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Draging Scripe + Planty ich Februar of Interstuil Screenie gublished in 1864

School of On dustrial Science of the Institute of Technology

It is the design of this School to afford to the public at large Oppostunities of instruction on the leading principles of Science, manually as affliced to the arts, and at the Same lime to provide for Systematic Studients of wary of the applied Jainey the Beens of a continuous of therough to many in the Studies of practice affectaining to these Subjects.

In pursuing this object it is related to going to the teachings such scope of method that while and reparting a due measure of Privalege, Kay Raving Cultivating the hobits of observation of mach thought so enducine to the property of privalent, and of an enterphenest them more freeze more thank thereof more holy the devoters housing the man satisfaction to enters more briding the devoters af a general screening Culture.

### Plan of Instruction

In an angering the plan of Instruction for the Other of Ind; science a ast- provision as made for how classes of persons - those who may be expected to resort to the Lecture rooms & School of Design for such assepul Pressing as they can acquire without methodical study of his hours not occupied by business, and those who institution and the wiew of a propression and another training his one or more branches of affliced science and who have the full survey of the prosecution of its studies.

[MC 1 3136A] Sarahan To be admitted to this Division of the School herefur to be presented, the presented, of the dans of preparation and after interest they write he subject to Classepastion of duration in their studies as well as to manualing Lotter than their studies as well as to manualing Lotter tists of acquirement in the prografs & at the Close of their terms.

general of More propular his bruction the teaching a white be hor ducted by hears of Lectures abone, which is the drawing school of mindentition time outputs requiring more familiai modes of exposition. As I'm the purpose of these Courses to Open the halls of the Institute as bridily as hopible to those who describe to propit by such teachings, students both he admitted to the Courses on general adopted accesses a in Massing without a preliminary examenation of evicine as in Massing without a preliminary examenation of earlies only to the Conditions of listraints that are limited to the lactures, the as may be found bust fiture to make them assigned a interesting.

On the second deviser of the School that of Systematic of professional testimaters. The student while attending lectures on the several branches with have the benefit of laboratory crowners in Manipulation of Manipulation of Managers, of continued practice withe Monding in Manipulation of Managers of the Monding in the class room a by encountered, as total quie firm the class room a by encountered, as total quie firm the mady Command over the (Samutagent provident) problems with what as a mechanician, Ingineer, builder practice Chemit or for Scientific Municipal de Soulder product when the deal. See officially music be confined to the state the devision the proposate of the continued of the state o

### First Department.

General or Dopular- Course.

Shele bectures will be grouped into more or less lytended courses as may be found expedient, a biesides the ordinary methodrical teachings will have for their object to make known mew facts of discoveries in the applied sciences as they are brought to light, as well with a view of Almula ting invention as of giving to the public the early benefit of hisportant additions to our with the public the with the public the early benefit of hisportant additions to our

In the same department will be included a fully equipped traving school where he addition to systematic exercises in elementary & free-hand drewing instruction will be quiew in artistic design and modelling as applied to manufactures architecture & Decoration. & It is expected that the Drawing School of the Sowell Institute will

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be brought into connection with the School of Industrial Science in Such manner as to afford to the Students of the latter the free healfit of its methodish & that the subjects above referred to wile mostly if not wholly come within its new & enlarged plan of operations.

These courses of Instruction will be given to brite he speed. I have been to beth leaves of practical subject subsaced in them, a the convenience of the hour, it is expected that they will be attended by persons engaged in mechanical manufacturing a hiercantile pursuits, by teachers & structuring in the hornal & other schools, as well as by others whose taste & leisure leas them to avail property fuch historichois.

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#### Googramme of the General Courses.

The letteres a other teachings in Mathematics. It is and geteration party of duttratic a algebra, and geteration geometry Josephonetry & Description Geometry, with application to business computations, weights a measurest, measuration, guaging, developing, Projection of makes Construction of Current Properties of Managelet, Romaniles of Porbless is Surveying & Mangelet, Romaniles of Properties of Mantecie a Strong on Principles of Perspectations in Mantecie a Strong on Principles of Perspectations.

#### II. Lectures on Physics & Mechanis.

This Pourse cole en brace the General doctrines of mount of Force, the Muchinis of Soleds doftends, the daws of Sound, dight, theat, Magnetistic at Electricity, Elmang the lopics boil be

- 1. Gravity, the Pendulum a its afflication, Elements of Marchinery Saws of friction, latin of Work by Ognonomenters.
- 2. Molecular mechanici. Elasticity. Strongth of maleries. Primiples of passing - Capillaring. Britis force.
- 3 Preferre & Mor of Water and & gases. Canels, Drainage mile Wheels - Turbines . Passes

Resistance of fluids. Form y Ships, Paddles & Serews.

- Dorce, Keering, Halls for Peakers de
- The Eye bisin . The She droscope atts user.
- 6. Heat Beforesin, Vermeneters, Conduction Radiation & Connection, absorption; melling, evenuation, Steam, Steam, Steam Engine, Idel-au Engine, Warming & Dentilation, menufacture of See.
- 7. Magnetic polarity & mouchon, Variation, Dep & Interesty.
  Magnetic Charts, Confess on Shep board and its lorrectua,
  8 States Electricity, machines, Conduction & Connection, accumile,
- States Electricity, machines, Conduction & Connection, accumulation Systems 2007 d.

  Dynamic Electricity voltain Encles & their Chemical Magnetic de Other effects. In Tucas Currents. Induction Coils ...

  Cyplecations his Blasting, Jelography, Electric dight de,

#### III Lectures on Chemistry dets applications

The subjects of this Course will be entraced wasen

- 1. Preliminery doministrations relating to le per leading
- 2. General doctrine of Chemical borces, & daws of
- 3. more detailed account of the Elements & Companied, in heavilly those which are Important in the Arts & Domestic economy. Medicaling water are the Moneral aced, alcalis, Arm Copper Lead Tim Denie Selver Gold de.
- 4. Chemical Kestory of the principal organic greeps, sugars, starches, alwhol orli fatty bodies a.
- 5. Chief Constituents of the veget able & animile Organisms both the Chemistry of food resperation and nutrition.

Esteare attention look be given to the lipplications
of Chemistry in the Manufacture of Metals, Pottern, Stap,
Soap, Illumenating gas, Coments, Alum, Sugar So...
In Harbert Dyenig, Bleaching & Other Chem? and The
actual process where machicable with be experimentally
Shown & the States of Materials a products contained in the
Melseum wile be used to aid of the Lectures. as occasion ausies
examples with he given of such simple methors of Volumetria
analysis or other Chemical testing as can be assignably
shown in the Section voon.

### IV Lectures on Geology & Mining

This Pourse bile embrace.

- I. a general outlieri of Mineralogy todamendadognale al escuptions of the principal Constituents of Evels & the more important over a other useful mineral products, but the mechanici, Chemical a optical moder of discrimination.
- 2. (Dhising of Rocks with Eignewin I greens & metamorphic, specialition of thatified, marine, Della & perh water deports, & of I green & metamorphic makes with an accounty the actions ancerned in their production.
- 3. Illustrations of Geological Structure as seen in a lases, faults, Basens, Balleys of elevation & erosion, escarpments, & bith the Brethows of Autominents, the Mix of thata & rees & of making a Be appealing Geological & mining surveys
- 4. Organi remains d'Iteri use si determining the sequence of the strata.
- I have of geological formations poin the Most ancient to the present time with a special account of the north american strate, showing by the use of maps & Sections the geographical position & range of each great formation, marking out the healighter, belts of From bearing Gold-bearing & other metalliferous locks, a the ranges of the granites states sands tones domestimes marbles & other mineral aggregates wheat may be bringht to profitable use for building or other purposes.

### V. Lectures on Bottery & Boology

Odis come bre melude ..

- In An outline of Botany unbracing the growthe Morphology structure a Classification of Plants 2. Economic Botany. Plant, written for food & mi the Ports.
  - 3. On outline of 300logy nicleading the Shuchure Physiology & Classification of animals.
  - 4. Earonic 300logy. annals unful for food & h. The Cer 13.

In addition to these general locture, it is proposed to make special provision for the more extended and technical troubles of branches of troubles on the throwbage hur-included or but brighy touched on the the general Courses. Such would be the manufacture of Collon a other textile fabricis, the Cirts of Printing a Engraving. The Manufacture of Paper so. Including for each the Mistory a Statistics of the subject and an accounty the Machinery aproaches employed Mushaled by Apecinous a models from the Industrial Museum.

Cale the Subjects of this class may perhaps at an early day be embraced as a destinct sentended Course under the head of specicle Technology in which many of the materials sproducts gathered in the museum would find their most useful medicin of Interpretation.

Me decim of Interpretation.

As the Southern above described are intended to meet-the general alimand for Instruction in the afflications of Science to the arts as well as to led students in preparing for a more thorough course of study they will heat only of such subjects as can be readily understood without previous training. At the same time it will be their aim to teach the several branches to which they relate with such logical accuracy a completents as to give the student a clear understanding of principles a of their afflication in horischol a Civil economy of the Industrial arts.

### Second Department

Shead and Professional Intruction.

This Department of the School is intended first for Such Students as by a full Course of scientific Studie; & practical enousies, such to quely, thenselves for the professions of the Mechanical Engineer, the Civil Engeneer, the Builder & Architect, the Practical Chemist and the Engineer of Mines.

Second for those who aim surply to secure a training m' some one or more of the branches of Office Ocience, such as Construction Parfection of Chemical and appeared to Construction Parfection se; Chemical analysis; Inachinery of motions powers. June Physics of Chemistry with manipulations; Gurbay a mining; havegation of nautical asturiony. Mutallying of from Copper so.

The estern series of Instructions arranged in reference Sexuspendent the libour named professional divisions Offers to the Student bui Courses having more or less he Consum. bus.

- 1. a Course on Mechanical Construction & Engineering
- 2. .. . livel & Topographece's Engeneering
- 3... Building a architecture
- I " " Practice & Technicie Chemistry

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agree the land Engersie the Great des Allecheters

6. Pradici in the less of the Cheer Level, Therostate

Sentan de Where produced dury the come, but Cheff,

The Studies of each of these Olivisions are anango on as to estend over a period of four years including the first or introductory lowerse; but as students liste he permitted to enter any of the advanced Clapses for which they are prepared, they will in many Cases he able to Complete the prescribed Course in three on ever lefs then three years.

For the first two years the Studies & exercises books he the same for all the regular Students, each then obtaining such as acquaintance with the whole field of pradicie blueses as is heeded for a complete + satisfactory study of either of its professional departments.

The Courses of Instruction in the first & Scoons General will be as follows.

First Year your Britisheductor, Correr.

- 1. Algebra, Geometry, Plane Tregon conetry.

  Geometrice Construction, List confessor Protection &

  Scales. Imple applecations to Mensuration. Hughts &

  Distances, Plani Durveying, Levelling 20.
- 2. In troductory Physics
- 3. Introductory Chemistry
- 4 Description astronomy
- 5. Drawing. Server & Gunetric
- 6. (Lee op.)

[mc1 3:36A] The Ober des of least of these thereases are anest in in the voters over a faces of four years biolishing The front on Whose tong lower , but as aludish liste he personthed to content and of this advances clapes for Wheel they are prepared, they beste in many can be obte to Conflate Me presented Come in William to law lefs than those years. it is the first low years the studies downers between the same for all the regular Mudenty and then obtaining and as as years take the had fully produce there as is needed for e conflict I datespecter, atender of entire of the profespece the advant. The l'ener of this historia he that from a droom your laste to at follows: 70 fines quare. Returbantery Conser. Generaliza Personatur, late wifefor Protector t Election Thom Surveying Landling in

Second year. 1. Advanced algebra, Spherecie gunetry & Togeneraly navigation Manticce astronomy . On alytical Geometry . First edein of the organt the Colone Shorkrefalmi Generaly much ancio healed chiefly without the Calculus. Machining & moliss . Slean Engine La. 4 Physici with hanifulations to mer use the Student In the like of apparatus. 5. Chemisky with Branspulations & simple qualitative 6. Descriptione & general Globogy. Elements of Rossym. Botany and Loology. Description Gunetry Dr'hung, Granetie, Parspectione, Lyti, altares

[MC13:364] Third year. The the dos of the year late he the own for The process the large of the chance a gland Frequency so y tuitary a les chile deser sumplant I moraning the things & thans of materials werd in listeristers . Perinter of Jorney : Therestook 6. Physical & Structural Geology. Constitutes I her engement of the moderals of the Earth, Crust, Phenomena & Laws of Shucture, moder of Observation. to the distance of the larming should file shiping

## Course of Practical & Industrial Chemistry

1. Chemecie analyses qualitative & quantitative, Chiefy of inorpassi Intraces, including the Bolumetric Belhoos. Lectures to accompany the Laboratory mercuses

2. Descripture & Action encluse Busieralogy. Else y

3. Lectures on Confuntion & Glack, Warming & ventelation & Street, Warming & ventelation & Lighting,

4. Lectures & ellustration, on Produstrice Chemestry, manufactures of Glass, Pottery Tiles Soda ash. Aceds, Salls Do aps de.

t. Drawing of Opparetus. Plans & projects for Chancie works, & aboutor, ananjanests L.

6 Lee appoite

4. Astonica Gulozy Candentan y Description Systems
Sunt of formations with Characteristic foful.

Shear Jalogy of Coal Jon, Gow, Late- Le

Course of Practice of the bestical Thousand

in Willeligher you whilehow a forest

him to the to ancher Miller along, ... Il so

# Course of Practical Geology & Mining.

- 1. Chemical analysis qualitative & quantitative as wir du the preceding head
- 2. Description & delermention mineralogy like of the
- 3. Lectures on Combustion & Fuel, and on Warning, best takes & Lighting
- 4 . Historical Geology. Successone Dystens Grente to formation, with their leaving bossels.

  Dotaled Study of the Geology of No. America.
- 5. Drawing. Echographicie & Gulogicie Rections & Maps. Conventional representation of rocks, Colouring of Maps & Lections.

[MC 13:36A] China your during -Chancel analyses problemed grantetilen Tidenthine a deleter state he weeky - her g the Continued dies, as a harasi, butthe Them on the Heart Juday of love, when

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In this year the Brusses for

On this near the towners professive Courses becoming have Completely separate from one another write be as follows.

Course of Mechanical Engineering

1. Amestigation of Machinery & motors Continued.

2 Sheard Study of Steam & Steam Engines, Statusary, documentem & Marine, of leir and gas engines,

3. Construction & an anyment of Machinery In: Franci Miller for Joseding. for Testele Brasufactures do.

Drawing of Machine's looking plans & project, of Machinery miles de.

