OUTLINE OF STUDIES

IN THE

DEPARTMENT OF PRACTICAL GEOLOGY,
MINING, AND METALLURGY,

OF THE

School of Industrial Science

OF THE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Extracted from the Report of the Committee of Instruction.

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OUTLINE OF STUDIES.

The instructions in this department of the school are intended to embrace a full course of the scientific studies and practical exercises necessary to qualify the student for the professions of the practical Geologist, Mining Engineer, and Superintendent of Furnaces, and other Metallurgical operations.

They will extend over a period of four years, including the first or introductory course; but, as students will be permitted to enter any of the advanced classes for which they are prepared, they will, in many cases, be able to complete the prescribed course in three, or even less than three, years.

FIRST YEAR, OR INTRODUCTORY COURSE.

1. Algebra, Geometry, Plane Trigonometry, Geometrical Constructions with Compasses, Protractor and Scales, Simple Applications to Mensuration, Heights and Distances, Plain Surveying, Levelling, &c.
2. Elementary Physics.
3. ,, Chemistry.
4. ,, Astronomy.
5. ,, Botany.
7. Practice in the use of the Chain, Level, Theodolite, &c., Sextant, &c., when practicable, during the course; but chiefly in the vacation succeeding.
SECOND YEAR.

3. Mechanics and Physics, with Manipulations, to exercise the student in the use of apparatus.
4. Chemistry with Manipulations, and simple qualitative testing.
5. Physical and Structural Geology; Constitution and Arrangement of the Materials of the Earth's Crust; Phenomena and Laws of Structure; Modes of Observation.
7. Descriptive Geometry.
9. The German Language.

THIRD YEAR.

1. Chemical Analysis, qualitative and quantitative; as under the preceding head.
2. Descriptive and Determinative Mineralogy; Use of the Blow-pipe.
4. Historical Geology,—Successive Systems, Groups, and Formations, with their leading Fossils.
5. Drawing, Topographical and Geological Sections and Maps, Conventional Representation of Rocks, Coloring of Maps and Sections.

FOURTH YEAR.

In this year, the professional courses, becoming more completely separate from one another, will be as follows: —
Course of Practical Geology and Mining.

1. Special Geology of Coal, Iron, Copper, Salt, Plaster, &c., with particular reference to North-American localities; and an account of important Mines, Quarries, &c.

2. Lectures on Mining; treating of—
   Prospecting, Breaking Ground, Boring, Blasting, Tubing, Sinking Shafts, Driving Tunnels, Ventilating and Lighting.
   Of the different methods of Working Mines.
   Of Mining Machinery and Motors—Engines, Horses, Pumps, Wagons, Drums, Ropes, &c.—for conveying and raising the material.
   Of the Dressing and Concentration of Minerals, Crushers, Stamps, Washers, Amalgamators, &c.; and Machinery used in the Pennsylvania Anthracite Region.
   Of Quarrying and Open Mining.
   Details of Mining in this country; with History and Statistics of Mining generally.

3. Drawing,—Plans and Sections of Mines and of Quarries, and other Open Workings; Mining Machinery and Implements; Topographical and Geological Maps of Mining Districts, &c.

For students who have passed through the third year’s course on Practical Geology and Mining, and who wish to prepare specially for the superintendence of furnace operations, and other branches of Metallurgy, the following course will be provided for the fourth year:

1. Special Geology of Coal, Iron, &c.; as in the course of Practical Geology and Mining, &c.

2. Chemical Analysis; including, chiefly, Assays in the Wet and Dry Ways of Ores, Fluxes, Slags, and of the Metals and their Alloys.

3. Lectures on Metallurgy; Review of the more important Metals and their Ores; Discussion of Fuel, and Methods of determining Heating Power and Intensity.
   Metallurgical Implements, Structures, and Processes; Crucibles, Furnaces, Blowing-machines.
Details of the Smelting and Manufacture of Iron, Copper, Lead, Zinc, Silver, Aluminum, &c.


Laboratory for General Chemical Analysis.

In this laboratory, provision will be made for a complete and comprehensive course of instruction in qualitative and quantitative analysis,—embracing organic as well as inorganic substances,—and blending lectures with the systematic practice of the laboratory.

Students proposing to take the course will be expected either to have passed through the first two years' teachings of the Institute, or to be possessed of such knowledge of general chemistry and physics as these preliminary studies are intended to impart.

Besides this general and extended course, it is proposed to have certain partial courses, in which students having a special object in view may obtain instruction of a specific kind, without going through the entire range of laboratory training. Such would be,—

1. Exercises in Organic Analysis.
2. Exercises in Blowpipe Testing.
4. Chemical Toxicology, Detection of Arsenic and other Poisons.

Laboratory for Mining and Metallurgy.

