



Hunt Institute for Botanical Documentation
5th Floor, Hunt Library
Carnegie Mellon University
4909 Frew Street
Pittsburgh, PA 15213-3890
Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
Web site: www.huntbotanical.org

The Hunt Institute is committed to making its collections accessible for research. We are pleased to offer this digitized item.

Usage guidelines

We have provided this low-resolution, digitized version for research purposes. To inquire about publishing any images from this item, please contact the Institute.

About the Institute

The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

A Discussion of
A Plan
of a
Scientific Course.

Digitized by Hunt Institute for Botanical Documentation
by C. E. Bessy
Ames. Iowa.

Read before State Teachers Association
Linnell Iowa.
Dec. 28, 1876

1
A Discussion of
A Plan of a Scientific Course.

Before beginning, I would have it clearly understood that this essay has nothing to do with the needless and unfortunate quarrel which has arisen between some of the teachers of Science on the one hand, and of the Classics on the other. Those who think there is cause for such a quarrel, and who imagine an antagonism between the languages and the Sciences, may fight it out if they choose; for myself, I see no necessary antagonism, and know of no cause for quarrel.

The main object of a scientific course of study is, as I shall assume in this discussion, to give that training which will prepare the man of rather more than average ability for successful labor in some of the fields of Science. It must not be expected of such a course that it shall make a man master of the sciences, nor even master of a single science, but that it shall give to him such training as will prepare him to pursue to the greatest advantage, during his post-graduate life, the study of one or more branches of Science, and to meet intelligently the difficulties which will arise while making his in-
 Digitized by eGangotri Institute for Botanical Documentation

3

tigations. The proper work of the school and of the college, is to train the man for his work, to familiarize him with the methods, and to give him those habits of mind and body, which have proved most conducive to valuable results in the workers who have preceded him. The School of Science is not essentially different in this respect from other schools; the object is not so much to put the student in possession of great stores of knowledge as to give him the power to acquire them.

Hence there must be laboratories of Chemistry, of Physics, of Biology, and of Geology; there must be libraries,

4
and museums, and collections
of apparatus; for these are the
materials with which the scien-
tific man is to make his in-
vestigations. That course
of study can not be called a
course of training, which omits
what ~~training~~ we are ^{now} in the hab-
-it of calling Laboratory Prac-
-tice. The old motto "Science
with Practice" is today the ruling
maxim with our foremost sci-
-ence teachers.

5
Another object of a Scientific
-ic Course, which is perhaps
not clearly distinct from the
former, is to arouse in the
young a love for plants and
animals, and a curiosity
about stones and fossils, the
wind, the snow, the rain, and
the thousand and one other nat-
-ural phenomena which too
often are entirely unobserved,
or if observed scarcely more
intelligently than by the wild Indians.

Digitized by Hunt Institute for Botanical Documentation
These are many boys and girls
who need but to be guided to make
close observers, or careful collect-
-ors. They readily learn to use
their eyes, and it is astonishing what
rapid progress they can make, and what
enthusiasm they are capable of exhibiting.

6

While a teacher in the common schools, I saw some wonderful developments of this kind.

I once organized a class in Natural Philosophy in a school where the old routine of reading, writing, spelling, arithmetic, geography, and grammar had never within the memory of man been varied from. I gave the class a plainly written book filled with excellent woodcuts.

Being an adept in whittling I constructed during my leisure moments many little pieces of apparatus for illustrating the topics taken up from day to day. As the school-room was merely a common single

17
room, the class recited in the pres-
ence of the whole school, and
I may almost say that the
whole school took part in that
exercise. Grammar, Geog-
-raphy, Arithmetic, play, mis-
-chief, drowsiness, — all gave
way to intense interest. Even
the little six- or seven-year-old
watched and listened with glis-
-tening eyes and attentive ears.
My devices were all duplicat-
-ed, and my experiments were
repeated ~~repeated~~ ^{repeated} morning
and night a hundred
times. A mill in the
vicinity was invaded night
and morning by an eager
crowd of boys, and no mechan-

8
-ical arrangement, from the
big water-wheel down below, to
the dusty pulleys and cog-
wheels in the attic escaped
them. A company of
them took a twenty mile
ride on a bitter winter day
in order to examine the mechan-
-ism for reversing the motion
of the locomotive engine.

The country was ransacked by
these embryo scientists, and
old and forgotten apparatus
was brought to light and made
to contribute to our stock.

And yet this was in a common
school, and the pupils were
such as you may find in
thousands of places in Iowa.