No Dest She desto

Junt year. in in the convene perfeture leaves ( me of thechanics ingerenage 2 Mindy of Street & their Engire, Stellars and them if the or for engine and the market of the day of Proper de

Fin De Sterdents

Fourth year. Course og Civil & Topographicil Engineening e

- · 1. Oxxxxxxxxxxxx Ophere cie Cestroning , with the lese of Instruments
  - 2. Location & Construction of Roads Rentweys
  - 3. Supply & Mittitutes of Water water works . Dams Phos de Distribution y Ster. Drainagi . Impetion.
  - 4. Enterded healment of Sheeders, marin work, archer & Briging Stone. Thuctures in Iron, including Gudin Column Roofs Suspension Gragin Inbular Briges Le.
- 5. Drawing, working drawings of Constructions, of plus of projects of P. Row & other Conveys, Pople & topographice otawi,

For Duch Students as deseri to devote themselves especially to Topographical Engineering the above Course wile be modified de as to medicale

1. Of extended study of Branch astronomy, and practice but ashinosecie Instruments. (No. 4.) 2. Lectures & essences in the higher Geodesey hickerding the Durvey of Harborns Courts to Estessive Regionis.

At the same time a larger space will be allotted to Topographical & map drawing , and The Dubjects Mestines wader heads 3 x4 g/Le preceding programme wile be in proces part omitted, [MC 1 3136A] Com y line a Topopaphine Empreoning a . Character and Other in lesters on , with the loss layer a minimum of leader ... , leader limbs , some hor in Gesterlater of far. Drawage, Imperio. take on tendent of thereties , I man hard Perdan Clerk May Mayon Wheater in there, and wing form Charge Mayon Mayon the His She Laborer On any, Workey drawing of tenshere then , I place of propert of Relies I other Courses, Paper & . I'm Just The state or there to down Honoring The telles and the same a star course for in the grant of as to the tenth of the extraction "Historian displace

## Course of Building & architecture.

- 1. Entended heatment of Structures. Mason work, anches + broker of Stone. Bon Junein, Columns, Volumns,
- 2 Détails on Warmong, Gentelation, & Systims,
  - 3. Ledures or bluidering or practicil architecture entracing a review of the moderning, weed, their preparation of brechouses Continued in the creation of Chaellerys, Hales, courts of Justice, Presons, manufations de illustration by Models of Mourings.
- A. Le sives on Dex architecture es a Fisi and with a history god ellustrations of the frech archetecture works of Down Classice medicial of modern times.
- 5. Archetecture Drawing Properts for dwellings

· French your Course of Bustons + architecture The day he along to allow about the day to the when i living a fletter them James fillings The state of the s Court is on Warmeni, bentileties, o days ling, In the thinkering a heales & files. Moderick where a building a practice and les hites town which is a review of the molare of hear there of when I herhand later To hi the weeks of leading William Courts of Justinian Oringing Manufaction to Market I, Madell, a Mawrey ; de les a KRX linchete time es a drei anthatt a hater and Mustrations of the part. Dea-Wales We do testine harter of Kom Chaper & Reducine Whatestern Transmy Papels for Musery;

Course of Practical & Francis Chemistry.

1. Chemical analysis lordmied, intraceris Mansagin karthingsman Comalysia the an alyse. and Commer aich lesting of

(a) Ores dimentiones Clays & other Crude mornie

(b) Cast Ism Copper dead do so Motellically

[ 1 Soka lest, Bleaching delt Common sals, Salt-petre Guspowder Indigo Paints Drugs, quano doller monerser de. (d) Drinking & Minerie Waters, Brine's &

(e) Coal-gas & Other gaseins mixtures mercesis si Organie analysis -

3. Lectures on Industriel Chemistry moderning the Certs of Dyeing, Colour printing, Janning, Brewing, Distillation on the Many acture of Alluminating flas 4 Mangener of Dyening & Print world,

[MC1 3:34A] Fourth Jean where Charity. Courseil Con abyers teatening intraceing mount dishiping throughout to la segen on Connercui lesting of cotto deute sensis maluria 16 Castelin Coffee dead so and hetele allege 121 dilla ledt. Bloadong dels Conna sole, cell felie Guspouler Prospe Person Drugs , furne & other morning de. (d) Diesting a Museia Deless of Bross of (e) Cod gas a color grains mations. 2. Provision to Organic analysis. Lichard on Brownie Chemother I hadering the Certs of Depeny , Colon printing Turning Brewing Tweeterta of the He On one faction of Elementers for

## Course of Practical Geology & Mining

In Special Gillogy houstraining Coul Iron Lawren for Salt- Plaster de, with particular Reference to B. american localities and an

account of Important Minis quarreide

2. Lecture on Mining, heating of

(a) Prospecting, breaking grown, boung, blusting tubing a Sinking Thatto, driving turnels, vertilating & lighting; (b) of the different bretters y bootening meries

(c) of Moring Machinery & Motors, Engine, Horses, Pumps Waggers Drums Ropes de for linneye, L'Iaisnig the Melinie.

(d). Of the arefring & Concentration of mineril, Constens
Slands, Washers, & Machinery Wise he the Pa.

anthracte region.

(e) Of quarrying & Open Brining G. Details of mining a this Country - little this try & Materiar of Mining generally.

3. Drawing, De Man Plens & Sections of Mening Quencies & Quencies of Mening Macherer, & inflements.

Geological & Telographic Maps of Mening Mestuit, &.

For Studists who have paper through the third years course on Precedent Gulogy & Mining & Who with to prepare specially for the decreation of Turnaceoperations & after Grander of metalling y the following Course with he provided for the fourth year...

- 1. Sheart Gestogy of Poal Ison do. as hi the
- 2. Chemical analysis, mohisons Chuby apays in the lost of My ways of thes, Fluxes, Slags. and of the metals of their alloys.
- 3. Le dure, on Metallers gry Miring the of the

  More Infultat Metals, Besaiser of The Abellows

  of determing heating prover & mensely.

  Shetelluspe. A Implement, Vhudenes of processes.

  Ornables Firmere, Blowing Machines.

  Details of the Melling & Manifacture of

  Don Copper Lead Free Silver Stein Aleminus dos

  A. Orawing. Plans & Mojects for Colling Chess,

  Thinaces Refineries but I Cold blast linearing

### Military Tucker

The regulen Students of the School bile be laught the lise of male arms & the Simple pents of Taches of for this purpose both he Organisa how one or how companies to meet in stated Clays for Military Inshorten & Greece ... Gdiv Termission of Students

She leading trunciples governing the admission of Shederts into the Meparement was boli be 1.

First . That all person who are qualified to enter upon any one of the full Courses or of the Special Steedies of the School whole have the press of aportunity of owing so; and search . That no students whole he admitted to any of the tourses of this truction who have not the preliminary trustage heeded for a satisfactory pursuit of the studies proposed.

Student, to be admitted to the Inhoductory or pirst years towards the lage of 15 years a must present freedown with a course of the studies of the superior of the superior of the superior of the superior of the students of the students of the superior of the superi

In order to inter the sunds years Course the student toust be at least 16 years of lige a must give widence by incomendation or otherwise of such throwlege of the prist years studies as would enable a student of the first year to pass into the second, and a little rule write apply to the Case of the death, seeking admission into the classes of the succeeding years.

To make the Opportunities of Mistruction as widely acceptable as possible students true he allowed to interspecial divisions of either of the courses after the first year In for enample the classes of Mathematics of mechanical Construction of Chemical analysis, of Physics of morning amelallusty, on giving validactory conduce that they are duly prepared to pursue such special studies with advantage.

### Déplomas a Certificales.

As the Officer or lertificate is intended not only to be a reward to the student for his diligence & altains ent, but an aparance to the public of his Knowlege a skele in the particular department of applied science to Wheil it relates I will be conserved on such students only as by their enamerations a other exercises quie proof that they propely the presented qualifications -; but all students who fulful the requirement shale be intitled to the lestemonics of the Institute without regard to the queater or left number of works they may have attended in the Institute without.

The degrees or defelonas consponding to the leading divisions of the school will be as bellows.

general Scientific education, such as may qualify them to become teachers, rather than a propersional training in applied science, a vokedule of studies looke he appointed imbracing he whole of the hor first years and certain harts of the third a fourth years and certain a farts of the third a fourth years and as to form a general Scientific Course, for proficiency in which the Degree of Backelor of Science write he Conferred.

To be estitled to either of these degrees the Studentmust hap a vatisfactory exemenation on the Whole course
of studies and exercises prescribed in his department industry
the dementary a general, no left than the advanced of
special subjects. He must moreoner prepare a deformation
on some dudgest in pure or applied science, or Submit
an original report on some Machine or loveth of
Engineering or some morie or storage, mineral survey,
or Chemicile truestegation which shale he approved by
the faculty of Mishaulia or other issensings board.
He write he required also to have sufficient fameliarity in the

the French & German languages to be able to head without difficulty works in these languages relating to the cliences & arts.

Besides the Degrees or Deplomas Covering the Comptere Courses of Steady above referred to . There will be given Certificates of Wearins end to Special Subjects to Luch Steaders; as on examination are found to have sorganized the required professioney in them. Coming the Special Subjects for Which such Certificates may be awarded are.

L.p.

Production Drawing Standard Grandy

Description Germetry dets applications

Mathematicas applies to mechanics or machinetics

Physics + Chemistry list manifolders

Chemical analysis - 44

### methods and apparalus of Instructur

The Instructions in their Department of the School wile be given through the Medicin g

- Lectures and familiar capositions
- Oral & written maninations
- 3 Enercesis in the solution of problems
- Practice in Physical & Chenical manipulations
- Laboratory Naining si Chenerie analyses, was
  - Metallurgy & Frontail Chemistry. plans & Drawnig & the Construction of special projets of Machines and Worter of Engineering & architecture. Practical over uses in Surveying develling Geodory

a nautical ashonomy.

Excursions for the Inspection of Study of Machines motors processes y munufacture, buildings, works of Engeneering, Geological declisis, quarres a Mines.

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Lectures and Expositions.

preceded by Merrogeteens on the Subject of the preceded by Merrogeteens on the Subject of the precedering becture in which the teacher write have the Opportunity of re-enforcing the instruction already given as well as of testing the prospers of motividual pupils.

Ceffer the first quar the Student will be expected to lathe notes of the bectures as they proceed and afterwards to write them out with the accompanying Drapam is drawings, so as to form, in consession with lack of his Claps, a last for Inmediate study as buile as future reference.

In addition to those to the of Lectures he will be upleated to otteday or to Consult Text books or works of deference whenever send are appointed to be used, but his view of the value of the method of Lectures combined with examenations as a means of Commanding the attention a Stimulating the zeal of students this method with the used whenever practicable; and in no case will meri text-books recitated he is distinctly relied upon. In the meritary approximation and the observation and the observation with the observation of the work the observation with the order.

7 29

Where passeliai expositions rather than formel lectures are given as in many of the mathematical Classes & in the Unstruction connected with duboratory work the student write be interrogated by his teacher from time to tenie so the property of the Lefon as bulle as at its Commencement.

# Or al a written examonations

les pequent sthown to examinations from the best means of maiting students to diligener as will as of testing their property mitheir studies and of discovering how individual needs a difficulties which the teacher should indeavour to obvide they write constitute a leading feature in every department of instruction in which they can be employed.

Besides the Clarky of al examinations wheaty referred to as meceding a a companying the lectures of al examinations will be held once every month, separate from the lectures on a day set what for the purpose at which each entire class or, when humans parts of the taken to succession with he cramined a drilled in the subjects becture upon or appointed for study the month just elapsed.

At or near the close of each term viz in

lorde be held, that of Febs ambracing the subjects studied during the first term, that of Jane Covering the Studies of both terms. On these occasions the Courses of Instruction wile cease and a sufficient period with he allow the classes time for a brief review of Studies & bule Opportunity for the several enaminations.

Move of low when the livition in connations.

The Students later by Classes and provided with liviting of when recipany will Drawing Implements of materies, with he placed at defearable tables, in the momentant with look, with them withen book, no memoranda of any Rind he and then in them look, who then furnest to each student a copy in printed or written form of the series of questions which he has preferred to test their proprierry and these the Students will be required to assure in writing as well as they can written to assure in writing as well as they can written to assure in writing as well as they can written to assure in the interior or consulting any other Longeries with one another or consulting any other Lources of information.

It shale be the duty of the teachers to Keep a working to forms hereafter to be prescribed of the performance of each student in the Several Classes both at the monthly or al examinations and at the Written examinations furt clescribed. These records write form the

Swedings at the end of each Course of for deciding when those to whom Certificates of proficiency are to be awarded.

The lawneration for Degrees who he held at the Close of the June term a write he hearthy oral apartly in writing. In the former each Candidate write he miterrogated apart from the rest; the latter the mode of proceeding will be the same as at the term examinations above described. In both the questions while range over the entire serie; of Studies on which the student is required to be prepared.

As part of these craminations the Candidates will be called upon to exhibit the Drawings a Projets prepared by then for the Occasion of the perform such laboratory manipulations & essences is as the examining Consisteed may afregio.

De the Same theme the Theses of the Candedater with be brought forward for examination and where expedient them authors be called upon to explain or-defend them.

As a further test of their qualifications as teachers of Science the Candidates for the degree of Backelos of Jaine, he addition to their examinations will be required to grain a brief or al lecture on such topic instruced hi their studies as may at the time be designated for this purpose.

Enerciae's ni Problem.

Lecture room and of inobling the Student to acquire facility in the application of principles to special Cases problems with from time to time be given out to the matterities & other Classes Where applicable, of which written solutions will be required, and these solutions the Students presenting then they be called upon to caplain.

Practice to Physical & Chemical Manifulation.

Student practically paralies with the adjustment, and use of the appearance and agents employed in the more important caperement, a processes in natural Philosophy a Clemistry. With this view the Students under the director of their leacher with the called by small classes at a time, to execute with their own hands barrons caperements in mechanic, meaning neumatics sound, Electricity a title brenders of experimentated Physics, and to whibit Clemes is leactions to fit of the Chemical applications, to prepare gase, a other province a demonstrate their properties by deutable experiments, accompanying these manificulations when required with an explanation of the appearance will or y the process or experiments of the appearance will or y the process or experiments her formed.

These overceses tothe he held cether in the Lecture rooms on the appropriate laboratories, hereafter to be described as at the time may be found most expedient.

# Laboratories and Laboratory training.

The Saboratory arrangements of the school are designed when complete to embrace the polevising departments:

- 1. A daboratory of Physics & Mechanics
- 2 & daboratory of General Chent, analysis and manipulation
- 3 A debretory for metallurgy & Mening
- 4. A Laboratory for Industrial Chemistry.

While Intended premarily for the Instruction of the Students these laboratories will be used for the prosecution of experiments and investigations on subjects referred to them by the Committee of the museum or the Soveral Connittees of Arts, including the enamenation a testing of Mero Machines a processes and the Conducting of Original researches in the different department, of applied science; and in These Critical studies a experiment, the advanced students the any when expedient he permitted to assist.

Laboratory of Physici & Mechanics.

In the laboratory it is proposed to provide inflement, and apparetus with which the student may be exercised in a variety of mechanical & physicial processes and experiments. Thus he may learn practically the methods of estimating motors and machines by the Dynamoneter, of experimenting on the flow of water sandai and ari or other gases and of testing the other gate of the material, and it construction; he may be come familiar with

the adjustments and applications of the Microscope, he practised in Observing with the Barometer Thermometer a languarder, and in a room better up bu Photometry may learn the move of measuring the dight-provinced by gas a other Sources of ellumenation of the value of Afferent Roads of burners lamps at their appendages.

