

ANNUAL CATALOGUE

OF THE

COLORADO SCHOOL  
OF  
MINES.



GOLDEN, COLORADO.

1902-1903.

C. W.

# COLORADO SCHOOL OF MINES GOLDEN COLO



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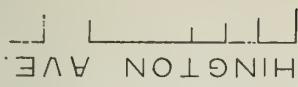
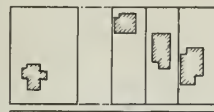
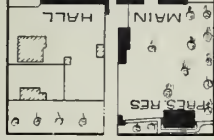
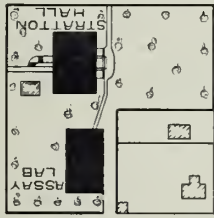
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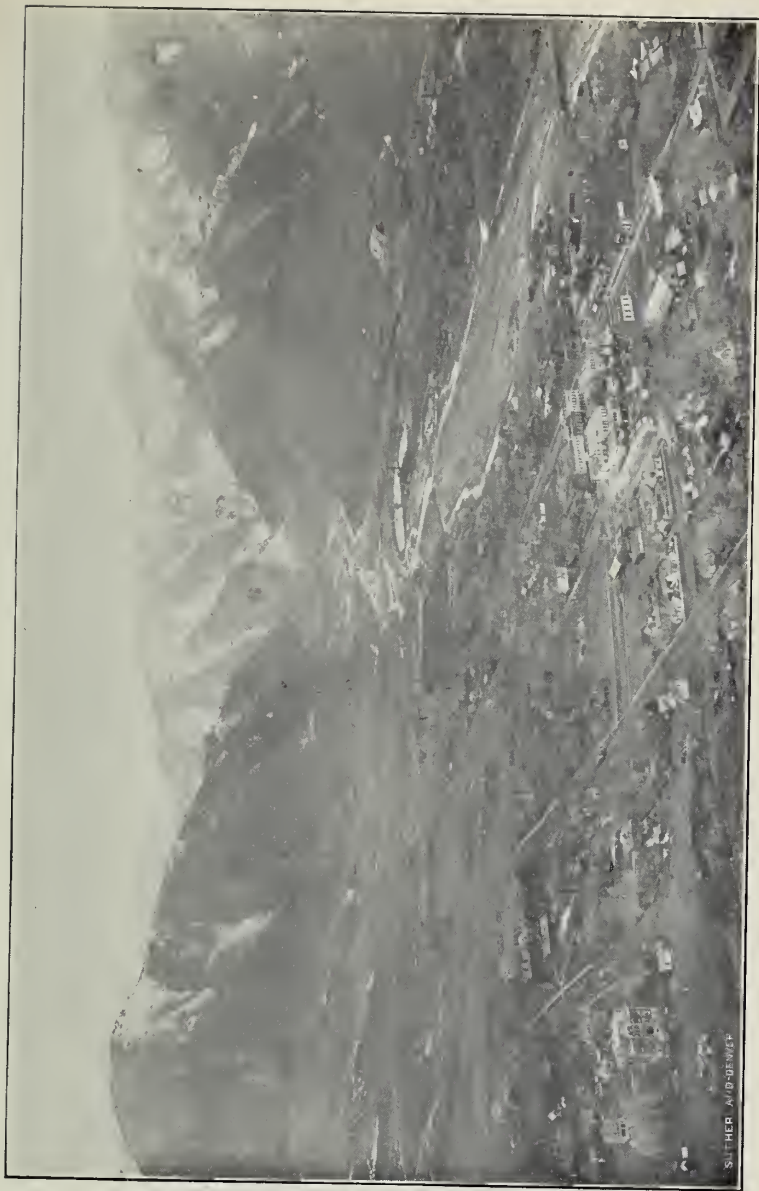
FIFTH ST

PREBYTERIAN CHURCH

COURT HOUSE

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SUTHER, A. D. DENVER

SCHOOL OF MINES  
GOLDEN AND CLEAR CREEK CANON LOOKING WEST FROM CASTLE ROCK.



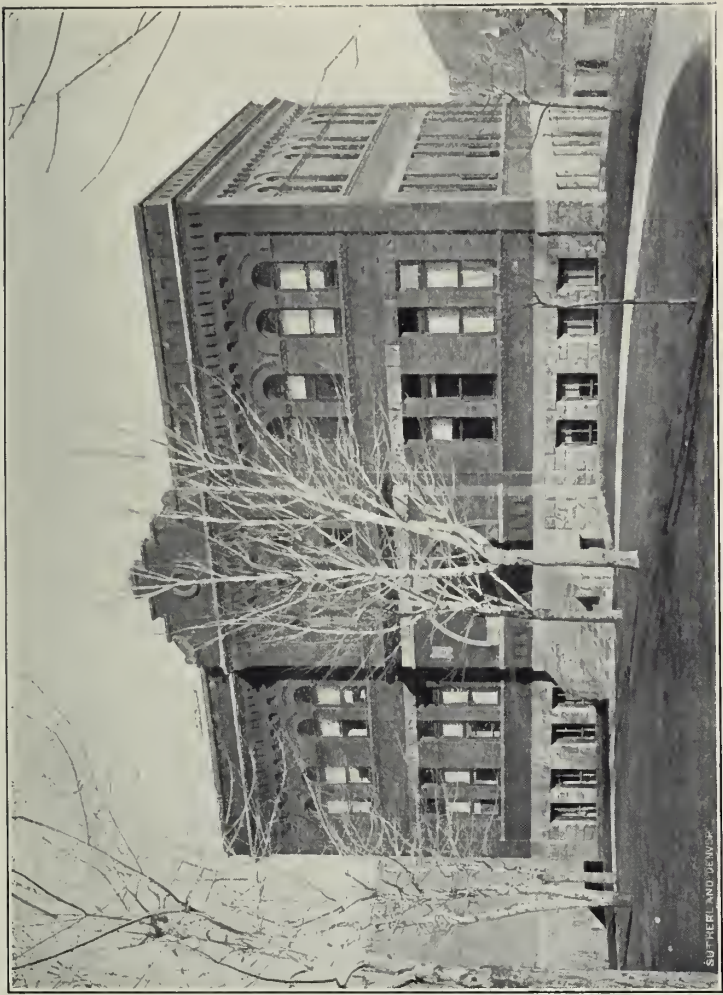
SUTHERLAND & BROS.

1880.

1882.

1890.

EAST FRONT MAIN BUILDING.



© SUPERLIND & WOOD

WEST FRONT, HALL OF ENGINEERING.



LOOKING NORTH FROM THE SCHOOL OF MINES.



LABORATORY OF ASSAYING.

# ANNUAL CATALOGUE

OF THE

# COLORADO SCHOOL OF MINES.



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1902-1903.

C. W.



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# CALENDAR—1902, 1903, 1904.

1902							1903							1904													
JULY							JAN.							JULY							JAN.						
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13	14	15	16	17	18	19	11	12	13	14	15	16	17	12	13	14	15	16	17	18	10	11	12	13	14	15	16
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17	18	19	20	21	22	23	22	23	24	25	26	27	28	16	17	18	19	20	21	22	21	22	23	24	25	26	27
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## SCHOOL CALENDAR.

### 1902.

- June 19..... Graduation of the class of 1902.  
Sept. 10..... Beginning of entrance examinations.  
Sept. 15..... First semester begins.  
Nov. 20..... Laying of the corner stone of Stratton Hall.  
Nov. 27..... Thanksgiving recess begins.  
Dec. 20..... Christmas vacation begins.

### 1903.

- Jan. 5, 10 a. m. .... Christmas vacation closes.  
Jan. 22..... Close of recitations of the first semester.  
Jan. 23..... Beginning of examinations of the first semester.  
Feb. 2..... Beginning of second semester.  
Feb. 22..... Washington's Birthday.  
(No holiday, it being on Sunday.)  
April 17..... Arbor Day.  
May 15..... Senior trip begins.  
May 15..... Close of recitations of the second semester.  
May 18..... Beginning of examinations of the second semester.  
May 21..... First examination for admission to the class of 1907.  
May 22..... Close of examinations of the second semester.  
May 24..... Baccalaureate Sunday.  
May 25-27..... Commencement exercises.  
Sept. 9..... Second examination for admission to the class of 1907.  
Sept. 10..... Re-examinations of matriculated students.  
Sept. 14..... Opening of the first semester of the academic year 1903-1904.  
Nov. 26..... Thanksgiving recess begins.  
Dec. 19..... Christmas vacation begins.

### 1904.

- Jan. 3..... Christmas vacation closes.  
Jan. 22..... First semester ends.  
Jan. 25..... Second semester begins.

**BOARD OF TRUSTEES  
OF THE COLORADO SCHOOL OF MINES.**

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EDWARD L. BERTHOUD, C. E..Golden, Colo.	Term expires 1903
FRANK BULKLEY, E. M.....Denver, Colo.	Term expires 1903
W. S. MONTGOMERY...Colo. Springs, Colo.	Term expires 1903
JAMES T. SMITH.....Denver, Colo.	Term expires 1905
OTTO F. THUM.....Denver, Colo.	Term expires 1905

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**OFFICERS OF THE BOARD OF TRUSTEES.**

MR. FRANK BULKLEY.....	President
MR. JAMES T. SMITH.....	Secretary

The regular meetings of the Board are held in Golden, at the School of Mines, on the second Thursday of each month.