Connected with the general laboratory, but forming a distinct department, will be a laboratory of mining and metallurgy, designed for special instruction in whatever relates to practical mineralogy, the chemical valuation of
ores, and the operations of smelting and other processes for
the separation and refining of metals.

In this department, students already trained to some extent
in analytical processes will be exercised in the examination
and discrimination of rocks and minerals by mechanical and
chemical tests, including a course of practice with the blow-
pipe; and will be taught the several methods of assaying the
ores and alloys of copper, iron, lead, silver, and other useful
metals, as well by the dry as the wet method; of analyzing
the fluxes used in the smelting furnace, and the slags result-
ing from the blast; and of determining the combustible value
of the mineral or other fuel with which furnaces are sup-
plied.

In aid of these instructions, the student will have the
opportunity of studying the models of mines, and of mining
and metallurgical implements and machinery, and the collec-
tions of rocks, fossils, minerals, and ores, with their manufac-
tured products, provided and arranged specially to facilitate
his studies in this department.

Laboratory for Industrial Chemistry.

It is further proposed to connect with the general laboratory
a department of industrial chemistry, where students may
have an opportunity of becoming practically familiar with the
materials, implements, and processes of the more important
chemical arts and manufactures.

In this department will be provided a collection of dye-
stuffes, mordants, discharges, and other substances used in the
operations of dyeing, color-printing, and bleaching; together
with such apparatus as may be necessary, on a small scale, to
exemplify these several processes as in actual use.

Here the student will have access to suites of specimens,
embracing the crude materials and products of the glass and
pottery, and brick and tile manufactures, the different soaps,
soda-ash, bleaching salts, acids, saline products, lakes, pigments, inks, cements, tanning substances, and other materials and products of the chemical arts; and will be provided with facilities for studying practically the re-actions and processes connected with their use and manufacture.

Provision will also be made in this laboratory for the practical illustration of the chemical modes of engraving and lithography, and for exhibiting the various methods and processes of electro-metallurgy as applied to silvering, gilding, and the deposition of copper and brass.

EXERCISES IN DRAWING AND DESIGN.

The facilities in this department, which are to be anticipated from the Lowell Drawing School, when placed in connection with the School of Industrial Science, will, it is expected, provide amply for instruction in free and general drawing, and thus furnish students with a valuable introduction and continual help in the special branches of drawing and design appropriate to the applied sciences with which they are occupied.

Instruction and practice in this department will form an essential feature in the daily duties of the School throughout most of the regular course of four years.

During this time, the students will be carried through a course of exercises in geometrical drawing, including the applications of descriptive geometry to perspective and lights and shadows, to carpentry and stone-cutting, and other practical work. They will be taught contour-drawing, the projection of maps, the construction of topographical and geological sections, and the drawing of engineering constructions, and of subjects belonging to household, public, naval, and ornamental architecture. They will also be called on
to execute drawings and plans of models representing the external and the internal organs of machines, as articulations, cranks, cams, connecting-rods, fly-wheels, pistons, valves, steam-cylinders, wheel-work, entire machines of various kinds; and to prepare projets and working plans of roofs, arches, bridges, mills, furnaces, chemical works, heating and ventilating arrangements, dwellings, halls and public buildings, and other constructions; such as the mechanician, builder, engineer, or manufacturer may be called upon to devise or provide.

In these special exercises, the students will be aided by the use of models and large drawings of the various elements of machines, of certain machines in their complete state, and of roofs, bridges, domes, buildings, and other works of mechanical and constructive engineering and architecture.

VISITS AND EXCURSIONS FOR OBSERVATION AND PRACTICE.

In aid of the practical studies of the School, and as a means of initiating students into the actual details of the professions for which they are preparing, they will be required from time to time, in the progress of the course, assisted by one or more of their teachers, to make visits of inspection to machine-shops, engines, mills, furnaces, and chemical works, and to important buildings and engineering constructions which are within convenient reach.

With a like view, and under the same direction, they will be expected to spend a part of the vacations of the second and third years in excursions for observation and practice, extending sometimes to distant points, and so arranged as to afford to each class the experience and training most likely to be useful to them in their future pursuits.
Thus, in consonance with their special studies, they will severally employ themselves in the details of road, railway, and topographical surveys, barometric measurement, triangulation and geodetic astronomy; in taking notes and making drawings of such processes, machinery, works of engineering, and buildings, as are instructive or remarkable; and in making themselves practically familiar with the working details of laboratories, print-works, furnaces, forges, rolling-mills, and foundries; with the methods of geological exploration, the tracing of veins and beds, the sinking of shafts, the conduct of open and underground operations, the mechanical arrangements for raising the product to the surface and preparing it for use; and, in general, with all the processes and constructions appertaining to the practice of industrial metallurgy and the working of quarries and mines.