Laboratory for general Chemical Analyses

On their Laboratory provision while bee made for
a complete and comprehensine course of Instruction mi
qualitative and quantitative analyses embracing organic
as well as morganic substances, and blending lectures
both the Systematic practice of the Laboratory.

Steedents proposing to take this course whi he expected wither to have paper through the first love years teacheries of the Institute or to be proposed of such Monorlege of general chemistry & physics as these preliminary streeties are Intended to Impart.

Besides this general destended Course it is proposed to have Certain partial courses in Wheel tradents having a special object no view may other mituation of a special Rind without going through the contribution of a specific Rind without going through the contribution of laboratory training. Such would be ...

- 1. Esurcisis in Organic analyses
- 2 . Enercision hi Blowpipe testing ..
- It Tord so. Colcalinetry . accessmenty.
- 4 Chemical Toxicology Detectur glarsenec &

# Labordory for mining & metallurgy.

Corrected with the general Laboratory but forming a distance department with he a laboratory of minering of motelliergy - designed for special Instruction to Whalever relate, to practical mineralogy, the Chemical Baluation of ores and the operations of melting a other processes for the Separation a reference of metals.

In the department Students already trained to some enters in lineary trained to some enters in lineary trained to some enters of mechanical so the commence of rocks a mineral, by mechanical Chesicie test, including a course of practice with the Blowpipe, and both he traight the several methods of afraying the ones a ellege of Copper from dead Silver a other lessing mother as well by the May as the boot town method, of analysing the blusses used his the Shelling formace a the Slags resulting from the blast, and of determining the Constration to solve of the mining the

with which burnaces are supplied.

The aid of these Instructions the Student with lawe the Opportunity of Audyrig the models of Menes and of Moneing & Belellurgical Inflements & Machenery & the Collections of wells bossis minerals and ones with their manufactures products provided & arranged speacely from to facilitate his studies his their department.

Laboratory for Industrial Chemistry

It is further proposed to consect with the general laboratory a department of Industrial Chemistry where the death, may have an opportunity of becoming practically familiar with the materials implements a processes of the more important Chemicie arts & manufactures.

In this department while he provided a collection of Dye Otuffs Mordants discharges & other substances used his the Operations of Dyeing Colone printing & Bleaching, together with such apparatus as may be neafsary on a small scale to examplely these several proafses as his acture use.

Here the student wile have accept to scriter of the among on brawing the Crude Materials and products of the Glafs a Dile Le Pottery manufactures, the different Soaps, Suda ash Bleaching salts, a wis, Dalini products, Laker, Prignents, Inks, Coments, Jamening Substances and other materials

Invoided with bacilities for studying practicely the reactions of processes consected with their use a manufacture. Provision both also be made hi this datoratory for the practice clustration of the Chemica modes of Engravoring a dittrography of for exhibiting the various methods of Electro-metallusque as applied to silvering gibbing a the Cleposition of Copper at Brass,

Enercisis hi Drawing & Design -

The facilities in this department what are to be anticipated from the downer Dawing School When placed in Conserver with the school of Ind. Science will

It is expected provide amply for Instruction in free of general Arawing and the, furnish Students with a valuable introduction a continued help in the speciel branches of Arawing & design appropriate to the applied sciences, but what they are occupied.

Instruction & practice in this department will form on exentice because in the darly duties of the School throughout most-y the regular Course of from years

During this time the students will be carried throng a Course of energies to Geometrice the awing Including the applications of Descriptione questry to to Perspection & dights whatever, to Carpentry & Stone -Cultury a Other practical work. They will be taught Conton chawing, the projection of Maps, the construction of Topographical & fivtograil sections & the Grawing of Injeneering Constructions, & store of Subjects belonging to household & on evental architedure. They wie also be letter on to one certo chavings & plans, of models representing the especial & the internal Organ of Machines, as-Urticulations, Cranks, Carns, Cylinders, on wheel work of Various Rinds, and to prepare properts & working plans of Roofs Arches Porges, Mills, Furnaces, Chemical Works, Heating & hentildering arrangements, Deullerigs Such as black, as black, as black, as black, as black, the tredericias, builder, enjoreer or menquetures May be Called upon to Clavese or- provide. On there special mercies the Students will be and by the use of somewhat acceptante models on a large drawing's of the Banin elements of the achines in building's liter Corplete State & of English States of States Corplete State & of Engs, Brooks, Dones & other

looks of medanecie + Constructure engeneering & an chitecluse,

Visits and encursion on Observation of practice.

In leid of their practical studies of the School and as a mean of mitialing students into the Cectual detects of the propersis on which they are preparing, they write he required from time to time in the progress of the Course, aprilid by one or more of their teachers to make visits of inspection to machine-shops Engines, mills Furnaces a Chemicie worlds and to Important buildings a engineering Constructions which are within Convenient-reach.

With a like brien and under the Same directed they both he enfected to spend a part of the Vacalua of the decord of their years hi encursions for observation of heactive, entereding directions to distant points a surrounded as a affect to each Class the enferience of training most likely to be useful to them in their future pursuets.

Thus he consoner loth their special studies they will severally comply Themselvery in the details of Road Railevay & Topographical Surveys Burnetic Measurement Françalation & Geodetic ashonomy, mitakering Works of engineering and bruildings as are vorted naturely works of engineering and bruildings as are vorted naturally funition with Laboratoring Print works the Working details of Junitian with Laboratoring Print works the working details of Junices, Forger, Rolang miles & Jourdanies, with the methors, geological exploration, the having of veries whed, the surking of shaft, the landout of Open & underground Chentury, the medianical burrangements for raising the product to the surface of preparing of for use, and in general late the production of the descriptions of the practices.

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J.B.R. Popers

Scope and Plan

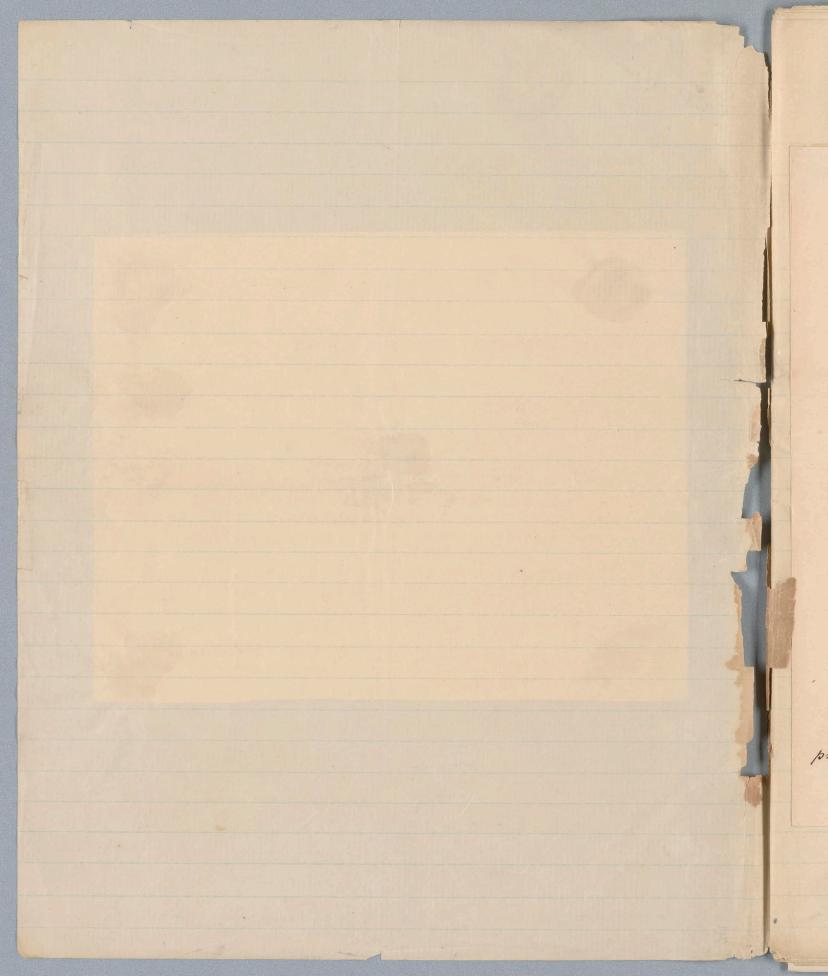
SCHOOL OF INDUSTRIAL SCIENCE

OF THE

# Mapachuseks — TECHNOLOGY.

It is the design of this School to afford to the public at large opportunities of instruction in the leading principles of science, as applied to the arts; and, at the same time, to provide for systematic students of the applied sciences the means of a continuous and thorough training in the studies and practice appertaining to these subjects.

In pursuing this object, it is intended to give to the teachings such scope and method, that while imparting a due measure of knowlege, and cultivating the habits of observation and exact thought,—so conducive to the progress of invention, and the development of an enlightened industry,—they may help to extend more widely the elevating influences of a generous scientific culture.



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#### PLAN OF INSTRUCTION.

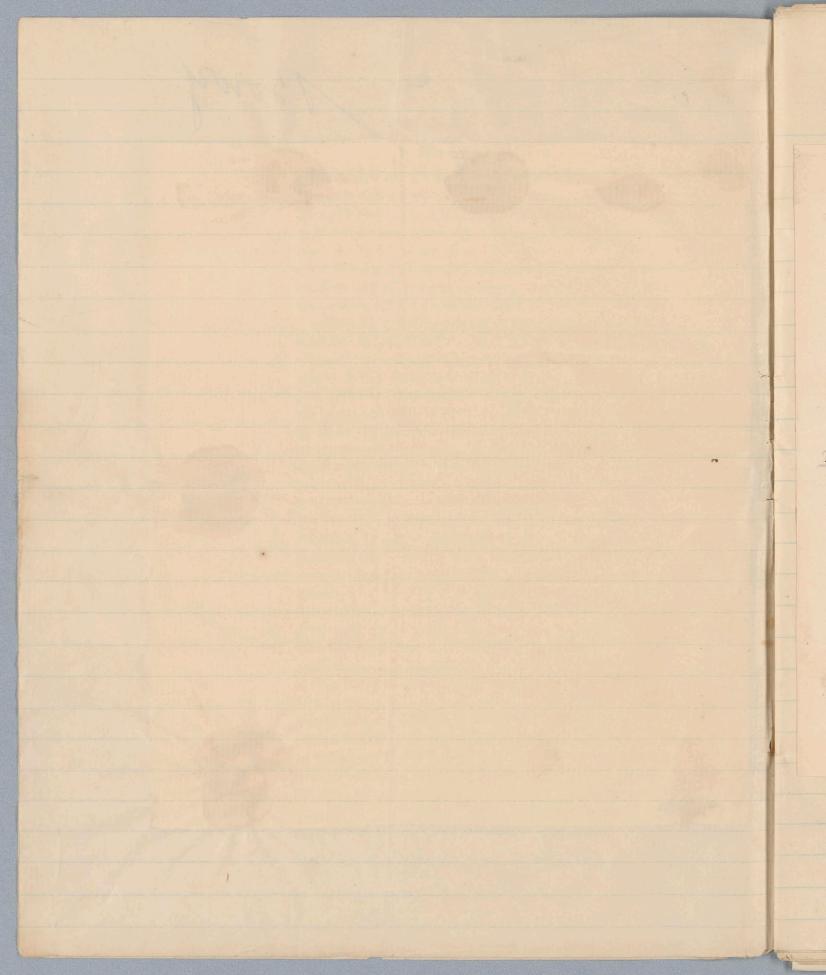
In arranging the plan of instruction for the School of Industrial Science and Art, provision is made for two classes of persons,—those who may be expected to resort to the lecture-rooms and school of designs for such useful knowledge as they can acquire without methodical study and in hours not occupied by business; and those who enter the institution with the view of a progressive, systematic training in one or more branches of applied science, and who have the preliminary knowledge as well as time for the prosecution of its studies.

In the former of these divisions, — that of general and more popular instruction, — the teaching will be conducted by means of lectures alone, except in the drawing-school, and in mathematical subjects requiring more familiar modes of exposition. As it is the purpose, in these courses, to open the halls of the Institute as widely as possible to those who desire to profit by such teachings, students will be admitted to the courses on general and applied science, and on drawing, without a preliminary examination, and subject only to such conditions and restraints as are usual in public lectures, or as may be found best fitted to make them useful and interesting.

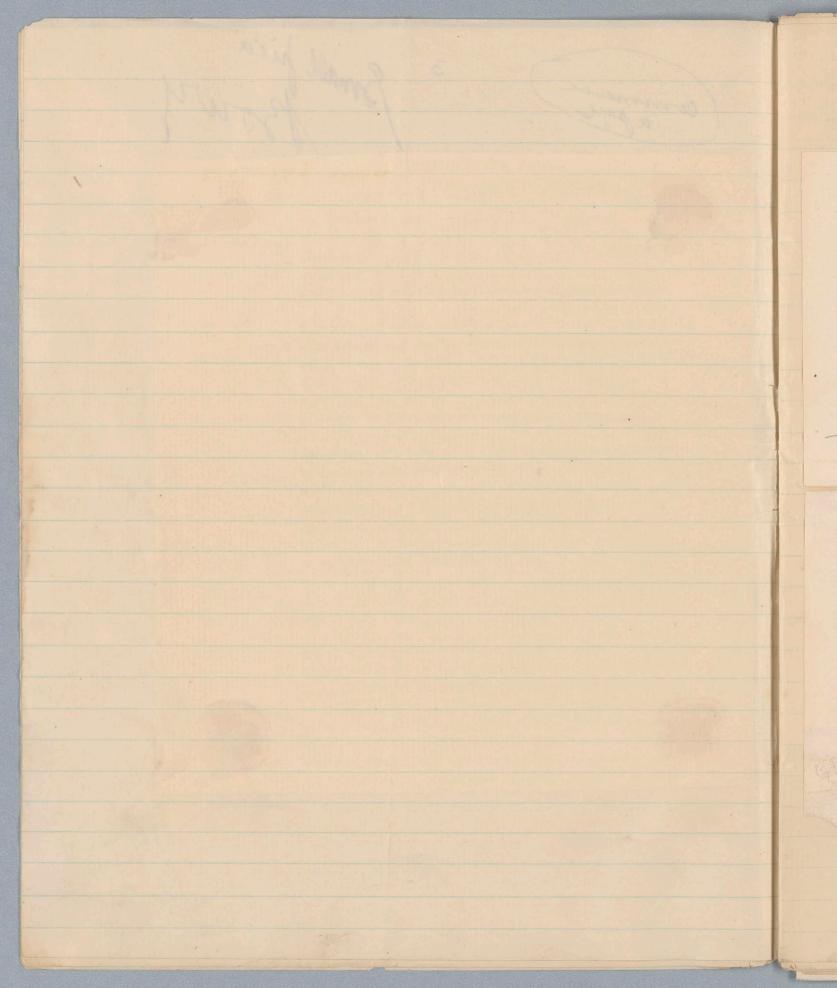
In the second division of the School, — that of systematic and professional instruction, — the student, while attending lectures on the several branches, will have the benefit of laboratory exercises in manipulation and analysis; of continued practice in the kinds of drawing appropriate to his studies; and of such prolonged and thorough training in the class-room, and by examinations as will give him a ready command over the problems with which, as a mechanician, engineer, builder, practical chemist, or scientific miner, he may be called upon to deal.