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**NEW MEMBERS OF THE BOARD.**

JAMES F. CONE.....Canon City, Colo.	Term expires 1907
JOSEPH S. JAFFA, LL. B....Denver, Colo.	Term expires 1907
JOHN P. KELLY, Ph. C., M. D. .Golden, Colo.	Term expires 1907

## FACULTY.

*U. C. Alderson*

CHARLES ~~SKEELE PALMER~~, Ph. D.  
President.

PAUL MEYER, Ph. D.  
Professor Emeritus of Mathematics.

LOUIS CLARENCE HILL, B. S., (C. E.), (E. E.)  
Professor of Physics and Electrical Engineering.

HORACE BUSHNELL PATTON, Ph. D.  
Professor of Geology and Mineralogy.

ARTHUR RANSLEY CURTIS, B. S.  
Professor of Machine Design and Drafting.

ROBERT SUMMERS STOCKTON, E. M.  
Professor of Mathematics and Acting Professor of  
Mining.

CARLTON RAYMOND ROSE, A. M.  
Professor of Assaying (and acting Professor of Metal-  
lurgy till Feb. 1903).

ROBERT NELSON HARTMAN, Ph. D.  
Professor of Chemistry.

CLAUDE W. L. FILKINS, M. C. E.  
Professor of Mechanics.

WILLIAM GEORGE KING, A. M.  
Professor of Metallurgy.

WILLIAM JONATHAN HAZARD, E. E.  
Assistant Professor in Physics and Descriptive Geome-  
try.

ANDREW WEISS, E. M.  
Assistant Professor in Mathematics and Surveying.

CHARLES DARWIN TEST, B. M. E., A. C.  
Instructor in Analytical Chemistry.

WILLIAM GEORGE HALDANE, B. S.  
Instructor in Mathematics and Drafting.

JULIUS WOOSTER EGGLESTON, A. M.  
Instructor in Mineralogy.

EUGENE WILSON GEBHARDT, B. S.  
Instructor in Mathematics and Drafting.

HERMAN CLAUDE BERRY, A. B., B. S.  
Instructor in Mathematics and Surveying.

MABEL CLAIRE SHRUM, B. L. S.  
Librarian.

GEORGE P. ROBINSON,  
Library Assistant.

BENJAMIN ATLAS ~~AMBLER~~,  
Registrar.

*J. C. Doolittle*

## COMMITTEES OF THE FACULTY.

COMMITTEE ON ADMISSION AND STANDING,  
Professors Hill, Stockton, Hazard.

COMMITTEE ON THE CATALOGUE,  
Professors Hill, Hartman, Filkins.

COMMITTEE ON BUILDINGS AND GROUNDS,  
Professors Curtis, Hill, Filkins.

COMMITTEE ON THE LIBRARY,  
Professors Rose, Curtis; Miss Shrum.

COMMITTEE ON ATHLETICS,  
Professors Patton, Hartman; Messrs. Haldane, Test.

COMMITTEE ON THESES,  
Professors Filkins, Rose.

COMMITTEE ON GRADUATE WORK,  
Professors Hartman, Filkins, Curtis.

COMMITTEE ON THE BULLETIN,  
Professors Stockton, Filkins.

COMMITTEE ON THE Y. M. C. A.,  
Professor Hazard; Mr. Eggleston.

COMMITTEE ON SOCIAL AFFAIRS,  
President Palmer.

**LOCATION, HISTORY, ORGANIZATION, ETC.**

**Location.** The Colorado School of Mines is in the south-central part of the city of Golden, Jefferson County. Golden is about fifteen miles from Denver, and can be reached either by the Colorado & Southern R. R. from the Union station at the foot of Seventeenth Street, or by the Denver, Lakewood & Golden R. R., from the Arapahoe Street station between Fourteenth and Fifteenth Streets. From the necessities of the work all students reside in Golden.

Golden has about three thousand inhabitants and is one of the oldest cities in Colorado. When the Colorado School of Mines was located at Golden, the city was one of the most important smelting centers of the State, and its selection as a permanent home for the School was both natural and appropriate. Subsequently the business and the population of Golden suffered by the removal of the smelters and their concentration at Denver; but recently the little city has awakened to a new birth of activity and anticipation, due to its certain development into a residence town such as usually clusters around a college—which promise is strengthened by the fact that Golden is the most available mountain or foot-hill home suburban to and available from Denver.

Golden has one bank, many churches, a fine public school system, two newspapers (weekly), several elevators, and other lines of business, including a smelter, brick works, etc., and altogether is a thriving, prosperous, growing city, an ideal home for a great school of mines. The peculiar grouping of the neighboring hills is such as to combine the practical and the picturesque—freedom and isolation.

The School owns about four blocks, as shown in the map accompanying this catalogue.

The altitude of Golden is five thousand seven hundred feet above sea level, or about four hundred and fifty feet higher than Denver.

The town lies close to the first foot-hills of the Rocky Mountains, but can hardly be considered as a "mountain town," though within an hour's ride, by rail, of some of the well-known mining camps of the region.

No place in Colorado has a better health record than Golden. The climate is invigorating and pleasant, with open winters, and a large proportion of clear days.

The surrounding region is rich in the characteristic scenery of the Rocky Mountain region. The famous Clear Creek Canon begins at the town of Golden, and within a few miles may be found many points of view which the railroad tourist travels to see imperfectly from the car window.

Probably no locality in the United States could be found richer in geological illustrations of the formations of various ages, affording abundant opportunity for practical instruction, as well as exercise.

**History.** The Colorado School of Mines was established by an act of the Territorial Legislature, approved February 9, 1874. After an unsatisfactory experience in shifting in temporary quarters, the School was permanently housed in the original "building of 1880," upon lots given by the citizens of Golden. Since then the School has enjoyed a strong and steady growth in buildings, in equipment, in students and faculty, and in strength and rigor of the course. Additions were made to the original building of 1880, by the building of 1882 and the building of 1890. Engineering Hall was erected in 1894, the Stratton Assaying building in 1900, and the new hall of engineering called Stratton Hall is now in process of completion.

The list of faithful, able and scholarly men, who have contributed to the growth and reputation of the School in the past, is a long one, and among them may be counted President Gregory Board, President Albert C. Hale, President Regis Chauvenet; but it is to the latter that the Commonwealth is chiefly indebted for his ambition, determination, and patience in raising the standard of the School so that her present prosperous state may be regarded as his handiwork.

**Organization.** The corporate name of the institution by statute is "The School of Mines." The general management of the Colorado School of Mines is vested by statute in a Board of Trustees, consisting of five members appointed by the Governor of the State with the advice and consent of the Senate.



The members of the Board of Trustees are appointed in alternating sets of two and three, and hold their office for a period of four years and until their successors are appointed and qualified. The Board of Trustees elect one of their number President of the said Board. They also appoint a Secretary and Treasurer either from their own number, or they may select other suitable persons as they may deem best. Any three of said Board of Trustees shall constitute a quorum for the transaction of business.

The president of the faculty of the School, who shall be appointed by the said Board of Trustees, shall be known as "President of the School of Mines."

By the organic Constitution of Colorado, the School of Mines is regarded as an Institution of the State.

**Financial Support.** The Colorado School of Mines is supported by the income derived from the annual tax of one-fifth (1-5) of a mill on each dollar of the assessed property of the State, and this is known as the "School of Mines Tax." In addition to this the legislature has, from time to time, provided by special appropriation for such emergency funds as the means of the State treasury and the necessities of the School might suggest.

Of the two hundred and fifty thousand dollars now represented by buildings and equipment—as shown by the last inventory—only about fifty-seven thousand has been given by special appropriation; about twenty-six thousand has been received as gifts, and the balance, about a hundred and sixty-seven thousand, has been saved from the general revenue by strict economy.

## GENERAL MEETINGS.

**Weekly Assembly.** A new departure in the school life is the weekly assembly of all students in the gymnasium. The programme, which opens at 10:10 on Monday morning, includes general notices, music, and an address by some member of the faculty, each in his turn, or by some distinguished guest; or the morning hour may be given over wholly or in part to a student athletic rally or the like. The meetings are of value in bringing together all members of the school, both students and faculty. In a technical school the human side of man is liable to be neglected, and these gatherings are coming to be counted as one of the most valuable, most necessary, and most natural of the various assemblies.

**The Scientific Society.** This organization includes all the members of the senior and junior classes. Fortnightly meetings are held at which technical papers are read. The official publication of the society is the "Bulletin," a high class journal of papers prepared by the faculty, the alumni, and the seniors. Two numbers of the Bulletin will be published this year.

**Spanish.** An optional class in Spanish has been conducted by a student, Mr. Paredes.

**The College Y. M. C. A.** There is in the School an active branch of the Young Men's Christian Association. The Association has rooms in which are held religious meetings and social gatherings. A class in Bible study is conducted throughout the year. An effort is made to receive and assist incoming students to whom also a reception is given at the opening of the school year. A hand-book of school information is issued by the Association and can be obtained on application to the corresponding secretary, Max W. Ball, Golden, Colorado.