But this was not all; their⁹ enthusiasm was not expended upon Natural Philosophy alone.

One morning a boy brought a little stone containing a fossil, and laying it on my table, asked what it was; I told him, and in an hour or so made it the text for a little geological lecture to the school. Soon the stones began to come in, and some mornings my table would be literally covered with the contributions from my 'amateur paleontologists'. In this again the whole school seemed to be interested. I shall ~~never~~^{not soon} forget one little fellow, the only one whose eye

10

I could never catch while talking about the specimens before me, and whom I supposed to be utterly indifferent to all this scientific furor. One evening as I was walking alone to my boarding place, an hour or so after the close of school, as I rose above the crest of a hill, I saw in the distance some one, with a great stone held in his two hands, hammering vigorously a large ~~stone~~ ^{rock} by the road-side. I soon found that it was my pupil, and so intent was he, that he did not discover that he was observed until I approached quite near to him, when, dropping his stone and seizing his basket, he

11
marched on with an air of the
utmost indifference for me,
or for rocks, or for fossils,
And yet a day or two later
that little fellow brought me a
magnificent specimen of a fossil
coral.

There is no question at all
~~as to~~ the possibility of introduc-
-ing the Elements of Science into
the common schools. It can
be done, and, when proper-
ly done, with great profit to
the pupils.

12
Do you ask then, "when shall we begin to teach the Elements of Science?"

Unfortunately the question can not now be answered as it should be. Were our teachers ready to do so, they should begin with the primary classes in the Common School.

There appears to be a great fear, on the part of some, lest the children's minds should not be ready for the reception of scientific facts: but the trouble is not with the children, they are ready to learn about plants and animals and simple machines, and have always been ready; it is the teacher who lags ~~behind~~ in this.

13

It is perhaps hopeless to expect, for a long time yet, that teachers in the common schools will be able to instruct their pupils in Elementary Botany, Zoology, and Physics; but it is nevertheless exceedingly desirable; and it is the duty of those controlling school affairs in the country, to bring about as rapidly as possible, the necessary improvement in the qualifications of teachers.

Digitized by Hunt Institute for Botanical Documentation

Do you ask how shall we begin the teaching of Science? Begin by making yourself well acquainted with the trees, the shrubs,

124
and the wayside herbs, the birds,
the quadrupeds, the frogs, and
the snakes in your neighborhood
and then take these as your
subjects, not for the didactic
-ious, ~~of~~ barren "object-
-lesson", but for suggestive
little talks, Encour-
-age the natural curiosity of
your pupils: lead them to
ask questions about every-
-thing they see. Tell them
frankly that there are a great
many things you do not under-
-stand, but let there be nothing
you do not wish to understand;
possess this spirit yourself, and
your pupils will certainly ac-
-quire it.

15

But a Scientific course must include more than the sciences alone. The mechanic who has the greatest number of necessary tools, in the best order, can, other things being equal, do the best work; so it is in scientific work; the man who has at hand, and in good order, the greatest number of helps, will, ~~in general~~, be able to do the most and the best work. The most skillful mechanic with poor tools can do but indifferent work, and in like manner, some an Agassiz, and a Huxley would have been unable to ~~be~~ lead the scientific men of their times, had they been

16

hampered by poor preparation,

Science is mainly cultivated today by the German-speaking people, followed by the English, French, Italian, Russian, Scandinavian, Danish and other Continental workers, in probably something like the order I have given. The literature of the science of today is, consequently, scattered throughout the languages spoken by the principal nations of Europe.

Until within a comparatively short time, the records of all scientific work were ~~the~~ mainly written in Latin, and it is still the custom in the

178

Biological Sciences to write descriptions of species; and the results of ^{certified} investigations in this common language of the educated world. The man, therefore, who knows no Latin is crippled in his work, through being unable to use the valuable literature of the last century, as well as ^{of that} ~~the~~ ^a not inconsiderable part ~~of that~~ belonging to the work of today.

It is then not too much to say, that any scheme of education from which the principal Continental languages, and Latin are absent, is ~~not~~ imperfect. A full command of one language (the mother tongue) and

18
~~and such command~~ ^{a fair knowledge} of Latin
and two or three of the other
more important languages I
have mentioned, is the very
least that can be allowed.
An Englishman, or an Ameri-
-can should be master of his
own language, for in it he
will record the greater part of
his work; he should in addi-
-tion be able to read with reason-
-able ease Latin, German and
French; if to these he can add
Italian he will find opened
to him many valuable records
with which he can ill afford to
dispense. I would em-
-phasize this point, the man
who would enter the higher

19
departments of scientific work
must not be meanly equipped
in the languages.

