

M.S. thesis 1886

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

A. A. Remington.
Fort Collins,
colo.

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, by an interest in natural ^{science} history.

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 go 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

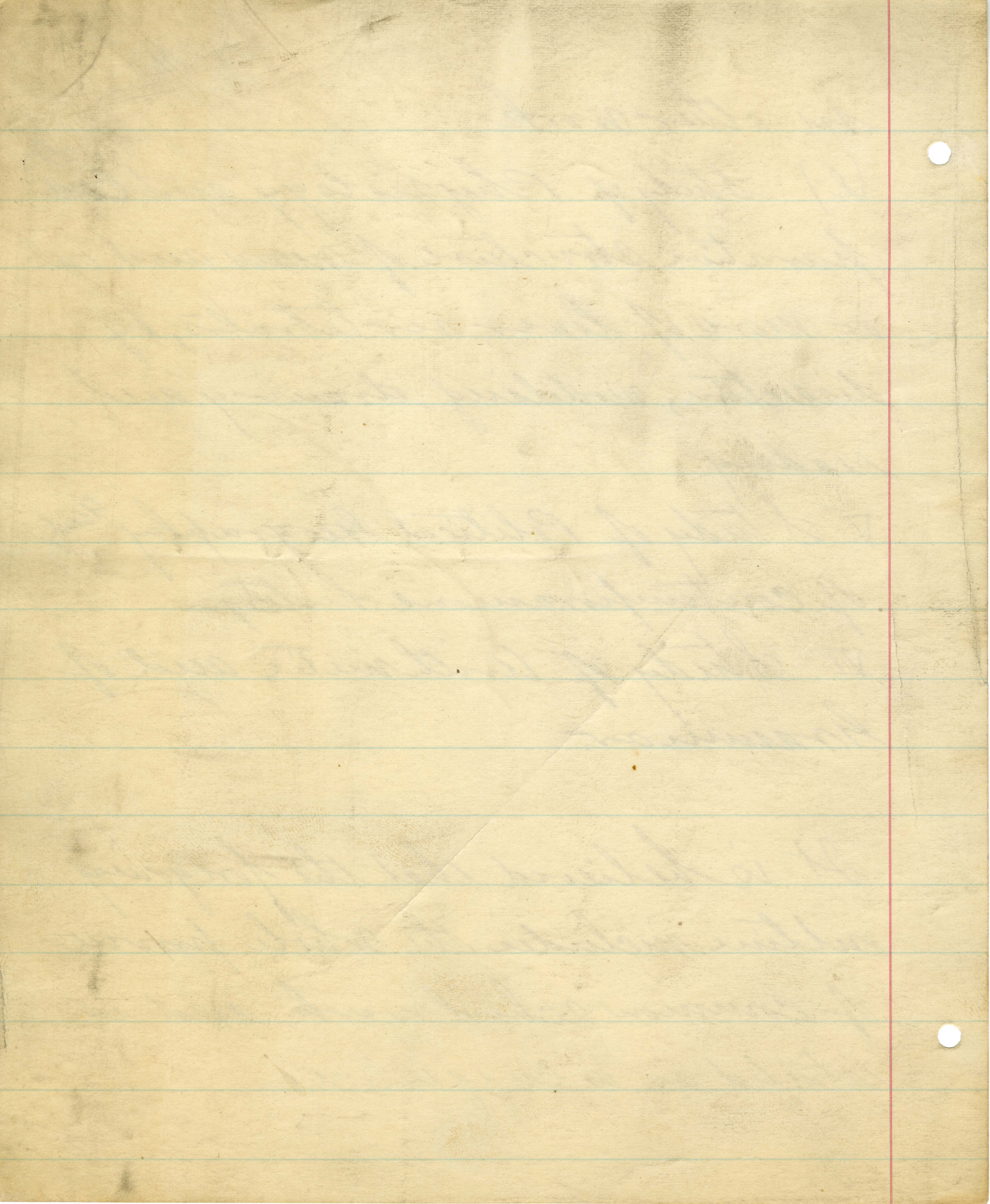
in other work

(c) 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 contemporaneous 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.