## BUILDINGS.

**The Main Building.** This is a continuous group of brick structures including the building of 1880 and that of 1882, as well as that of 1890. The first two are practically thrown together, and with one large and one small laboratory, two private laboratories, the stock room, two balance rooms and two lecture rooms, accommodate chiefly chemistry and some of the mathematics. In the cellar of the building of 1882 is placed the Riehlé testing machine, some cyanide apparatus and much of the surplus geological material; the ground under the original building of 1880 is not excavated. The more recent and more modern part, the building of 1890, has two full stories in addition to the attic and the basement. In the body of the first floor are located the President's office, the Registrar's office, the library, and the geological cabinet and lecture room. On the second floor are placed the temporary lecture rooms in Metallurgy, and the several lecture rooms for Mathematics and Mechanics, as well as two private offices for the same. The attic is devoted to the Freshman drafting room, and the basement to the temporary heating plant, the gymnasium lockers, the bath rooms, and the gymnasium, which is now the only available assembly room.

The total floor space of the buildings of 1880, 1882 and 1890 is forty thousand square feet.

**Hall of Engineering.** This building, consisting of two floors and a basement, and constructed of red pressed brick, was completed in the fall of 1894. The upper floor contains the Junior and Sophomore drafting rooms, a blue print room and a private office. The physics lecture room and apparatus room, a photometer room, the physical laboratory, balance room and apparatus room, as well as a private office, occupy the first floor.

The basement contains the dynamo and the engine room, three electrical laboratories, a battery and switch-board room and a small shop. The floor space is eleven thousand square feet.

**Assay Building.** This building, completed in the fall of 1900, is devoted entirely to assaying. It is a brick structure, forty-six feet by ninety-two, without cellar, and is well equipped with balance, store and parting rooms, as well as an office. There

are at present thirty-two large muffle furnaces, each with its work desk and coal bin; there is room for sixteen more furnaces.

This structure, which is one of the most perfect of its kind in the world, was erected by a gift from the late W. S. Stratton.

**Stratton Hall.** This structure, the corner stone of which was laid by the A. F. & A. M. of Colorado, on November 20, 1902, will be ready for occupancy at the beginning of the next academic year. The dedication will probably constitute part of the Commencement exercises in June, 1903. The building is to be of two full stories, not including the basement and attic. The basement wall and first story are to be of Lyons sandstone, in broken ashlar, topped by a story of gray Golden brick. The building will be finished on the interior with red pressed brick; and but little wood will be used, beyond that in the floors and staircases. The basement will accommodate several rooms for metallurgical and cement laboratories. The first floor will be devoted to two large lecture rooms, each with apparatus and private office—for Metallurgy and Mechanics. The second floor will, in one half, accommodate Surveying and Mining in one large lecture room, with its apparatus room and private office, and in the other half, a drafting room. The attic floor will be devoted entirely to a large drafting room.

The completion of the building will greatly relieve the present congested state of the departments of Mathematics, Surveying, Mechanics, Metallurgy, and Mining.

The total floor space of this building is twenty thousand feet.

The structure was named in honor of the late W. S. Stratton, whose generosity has won the lasting gratitude of the School.

**The President's House.** This is a brick building of two and one-half stories. It was built in 1888, and was quite thoroughly overhauled in 1902.

**The Wood Shop.** This is well equipped for the special demands which are continually arising around a technical school. This work varies from the ordinary repair work on the one hand, to the careful construction of special apparatus on the other.

**The Iron Shop.** What has been said of the wood shop is equally true of the iron shop. There is no machine shop of any kind in Golden, and so it is imperative that the school have one of its own in order to keep its mechanical apparatus in proper repair and working order, as well as to construct such apparatus as is necessary to carry on any new or original work. The machines of both shops are driven by direct connected motors, thus giving a very good idea of this method of operating machines of all kinds. Both shops are fully equipped with the necessary benches and hand tools. They occupy a building sixteen by fifty feet in addition to the store room for lumber, etc. The shops have proven to be not only a great convenience, but also a means of economy.

**Boiler House.** This building contains an eighty horse power fire-tube boiler, the Sturtevant fan and engine for heating Engineering Hall, and the necessary receiving tanks, feed pumps, etc., of a power plant.

## EQUIPMENT.

### Physical Laboratory.

This department is fairly well supplied with demonstration apparatus, and the equipment of the laboratories is excellent for the courses given. A full line of micrometers, vernier calipers, scales of all kinds, Jolly balances, physical and analytical balances, accurate Boyle's-law apparatus, Kater's pendulum, inclined planes, pulleys, etc., these and much other material furnish a good equipment for the laboratory course in Mechanics. For measurements in light, this department is furnished with a Bunsen photometer and a Lummer-Brodhun photometer, with lenses, mirrors and prisms for illustrating and verifying the various laws of reflection and refraction. Hypsometers, numerous thermometers of all grades, including standard and Beckman thermometers, calorimeters, latent-heat-of-steam apparatus, both the ordinary and the Parr's coal calorimeter, electrical apparatus for the determination of the mechanical equivalent of heat, apparatus for the measurement of the expansion of metals, etc., these and many other pieces furnish the equipment for the work in heat.

The laboratories for work in elementary electricity and magnetism are well equipped with good modern apparatus. The list comprises five British-Association bridges, three Wheatstone bridges, a revolving bridge, standard resistances and resistance boxes, five D'Arsonval galvanometers, two Thompson galvanometers, electrolytic apparatus, etc. For the more advanced work in this subject there are Weston, Whitney and Thompson direct-reading instruments, three Siemen's dynamometers, a dynamometer wattmeter, a Kelvin balance, condenser standard cells, permeaters, etc.

### Chemical Laboratory.

The laboratories, lecture rooms, and equipment of the department of Chemistry occupy almost all of the space of the buildings of 1880-1882, and on the completion of the Stratton Hall of Metallurgy, now under construction, still more space will be available, and it is the intention of the School to use this at once for additional laboratories, principally for special work.

The main laboratory is situated on the first floor of the buildings mentioned which have been thrown together for the purpose. It is equipped with tile-topped oak desks, especially designed, which are fitted with gas, water, and filtering apparatus. The laboratory will accommodate one hundred and two students at one time. The desks are so constructed, however, that it is possible to have twice this number in two sections. There is ample light and ventilation, and the numerous effective hoods are connected with a large Sturtevant blower, which discharges from a high brick stack. The hoods are also fitted with gas attachments, and a number are fitted with connections for hydrogen sulphide gas which is generated in the basement. A three-muffle fusion-and-assay furnace is part of the equipment. There are on this floor in connection with the main laboratory, the issue room for supplies, two private laboratories, and a balance room.

On the second floor of the building of 1880 is a large laboratory, accommodating fifty-five students, which is fitted with gas, sinks, and hoods. This is used mainly for the commercial analytical work. There is also an office and a balance room in connection with this department. The Chemical lecture room is on the second floor of the building of 1882, and is the largest lecture room in the school, having a seating capacity of about one hundred and twenty. It is fitted with a desk adapted for experimentation and has an apparatus room attached.

In the basement of the buildings are the chemical and apparatus supply rooms, which connect with the issuing room by elevator; also a special laboratory, used mainly for thesis work, the gas machine room which contains the hydrogen sulphide apparatus, and a three-hundred-light Detroit Gas machine, with mixer.

In addition to the usual supply of apparatus and chemicals used for general analysis, the department possesses a fair supply of pieces of apparatus designed for use in the more advanced courses. This includes electrolytic apparatus, combustion furnaces, gas analysis apparatus, spectroscopes, and numerous other supplies for special work.

### Mineralogical and Geological Laboratory and Cabinet.

Under the name cabinet is embraced not only the distinctively display collections which may perhaps be called the cabinet proper, but also the other collections that have been prepared mainly for the purpose of class instruction. These collections are necessarily changing rapidly from year to year as new material is constantly being added. This new material is obtained partly by purchase but mainly by direct collecting and by means of exchange with other institutions.

Owing to the rather limited quarters assigned to this department the display collections are not classified systematically but are arranged in different cases with a view to displaying certain groups of minerals or minerals from certain localities. The display collections are to be found in flat glass-topped cases and the other collections in cases of drawers.

Among the more interesting displays are quartz and microcline crystals from Florissant, Colo.; golden calcites from Joplin, Mo.; fluorite and barite from England; epidote crystals from Alaska; pyroxene, epidote and magnetite crystals from Salida, Colo.; sphalerite crystals from Kokomo, Colo.; pyrite crystals from Gilpin County, Colo.; crystallized sulphur from Sicily; dolomite and calcite from Ouray County, Colo.; geyserite from the Yellowstone National Park; and, above all, several cases of zeolites (thomsonite, mesolite, analcite, chabazite, etc.), from North Table Mountain, Golden, Colo. The case of mesolites is unique as well as beautiful, as it cannot be duplicated by any cabinet in the world.

The various collections are classified as follows:

**First—A Mineral Type Collection**, consisting of well-characterized specimens to be used by the students for the purpose of study and comparison. This collection at present contains specimens representing two hundred and seventeen species and sixty-one additional varieties. These specimens come from many countries, but Colorado minerals are especially well represented.



**Second—A Display Collection**, mainly of large and fine specimens of minerals and rocks. Many graduates and mining men, friends of the institution, have contributed gifts to this collection.

**Third—A Supplementary Collection**, containing the rarer and more expensive minerals not placed in one of the above mentioned collections.

**Fourth—A Descriptive Collection**, illustrative of the terms used in describing the various structural, physical, optical, and other properties of minerals.

**Fifth—A Student's Working Collection of Minerals**, consisting of over twenty thousand unlabeled specimens, similar to those in the Type Collection, to be used by the student for study and determination.

**Sixth—A Crystal Collection**, consisting of natural crystals to be used in the determination of crystal forms.

**Seventh—A Crystal Model Collection**, containing a large number of glass and wooden models used in the study of Crystallography.