To be admitted to this division of the School, students must have attained a certain degree of preparation, hereafter to be described; and, after having entered, they will be subject to classification and direction in their studies, as well as to examinations and other tests of acquirement, in the progress and at the close of their terms. and often ever ever

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Small frien Bowy FIRST DEPARTMENT. GENERAL OR POPULAR COURSES This department of the School is designed to embrace lectures in elementary hathematics, in thysics and mechanics, in Caps shemistry, in geology and mining, and in Jotany and goology; especial regard being had in each case to the facts and scientific principles which are of leading importance in connection with the useful arts. These lectures will be grouped into more or less extended courses, as may be found expedient; and, besides, the ordinary methodical teachings will have for their object to make known new facts and discoveries in the applied sciences as they are brought to light, as well with a view of stimulating invention as of giving to the public the early benefit of important additions to our industrial knowledge. In the same department will be included a fully equipped Arawing-school, where, in addition to systematic exercises in 1 elementary and free-hand drawing, instruction will be given in artistic design and modelling, as applied to manufactures, architecture, and decoration. It is expected that the drawingschool of the Lowell Institute will be brought into connection with the School of Industrial Science in such manner as to afford to the students of the latter the free benefit of its instructions; and that the subjects above referred to will mostly, if not wholly, come within its new and enlarged plan of operations. These courses of instruction will be given chiefly in the evening, and will be open to both sexes. From the variety of practical subjects embraced in them, and the convenience of the hour, it is expected that they will be largely attended by persons engaged in mechanical, manufacturing, and mercantile pursuits, by teachers and students in the Normal and other schools, as well as by others whose taste and leisure lead them to avail themselves of such instruction.



Long Joumer PROGRAMME OF THE GENERAL CONSESS LECTURES. I. — Lectures and other teachings in Mathematics. These will embrace parts of Arithmetic and Algebra, and of Elementary Geometry, Trigonometry, and Descriptive Geometry, with application to business computations, weights and measures, mensuration, gauging, levelling, projection of maps, construction of curves, problems in surveying, navigation and nautical astronomy, principles of perspective. II. — Lectures on Physics and Mechanics. This course will embrace the general doctrines of Motion and Force; the mechanics of Solids and Fluids; the laws of Sound, Light, Heat, Magnetism and Electricity. Among the topics will be, -1. Gravity, the Pendulum and its Applications, Elements of Machinery, Laws of Friction, Estimation of Work by Dynamom-2. Molecular Mechanics, Elasticity, Strength of Materials, Principles of Framing, Capillarity, Osmotic Force. 3. Pressure and Flow of Water, Air, and Gases; Canals; Drainage; Mill-wheels; Turbines; Pumps. Resistance of Fluids, Form of Ships, Paddles and Screws. 4. Waves and their Propagation, Sound, Music, Musical Instruments, Voice, Hearing, Halls for Speaking, &c. 5. Light: its reflection, refraction, dispersion, interference, &c.; the Eye; Vision; Optical Instruments; Measure of Light from Gas, Candles, &c., by phitometers; the Spectroscope and 6. Heat; Expansion; Thermometers; Conduction, Radiation, and Connection; Absorption; Melting, Evaporation; Steam; Steam-Engine; Hot-air Engine; Warming and Ventilation; Manufacture of Ice.

7. 8. Magnetic Polarity and Induction; Variation; Dip and Intensity;
 Magnetic Charts; Compass on Shipboard, and its Correction.

8. Static Electricity, Machines, Conduction and Connection, Accumulation, Lightning-rods, &c.

Dynamic Electricity; Voltaic Circles, and their Chemical, Magnetic, and other effects; Induced Currents; Induction Coils; Applications in Blasting; Telegraphy; Electric Light, &c.



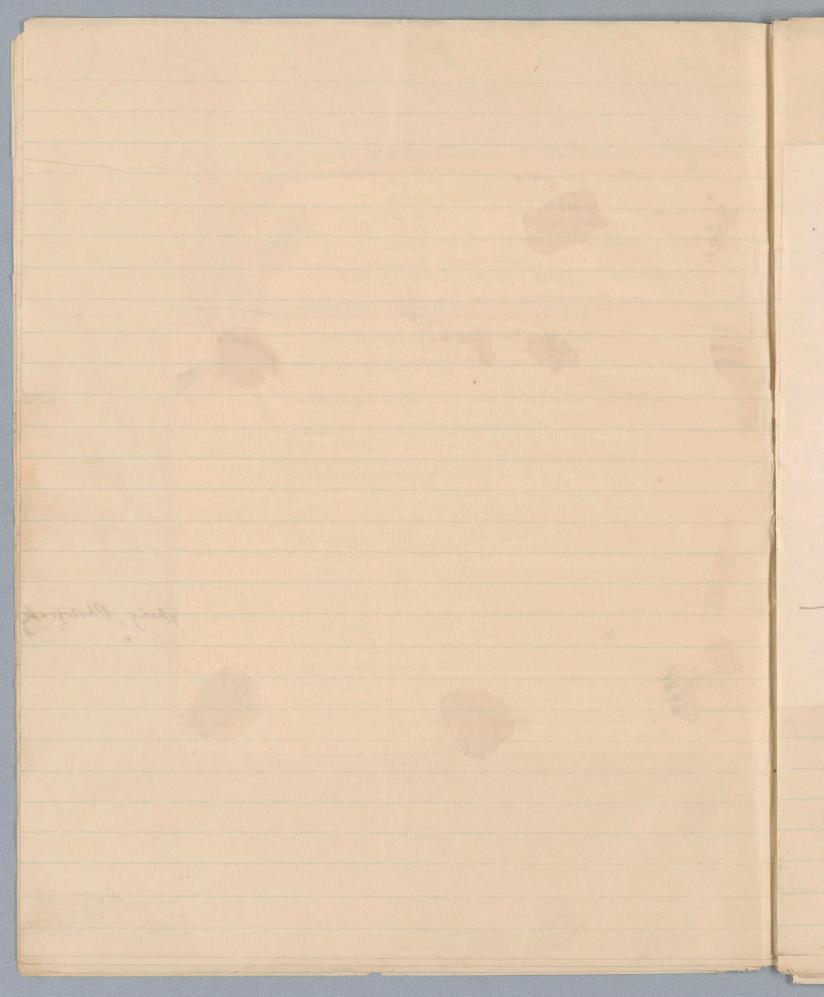
#### III. — Lectures on Chemistry, and its Applications.

The subjects of this course will be embraced under the following heads:—

- 1. Preliminary demonstrations relating to a few leading Elements and Compounds.
- 2. General doctrine of Chemical Forces, and Laws of Combination.
- 3. More detailed account of the Elements and Compounds, especially those which are important in the arts and domestic economy; including Water, Air, the Mineral Acids, Alkalies, Iron, Copper, Lead, Tin, Zinc, Silver, Gold, &c.
- 4. Chemical history of the principal organic Groups, Sugars, Starches, Alcohol, Oils, Fatty Bodies, &c.
- 5. Chief constituents of the Vegetable and Animal Organisms, with the Chemistry of Food, Respiration, and Nutrition.

Especial attention will be given to the applications of chemistry in the manufacture of metals, pottery, glass, soap, illuminating gas, cements, alum, sugar, &c., and in dyeing, bleaching, and other chemical arts. The actual process, when practicable, will be experimentally shown; and the suites of materials and products contained in the museum will be used in aid of the lectures. As occasion arises, examples will be given of such simple methods of volumetric analysis, or other chemical testing, as can be usefully shown in the lecture-room.

Electrotyping, Photograpy



page

## IV. - Lectures on Geology and Mining.

This course will embrace, -

1. A sound duding of the principal constituents of rocks and the more important ores, and other useful mineral products; with the mechanical, chemical, and optical modes of discrimination.

Division of rocks into aqueous, igneous, and metamorphic. Description of stratified, marine, delta, and fresh-water deposits; and of igneous and metamorphic masses, with an account of the actions concerned in their production.

3. Illustrations of Geological Structure, as seen in flexures, axes, faults, basins, valleys of elevation and erosion, escarpments, foliation and cleavage of rocks, &c.; with the methods of determining the dip of strata and veins, and of making and mapping geological and mining surveys.

4. Organic Remains, and their use in determining the sequence of the strata.

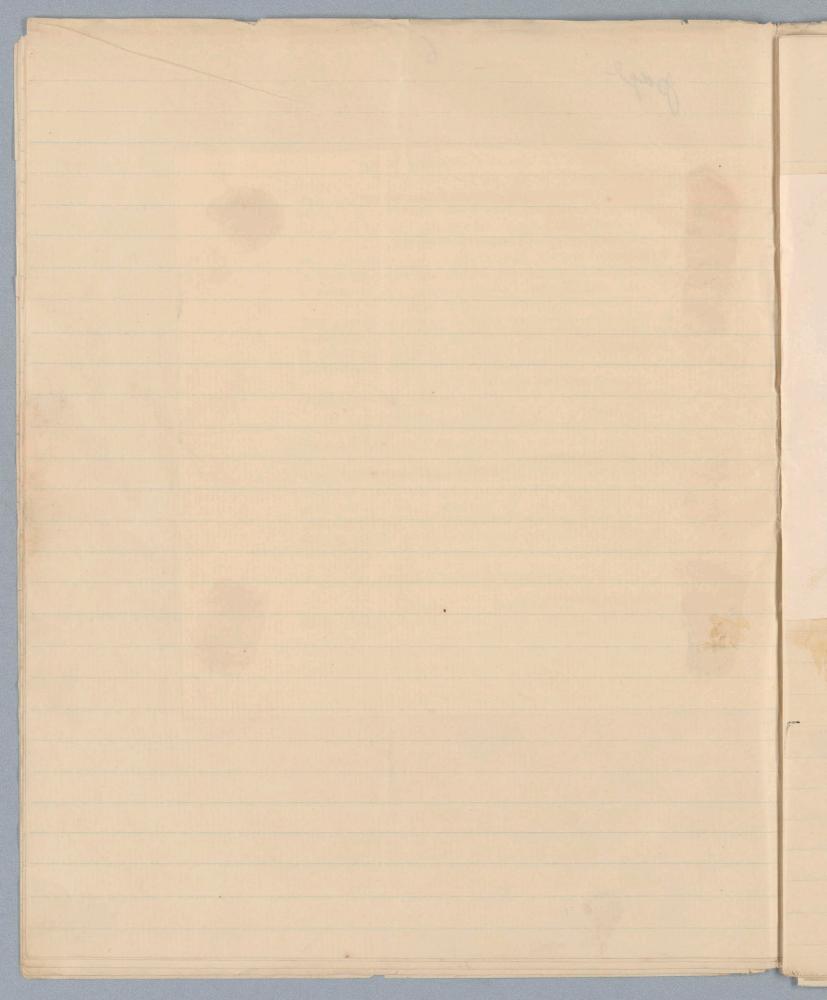
5. Table of Geological Formations, from the most ancient to the present time, with a special account of the North-American strata; showing, by the use of maps and sections, the geographical position and range of each great formation; marking out the coal-fields, belts of iron-bearing, gold-bearing, and other metalliferous rocks; and the ranges of the granites, slates, sandstones, limestones, marbles, and other mineral aggregates, which may be brought into profitable use for building or other purposes.

## V. - Lectures on Botany and Zoölogy.

This course will include, -

- 1. An Outline of Botany; embracing the growth, morphology, structure, and classification of Plants.
- 2. Economic Botany, plants useful for food and in the arts.
- 3. An outline of Zoölogy; including the structure, physiology, and classification of Animals.
- 4. Economic Zoölogy, animals useful for food and in the arts.

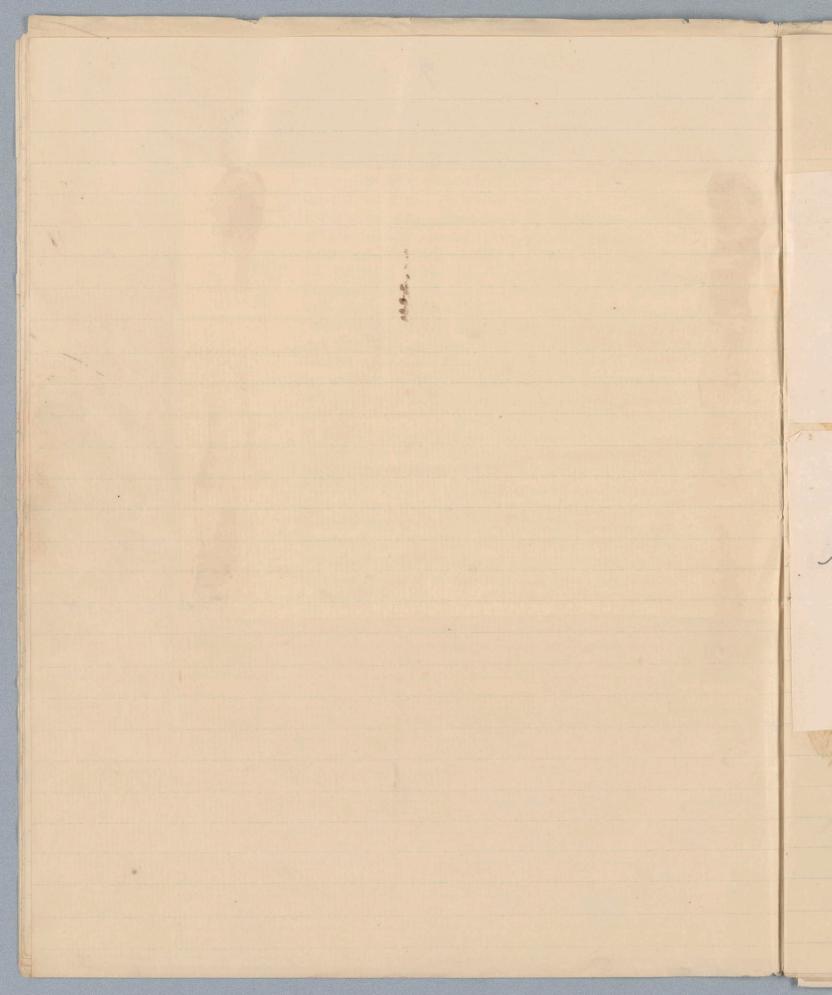
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In addition to these general lectures, it is proposed to make special provision for the more extended and technical treatment of branches of industrial knowledge not included, or but briefly touched on, in the general courses. Such would be the manufacture of cotton and other textile fabrics, the arts of printing and engraving, the manufacture of paper, &c.; including for each the history and statistics of the subject, and an account of the machinery and processes employed, illustrated by specimens and models from the Industrial Museum.

