M.S. Thesis 1880

The Place and Value of Natural Science in the Public School.

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Fort-Collins
etc.
Man's position at the highest point yet reached in the upward march of development, and the fact that all lower forms of life are more or less directly subservient to his existence and well-being would seem to indicate that in the human mind an interest in man should be closely followed, both in order of development and in importance. The a priori argument is supported by the facts of the real order of development as...
observed in young children. One need but give close attention to the matter to discover that when the child is able to engage in mental activity beyond his immediate wants and his relations to others of the household, his closest attention is given to the living things about him. Any new object is regarded, but as he sees, hears and feels not alone with the organs of sense but also with and through all previously acquired knowledge, he is most interested in living forms because he associates the new idea with one or
in other work
(e) Study of Physiology and Comparative Structure of man and one or more of lower vertebrates, by dissection, modeling, drawing, and reading.

V. Study of Political Geography and of Contemporary History.

VI. Study of Arithmetic and of Grammar.

It is believed that the foregoing outline includes the whole province of common school work and is intended as a suggestion.
more which are already in consciousness. Having made a wider circle of knowledge, the child invests, by a vivid power of imagery, the plant, and even the mongrels, with the attributes of human beings or of the lower animals. Witness familiar facts. The child asks, 'Don't the plants be sorry if you take its flowers away?' 'What does the plant have flowers for?' 'What does it do with its flowers?' 'How does a plant get its flowers?' These questions, asked by a boy four years old, carry the thought of applying to the plant the attributes of higher organisms. But, while reasoning from analogy...
as applied to likenesses of form, the child soon begins to discover differences.

of function and immediacy as new interest

is created leading to closer observation. The

new form suggest new function and

experiment begins. A boy three years

of age tries, by opening the cat's mouth

and feeling in his own, to learn why the

cat cannot talk; or he tries to make

kitty pick up the ball with one

foot as he picks it up with one hand.

The methods of investigating of the

child and of the adult savage are

identical. Both observe, compare,

note differences, experiment, classify and

generalize, drawing conclusions from premises.
Both the child of civilized parents and the adult race do these things, in short, both reason. Their reasoning differs from other reasoning in degree only, not in kind. So in the material world the highest in some stage of development corresponds successively to a gradation of lower types, so the mind most highly developed has passed through each stage as correspond to all lower types. He who has then to deal with development in himself as student or with development in others as teacher must not fail to be guided by the nature of the human mind to the methods of nature. They are the ways
to which the civilized man resorts
in spite of the schools, - when he
desires to really know. Through and
by these methods of study the race has
advanced and the influence of
heredity and environment must
perpetuate them. The methods of
the schools in so far as they
repress the mental activity or energy
of the child, - for they do this, - and
in so far as they present substitute
the artificial form or representation
when the natural or the less artificial
might be used, - they do this also, - tend
away from these methods and proceed
by a line along which the resistance
is infinitely greater. Simple facts will illustrate.

There is no conscious mental effort in the case of a man's picturing to himself the spot in which his boyhood was spent. He sees it all without trying. But a body of intelligent-experienced teachers were asked to imagine a river basin with the result that less than six out of fifty could do it at all accurately. The thing they saw was a map, an artificial representation as inadequate as words alone would be to make enables a child to make a mental picture of a cow.

A visit to the eighth grade of the schools of a city noted for good schools
was so timed as to include the science lesson for the day. It was easily seen that the teacher was above the average in ability and good. The subject for the work as laid down by the superintendent was the manufacture of leather, an industry not carried on in the city. Although the teacher had, with great effort, done the best with the means, yet she felt and the class knew that the lessons failed not only to be interesting but even to be useful. It was attempted merely because of the course of study. Now, on the desk and on the walls of the room were
Several well-made cases containing insects well-mounted in cornu-fili. The teacher showed these and said, with pardonable self-gratulation, that the work, cases included, had been done by the pupils of the class then in the room and under her direction. Doing were routine work when the spirit of original investigation had been roused. Talking of wealth in the words of an encyclopedia where there are smelters, steelworks, smelters, gasworks, and excellent museums within the city limits, and a whole world of knowledge truth in plain and mountain and river within.
a half day's journey? This state of affairs is not uncommon and must continue to be found so long as the attempt is made to fit children to a cut and dried course of study.