**Eighth—A Blow-Pipe Collection**, containing materials used in Blow-Piping.

**Ninth—Rock Type Collection**, containing (a) a collection of rocks from different countries of the world; (b) a series of Colorado rocks; (c) various rocks illustrative of structural features.

**Tenth—A Working Rock Collection**, containing miscellaneous unlabeled rocks, to be used by students in connection with the study of Lithology.

**Eleventh—A Collection of Fossils**, to be used in connection with the course in Historical Geology.

**Twelfth—The United States Geological Survey "educational series" of rocks.**

**Thirteenth—Professor Patton's private collection of minerals.**

**Fourteenth—Professor Patton's private collection of rocks.**

## Summary of Collections.

Type Collection of Minerals.....	3,700
Working Collection of Minerals (about).....	21,000
Display Collection of Minerals.....	1,305
Supplementary Collection of Minerals.....	950
Crystal Collection .....	1,800
Display Collection of Fossils.....	342
Miscellaneous Collection of Fossils.....	1,360
Type Collection of Rocks.....	1,800
Working Collection of Rocks.....	7,408
United States Geological Survey Educational Series of Rocks .....	156
Professor Patton's Collection of Rocks.....	1,700
Professor Patton's Collection of Minerals.....	970
<hr/>	
Summary of specimens.....	42,451

Owing to the constant growth of the Cabinet, many recent additions are not included in this summary.

## Exchanges.

The School has prepared a printed list of exchange material, covering both minerals and rocks. This list will be sent to all who wish to arrange for exchanges. Correspondents should state what material they are prepared to offer in exchange, and letters should be addressed to Prof. H. B. Patton, Golden, Colo.

### Drawing Rooms.

**Freshman.** This occupies the whole of the top floor of the main building. The floor area is about four thousand square feet. It is lighted by windows on the north, east, and west, and by eight large skylights in the roof.

A suitable office for the instructors is located in a central position in which all drawings are filed and all records kept. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. The present equipment will accommodate about one hundred and fifty students.

**Sophomore-Junior.** The removal of the Senior drawing to Stratton Hall will make available ample space for the Sophomore drawing, which at present is very much cramped for room. Thus the whole of the top floor of Engineering Hall will then be used for the Sophomore and Junior drawing in connection with the subject of Mechanism and Machine Design. (The Junior drawing in connection with surveying and graphics will be done in Stratton Hall). The two rooms in the Hall of Engineering to be used for the drawing proper are each twenty-seven by fifty feet. They are lighted by windows on three sides and by skylights.

Each student is provided with a drawing table, a drawer, a drawing board, and a stool. The tables are independent of each other and are adjustable. The present equipment will accommodate about seventy-five students.

There is a blue print room fully equipped with an adjustable printing frame, and all other necessary appliances; also an office for the instructor where all drawings and records are filed.

**Senior.** This work until the present has been carried on in the north half of the upper floor of the Hall of Engineering; but after the completion of Stratton Hall, most of the upper floor will be devoted to the Senior drafting.

### Surveying Equipment.

The equipment of the department of Surveying is well adapted to the practical course given. Students are organized into parties for field work. Each party is assigned a locker con-

taining steel measuring tapes, marking pins, hatchet, plumb bobs, etc. For transit work there are available six light mountain transits, four of which are provided with auxiliary telescopes for underground work; and all have some form of solar attachment to be used in determining the true meridian, and latitude from the sun.

There is also one six-inch engineer's transit with Saegmueller attachment, and one heavy transit of English make. For the level work, five wye levels are used. For reconnoissance work or stope measurement, the department has a Locke hand level, a pocket compass and clinometer, and a Brunton transit.

The instruments above noted are of standard makes. Among them may be mentioned Buff & Berger, Heller & Brightly, W. & L. E. Gurley, Keufel & Esser, and Young & Son.

Additions are constantly being made, keeping pace with the growth of the school and the wearing out of the instruments.

All instruments belonging to the school are intended solely for use in class instruction and will not be loaned to students or others. This regulation holds during vacation as well as in the school semesters.

#### Hydraulic Laboratory.

Part of the laboratory work in hydraulics will be given in the new power house where the experiments will be conducted on the flow over weirs, and through orifices and pipes. Experiments on the flow through ditches and flumes will be made on the numerous irrigating canals in Golden. By special arrangement, the experiments on water wheels will be made in the new power house of the Golden Illuminating Company. This will make available a head of nearly twelve hundred feet and a quantity of water during the time when this work is in progress sufficient to generate three hundred to three hundred and fifty horse-power. The long wood-stave pipe line will be available for experiment on the flow in that class of pipe. This line is nearly thirteen miles in length and will be available in long stretches for experimental work.

### Steam Laboratory.

The very crowded quarters of the present laboratory are to be exchanged for far more commodious ones in the new power house. There will then be available for testing purposes one compound direct-connected engine, one high speed automatic engine, one fifteen horse-power throttling engine, besides six or seven pumps of various makes. It is expected that a small rotary engine as well as a small steam turbine will soon be added to the equipment. The water tube and fire tube boilers are to be so piped that they may form part of the laboratory equipment. The laboratory is provided with continuous counters, recording counters, indicators, gauges, gauge testers, mercury-column, steam calorimeters, a coal calorimeter, measuring tanks, scales, etc.

### Electrical Laboratory.

This laboratory is well equipped with standard voltmeters and ammeters, large resistances, (inductive and non-inductive), motors, dynamos, and storage batteries. Tests are made of the efficiency of the various machines, their characteristic curves are obtained, and their behavior under various loads is noted. A large part of the work of this laboratory is done in connection with that in the steam and hydraulic laboratories, as part of the apparatus will be in the new power plant.

### Testing Laboratory—(Mechanics.)

The laboratory is provided with a one hundred thousand pound Riehlé testing machine arranged for experiments in tension, compression, shearing, and flexure of most materials of construction. Extensometers for measuring elongations, and electrical contact micrometer for measuring deflections and compressions are employed. Apparatus for testing columns of small dimensions, and a simplified machine to examine the strength of beams in flexure will soon be ready for use in the laboratory.

In Stratton Hall will be found a complete equipment for examining the quality and strength of cement and cement mortars.

### Laboratory of Fire Assaying.

Through the generosity of the late W. S. Stratton, of Colorado Springs, the Board of Trustees has recently completed a building forty-six by ninety-two feet, which is devoted entirely to assaying. This building is well equipped with parting, balance and store rooms and office, and has at present thirty-two coal-fired muffle furnaces, with space for sixteen more. Each student has his own muffle, with his own coal bin, pulp balance and desk room, conveniently arranged with regard to his furnace; he also has access in the balance room to the best assay balances to be obtained on the market. In addition to the use of coal-fired furnaces, the student is instructed in the use of gasoline furnaces, two varieties of which are in the laboratory.

### Metallurgical Materials.

1. The School has the advantage of a fine collection of models from the works of Theodore Gersdorf, Freiberg, Saxony, illustrating the best types of furnaces, in this country and Europe. Each model is made to a scale and is complete in every detail. The following furnaces are represented:

Long hearth roasting furnaces, for silver, lead and copper ores.

American lead-silver furnace, as used in Colorado smelters.

Round silver-lead furnace, as used in Germany.

Small round silver-lead furnace, of type used with scant water supply.

Complete "plant" for refining "base bullion," including the following models:

Softening furnace in Parks' process, as used at Pueblo, Kansas City, St. Louis, etc.

Zinc pots as used in same.

Sweating furnaces as used in same.

Lead pots as used in same.

Concentration cupel for making silver bullion.

Belgian zinc furnace, as used in Missouri, New Jersey and Belgium.

Silesian zinc furnace, as used in parts of Europe.

Silver amalgamation pan (working model), as used in United States.

Copper reverberatory furnace, as used in Montana, Colorado, etc.

Gerstenhofer roasting furnace, for fine copper and iron sulphides.

Tin blast furnace, as used in Saxony.

Bismuth smelting furnace, as used in Germany.

Large mercury furnace, as used in Almaden, Spain.

Fume furnace, for making lead and zinc paints.

A handsome addition to these models has come from the liberality of Mr. John W. Nesmith, President of the Colorado Iron Works. It includes:

Working model of twenty-stamp mill, on scale of one and one-half inches to the foot.

Working model of ore rolls, same scale.

Working model of a Dodge crusher.

Model of modern blast furnace for lead-silver ores, with water jacket.

In addition to the above there are a large number of smaller models, such as the complete set used in the famous Keyes and Arents lead-well suit.

2. The School has considerable apparatus in practical demonstration, including jigs, tables, crushers, amalgamating machinery, a cyaniding outfit, etc., and much more is promised as soon as proper space is provided. The immediate expansion of this department will constitute an important feature of the policy of the School.

3. The whole neighboring region with its numerous and varied metallurgical, milling and mining plants, represents an available study laboratory rarely equalled and never surpassed.

### Mining Material.

This department is equipped with many mine models, in glass, paper, or metal, and showing all details of geological structure, mechanical working, timbering, lighting, etc. The equipment is being increased constantly, one of the latest gifts being

a model of the **Colorado Central Mine** at Georgetown, presented by Mr. Ernest Le Neve Foster. The development of this department comprises some of the most important problems connected with the practical training of a Mining School, and it will undoubtedly claim and assume large attention in the immediate future.