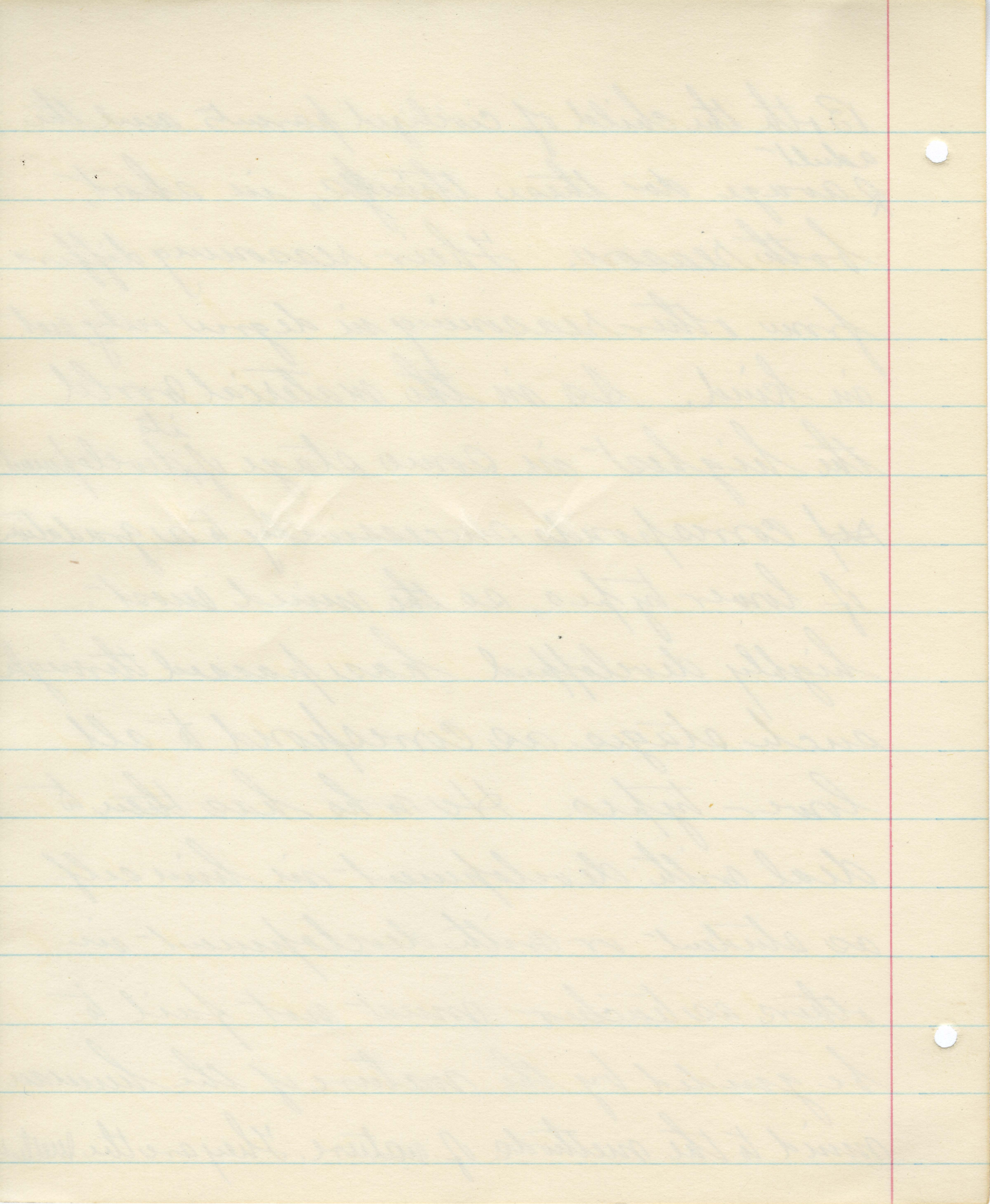


more which are already in
consciousness. Having made a
wider circle of knowledge, the child
invests, by a vivid power of imagery,
the plant, and even the inorganic ^{form}, with
the attributes of human beings or of
the lower animals. It witnesses familiar
facts. The child asks, "Won't the plant
be sorry 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~~ apply 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 immediately a new interest is created leading to closer observation. The new form suggests new function ^{or vice versa} 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 investigation 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} savage do these things, in short, both reason. Their reasoning differs from other reasoning in degree only, not in kind. As in the material world the highest in some stage of ^{its} development ~~it~~ corresponds successively to a gradation of lower types, so the mind most highly developed has passed through such stages 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 methods