All the subjects of this class may perhaps, at an early day, be embraced as a distinct and extended course, under the head of Special Technology; in which many of the materials and products gathered in the Museum would find their most useful medium of interpretation.

As the courses of lectures above described are intended to meet the general demand for instruction in the applications of science to the arts, as well as to aid students in preparing for a more thorough course of study, they will treat only of such subjects as can be readily understood without previous training. At the same time, it will be their aim to teach the several branches to which they relate with such logical accuracy and completeness as to give the student a clear understanding of principles, and of their application in household and civic economy and the industrial arts.



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#### SECOND DEPARTMENT

SPECIAL AND PROFESSIONAL INSTRUCTION.

This department of the school is intended, -

First, For such students, as, by a full course of scientific studies and practical exercises, seek to qualify themselves for the professions of the mechanical engineer, the civil engineer, the builder and architect, the practical chemist, and the engineer of mines. And, -

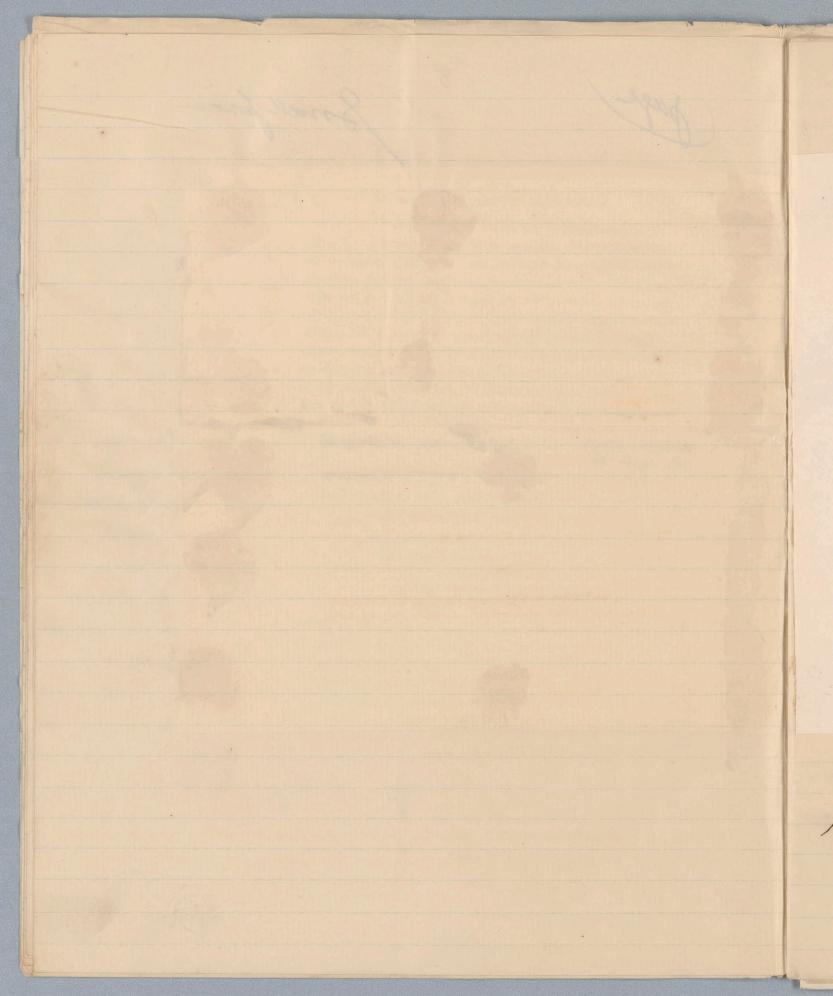
Second, For those who aim simply to secure a training in some one or more of the branches of applied science, - such as descriptive geometry applied to constructive perspective, &c.; chemical analysis; machinery and motive powers; general physics and chemistry, with manipulations; geology and

mining; navigation and nautical astronomy; metallurgy of iron, copper, &c.

The entire series of instructions, arranged in reference to the above-named professional divisions, offers to the student five courses having more or less in common; viz.,-

1. A course on Mechanical Construction and Engineering.

The studies of each of these divisions are arranged so as to 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.



For the first two years, the studies and exercises will be the same for all the regular students; each thus obtaining such an acquaintance with the whole field of practical science as is needed for a complete and satisfactory study of either of its professional departments.

The courses of instruction in the first and second years will be as follows: -

#### 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. Introductiony Physics.

3. Attraction Chemistry.

1 5. 8 Botany 4. Description Astronomy. 6 7. Drawing, Linear and Geometric.

Elementary

7 /. Practice in the use of the Chain, Level, Theodolite, &c., Sextant, &c., when practicable, during the course; but chiefly in the vacation succeeding.

8. French Language.

#### SECOND YEAR.

1. All Architecture Spherical Council Trigonometry, Navigation and Nautical Astronomy.

2. Analytical Geometry; franches of the Differential and Integral Calculus.

Elements

3. Mechanics was died without the Galadre Washingrand Notors: Steam-engine Cann

A Physics with Manipulations, to exercise the student in the use of

4. Chemistry with Manipulations, and simple qualitative testing.

of Descriptive and General Goolegy.

& Elements of November Zoölogy.

Descriptive Geometry.

Brawing: Geometric, Perspective, Lights and Shadows.

I. The German Language.

5. Physical & Shuchuck Geology; Constitution and unanjunest-of the malerials of the Carth's Crust ; Phenemena & Laws of Muchine; modes of Observations

I. The German Language.

THIRD YEAR.

The studies of this year will be the same for those pursuing

Engineering

Jourses of Mechanical and of Civil Engineering and of Building and Architecture

Italian

- 1. Differential and Integral Calculus; Rational Mechanics.
- 2. Strength and Strain of Materials used in Construction; Principles of Joinery, - Framework, Roofs, Wooden Bridges, &c.
- 3. Investigation of Machinery and Motors; Elements of Machines; Combinations; Effective Work; Dynamometers.
- 4. Chemistry and Geology of the Materials used in Construction.
- 5. Combustion and Fuel; Warming, Ventilation, and Lighting.
- 6. Descriptive Geometry applied to Carpentry 12.
  7. Drawing of Machinery, Roofs, Bridges, Buildings, Maps, &c. 8 Liferen on Photography

Course of Practical and Industrial Chemistry.

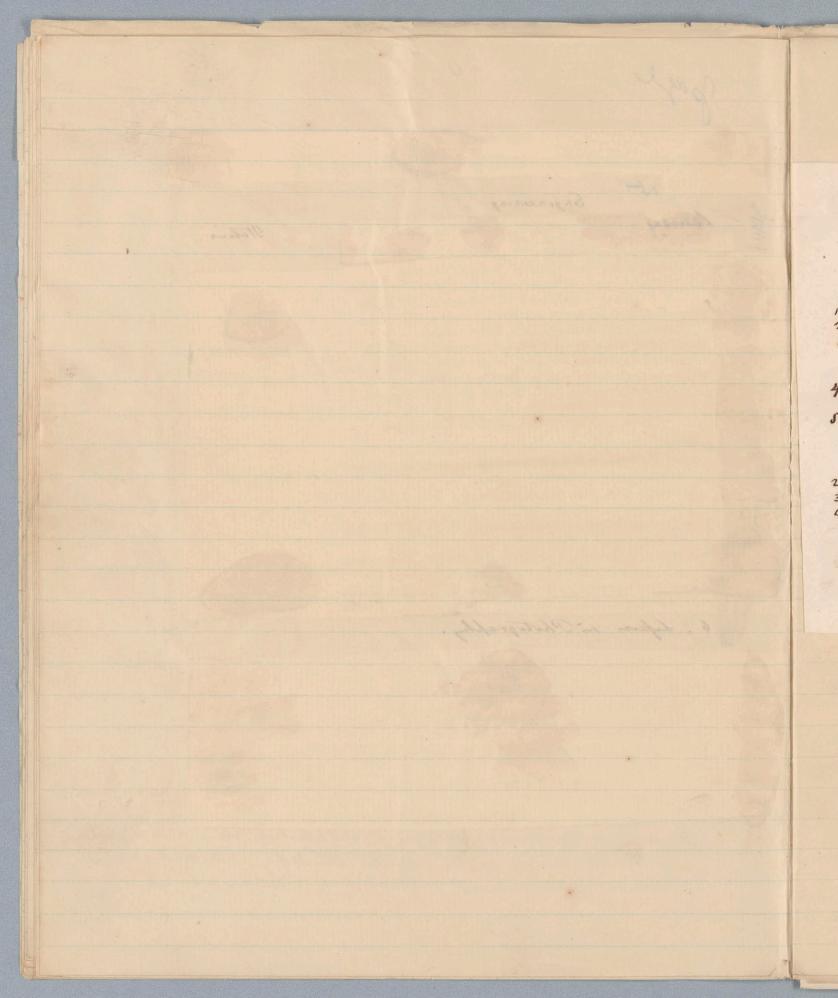
- 1. Chemical Analysis, qualitative and quantitative, chiefly of inorganic substances, including the volumetric methods. Lectures to accompany the laboratory exercises.
- 2. Descriptive and Determinative Mineralogy; Use of Blowpipe,
- 3. Lectures on Combustion and Fuel, and on Warming, Ventilation, and Lighting.
- 4. Lectures and Illustrations on Industrial Chemistry; Manufactures of Glass, Pottery, Tiles, Soda-ash, Acids, Salts, Soaps, &c.
- 5. Drawing of Apparatus, Plans and Projects for Chemical Works, Laboratory Arrangements, &c.

6. Lepan in Photography.

## Course of Practical Geology and Mining.

- 1. Chemical Analysis, qualitative and quantitative; as under the preceding head.
- 2. Descriptive and Determinative Mineralogy; Use of the Blow-
- 3. Lectures on Combustion and Fuel, and on Warming, Ventilation, and Lighting.
- 4. Historical Geology, Successive Systems, Groups, and Formations, with their leading Fossils.

Detailed study of the Geology of North America.



5. Drawing, Topographical and Geological Sections and Maps, Conventional Representation of Rocks, Coloring of Maps and Sections

6 Lipon ni Phitosrchhy. FOURTH YEAR.

In this year, the professional courses, becoming more completely separate from one another, will be as follows:—

Course of Mechanical Engineering.

2 1 Investigation of Machinery and Motors continued, in cluding 3 2. Special Study of Steam and Steam-engines, Stationary, Locomotive, and Marine; of Air and Gas Engines; of Hydraulic Machines and Motors; of Pumps, &c.

4 Construction and Arrangement of Machinery in Mills for Grinding, for Textile Manufactures, &c.

The Drawing of Machines, Working Plans and Projects of Machinery, Mills, &c.

Course of Civil and Topographical Engineering.

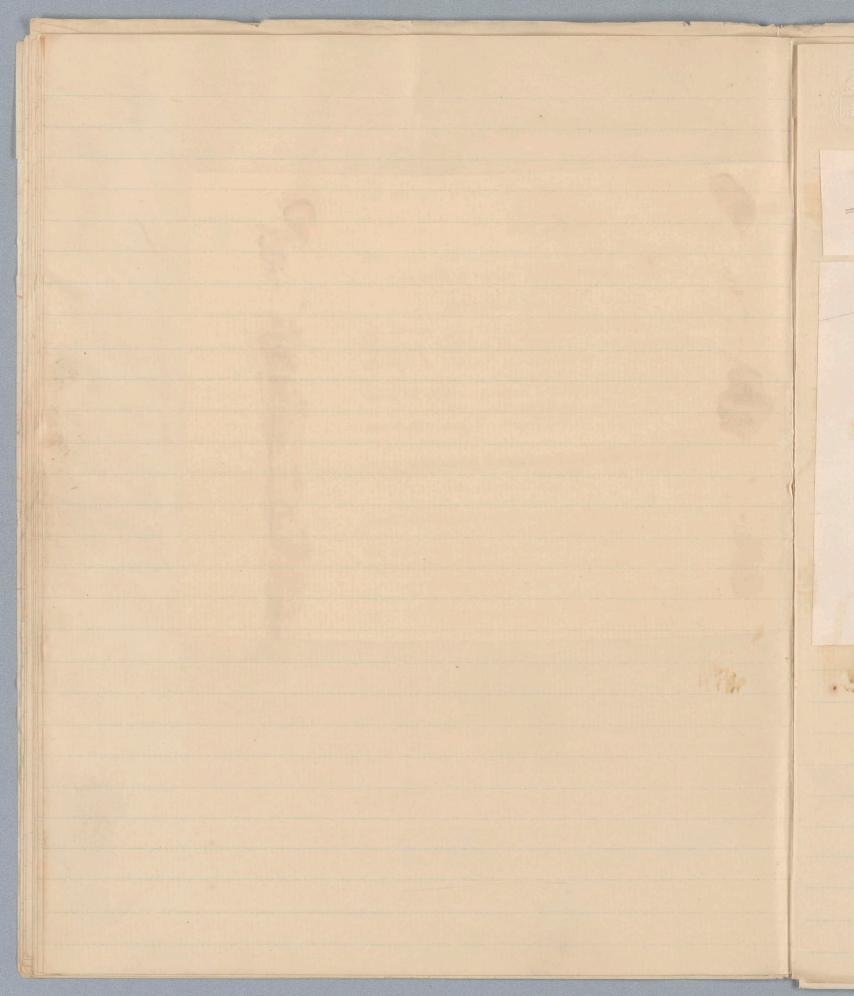
2 1. Spherical Astronomy, with the use of Instruments.

3 \( \). Location and Construction of Roads, Railways, and Canals.

4 & Supply and Distribution of Water; Water-works; Dams, Ponds, &c.; Distribution of Gas; Drainage; Irrigation.

4. Extended treatment of Structures, — Mason-work, Arches and Bridges of Stone; Structures in Iron, including Girders, Columns, Roofs, Suspension-bridges, Tubular-bridges, &c.

5. Drawing: Working Drawings of Constructions, and Plans and Projects of Railroad and other Surveys; Profile and Topographical Drawing.