A great wrong has
been done to Science by
many schools and colleges,
which have established courses
of study in the sciences, and have
neglected the languages. [in those
courses] I have in mind some
such courses^{of study} which have been reduc-
-ed to the leaniness of only a very
little English, - and yet the fram-
-ers of these courses hope to make
scientific men who can com-
-pete with the better furnish-
-ed students sent out by wiser
institutions! What should
we think of a Governor who

20
sent his troops into battle un-
-armed?

It is gratifying to know, how-
-ever, that in this matter our
Colleges are improving; ^{and} ~~an~~ ^{an}
extensive examination of Col-
-lege catalogues within the
past month, shows that nearly
all recognize the need of German
and French ^{in their courses in Science} and nearly if not
^{quite} ~~two~~ thirds add from one to three
years of Latin. This indicates
a healthy growth, and shows
that the Scientific courses in
our Colleges are coming more
and more under the control
of men who know some of the
demands of Science.

21

And now while talking about the colleges, I may as well offer some criticisms to which, despite their improvements, their scientific courses appear to me to be open,

(1) They are, with scarcely an exception, entirely too short to accomplish the best results. In some cases the attempt is made ^{to} crowd all Science into four college years, taking the student upon his entrance at the point where he was left by the common school. In most cases five or six years are all that are allowed for the work, while in but one instance, out of a great number

22

which came under my observa-
-tion, were seven years of study
above the common school re-
-quirement of the candidate for
the degree of Bachelor of Science.

leave
out

When now we consider that
in none of the Colleges are the
facilities for scientific instruc-
-tion complete.

Digitized by Hunt Institute for Botanical Documentation

(2) Time is wasted by the practice
which largely prevails, of taking
up one study for a time, and then
abandoning it for another and
another, only to return again "after

many days" to the first. This²³
want of continuity in study is,
I am confident, one of the great-
est evils found in our scientific
courses. It indicates the
absence of a clear understanding
on the part of those who framed such courses of
the work to be accomplished: ~~and~~
~~the part~~ and in its results it is
apt to bring about the same con-
fused notion of Science, in those
subjected to such desultory train-
ing.

No doubt there may be
many excuses for this condi-
tion of things: the small
number of teachers, the want
of adequate museums, labora-
-tories and apparatus, too com-
-monly the case in our Colleges,

24

have had much to do with de-
termining what should and
could be done. *Heslin*
our Classical courses are
almost infinitely superior to
those in Science; in the former
the student, once started in his
work, keeps at it, and wastes
no time in the intermittent and
desultory method of study pur-
sued in the latter. In this
matter the Science teacher must
learn to be as wise as the teacher
of the classics. I believe it
to be a law which can not
be broken without great harm
to the pupil, that a study
once taken up should not be
laid down.

(3) Another serious fault in ²⁵
a large number of college
courses is what I shall de-
-nominate weakness in the
Senior year; that is I find
that in fully two thirds of all
the cases which have come un-
-der my notice, the Scientific
studies are mostly placed in
the Sophomore and Junior years,
so that in the student's progress
through college he finally passes
beyond the study of Science. A
more unwise plan I cannot im-
-agine; were the object to not
make Scientific men, one could
not well devise a method better
suited to the work.

This fault, however, is not

26
confined to the scientific course,
it is a common characteristic.
Take up the courses of Study,
Classical and Scientific, which
may happen to be at hand;
run them through, and you
can not help remarking upon
their similarity in the last
College year, and upon the
general abandonment of
a definite aim in the course.
They lead nowhere, or ~~rather~~
perhaps we may ~~say~~ ^{say} more
properly, they all lead to the
same unprofitable confusion
in which we find "Butlers Anal-
ogy," "Psychology," "Evidences
of Christianity," and other like
matters as prominent ingredients.

What natural relation is there²⁷
between the student's earlier
training and the topics given
him for study in his last
College year?

The fact is, we go at
this matter in the wrong way.
Our half dozen or dozen
professors are like so many
specialists in house building
who, instead of all working
together, work independently.

The mortar maker, the hod
-carrier, the wall-builder,
the chimney builder consult
no common plan, but perform
their allotted tasks according
to their individual convenience.
The joiner makes doors and

windows when and where ²⁸
he chooses, and so on the
building grows in its gro-
tesqueness, until at the
end of so many years, with
no regard for the intended nature
of the building, a bell-tower
and a steeple are fastened
over it all.