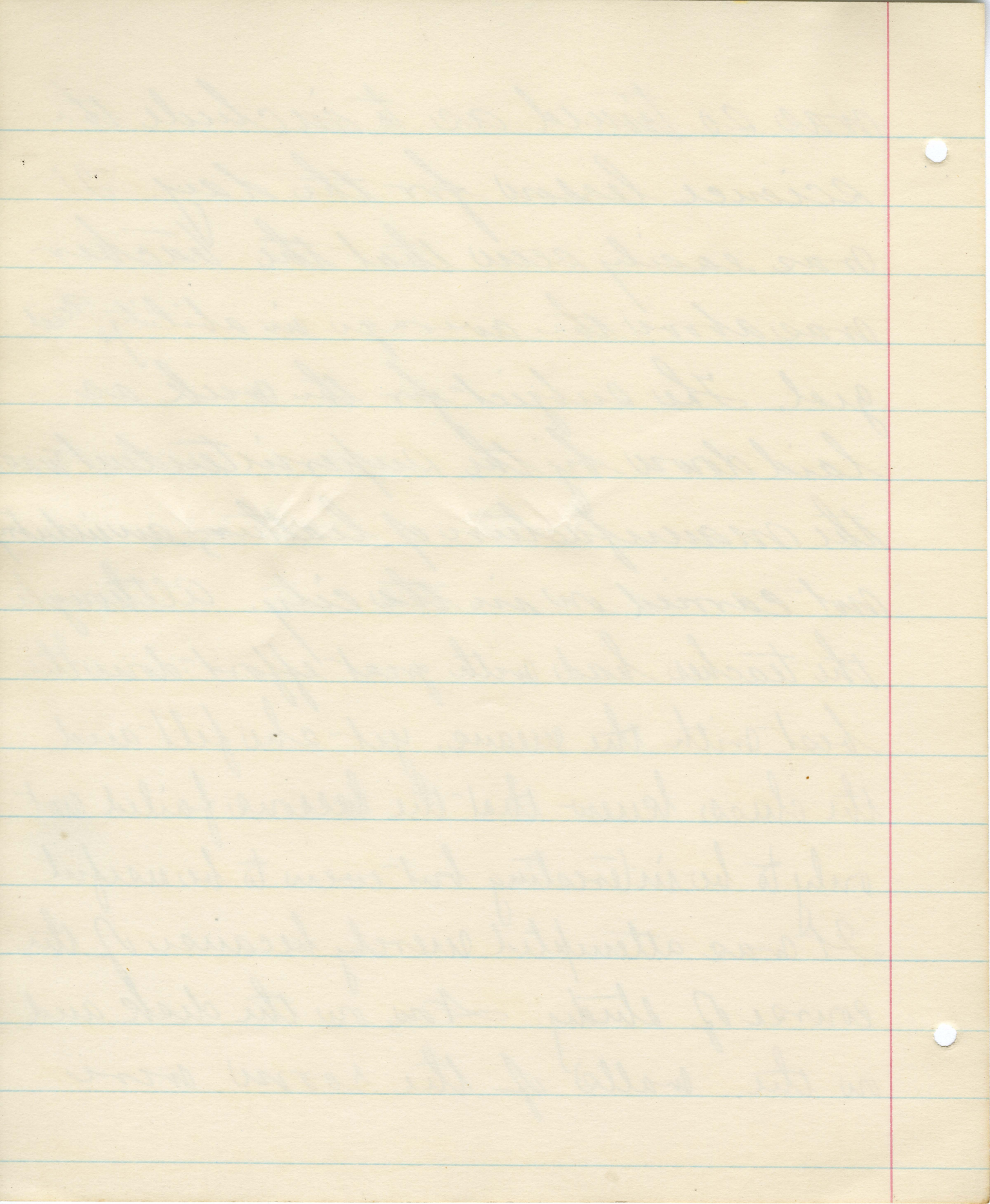
to which the civilized man reverts, - in spite of the schools, - when he desires to really know. Through and by these methods of study the race has advanced and the influence of heredity and environment must perpetuate them. The methods of the schools in so far as they repress the mental activity or 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~~ enable 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 zeal. The subject for the week 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 ~~on~~ in corn-pith. 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 mere routine work when the spirit of original investigation had been once roused? Talking of leather in the words of an encyclopedia when there were smelters, steelworks, foundries, 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 schools of Ft. Collins, Colo., 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