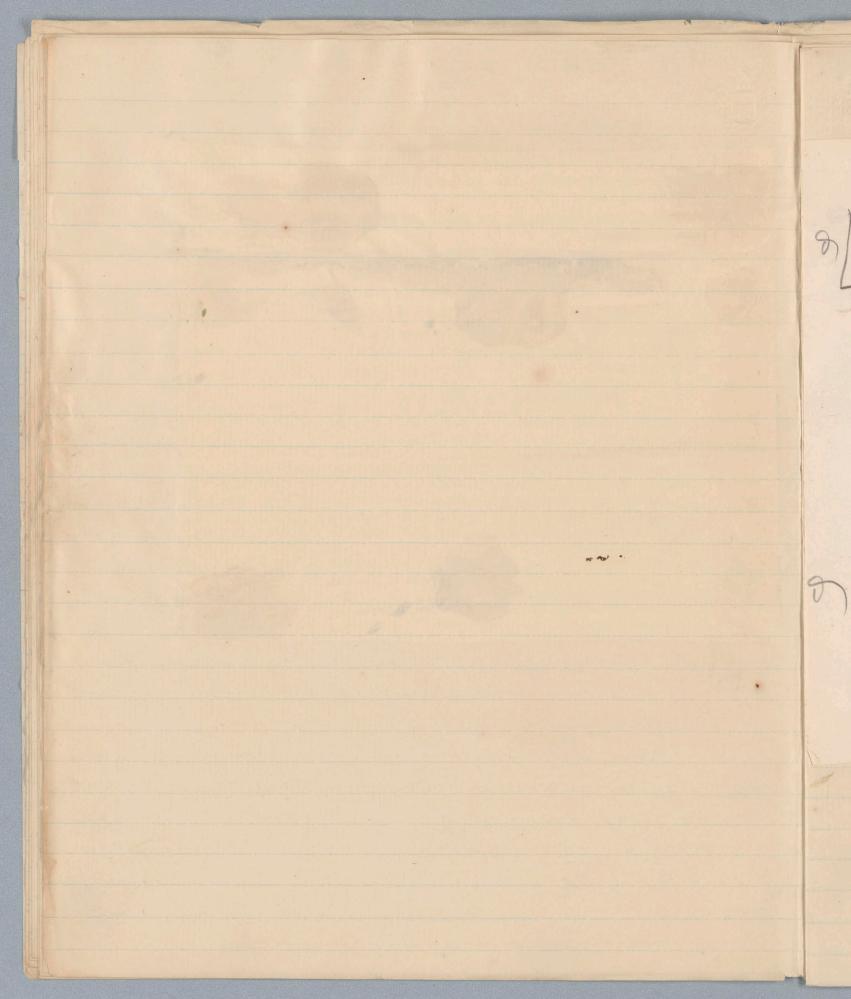
For such students as desire to devote themselves especially to Topographical Engineering, the above course will be modified so as to include,—

- 1. A more extended study of Astronomy, and practice with Astronomical Instruments.
  - 2. Lectures and exercises in the higher Geodesy, including the survey of Harbors, Coasts, and extensive regions.

At the same time, a larger space will be allotted to Topographical and Map Drawing; and the subjects mentioned under heads three and four of the preceding programme will be in part omitted.

### Course of Building and Architecture.

- 1. Extended treatment of Structures, Mason-work, Arches and Bridges of Stone; Iron Girders, Columns, Roofs, &c.
- 2. Details on Warming, Ventilation, and Lighting; and on the distribution of Water and Gas.
- 3. Lectures on Building or Practical Architecture; embracing a review of the Materials used, their preparation and mechanical combination in the erection of Dwellings, Schoolhouses, Halls, Courts of Justice, Prisons, Manufactories, &c., illustrated by Models and Drawings.
- 4. Lectures on Architecture as a Fine Art, with a History and Illustrations of the great Architectural Works of Classical, Mediæval, and Modern Times.
- 5. Architectural Drawing, Projects for Dwellings, Schoolhouses, Churches, &c.



# 13

### Course of Practical and Industrial Chemistry.

1. Chemical Analysis continued; embracing the analysis and commercial testing of, —

Ores, Limestone, Clays, and other crude mineral materials.
[7] Cast Iron, Copper, Lead, &c., and Metallic Alloys.

Soda-ash, Bleaching Salt, Common Salt, Saltpetre, Gunpowder, Indigo, Paints, Drugs, Guano, and other Manures, &c.

[1.] Drinking and Mineral Waters, and Sea-water.

Coal-gas, and other Gaseous Mixtures.

2. Exercises in Organic Analysis.

3. Lectures on Industrial Chemistry; including the Arts of Dyeing, Color-printing, Tanning, Brewing, Distillation; on the Manufacture of Illuminating Gas,

4 Drawing; Plans and Projects for Dyeing and Print-work, for Gas-works, &c.

### 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, -

[a.] Prospecting, Breaking Ground, Boring, Blasting, Tubing, Sinking Shafts, Driving Tunnels, Ventilating and Lighting.

[1.] Of the different methods of Working Mines.

[c] Of Machinery and Motors — Engines, Horses, Pumps, Wagons, Drums, Ropes, &c. — for conveying and raising the material.

[d.] Of the Dressing and Concentration of Minerals, Crushers, Stamps, Washers, Amalgamators, &c.; and Machinery used in the Pennsylvania Anthracite Region.

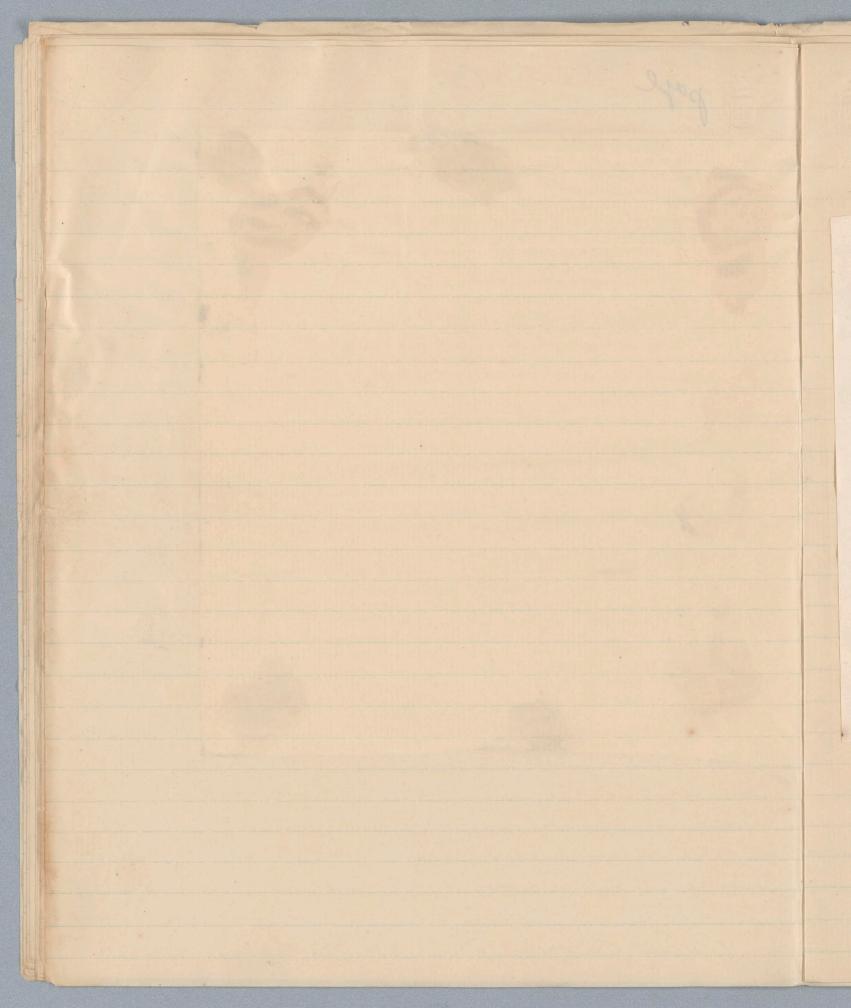
[6] Of Quarrying and Open Mining.

[f.] 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.

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### Course of Practical Metallurgy.

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:—

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

 Chemical Analysis; including, chiefly, Assays in the Wet and Dry Ways of Ores, Flumes, 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.

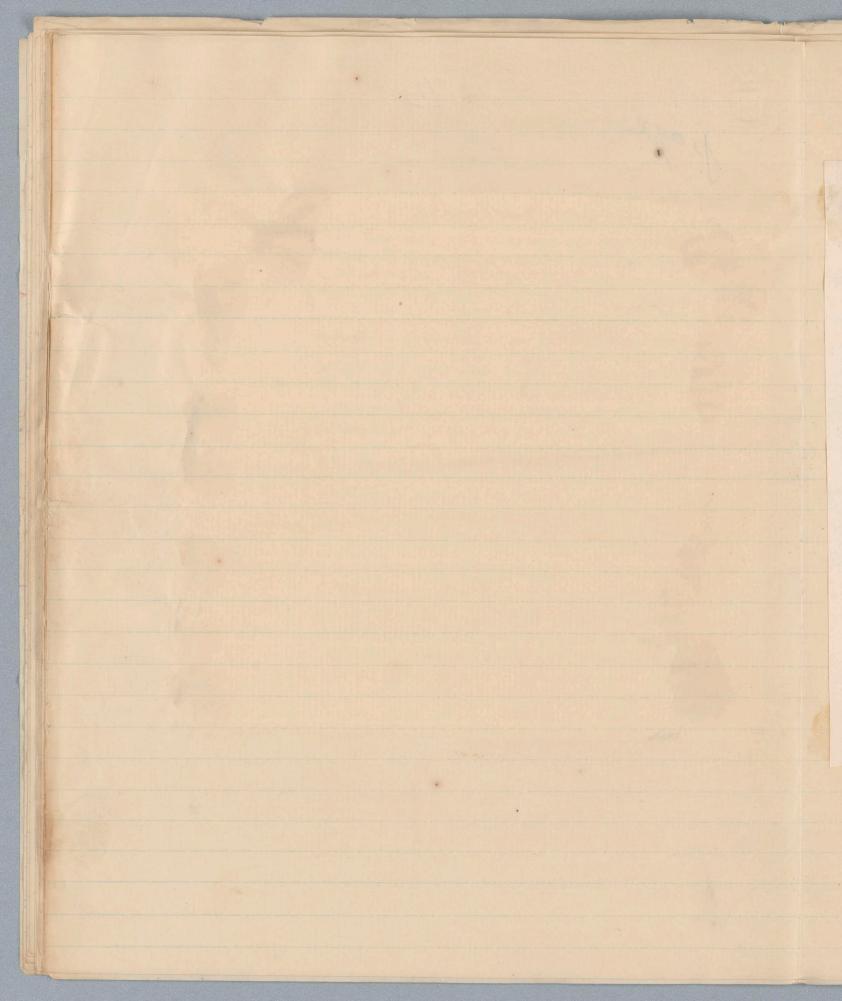
Details of the Smelting and Manufacture of Iron, Copper, Lead, Zinc, Silver, Aluminum, &c.

4. Drawing, — Plans and Projects for Cooking-ovens, Furnaces, Refineries, Hot and Cold Blast Arrangements, &c.

MILITARY TACTICS.

The regular students of the School will be taught the use of small-arms and the simpler parts of tactics; and, for this purpose, will be organized into one or more companies, to meet on stated days for military instruction and exercise.

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ADMISSION OF STUDENTS.

The leading principles governing the admission of students into this department will be,—

First, That all persons who are qualified to enter upon any one of the full courses, or of the special studies, of the School,

shall have the freest opportunity of doing so; and,—

Second, That no students shall be admitted to any of the courses of instruction who have not the preliminary knowledge

courses of instruction who have not the preliminary knowledge needed for a satisfactory pursuit of the studies proposed.

Students to be admitted to the introductory or first year's source must have attained the age of fifteen works, and must

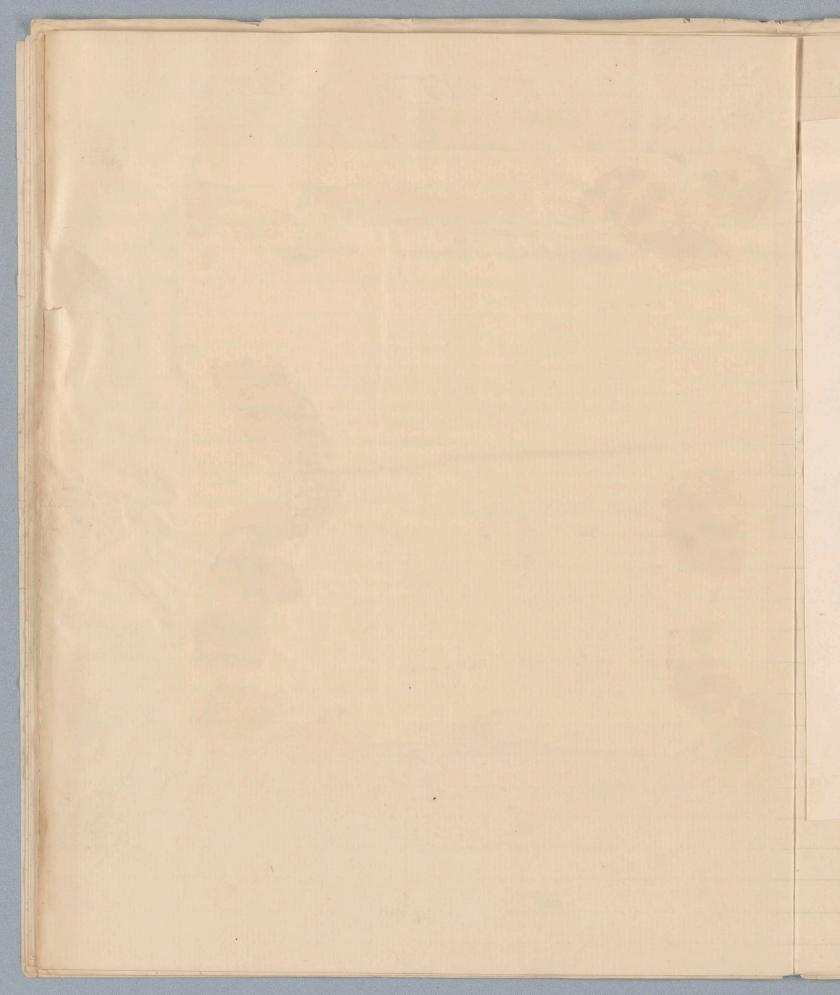
Students to be admitted to the introductory or first year's course must have attained the age of fifteen years; and must give satisfactory evidence, by examination or otherwise, of such training in elementary mathematics, and in the other subjects taught in the common schools, as shall hereafter be prescribed.

In order to enter the second year's course, the student must be at least stateen years of age; and must give evidence, by examination or otherwise, of such knowledge of the first year's studies as would enable a student of the first year to pass into the second; and a like rule will apply to the case of students seeking admission into the classes of the succeeding years.

To make the opportunities of instruction as widely accessible as possible, students will be allowed to enter special divisions of either of the courses after the first year,—as, for example, the classes of mathematics, of mechanical construction, of chemical analysis, of physics, or of mining and metallurgy,—on giving satisfactory evidence that they are duly prepared to pursue such special studies with advantage.

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#### DIPLOMAS AND CERTIFICATES.

As the diploma or certificate is intended not only to be a reward to the student for his diligence and attainments, but an assurance to the public of his knowledge and skill in the particular department of applied science to which it relates, it will be conferred on such students only as by their examinations and other exercises give proof that they possess the prescribed qualifications; but all students in good standing, who fulfil this requirement, shall be entitled to the testimonials of the Institute, without regard to the greater or less number of courses they may have attended in the Institution.