We are now ready to give definite shape to the foregoing discussion by incorporating its ideas into a course of training in science. For reasons given above we will not lay out any work for the common schools, but will begin at the point where the student usually commences his high school studies, or his work in the preparatory departments of most of our colleges.

In framing such a course we must keep in mind several requirements, which may be briefly recapitulated as follows:

1. The Course must furnish facilities for acquiring a knowledge of Latin, German, and French, besides a full command of the English language.

2. It must provide for an early introduction of scientific studies.

3. It must provide that a scientific study once taken up shall not be laid down.

4. It must provide for Laboratory ~~work~~ practice or its equivalent, for every branch of Science, throughout the whole time it is pursued.

5. It must become strong^{er}
-er in Science from year
to year, the last college
year being the strongest.

The Subjoined plan is presented
as a Study for a course of
training in Science; it is
merely provisional; and yet
I trust that it contains not
so much of error but that
it may ^{be worthy of} further study
and improvement ~~at~~ ^{at} your hands.

A Study for A Course of Training in Science.

32

First Year.

<u>First (or Fall) Term</u>	<u>Second (or Winter) Term</u>	<u>Third (or Spring) Term</u>
-----------------------------	--------------------------------	-------------------------------

English

English

English

Latin

Latin

Latin

Mathematics (Alg)

Mathematics (Alg)

Mathematics (Alg)

(Note for bottom of page 32)

Note. Unless otherwise indicated each study has five lectures or recitations per week; studies having a less number of exercises are followed by a fraction which in ^{lectures or} recitations devoted to them, e.g. $\frac{3}{5}$ means three recitations per week.

History $\frac{3}{5}$

History $\frac{3}{5}$

History $\frac{3}{5}$

Botany $\frac{1}{5}$

Botany $\frac{1}{5}$

Botany $\frac{1}{5}$

Zoology $\frac{1}{5}$

Zoology $\frac{1}{5}$

Zoology $\frac{1}{5}$

A Study for
A Course of Training in Science.

First Year.

First (or fall) Term | Second (or winter) Term | Third (or Spring) Term

English

Letter

Mathematics (Alg)

Drawing (1 hr daily)

English

Latin

Mathematics (Algebra)

Drawing (1 hr daily)

English

Latin

Mathematics (Alg)

Botany 1/5

Second Year

Latin

Mathematics (Group)

History $\frac{3}{5}$

Botany 1/5

Zoology 1/5

Latin

Mathematical Grammar

History $\frac{3}{5}$

Botany 115

Zoology 15

Latin

Mathematical Group

History $\frac{3}{5}$

Botany 5

Zoology 15

Officers:

Third Year.

33

Greek	Greek	Greek
Mathematics (Trig)	Mathematics (Trig)	Mathematics (Trig)
Botany $\frac{1}{5}$	Botany $\frac{1}{5}$	Botany $\frac{1}{5}$
Zoology $\frac{1}{5}$	Zoology $\frac{1}{5}$	Zoology $\frac{1}{5}$
Chem. & Phys. $\frac{2}{5}$	Chem & Phys $\frac{2}{5}$	Chem & Phys $\frac{2}{5}$
Drawing $\frac{1}{5}$	Drawing $\frac{1}{5}$	Drawing $\frac{1}{5}$

Fourth Year.

French	French	French
Mathematics (An. Geom)	Math. (Anal. Geom)	Math. (Anal. Geom)
Botany $\frac{1}{5}$	Botany $\frac{1}{5}$	Botany $\frac{1}{5}$
Zoology $\frac{1}{5}$	Zoology $\frac{1}{5}$	Zoology $\frac{1}{5}$
Chem & Phys. $\frac{2}{5}$	Chem & Phys $\frac{2}{5}$	Chem & Phys $\frac{2}{5}$
Geology $\frac{1}{5}$	Geology $\frac{1}{5}$	Geology $\frac{1}{5}$

Fifth Year

34

French	French	French
Math. (Calculus) $\frac{3}{5}$	Math. (Calculus) $\frac{3}{5}$	Math. (Calculus) $\frac{3}{5}$
Biology $\frac{2}{5}$	Biology $\frac{2}{5}$	Biology $\frac{2}{5}$
Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$
Physics $\frac{2}{5}$	Physics $\frac{2}{5}$	Physics $\frac{2}{5}$
Eng. Lit. $\frac{1}{5}$	Eng. Lit. $\frac{1}{5}$	Eng. Lit. $\frac{1}{5}$
Geology $\frac{1}{5}$	Geology $\frac{1}{5}$	Geology $\frac{1}{5}$

