in touch with enough of it to find lasting enjoyment in it if they are taught to see what it means, how can we justify ourselves, if we withhold this resource from this and coming generations?

Prompted by the attitude of mind which mountains inspire, I have repeatedly watched their effect on groups of students who, for the first time, live in them long enough to have their influence felt; and I have seen, or thought I saw, how littlenesses and meannesses drop away, and how the nobler qualities come to the fore. John Muir has made much of this idea in one connection and another, and I think he is entirely right. To many men, mountains are as inspiring, as uplifting, as soul-stirring, as great essays or great poems are to others. Is it not just as great a mistake to leave the one out of consideration, as the other? To the average young *man* at least, I suspect that the mountains are quite as much of an intellectual and moral tonic, as the best that he finds on the printed page.

What has been said of the mountains might be said, with modifications, of other parts of the earth. If there are those who think the landscape of an unrelieved tract like that about Chicago unlovely, I think this feeling would be changed completely, if the grand march of events which has made that surface what it is, were understood. While it can never have the charm to the eye that some other sort of surface has, it has its own elements of attractiveness, its own beauty, to the eye which really sees. When men belittle the attractions of the level prairie, they advertise their ignorance. One may not choose to read poetry all the time. With equal education in the two, I am confident that the normal man could live contentedly with the plains longer than with poetry—even of the best.

The sea has a charm for almost every soul, but he who gets only what the eye records of color and movement, fails of the larger meaning, which, to beauty, adds grandeur. What does

the salt of the sea mean? What is the period of time of its accumulation? What volumes of rock—many times all that is now above its surface—have been destroyed in its production? What range and volume of life of which the voyager has but a glimpse, does it harbor now? What of the life of which it has been the home in the time which has passed since life was, and what of the great evolutions that have taken place within it? And what is yet to come? The great panorama of events, of processes, of changes, all of which are involved in the history of the sea, add a meaning larger than the eye, unaided, sees. To see the ocean merely as it is, is like seeing the social fabric of today, without reference to what has been in the past, or what is to be in the future.

Our period of school is all too short to give us an intelligent look into all the fields with which it would be profitable to have acquaintance, but is this field on which we live and move and have our being, one we can afford to neglect?

There is one other aspect of both geology and geography, which gives them great educational value. Neither science is completed or nearing completion. There are great things ahead in both. As an organized science, geology is older than geography, at least older than geography in its modern sense, and is the more advanced. While geology has made phenomenal advances in the last half century, the problems ahead are so numerous and so interesting that even an elementary course in the subject, properly developed, opens up great vistas for the future. I believe it to be fundamentally important that young people should be led to see visions, and inspired by the allurements of future development. Nothing is more conducive to a right attitude toward life in general, than the feeling of the possibility of participation in the progress of the future. In this, geology is not peculiar. Only as it is less advanced than some other sciences, has it the advantage over them in this respect. In saying this, I am not losing sight of the fact that but few of those who give attention to geology in their student days, will ever go farther; but a comprehension of what is likely to come, stimulates an abiding interest, and abiding interests in various lines of work and thought, are important elements in a good education.

In modern geography the promise is perhaps even greater, since less has been accomplished. Perhaps no science touches human life and interests more closely, or in more ways. There is, I am confident, no science which, properly developed and utilized educationally, will do more for the development of good citizenship. Its substance perhaps touches the essence of material life, especially on the human side, more intimately than any other science. No other science and no other subject, unless it be sociology and possibly modern history, is likely to do so much to promote sympathetic understanding between the nations of the earth, and this is one of the greatest desiderata not only of this day and generation, but of all days and generations. For this reason, if for no other, promulgation of the knowledge of modern geography should be furthered wherever possible.

When geography and geology, and subjects which have similar advantages, occupy larger places than they now do in our educational system, I believe that our young men and women will be better equipped than they are now, to do their part in transforming a contentious world into a world of righteousness, based on mutual consideration.