The equipment of the department devoted to mining can be largely increased as soon as space is provided for exhibits of mining machinery, and for experimental work. Many hundred lantern slides are used to show the different methods of mining and timbering, and to illustrate the types of gallows-frames, and machinery used. A number of typical ore deposits are illustrated by a series of thirty-four large maps. These are designed to facilitate the detailed study of the mode of occurrence and probable origin of such ore bodies.

### The Gymnasium.

The Gymnasium is a valuable adjunct to the school equipment. It is in the basement of the building of 1890, its floor (sixty-five by forty) permitting drill exercise, with ample space for apparatus, while its height of twenty feet allows the use of swinging appliances and perfect ventilation. Around the walls are pulling weights of every description, while among the other instruments are swinging rings, parallel bars, horse buck, quarter circle, "cage" with apparatus for development of every set of muscles, ladders, spring board, complete sets of clubs and dumbbells and many other pieces.

The Gymnasium is open every school afternoon and till seven o'clock every evening. Shower baths (hot or cold) adjoin the gymnasium. Each student pays a fee of ten dollars a year to the Athletic Association and deposits one dollar for his locker key.

The gymnasium is managed by the "School of Mines Athletic Association," composed of officers and students of the institution.

The gymnasium is also used for the gatherings on Monday morning and on other public occasions.



## ATHLETIC ASSOCIATION.

By virtue of the athletic fee required from each student, all students regularly entering the School of Mines become members of the Athletic Association. The affairs of the association are managed by eight directors elected by the students, two from each class, and by the Faculty Committee on Athletics.

All matters involving expenditure of money are passed upon by both bodies so as to assure economy of management. In most matters the Faculty Committee serves as an advisory committee, the responsibility and initiative being left as far as possible in the hands of the student directors.

The association is supported by the students' fees, by gate receipts, and by contributions from the alumni and other friends of the School. All funds are in the hands of the treasurer who, by resolution of the Board of Trustees, must be one of the Faculty Committee on Athletics.

During the past year the athletic field has been purchased and paid for. It is expected that a permanent grand stand will be erected during the spring of 1903.

## Officers.

President of Directors.....	Harry G. Palsgrove
Secretary of Directors.....	Frank J. Nagel
Treasurer.....	Professor H. B. Patton

## Directors.

Seniors.....	Frank J. Nagel, Harry G. Palsgrove
Juniors.....	Lee L. Fillius, Robert M. Vaughn
Sophomores.....	Luther W. Lennox, Leroy L. Middlekamp
Freshmen.....	T. Stephenson, H. D. Whitehouse

## THE LIBRARY.

The accumulation of a library suitable for a technical school has been the growth of years, but it was not until January, 1902, that President Chauvenet and the Trustees wisely decided to reduce to a system the gathering and registering of the various materials, by employing a competent librarian, Miss Mabel C. Shrum. The books number six thousand volumes, including the bound files of the standard periodicals, and excluding many hundred unbound pamphlets. While the substance of such a collection of books must always emphasize particularly the technical phase, yet a touch of the human is recognized by including some of the standard histories, travels, and the English classics, as well as some of the more popular journals of the day.

In the long run every scientific library owes its chief value to, and is estimated by, its complete files of standard journals.

The list of the current periodicals is given below.

The following sets of publications in the library are entitled to special mention:

Transactions of the American Institute of Mining Engineers. (1871 to date).

Mineral Industry. (1892 to date).

Journal of the Association of Engineering Societies. (1882 to date).

Transactions and Proceedings of the American Society of Civil Engineers. (1866 to date).

Annual reports of the United States Geological Survey. (1880 to date).

Monographs of the U. S. Geological Survey. (1882 to date).

Bulletins of the U. S. Geological Survey. (1883 to date).

Pennsylvania Geological Survey. (1876 to 1892).

Hayden Geological Survey. (1870 to 1879).

Missouri Geological Survey. (1891 to date).

Powell Geological Survey. (1882 to 1893).

Smithsonian Publications. (1864 to date).

Pacific Railroad Survey. (1853 to 1856).

Transactions of the Federated Institution of Mining engineers (1895 to date.)

Transactions of the Institute of Mining and Metallurgy (1892 to date.)

Report of U. S. Coast and Geodetic Survey. (1865 to date).

Proceedings of the Colorado Scientific Society. (1883 to date).

American Institute of Electrical Engineers. (1888 to date).

Annales des Mines. (1830 to 1882).

U. S. Patent Reports. (1891 to date).

Journal of the Franklin Institute. (1893 to date).

Journal of Society of Chemical Industry (complete).

American Journal of Science. (1871 to date).

Philosophical Magazine. (1890 to date).

American Chemical Journal. (1893 to date).

Journal of American Chemical Society. (1876 to date).

Science (complete).

Electrical World. (1890 to 1898).

Electrical Engineer. (1890 to 1898).

Electrical World and Engineer (complete).

Transactions of American Society of Mechanical Engineers. (1885 to date).

London Electrician. (1890 to date).

Journal of the Iron and Steel Institute, (1883 to date.)

CURRENT PERIODICALS IN THE COLORADO SCHOOL OF  
MINES LIBRARY.

- American Chemical Journal.  
 American Engineer.  
 American Geologist.  
 American Institute of Electrical Engineers.  
 American Journal of Mathematics.  
 American Journal of Science.  
 American Machinist.  
 Anglo-Colorado Mining and Milling Guide.  
 Annales de Chimie et de Physique.  
 Annals of Mathematics.  
 Architects' and Builders' Magazine.  
 Astrophysical Journal.  
 Atlantic Monthly.  
 Aurum.  
 Australian Mining Standard.  
 Ballarat School of Mines Students' Magazine.  
 Berg und Hüttenmännische Zeitung.  
 Berichte der Deutschen Chemischen Gesellschaft.  
 Booklover.  
 Bookman.  
 Bulletin de la Société de L'Industrie Minérale.  
 Bulletin of the Geological Society of America.  
 Camp and Plant.  
 Cassier's Magazine.  
 Century.  
 Chemical News.  
 Chemisches Central-blatt.  
 Collier's Weekly.  
 Colorado School Journal.  
 Colorado Scientific Society Proceedings.  
 Compressed Air.  
 Comptes Rendus Mensuels des Réunions de la Société de L'Industrie Minérale.  
 Comptes Rendus des Séances de L'Académie des Sciences.  
 Cosmopolitan.  
 Cumulative Index.  
 Dingler's Polytechnisches Journal.  
 Electric and Automobile Patents.  
 Electrical Age.  
 Electrical World and Engineer.  
 Electrician.  
 The Engineer.  
 Engineering.  
 Engineering and Mining Journal.  
 Engineering Magazine.  
 Engineering News.  
 Engineering Record.  
 Fliegende Blätter.  
 Forum.  
 Gas Engine.  
 Le Génie Civil.  
 Government Publications.  
 Harper's Monthly.  
 Harper's Weekly.

- Illustrated London News.  
 Illustrirte Zeitung.  
 Institute of Mining Engineers' Transactions.  
 Iron Age.  
 Journal of American Chemical Society.  
 Journal of Applied Microscopy.  
 Journal of the Association of Engineering Societies.  
 Journal of the Chemical and Metallurgical Society of South Africa.  
 Journal of the Franklin Institute.  
 Journal of the Chemical Society, (London).  
 Journal of Geology.  
 Journal of the Institute of Electrical Engineers.  
 Journal of the Society of Chemical Industry.  
 Library Journal.  
 Lick Observatory Bulletin.  
 Liebig's Annalen der Chemie.  
 Life.  
 Literary Digest.  
 McClure's Magazine.  
 Metal Miner.  
 Metallographist.  
 Mineral Collector.  
 Mines and Minerals.  
 Mining and Scientific Press.  
 Mining Reporter.  
 Monthly Maroon.  
 Nature.  
 New York State Museum Bulletin.  
 Nineteenth Century.  
 North American Review.  
 Oesterreichische Zeitschrift für Berg und Hüttenwesen.  
 Outlook.  
 Philosophical Magazine.  
 Physical Review.  
 Political Science Quarterly.  
 Popular Astronomy.  
 Popular Science Monthly.  
 Publishers' Weekly.  
 Quarterly Journal of Geological Society.  
 Review of Reviews.  
 Revue Universelle des Mines.  
 Saturday Evening Post.  
 School of Mines Quarterly. (Columbia).  
 School Science.  
 Science.  
 Science Abstracts.  
 Science and Industry.  
 Scientific American.  
 Scientific American Supplement.  
 Scribner's Magazine.  
 Sibley Journal of Mechanical Engineering.  
 Silver and Gold.  
 Steam Engineering.  
 Stevens' Institute Indicator.  
 Stone.  
 Technology Quarterly.  
 Technology Review.  
 U. S. Forestry, Bureau of, Bulletin.  
 U. S. Geological Survey, Bulletin.  
 U. S. Labor, Department of, Bulletin.

U. S. Patent Office Official Gazette.	Zeitschrift für Angewandte Chemie.
University of California Bulletin of Department of Geology.	Zeitschrift für Anorganische Chemie.
University of Michigan Technic. World's Work.	Zeitschrift für das Berg, Hütten und Salinewesen.
Zeitschrift für Analytische Chemie.	Zeitschrift für Praktische Geologie.

## NEWSPAPERS.

Boston Transcript.	Golden Globe.
Chicago American.	Golden Transcript.
Chicago Record-Herald.	London Times.
Denver Evening Post.	New York Tribune.
Denver Republican.	New York World.
Denver Times.	Rocky Mountain News.