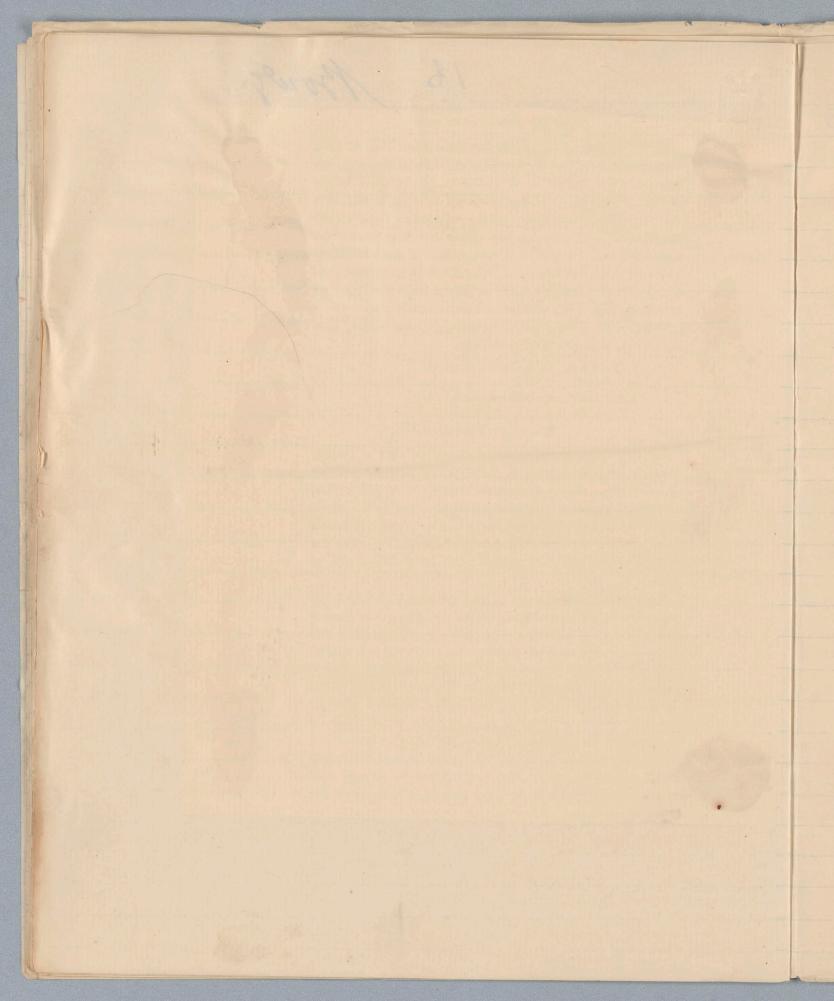
The degrees or diplomas corresponding to the leading divisions of the School will be as follows:—

- 1. The Degree of Mechanical Engineer.
- 2. " " " Civil and Topographical Engineer.
- 3. " " " Builder and Architect.
- 4. ,, ,, Industrial Chemist.
- 5. ,, ,, Geologist and Mining Engineer.

To suit the case of students having in view a general scientific education, such as may qualify them to become teachers, rather than a professional training in applied science, a schedule of studies will be appointed, embracing the whole of the two first years' and certain parts of the third and fourth years' studies, so as to form a general scientific course; for proficiency in which, the degree of *Bachelor of Science* will be conferred.

To be entitled to either of these degrees, the student must pass a satisfactory examination on the whole course of studies and exercises prescribed in his department, including the elementary and general no less than the advanced and special subjects. He must, moreover, prepare a dissertation on some subject in pure or applied science, or submit an original report on some machine or work of engineering, or some mine or mineral survey, or chemical investigation, which shall be approved by the Faculty of Instruction or other examining Board. He will be required also to have sufficient familiarity with the French and German languages to be able to read without difficulty works in these languages relating to the sciences and arts.

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Besides the degrees or diplomas covering the complete courses of study above referred to, there will be given certificates of attainment in special subjects to such students as, on examination, are found to have attained the required proficiency in them. Among the special subjects for which such certificates may be awarded are—

Machine Drawing.

Topographical and Constructive Drawing.
Architectural Drawing.
Descriptive Geometry and its Applications.
Mathematics, applied to Mechanics and Machinery.

", ,, to Construction.

Physics and Chemistry, with Manipulations. Chemical Analysis.

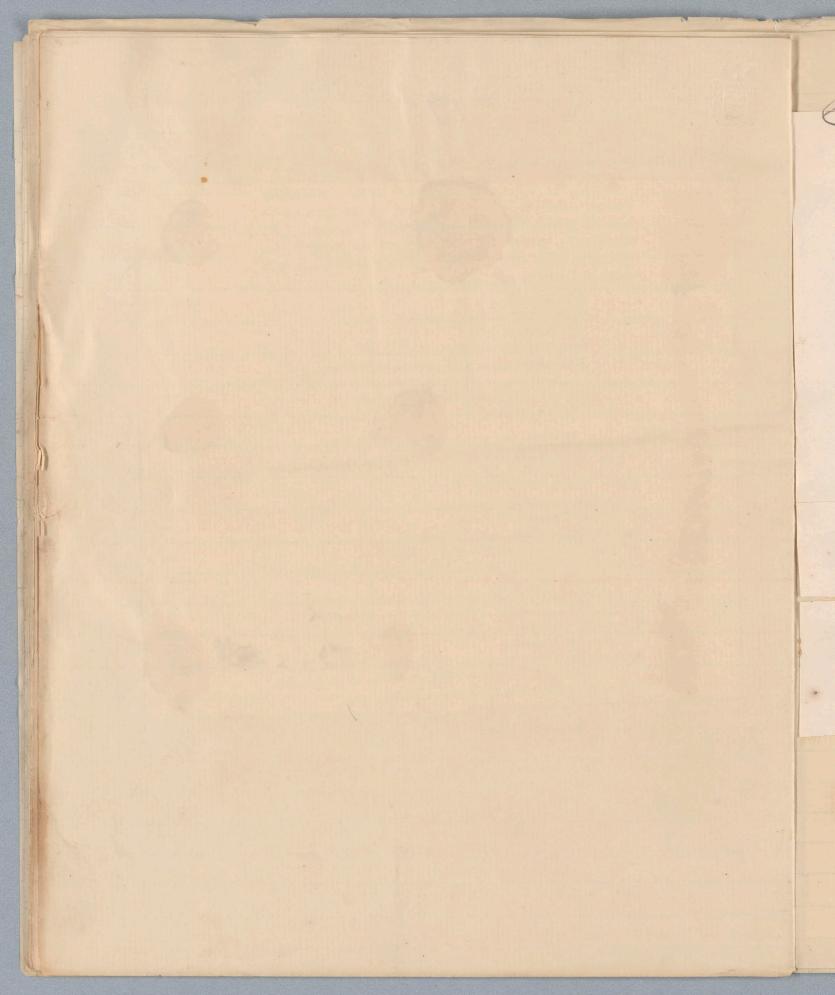
METHODS AND APPARATUS OF INSTRUCTION.

The instructions in this department of the School will be given through the medium of, —

- 1. Lectures and familiar Expositions.
- 2. Oral and Written Examinations.

### 3. Process in the Solution of Problems.

- 3 4 Practice in Physical and Chemical Manipulations.
- 4 5. Laboratory Training in Chemical Analyses, Metallurgy, and Industrial Chemistry.
- Drawing and the Construction of Special Plans and Projects of Machines and Works of Engineering and Architecture.
- 4 . Practical Exercises in Surveying, Levelling, Geodesy, and Nautical Astronomy.
- Excursions for the Inspection and Study of Machines, Motors, Processes of Manufacture, Buildings, Works of Engineering, Geological Sections, Quarries and Mines.



LECTURES AND EXPOSITIONS. As a general rule, each lecture will be preceded by interrogations on the subject of the preceding lecture, in which the 111 0118 teacher will have the opportunity of re-enforcing the instruc-

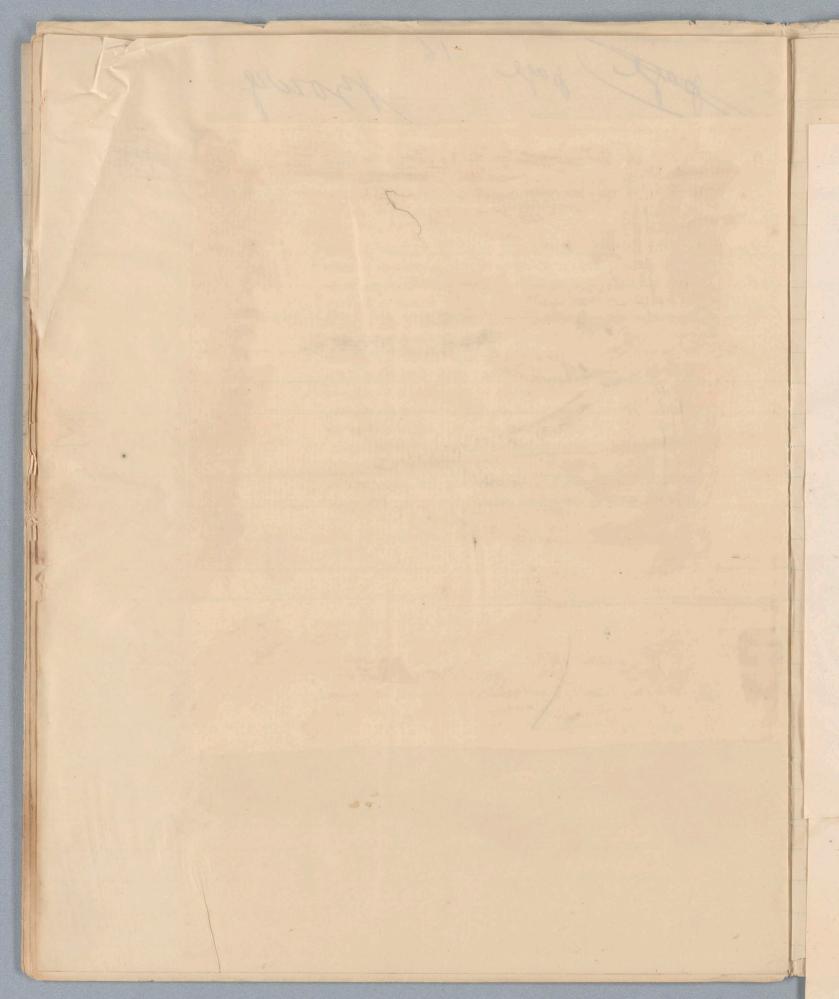
tion already given, as well as of testing the progress of individual pupils.

After the first year, the student will be expected to take notes of the lectures as they proceed, and afterwards to write them out with the accompanying diagrams or drawings, so as to form, in connection with each of his classes, a text for immediate study as well as future reference.

In addition to these notes of lectures, he will be expected to study or to consult text-books or works of reference, whenever such are appointed to be used. But in view of the value of the method of lectures, combined with examinations, as a means of commanding the attention and stimulating the zeal of students, this method will be used whenever practicable; and in no case will mere text-book recitation be exclusively relied upon. Until habituated to the work, the student will have the assistance of his teachers in correcting his notes, and in reducing them to methodical order.

Where familiar expositions rather than formal lectures are given, as in many of the mathematical classes and in the instruction connected with the laboratory work, the student will be interrogated by his teacher, from time to time, in the progress of the lesson, as well as at its commencement.

As a means of enforcing the instruction of the lecture-room, and of enabling the student to acquire facility in the application of principles to special cases, problems will, from time to time, be given out to the mathematical and other classes, where applicable, of which written solutions will be required; and these solutions the students presenting them may be called upon to explain.



ORAL AND WRITTEN EXAMINATIONS.

As frequent and thorough examinations form the best means of inciting students to diligence, as well as of testing their progress in their studies, and of discovering those individual needs and difficulties which the teacher should endeavor to obviate, they will constitute a leading feature in every department of instruction in which they can be employed.

Besides the daily oral examinations already referred to as preceding and accompanying the lectures, oral examinations will be held once every month, separate from the lectures, on a day set apart for the purpose, at which each entire class, or, when too numerous for this purpose, parts of the class, taken in succession, will be examined and drilled in the subjects lectured upon or appointed for study during the month just

At or near the close of each town, viz. in the months of half of the February and June, written examinations will be held; that of February embracing the subjects studied during the first term, that of June covering the studies of both terms. On these occasions, the courses of instruction will cease; and a sufficient period will be set apart to allow the classes time for a brief review of studies, and full opportunity for the several examinations,

Mode of conducting the Written Examinations.

These examinations will be conducted as follows: -

The students taken by classes, and provided with writing, and, where necessary, with drawing implements; and materials will be placed at separate tables in the examination-room, bringing with them neither books nor memoranda of any kind to aid them in their work. The instructor having charge of the class will then furnish to each student a copy, in printed or written form, of the series of questions which he has prepared to test their proficiency; and these the students will be required to answer in writing, as well as they can, without conferring with one another, or consulting any other sources of information.

It shall be the duty of the teachers to keep a numerical record, according to forms hereafter to be prescribed, of the performance of each student in the several classes, both at the monthly oral examinations and at the written examinations just described. These records will form the basis for determining the standing of the students at the end of each course, and for deciding upon those to whom certificates of proficiency are to be awarded.

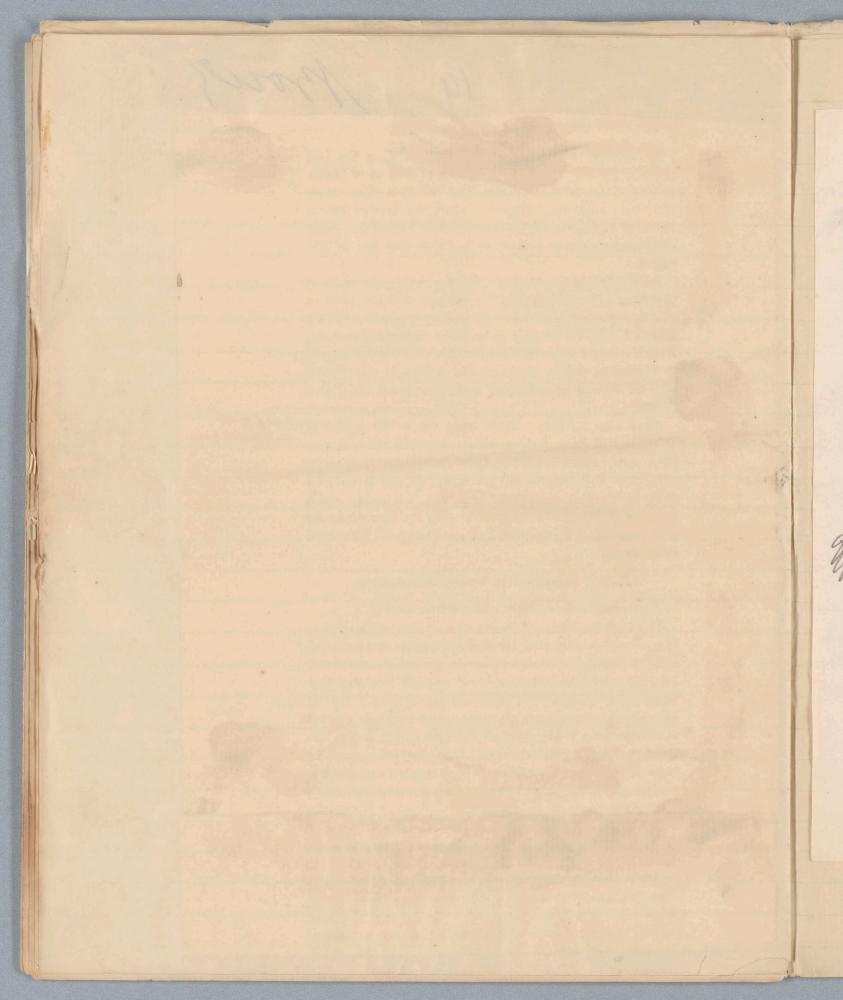
## Graduating Examinations.