In one of the grades of the school of Ft. LeFlour, etc., the pupils being from eleven to fifteen years of age, the teacher for the year 1885-6 proceeded in the following manner. Having arranged her daily program to suit the ordinary routine of the schoolroom, she reserved fifteen minutes during which the pupils were to ask questions upon any thing topic. Of course nearly all the questions referred to material things of the town and country. The
The teacher showed her interest in their questions by assisting them to answer their own questions. She also showed an interest in natural history by collecting and preserving insects, in geology and mineralogy by bringing in specimens and making inquiries for more, but she did so teaching in these lines in any other way. She studiously avoided answering questions but held herself ready to assist me.

The following form of announcement was drawn up:

A. B. has (or will) a head. He is intending to remain after school to find out about the ear. Those who wish to do so may assist.
The result of giving the class this opportunity to show their inclination was that forty-two out of a total number of fifty-one became much interested in studying mineralogy and natural history. Instead of leading them from the study and reading of books, however, the influence of their science work was to quicken their mental activity in all lines. The class drew more books, mainly scientific, that from the library than any other equal number of pupils. They inclined to original investigation, gained remarkably in power of concentration, and showed a marked disinclination for teaching from authority.
Enough has been suggested to show the tendency on the part of the pupils when free to choose, toward rejecting the school master's dogmatic instruction and the corresponding tendency to original independent investigation as applied to material surrounding.

The child six years of age, after allowing for parental instruction, taught himself a large amount, and the methods of his study, if known, should give clear and definite principles upon which the teacher may safely proceed. I shall refer to some points which, as it seems, do not receive sufficient recognition in the
every day schoolroom.

1. The work of the schoolroom
in so far as it relates to the teaching
of reading, writing, arithmetic, drawing,
etc. is but a means toward the
great end of gaining knowledge. To
illustrate:—The teaching of words, if
made an end, no matter how diluted
by "object teaching," cramps and limits
thought. The child has used work as
a means of telling, naming, what he
saw, of recalling it, and thinking of it,
and telling about it. Words have been
replaced by things. Let them continue
to be as and the child will gain in
power in school as rapidly as he
gained before entering school. Words are learned for all time without conscious effort if they are supplied when their need is clearly seen and felt. The objection that the number of words which could be thus taught would not be sufficient fails from the fact that the very nature of the work makes the number of words mastered keep pace as far as the school can control the matter at all, with the number of ideas acquired.

2. The early teaching of the pupil will give him power precisely in the degree in which it gives him new ways of approaching
material things or improves the 
old ways, so that a greater quantity 
of truth becomes, by these means, known 
in the mind of the child. Observe 
with or without the many-sided treatment 
of each new object by the young child. 
He dwells upon it in every aspect, yet 
casts it aside with indifference the moment 
it fails to yield him new ideas. Most 
of the play of children is really study 
of the nature indicated. Now, the teacher 
makes this little student a better student 
if she trains him to get more of truth 
from the same source as before, but 
not otherwise. She may take him into a 
order field but unless the power o
his mind keeps pace he is exhausted and the result is limitation not expansion. She may add with profit new or improved ways of expressing—painting, modeling, drawing, writing, talking more freely, new words—but these are all means and the source of real knowledge is not in them.

3. Expression of thought, which gives exactness of form, crystallizing truth, and which by its exigencies makes observation more critical and accurate should be varied up to the greatest possible limit.

Painting and modeling should precede drawing, color and surface
are grasped beforemittingpencil. A solid form is less artificial a drawing than one
Drawing should not begin with straight lines but with the thing to be drawn. The child’s critical faculty is not developed much in advance of his power of execution. As he sees better he will draw better, but he is not discouraged by failure for he sees no failure. Talking should lead to talking with the pencil without the intervention of printed matter. Let the child know the necessity for a record of knowledge and make such record of his new knowledge and he approaches the printed page with an interest and
with anticipations of the pleasure of knowing.

The study of the concrete as found in the natural world is the only study which admits of the application of these principles, the only study which admits of self-development, pure and simple, on the part of the child in the earliest years of school life. The work of the primary school must not be wholly done within the four walls of the schoolroom, and the teacher must not be cramped and limited by an arbitrary course of study. That which should be studied which is best adapted to the child and the time and
the means, and the work done this year may or may not be the best work to do next year. It will certainly not be done many times in the same way if the teacher keep steadily in mind the main purpose, increasing the mental power and grasp of the pupil.

The place of natural science in the public school is then, not a secondary one. Natural science is not to await greater maturity of reasoning power in the mind, for the child reasons, a certain so-called pedagogical principle is the contrary notwithstanding. It is not to await greater power of expression, for we
think in words, and words are best
learned when the need for them is felt.
It is not to give place to numbers,
for number is but a means of knowing
the external. It is not to give place
to language, for language is a
means of telling others the truth we
have found. It is not to give
place to reading, for this is but
a means of learning the truth others
have found. The position, broadly
stated, is that the earliest-mentioned
in the public school should be from
natural science and that painting,
modeling, drawing, writing, reading, number
should be accessory to the main
purpose, holding continuously the subordinate position they, from the nature of the case, deserve.