teacher showed her interest in their ^{work} 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 no teaching in these lines in any other way.

She studiously avoided answering questions but held herself ready to assist in continued observation or in experiment.

The following form of announcement was soon in use: -

A. B- has (an owl's head,) &c 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 ^{it} quicken their mental activity in all lines. The class drew more books, mainly scientific, ~~than~~ 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 pupil, when free to choose, toward rejecting the "schoolmaster's dogmatic instruction" and the corresponding tendency to original independent investigation as applied to material surroundings.

The child six years of age ^{has} 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 a schoolroom.

1. The work of the schoolroom in so far as it relates to the teaching of reading, writing, number, 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 words as a means of telling meaning what he saw, of recalling it, and thinking of it, and telling about it. Words have been secondary to things. Let them continue to be so 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, so 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~~ ^{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, knowledge in the mind of the child. Observe ~~with what~~ 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 sources as before, but not otherwise. She may take him into a wider field but unless the power of

his mind keeps pace he is exhausted and the result is limitation, not expansion. She may add with profit new or improved ways of expression - 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 before outlines and a solid form is less artificial ^{than} a drawing.

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 own knowledge and he ^{then} 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 earlier years of school life. The work of the primary school must not be wholly done within the four walls of the school-room, and the teacher must not be cramped and limited by an arbitrary course of study. That should be studied which ~~are~~ ^{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 view 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 to 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 number, 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 ^{earlier subjects of study} earliest ~~instruction~~ 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 "A. B. C." 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, "when" was recently given.

I brought into my schoolroom this morning, and have now in the closet,

an apple for each of you. I intended 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, ~~actively~~ directed methods of activity.

The teacher of today is not prepared for this work and, ^{much} 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 monarchical, 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 country ^{and}
as pupils have grown up in them
and have in turn become teachers
the ~~idea~~ opinion of the monarch
that the common people must be
^{in knowledge} limited, has been perpetuated in
the practice ^{of the schools} 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 on

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 farmers' institutes and giving the right sort of impetus at

these gatherings.

(One of the problems which must ~~soon~~
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 ^{the study of} natural science the central
idea of the school will aid in two ways.
"Pressure" will be removed and ^{more} ~~all~~
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 practicable,
animals.

(a.) Modeling, ^{and making impressions} 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 applied to names, followed ^{closely} 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.

(e) Reading of print.

(f) Number and counting incidentally.

II. Study of the "Inorganic World", beginning with ^{home} geography as determined by ~~strata~~ transportation, erosion, upheaval and stratification.

(a) Modeling in sand. Relief forms first.

- (b.) Effects of relief forms; including drainage, climate, 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 ~~the~~ surface as determined by it; drainage, products, and occupations and characteristics of men, by reading.

(a.) ~~Buying~~ ^{and} selling of products.

IV. Study of ^{natural} history, ^{of man} beginning with savage peoples; their homes, customs, appearance, 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