## REQUIREMENTS FOR ADMISSION.

To the Freshman Class. All applicants must be at least seventeen years of age. Those who are graduates of "accredited" High Schools—i. e., schools of accredited standing, each in its own State, and with its respective State University or other leading institution—such students are examined only in plane and solid Geometry. In later years further requirements will probably be made, due notice of which will be given. The list of accredited High Schools in Colorado is as follows, and is taken bodily from the list assembled by the State University. Too much praise cannot be given this sister institution for her work in encouraging the High School system in Colorado.

## List of Accredited Schools.

Denver High School District No. 1.  
Denver High School, District No. 2.  
Colorado Springs High School.  
Greeley High School.  
Pueblo High School, District No. 1.  
Pueblo High School, District No. 20.  
North Denver High School.  
Georgetown High School.  
Canon City High School.  
Durango High School.  
Aspen High School.  
Fort Collins High School.  
Golden High School.  
Trinidad High School.  
Denver Manual Training High School.  
La Junta High School.  
Central City High School.  
Idaho Springs High School.  
Longmont High School.  
Montclair High School.  
Fort Morgan High School.  
Cripple Creek High School.

Leadville High School.  
Victor High School.  
Monte Vista High School.  
Salida High School.  
South Denver High School.  
Las Animas High School.  
Lamar High School.

Blank forms of application are furnished to those High Schools desiring to be placed on the accredited list. All applications will be considered by the faculty.

Candidates for the Freshman class *who are not graduates of any accredited High School* must sustain examinations in English, Geography, History, Algebra, Geometry, Physics, and Chemistry.

In Algebra there are required the first eighteen chapters of Wentworth's **Higher Algebra**, or an equivalent.

Geometry includes the whole of Plane and Solid. Applicants are expected to show clear notions of the nature of geometrical reasoning. Some original work is given in each paper. Wentworth's **Geometry** or an equivalent is recommended.

English, Geography, and History of High School standard are required.

In English, exercises are given in writing from dictation, definition, correction of phrases, some technical grammar, and a short essay.

The paper in Geography includes the general, physical and political divisions of the subject.

The paper in History includes both General and United States History. In the former, Myers, and in the latter, Channing, or their equivalents may be a basis for preparation.

The composition, chirography and general style of all papers will be considered in judging the candidate's fitness in English.

In Chemistry, Remsen's **Inorganic Chemistry** (briefer course), or an equivalent, is recommended.

In Physics, Carhart and Chute's **Physics**, or an equivalent, is recommended.



**Entrance Examinations** are held in May and September.

Examinations may be taken at the homes of the applicants, papers being forwarded to some responsible examiner. This applies to Freshmen and only to those living at a distance. All candidates for admission are advised to take the May examination.

An applicant who has passed his entrance examinations or presented an approved diploma, is put upon the "accepted" list, and is so notified. But he is not "admitted" until his matriculation fee is paid.

The experience of several years has shown that any student entering with less than the equivalent of a good High School course, and that, too, thoroughly mastered, has little chance for success.

Too much emphasis cannot be placed upon the necessity for a thorough preparation before entering upon the severe course of the School. It may be noted that among the desirable elements in preparatory training, these should be enumerated; in addition to the mathematics, at least one year in physics, chemistry, botany, and zoology; several years in Latin; one or two in French and German; a fair acquaintance with the great English classics, and above all, the ability to write clear, smooth, honest English.

Owing to the number of valuable papers which continually appear in the French and German language, it is highly desirable and strongly advisable that students attain a reading knowledge of these languages before entrance. Indeed, we may go further and say that a working knowledge of these languages is indispensable to anyone who cares to be a first-class specialist in any line.

Spanish is highly desirable for all who may operate later in countries where it is spoken. The School usually offers optional courses in Spanish.

The sciences are needed almost as much in preparation as are the mathematics. In this connection, attention should be called to the presentation of the individual laboratory note-book, for however soiled or mutilated, it is the best evidence of the scope and quality of the science course.

The Latin is needed, even for students of Mining and Metallurgy, for the intelligent basis that it furnishes for general grammar in its exquisite and uncompromising attention to the details of language. The English classics and good translations of foreign classics, are required for their style and more especially for their thoughts on mind and modes and morals—in a word, for the ideals of life which are the common heritage of the materialistic student of technical science as much as they are of his more cultured brother in the college of liberal arts—and the more because in our technical course at present, little if any time can be spared from technical subjects for the culture of language, literature, history, art, or philosophy.

#### Announcement of Future Requirements in English.

The examination in English is based on the requirements adopted by the Commission of Colleges in New England and recommended by the Society for the Promotion of Engineering Education.

1. The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom, and division into paragraphs, and should be plain and natural in style. He will be judged by the manner in which he writes rather than by the quantity which he writes.

2. The candidate is required to have some acquaintance with good literature. The following works will serve as a basis, both for the examination in this and for the tests in the writing of English. With these books the applicant must be familiar. (All may be had in an inexpensive form.) They are, however, divided into two classes. Those marked (a) are to be read, and the candidate will be required to show a general knowledge of their subject matter and of the lives of the authors. Those marked (b) are to be studied thoroughly, so that the candidate shall be able to pass an examination upon their subject-matter and structure.

(a) Shakespeare's *The Merchant of Venice* and *Julius Caesar*; *The Sir Roger de Coverly Papers* in the *The Spectator*; Goldsmith's *The Vicar of Wakefield*; Coleridge's *The Ancient*

Mariner; Scott's *Ivanhoe*; Tennyson's *The Princess*; Lowell's *The Vision of Sir Launfal*; George Eliot's *Silas Marner*; Carlyle's *Essay on Burns*.

(b) Shakespeare's *Macbeth*; Milton's *Lycidas*, *Comus*, *L'Allegro*, and *Il Penseroso*; Burke's *Speech on Conciliation with America*; Macaulay's essays on *Milton* and *Addison*.

Note—The standing in English may be determined not solely by the rank attained in the examination in that subject; but, in addition to this, it is expected that the paper in history be written in correct and expressive English.

#### Admission Beyond Entrance Requirements.

**To Advanced Standing.** Applicants who are graduates of recognized collegiate institutions, or who have partially completed the course in such schools and who are candidates for the degree of the Colorado School of Mines, will be admitted, subject to the conditions enumerated below, to their appropriate stations; but in all cases they will be expected to pursue, and in order, from Freshman year on, those studies that they have not previously taken.

Candidates for advanced standing will be examined in all studies of the course below the class applied for, unless they can present credits sufficient, in the opinion of the Faculty, for admission without examination. The procedure at present is to accept the credits and admit the student on probation.

The Faculty reserves the right, however, to examine for admission to any higher standing than the first term of the Freshman year, irrespective of the credits brought from another institution.

It is necessary for all such applicants to bring with them the work that they have executed in Mechanical Drawing and in Descriptive Geometry.

There are no special courses. Graduate students attend lectures or practical work with regular classes, and are "specials" only in the sense that they may omit certain lines, and are not confined to the course of any one class.

Fire Assaying is excluded from these special or partial graduate courses, unless the student is a candidate for a degree and is regularly taking all the other work required.

**Special Graduate Students.** Graduates of any recognized collegiate institution, and who are not candidates for a degree, on the recommendation of the professor concerned, and with the permission of the Faculty, may take partial or special work as he may elect. Each case will be judged on its own merits and no case may be considered as a precedent for the careless over-running of the standards which have given the degree of this School her merited reputation.

**Degrees, Graduate Work, Etc.** The course of the Colorado School of Mines is essentially a bachelor's course. The degree given at present is E. M. (Engineer of Mines); the special degree of E. E. (Electrical Engineer) will not be offered for the present, although the work in electrical engineering appropriately accessory to the regular E. M. degree will be presented more thoroughly than hitherto. Inasmuch as the engineering degree is not properly a bachelor's degree, it is probable that the title of the degree conferred by the Colorado School of Mines after some years will be that of B. S. (in Mining or in Metallurgy, resp.), reserving the Master's or Doctor's degree of E. M. for subsequent and real graduate work presented after graduation, either in residence or in absentia. The Trustees and Faculty are ready to move in the direction of graduate work as soon as the growth and equipment of the school shall allow.

### THESES AND GRADUATION.

A thesis upon some practical subject is an important prerequisite to graduation.

Part of the work consists in visiting mines, smelters, power plants, and other works where the processes lectured upon may be seen in actual operation. Short trips of this description are frequent, while once a year a longer one is arranged, usually to some noted mining section.

When any prescribed trip is undertaken, having a practical bearing on the work of any course, the students in that course, and working for a degree to which that course is essential, shall

be required to attend such trip, unless excused by a vote of the Faculty.

Expeditions of this kind afford abundant opportunities for the student to collect materials suitable for memoirs and theses.

All memoirs, theses and drawings which constitute a regular part of the school work, may be retained by the institution, and preserved as a part of the permanent record of the student who executed them.

Each Senior shall submit to the Faculty, not later than November 1st, the subject of his thesis, which subject must be approved by the instructor concerned. Each thesis must be type-written or printed, on eight and one half by eleven inch paper, and bound in book form.

The completed theses must be handed in not later than May fifteenth.

Theses must be completed in final form, and handed to the librarian, before the delivery of diplomas. No diploma will be delivered until this requirement has been met.