Are not the names, used in Botany for example, too long, too hard to acquire, too difficult to remember, for the proposed plan to be practicable? The answer is that it is the word without the idea which presents the difficulties named. Show a child a large four-footed animal with a trunk, wait till he asks, “What is it?” tell him the name, and does he show any effort in learning or remembering? It is much easier to know the corolla than to know “4° 18’ 16,” for the idea may be preceded.
The more technical terms are not those of which the need will first be felt, and the less technical present little difficulty. One name is as easily learned as another. Among words purely descriptive, there are differences, and the rule is to give first those words which have the wider application.

Some words in common use have no application to the concrete, or they are such as will be difficult to apply to the concrete in teaching. As an example of this supposed class of words, "other" was recently given. I brought into my schoolroom this morning, and have now in the closet,
an apple for each of you. I intend giving them to you.” What will be the word which rises to the lips of every child? If a word cannot easily be made thus obvious and striking in its application, let it alone for a time. The greatest evil must arise from the attempt to force the mind out of its natural, kindly directed methods of activity.

The teacher of today is not prepared for this work and, time must elapse before she is either convinced of its desirability or prepared for its inception. Said Horace Greeley, “The way to resume is to resume,” and
the way to begin is to begin.
It will take years, perhaps many generations, to eradicate the monarchial, despotic theory of the school.
It will take years, no doubt many generations, to reach that high point in the evolution of the school at which the school shall be found to be permeated by the desire to know, but that time will come and it will come through recognition of the natural activity of the child as the guide of the teacher. When that time comes, we shall not train men to depend upon others for their conclusions, but rather to see
see for themselves, to know for themselves. Says a prominent educator, in substance, 'The methods of the schools of New England were those of the mother cow. Girls as pupils have grown up in them and have in turn become teachers. The idea of the school is that the common people must be instructed in knowledge. Has been perpetuated in the practice and the attitude of the teacher toward her pupils. The discipline of the school is founded on the patriarchal and despotic not on the democratic idea. When the school favors original study of
the part of the child the democratic idea will prevail.
This work may be much helped by a disposition on the part of parents to demand it of the teacher by a disposition on the part of the teacher to learn of her pupils those things which they know and she does not, by the right and proper attitude on the part of those who train teachers, and by beginning at once. The Michigan State Agricultural College can do much by inducing teachers to attend the farmer's institutes and giving the right sort of instruction at
these gatherings.

(One of the problems which must soon force itself on the attention of all is that of the education of girls so that vigorous health may not be sacrificed. To secure this end the making of physical science the central idea of the school will aid in two ways. “Pressure” will be removed and an active out-of-door life will be led. Boys and girls will have more interests in common.)
Order of Topics
and of Methods of Expression.

I. Plants and, as practically, animals
and making impressions
(a.) Modeling in clay; with names
of more obvious parts and descriptive
words of form.
(b.) Painting; with names as before
and descriptive words of surface
and color.
(c.) Drawing of the object; with
names as before and descriptive words
of outline.
(d.) Writing and reading of script;
names first, then descriptive words closely applied to names, followed by verbs and complete statements. Words always written as wholes and never written at all or presented at all except as needed to express an idea or thought for a purpose formed by the child.

(c) Reading of print.

(f) Number and counting incidentally.

II. Study of the Earth organic world, beginning with geography determined by strata, transportation, erosion, upheaval and stratification.

(a) Modeling in sand. Relief forms first.
(b) Effects of relief forms; including drainage, climatic, soil, mineralogy, and products studied as fully in detail as possible.

c) Drawing of outlines. Measurement.

d) Telling, orally and with pencil, of shapes, positions, and distances.

e) Number as used in measurements.

(f) Reading of descriptions of objects and modeling from them in clay, then oral descriptions from models.

III. Study of geography not-local from maps and printed matter.

(a) Modeling from map and print.

(b) Drawing of outlines with names.

(c) (With modeling) Geological structure
and to surface as determined by it, drainage, products, and occupations and characteristics of men, by reading

(a) Reading and selling of products.

IV Study of history. By gaining with savage peoples: their homes, customs, appearances, clothing, pursuits, and industries, and passing upward in the scale of civilization.

(a) Reading and modeling in clay or making models in wood.

(b) Reading and drawing.

(c) Reading and making of written abstracts from reading.

(d) Special work in number to secure facility in dealing with numbers as involved