The examinations for degrees will be held at the close of the June term, and will be partly oral and partly in writing. In the former, each candidate will be interrogated apart from the rest; in the latter, the mode of proceeding will be the same as at the term examinations above described. In both, the questions will range over the entire series of studies on which the student is required to be prepared.

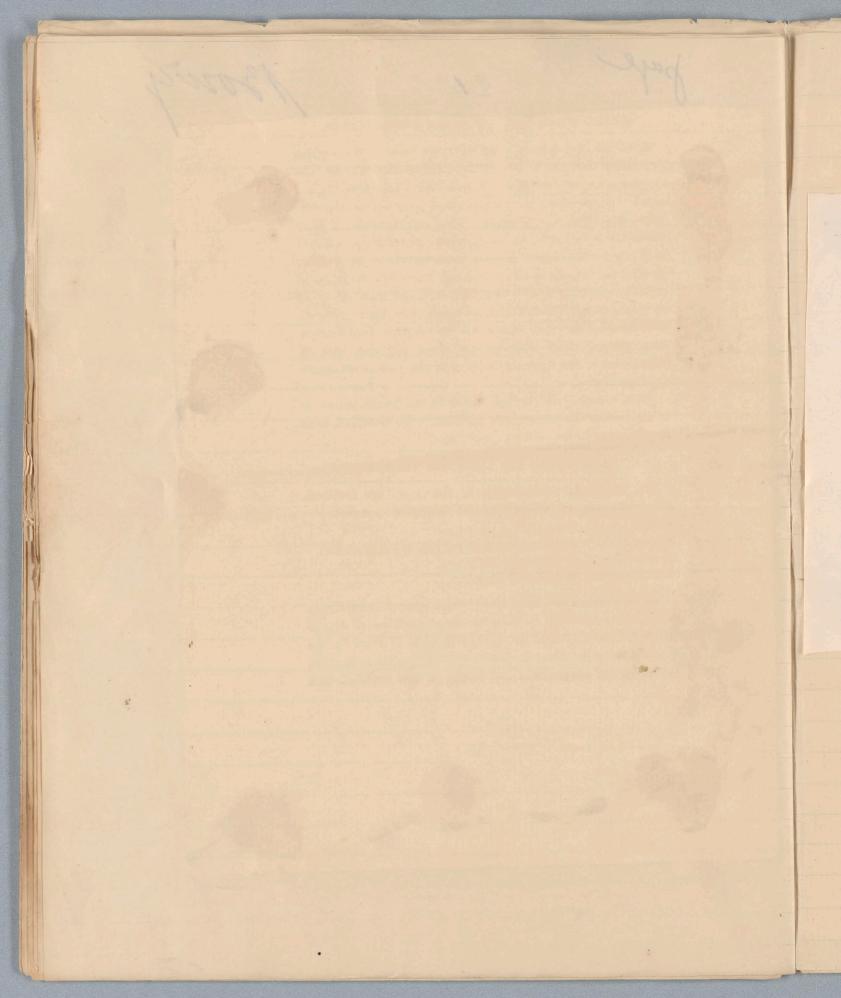
As part of these examinations, the candidates will be called upon to exhibit the drawings and projects prepared by them for the occasion, and to perform such laboratory manipulations and exercises as the Examining Committee may assign.

At the same time, the theses of the candidates will be brought forward for examination; and, where expedient, their authors be called upon to explain or defend them.

As a further test of their qualifications as teachers of Science, the candidates for the degree of Bachelor of Science, in addition to their examinations, will be required to give a brief oral lecture on such topic embraced in their studies as may at the time be designated for this purpose.



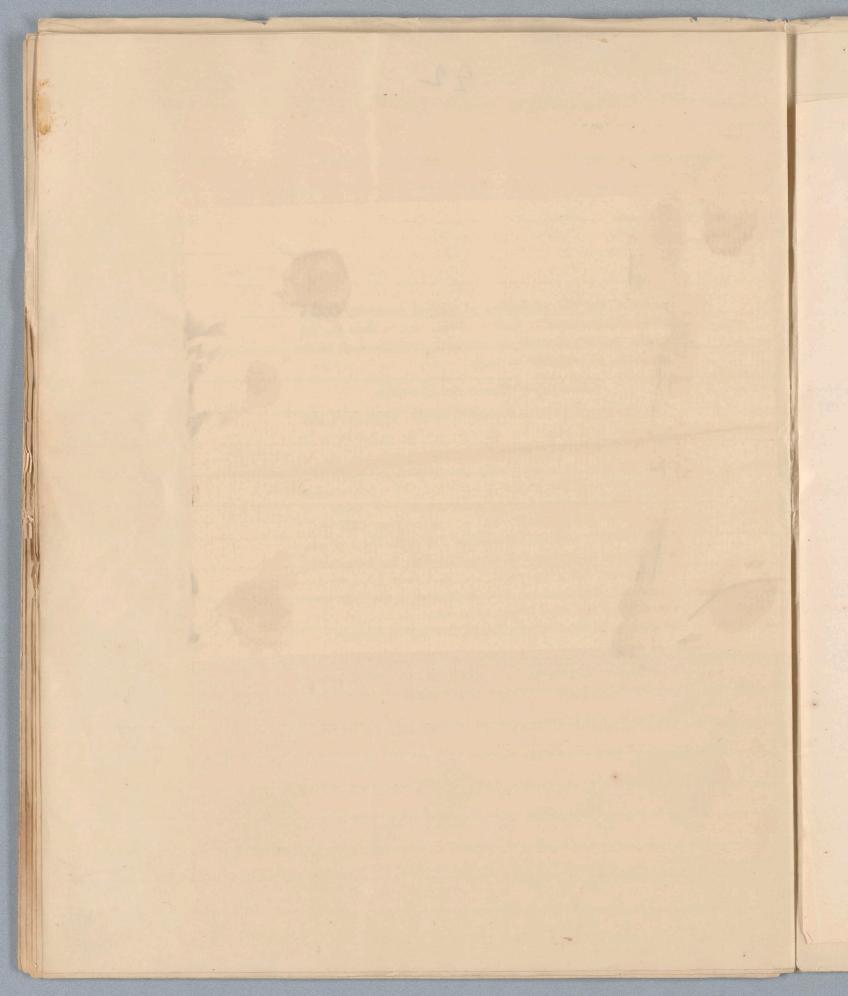
PRACTICE IN PHYSICAL AND CHEMICAL MANIPULATION. It will be the object of these exercises to make the student practically familiar with the adjustments and use of the apparatus and agents employed in the more important experiments and processes in natural philosophy and chemistry. With this view, the students, under the direction of their teacher, will be called, by small classes at a time, to execute with their own hands various experiments in mechanics, pneumatics, sound, optics, electricity, and other branches of experimental physics, and to exhibit chemical re-actions, to fit up chemical apparatus, to prepare gases and other products, and demonstrate their properties by suitable experiments, accompanying these manipulations, when required, with an explanation of the apparatus used or of the process or experiment performed. These exercises will be held either in the lecture-rooms or in the appropriate laboratories hereafter to be described, as at the time may be found most expedient. LABORATORIES AND LABORATORY TRAINING. The laboratory arrangements of the school are designed, when complete, to embrace the following departments:-1. A Laboratory of Physics and Mechanics. 2. A Laboratory of General Chemical Analysis and Manipulation. 3. A Laboratory for Metallurgy and Mining. 4. A Laboratory for Industrial Chemistry. While intended primarily for the instruction of the students, these laboratories will be used for the prosecution of experiments and investigations on subjects referred to them by the Committee of the Museum or the several Committees of Arts, including the examination and testing of new machines and



processes, and the conducting of original researches in the different departments of applied science; and in these critical studies and experiments the advanced students may, when expedient, be permitted to assist.

### Laboratory of Physics and Mechanics.

In this laboratory, it is proposed to provide implements and apparatus with which the student may be exercised in a variety of mechanical and physical processes and experiments. Thus he may learn practically the methods of estimating motors and machines by the dynamometer, of experimenting on the flow of water and air or other gases, and of testing the strength of the materials used in construction. He may become familiar with the adjustments and applications of the microscope; be practised in observing with the barometer, thermometer, and hygrometer; and, in a room fitted up for photometry, may learn the mode of measuring the light produced by gas and other sources of illumination, and the value of different kinds of burners, lamps, and their appendages.



### 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.
- 3. Household and Commercial Analyses, including the Testing of Waters, Detection of Adulterations in Food, &c., Alkalimetry, Acidimetry.
- 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 resulting from the blast; and of determining the combustible value of the mineral or other fuel with which furnaces are supplied.

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 collections of rocks, fossils, minerals, and ores, with their manufactured products, provided and arranged specially to facilitate his studies in this department.

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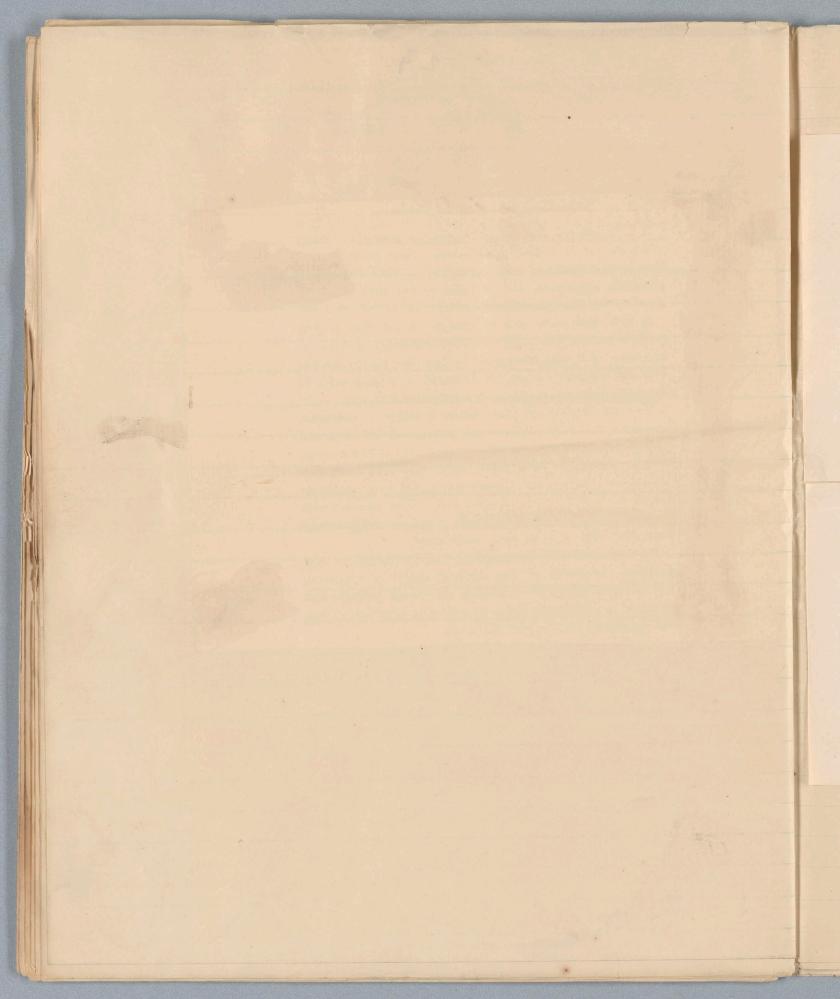
### Laboratory for Industrial Chemistry.

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 dyestuffs, mordants, discharges, and other substances used in the operations of dyeing, color-printing, and bleaching; togetherwith 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.

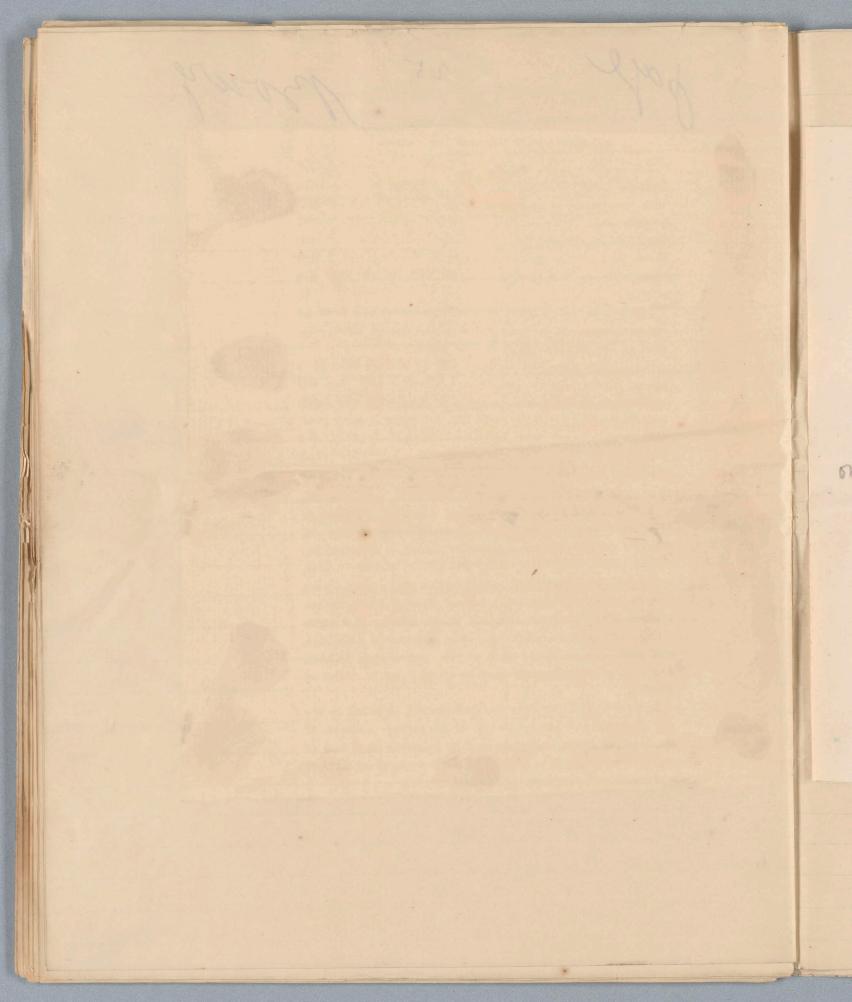
The facilities in this department, which are to be anticipated from the Lowell Drawing School, when placed in connection with the School of Industrial Science, will, it is expected, provide amply for instruction in free and general drawing, and thus furnish students with a valuable introduction and continual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

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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 cartoon-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 essential 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.



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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 machineshops, 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, triangulatic 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 founderies; 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.

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