**EXAMINATIONS AND RE-EXAMINATIONS.**

All students are expected to take the full regular quota of work, pursuing in order, as time and strength shall permit, all the studies of the regular course as laid down in the schedule, pages 43 to 46.

In case of enforced irregularities from natural limitations, poor preliminary training, lack of application, or sickness, the suggestion which will mainly guide the disposition of each individual case, is the principle of the logical continuity of studies, in their mutual relations of preparation and sequence.

Students should complete all Freshman studies before entering on those of the Junior year, and similarly, the Sophomore studies before entering the Senior year.

Each case will be considered on its merits, as natural exceptions and those that cannot be anticipated may present themselves. But no rule shall be so applied as to work hardship or injustice to a student, who really deserves and is fitted to anticipate the studies of a later year.

Regular examinations, which all students are required to attend, are held at the end of each semester on the various subjects pursued during the semester.

A condition incurred during the first semester may be removed by a first re-examination, held before the end of the second semester, at a regular date set for that purpose, and, in case of failure to pass, by a second re-examination, held in September at a regular date set for that purpose, before the beginning of the semester. Until so removed, the said condition shall remain in effect.

A condition incurred during the second semester may be removed by a first re-examination, held at a regular date set for that purpose, before the opening of the school in September, and in case of failure to pass, by a second re-examination, held before the end of the first semester of the academic year, at a regular date set for that purpose, and until so removed, the said condition shall remain in effect.

Failure to remove any condition within a year will require that the subject be repeated in the class room.

**EXPENSES.**

Tuition is free to bona fide residents of Colorado. Students from other states pay fifty dollars per semester, or one hundred dollars a year. All are charged for material consumed or broken.

The following are the various fees and charges:

Matriculation fee (paid upon admission).....	\$ 5.00
Athletic Association, annual dues (payable in two install- ments .....	10.00
Locker fee (paid once only, for the course).....	1.00

Of the other expenses a part, as shown below, are school charges, for such material, or wear and tear, as belong to the school issue of apparatus and supplies. Text books and drawing instruments and supplies are not charged in school accounts, but are inserted in order to give a fair idea of the total expense, exclusive of board, etc.

**Freshman Class.**

General Chemistry fee.....	\$10.00
General Chemistry, deposit (apparatus).....	10.00
Qualitative Analysis, fee.....	20.00
Qualitative Analysis, deposit (apparatus).....	15.00

(The "deposit" is often not consumed, in which case the balance is returned. The "fee" is also for material, chiefly chemicals. No part of it is returnable.)

Texts for Freshman course (both terms).....	\$15.00
Drawing Supplies, complete.....	20.00

**Sophomore Class.**

Quantitative Analysis, fee (for the year).....	\$20.00
Quantitative Analysis, deposit.....	15.00
Assaying, deposit .....	25.00
Supplies in Drawing Department.....	5.00
Blowpipe outfit (Mineralogy).....	12.00
Text books for the year, total.....	15.00

The only fee charged in the department of Geology and Mineralogy is a fee of twelve dollars for the entire course in Mineralogy. This fee covers the expense of the blow-pipe out-

fit which the student thus buys outright, and partially pays the cost of material used up and destroyed in connection with the courses in crystallography, blow-pipe work, and determinative mineralogy.

#### Junior Class.

Surveying course (use of instruments).....	\$10.00
Supplies used in Surveying course.....	2.00
Text books for the year.....	35.00

#### Senior Class.

Graduation fee .....	\$ 5.00
Text books for the year.....	12.00

There are other expenses incidental to *mining and metallurgical trips*, some of which are obligatory. These expenses for the entire course are always within one hundred dollars, but are necessarily variable.

The preparation of theses (Senior) involves expenses, which vary greatly according to the nature and treatment of the subjects. For laboratory work in special cases a deposit of fifteen dollars is required.

Students leaving in mid-term, except on account of sickness, are not entitled to return of fees.

**All charges are payable in advance.**

The expenses of the school year (tuition fee excluded) need not exceed three hundred and fifty dollars. Board and good accommodation can be had at from five to seven dollars a week.

Many applicants write asking whether the institution can furnish employment, or whether work may be secured in Golden, to aid them in meeting expenses. The school, however, cannot employ students, and the chances for employment in Golden are very slight. It should be added that the course is far too exacting to allow any student much time for outside work.

No student will be allowed to graduate while indebted to the school.

The Trustees reserve the right to make incidental changes in fees without printed notice, as new and unforeseen emergencies may arise.



## SCHEDULE OF COURSES.

## FRESHMAN YEAR.

## First Semester.

Mathematics .....	1	Algebra .....	5	hours*
Mathematics .....	3	Trigometry .....	3	hours
Machine Design and Drafting....	1	Descriptive Geometry .....	2	hours
Machine Design and Drafting....	3	Mechanical Drafting .....	.9	hours
Chemistry .....	1	General .....	3	hours
Chemistry .....	3	General Laboratory .....	6	hours

## Second Semester.

Mathematics .....	2	Algebra .....	5	hours
Mathematics .....	4	Analytical Geometry .....	3	hours
Machine Design and Drafting....	2	Descriptive Geometry .....	2	hours
Machine Design and Drafting ....	4	Descriptive Geometry Drawing...	6	hours
Chemistry .....	2	General .....	3	hours
Chemistry .....	4	Qualitative .....	9	hours

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\*Hours actually employed per week.

## SOPHOMORE YEAR.

## First Semester.

Mathematics	.....7	Calculus	.....3	hours*
Mathematics	.....5	Analytical Geometry	.....2	hours
Mineralogy	.....3	Crystallography	.....5	hours
Physics	.....1	Mechanics, Sound, Light	.....4	hours
Physics	.....3	Laboratory	.....2	hours
Machine Design and Drafting	....5	Mechanism	.....1	hour
Machine Design and Drafting	....7	Mechanical Drafting	.....4	hours
Chemistry	.....7	Gravimetric Analysis	.....1	hour
Chemistry	.....5	Gravimetric Analysis	.....9	hours
Assaying	.....1	Fire Assaying	.....	

## Second Semester.

Mathematics	.....6	Calculus	.....5	hours*
Mineralogy .5 and 6		Blowpiping Analysis and Deter- minative Mineralogy	.....9	hours
Physics	.....2	Heat and Electricity	.....4	hours
Physics	.....4	Laboratory (Heat and Electric- ity)	.....2	hours
Machine Design and Drafting	....6	Mechanism	.....2	hours
Machine Design and Drafting	....8	Mechanism Drafting	.....3	hours
Chemistry	.....6	Volumetric Analysis	.....6	hours
Chemistry	.....8	Volumetric Analysis	.....1	hour
Assaying	.....1	Fire Assaying	.....	

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\* Hours actually employed per week.

## JUNIOR YEAR.

## First Semester.

Geology .....	1	General Geology .....	4	hours*
Mechanics .....	1	Theoretical Mechanics.....	3	hours
Surveying .....	1	Lectures .....	3	hours
Surveying .....	3	Field Work .....	9	hours
Metallurgy .....	1	General Principles of Metallurgy	6	hours
Machine Design and Drafting ...	9	Machine Design .....	2	hours
Machine Design and Drafting...	11	Machine Design .....	6	hours
Mechanics .....	9	Testing Laboratory .....	1	hour

## Second Semester.

Geology .....	2	Lithology .....	2	hours
Geology .....	4	Economic Geology .....	2	hours
Mechanics .....	2	Dynamics .....	3	hours
Metallurgy .....	2	Metallurgy of Copper.....	6	hours
Surveying .....	2	Lectures .....	2	hours
Surveying .....	4	Field Work .....	9	hours
Mechanics .....	4	Graphics .....	5	hours
Machine Design and Drafting...10		Machine Design .....	1	hour
Machine Design and Drafting...12		Machine Design Drafting.....	3	hours

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\* Hours actually employed per week.

## SENIOR YEAR.

## First Semester.

Metallurgy . . . . .3	Metallurgy of Gold, Silver, etc. . . . .7 hours*
Hydraulics . . . . .1	Hydraulic Motors . . . . .3 hours
Hydraulics . . . . .3	Hydraulic Laboratory . . . . .3 hours
Thermodynamics and Power Trans- mission. . . . .1 and 2	Thermodynamics and Steam Engine. . . . . . .2 hours
Mining . . . . .1	Holsting, Pumping, etc. . . . .5 hours
Mechanics . . . . .5	Structural Details . . . . .2 hours
Mechanics . . . . .7	Structural Design . . . . .6 hours
Cement Laboratory.9	. . . . .1 hour
Chemistry . . . . .9	Technical Chemistry . . . . .2 hours

## Second Semester.

Metallurgy . . . . .4	Metallurgy of Iron, Steel, Lead, etc . . . . .7 hours
Thermodynamics and Power Trans- Mission. . . . .2 and 6	Steam Engine and Power Trans. . . . .5 hours
Thermodynamics and Power Trans- mission. . . . .4 and 8	Steam and Electrical Laboratory.3 hours
Mining . . . . .2	Tunneling, Sinking, etc. . . . .5 hours
Mining . . . . .4	Laboratory . . . . .3 hours

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\* Hours actually employed per week.

## DESCRIPTION OF DEPARTMENTS AND COURSES.

## DEPARTMENT OF MATHEMATICS.

Professor Stockton. Mr. Haldane, Mr. Berry.  
 Assistant Professor Weiss. Mr. Gebhardt.