Sixth Year

German	German	German
Botany $\frac{2}{5}$	Botany $\frac{2}{5}$	Botany $\frac{2}{5}$
Zoology $\frac{2}{5}$	Zoology $\frac{2}{5}$	Zoology $\frac{2}{5}$
Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$
Physics $\frac{2}{5}$	Physics $\frac{2}{5}$	Physics $\frac{2}{5}$
Eng. Lit. $\frac{1}{5}$	Eng. Lit. $\frac{1}{5}$	Eng. Lit. $\frac{1}{5}$
Geology $\frac{1}{5}$	Geology $\frac{1}{5}$	Geology $\frac{1}{5}$

Seventh Year.

35

German	German	German
Botany $\frac{2}{5}$	Botany $\frac{2}{5}$	Botany $\frac{2}{5}$
Zoology $\frac{2}{5}$	Zoology $\frac{2}{5}$	Zoology $\frac{2}{5}$
Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$
Physics $\frac{2}{5}$	Physics $\frac{2}{5}$	Physics $\frac{2}{5}$
Geology $\frac{2}{5}$	Geology $\frac{2}{5}$	Geology $\frac{2}{5}$

Eighth Year

Botany $\frac{2}{5}$	Botany $\frac{2}{5}$	Botany $\frac{2}{5}$
Zoology $\frac{2}{5}$	Zoology $\frac{2}{5}$	Zoology $\frac{2}{5}$
Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$	Chemistry $\frac{2}{5}$
Physics $\frac{2}{5}$	Physics $\frac{2}{5}$	Physics $\frac{2}{5}$
Geology $\frac{2}{5}$	Geology $\frac{2}{5}$	Geology $\frac{2}{5}$
Science of Language $\frac{4}{5}$	Sci. Lang $\frac{4}{5}$	Sci. Lang $\frac{4}{5}$
Logic $\frac{1}{5}$	Logic $\frac{1}{5}$	Logic $\frac{1}{5}$

36

These eight years of study might be divided between the high school and the College, or between the Preparatory and the Collegiate courses in College. What should be the limits of the High School or preparatory work. I shall not attempt to decide; in fact it is a matter of no great importance. The High-school can certainly do the work of the first and second years; many of them can do good work in the third year, and the best of them may perhaps extend to the fourth and even fifth years. The College courses in each case would be longer or shorter as the preparation was less or more extended.

37

If the High Schools will attempt to teach no further than their facilities for demonstration extend, there need be no difficulty in the matter.

I take it for granted that the High Schools are, or should be able to teach well the Languages, Mathematics, History and drawing of the first four years; the difficulties [of] will arise in finding means for properly teaching ^{the} Science.

The Botany of the first and second years should consist of general external structure, learned from the plants themselves. The pupil should be taught the authentic

38

common names of particular plants, and groups of plants. He should also practice drawing leaf and other easy forms, and should from the first be encouraged to collect and preserve specimens. In the third and fourth years, the student should begin, with the aid of books, to learn the technical names, the classification and the flower structure of the plants in his neighborhood.

The Zoology of the second, third and fourth years should consist of similar work, and here again, the student should be encouraged

39
to collect specimens for
himself.

I need perhaps go no
further for the preliminary
years; The method, it is
readily seen, is that of learn-
ing from Nature, under the
guidance of the teacher. The
teacher must exercise ~~and~~
intelligent discretion; too
little help given the pupil
is often as bad as too much.

During the later years
the training in Botany, Zool-
ogy and Physiology should
consist; ~~in~~ aside from the
lecture-room exercises, of
laboratory and field work, at

40

least three consecutive hours
per week being given to each.
Chemistry and Physics
should also have their labor-
-atory facilities, not alone
for simply repeating the exper-
-iments made by the teacher,
but for original investigation
as well.

I should say, before closing,
that I have used the names Chem-
-istry, Zoology and Geology
in their most comprehensive
sense; Mineralogy being
included in Chemistry; Compara-
-tive Anatomy, Human Phys-
-iology and Human as well
as Comparative Psychology in
Zoology. etc. etc.

Hoping that the ideas
brought forward in this es-
say may not prove bar-
ren ones, and trusting
that whatever of truth they
contain may fall on good
ground, I submit all
to your candid judgment.

Digitized by Hunt Institute for Botanical Documentation