## FIRST SEMESTER.

1. ALGEBRA. Assistant Professor Weiss and Mr. Berry.

The course begins with a review of some of the more fundamental portions of the subject, including Theory of Exponents, Surds, Imaginary Numbers, Simple and Quadratic Equations, together with a thorough drill in the theory and use of Determinants.

Five hours a week during the Freshman year.

Texts: Wells' College Algebra; Peck's Elements of Determinants.

3. TRIGONOMETRY. Mr. Haldane and Mr. Gebhardt.

Plane and spherical trigonometry, including a working knowledge of Logarithms and the use of tables. Many practical problems are given to the students to be worked out.

Three hours a week during the first semester of the Freshman year.

Texts: Crawley's Trigonometry; Jones' Logarithmic Tables.

5. ANALYTICAL GEOMETRY. Professor Stockton.

The Conic Sections. The nature of the conic corresponding to the general equation of the second degree is determined.

The analytical geometry of three dimensions.

Three times a week during the first semester of the Sophomore year.

Requires courses 1, 3 and 4 in Mathematics.

Text: Tanner and Allen's Analytical Geometry.

7. CALCULUS. Professor Stockton.

Differential Calculus. Differentiation; also the general nature and use of Integral Calculus is explained. The expansion

of functions. Partial differentiation. A discussion of tangents, asymptotes, points of inflection, etc.

Lectures three times a week during the first semester of the Sophomore year.

Requires courses 1, 2, 3 and 4 in Mathematics.

Text: Osborne's *Calculus*.

## SECOND SEMESTER.

### 2. ALGEBRA. Assistant-Professor Weiss and Mr. Berry.

During this term the time is mainly devoted to the Theory of Equations, Probability, Series, Binomial Theorem, and the Logarithmic and Exponential Series.

Five hours a week during the second semester of the Freshman year.

Requires course 1 in Mathematics.

Text: Wells' *College Algebra*.

### 4. ANALYTICAL GEOMETRY.

Mr. Haldane and Mr. Gebhardt.

The point, straight line and circle are treated quite fully, the conic sections are defined, and the general theorems (relating to tangents, normals, poles and polars, and diameters) are derived.

Three hours a week during the second semester of the Freshman year.

Requires courses 1 and 3 in Mathematics.

Text: Tanner and Allen's *Analytical Geometry*.

### 6. CALCULUS. Professor Stockton.

The problem of maxima and minima of analytical functions is treated, the necessary and sufficient conditions being established in determinant form.

In Integral Calculus; general methods of integration are taken up and numerous examples worked. Then the applications of integration to plane curves, areas, surfaces, volumes, moments of inertia, centre of mass, etc., are taken up.

Lectures five hours a week during the second semester of the Sophomore year.

Courses 5 and 7 are required.

Text: Osborne's *Calculus*.

## DEPARTMENT OF PHYSICS.

Professor Hill.

Assistant Professor Hazard.

## FIRST SEMESTER.

## 1. MECHANICS, SOUND AND LIGHT. Professor Hill.

This course is given by lectures, illustrated by experiments, and by recitations. It is required of all Sophomores.

Lectures three times per week. Recitations (two sections) once each week.

Courses 1, 2, 3 and 4 in Mathematics required, and must be preceded or accompanied by course 7 in Mathematics.

Texts: Carhart's University Physics; Hasting and Beach's General Physics.

## 3. LABORATORY COURSE IN MECHANICS, SOUND AND LIGHT. Assistant-Professor Hazard.

Thirty experiments are performed by each student, all of a quantitative nature.

Laboratory work (two sections) two days per week.

Accompanies course 1, Physics.

Texts: Ames and Bliss's Manual of Experiments in Physics; Nichol's A Laboratory Manual of Physics.

## 5. ADVANCED LABORATORY COURSE IN MECHANICS.

Professors Hill and Hazard.

Three hours each week. Hours to be arranged with instructor.

Requires courses 1, 2 and 3 in Physics.

## SECOND SEMESTER.

## 2. HEAT AND ELECTRICITY. Professor Hill.

This course is given by lectures, illustrated by experiments, and is a continuation of course 1.

Lectures three times each week. Recitations, each section, one hour per week.

Courses 1, 2, 3, 4 and 7 in Mathematics required and should be preceded by course 1, Physics.

Texts: Carhart's University Physics; Hasting and Beach's General Physics.

**4. LABORATORY COURSE IN ELECTRICITY AND HEAT.**

Professors Hill and Hazard.

Thirty quantitative experiments are performed by each student.

Laboratory work (two sections) two hours per week during the second semester of the Sophomore year.

Accompanies course 2, Physics.

Texts: Ames and Bliss's *A Manual of Experiments in Physics*; Nicholl's *Laboratory Manual of Physics and Electricity*.

**6. ADVANCED LABORATORY COURSE IN HEAT.**

Professor Hill.

This course includes such experiments as the determination of the calorific power of fuels, the mechanical equivalent of heat, the P. V. curves of vapors, etc.

It requires at least one afternoon of four hours each week. The course is elective and the hours are to be arranged with the instructor.

Requires courses 1, 2, 3 and 4, in Physics.

**8. ADVANCED LABORATORY COURSE IN ELECTRICAL MEASUREMENTS.**

Professors Hill and Hazard.

This course may be elected by those who have completed courses 1, 2, 5 and 6.

Hours to be arranged with instructor.

**10. ADVANCED LABORATORY COURSE IN MAGNETISM.**

Professors Hill and Hazard.

This includes the study of hysteresis curves, the testing of transformers, etc. This course may be elected by those who have completed courses 1, 2, 3, 4 and 8.

Hours to be arranged with the instructor.



## DEPARTMENT OF CHEMISTRY.

Dr. Hartman.

Mr. Test, Dr. Palmer.

The following courses of instruction are offered in the department of Chemistry, all of which are required of candidates for the degree of E. M.:

## FIRST SEMESTER.

## 1. GENERAL CHEMISTRY (Lecture course). Dr. Palmer.

Lectures and recitations on the theories and principles of Chemistry, with special reference to their applications in practical work. The typical elements are first studied at length and then the remaining elements according to the periodic grouping. Technical processes receive much attention, and the latest developments of chemical theory are discussed. A feature of the course is the attention paid to stoichiometrical calculations. The lectures are illustrated by numerous experiments and the mineralogical collections are constantly used for illustration of the naturally occurring compounds of Chemistry.

Text: Richter's *Inorganic Chemistry*.

(The works of Remsen, Erdmann, and Roscoe and Schorlemmer are recommended for the supplementary reading.)

Freshman year, first semester, three hours weekly.

## 3. GENERAL CHEMISTRY (Laboratory course).

Dr. Hartman, Mr. Test.

A course designed to supplement the work of course 1. Advanced experimental work; studies of reactions; spectroscopy; chemical preparations, and studies introductory to qualitative analysis are included in the work of the course. No single text is used and the student must continually refer to the literature for information and data.

Freshman year, first semester, two afternoons weekly.

## 5. QUANTITATIVE ANALYSIS (Laboratory course).

Dr. Hartman, Mr. Test.

The course of instruction in Quantitative Analysis begins with the analysis of simple salts and passes to that of more complex bodies, as ores and alloys. A varied series of determina-

tions is required which illustrate the most important types of gravimetric methods. A large supply of carefully checked samples is available, and students must show a high degree of accuracy in their work. Among some of the exercises of the course are the analysis of pyrolusite, dolomite, wolframite, silicates, coal, iron ore, and alloys.

Text: Cairn's Quantitative Analysis.

Sophomore year, first semester, three afternoons weekly.

Courses 1, 2, 3 and 4 in Chemistry are required.

#### 7. QUANTITATIVE ANALYSIS (Lecture course).

Dr. Hartman.

A course of lectures on the work of course 5, and the applications of chemical theory to analytical work.

Sophomore year, first semester, one hour weekly.

#### 9. TECHNICAL CHEMISTRY (Lecture course). Dr. Hartman.

A course of lectures on selected topics of interest to engineers. Among other subjects, the analysis of cyanide solutions, gases, oils, paints, explosives, fuels, water, petroleum and asphalt, cements and clays, alloys, and iron and steel are taken up.

Senior year, first semester, two hours weekly.

#### 11. THEORETICAL CHEMISTRY (Lecture course).

Dr. Palmer.

A course of lectures on advanced theoretical topics, including a discussion of the relations of the chemistry of carbon to general chemistry, particularly in connection with considerations of structure. Also a study of the principles of chemical research, and discussions of the latest discoveries of chemistry.

(Senior year, first semester, two hours weekly.)

### SECOND SEMESTER.

#### 2. GENERAL CHEMISTRY (Lecture course). Dr. Hartman.

A continuation of course 1.

Freshman year, second semester, three hours weekly.

Courses 1 and 3 in Chemistry are required.

**4. QUALITATIVE ANALYSIS (Laboratory course).**

Dr. Hartman, Mr. Test.

The reactions of the important basic and acidic elements are rationally studied and their identification and separation in mixtures of varying complexity is required. In addition to the analysis of simple solutions, the analysis of ores, minerals and insoluble products is taught, and the reactions of the rare elements are taken up to some extent. Spectroscopic work forms part of the course. Every effort is made to avoid mechanical work, and all students must write out the reactions and separations as they occur, and submit their notes for correction. Frequent quizzes are held and the theory of analysis is emphasized.

**Freshman year, second semester, three afternoons weekly.**

Text: Medicus's *Qualitative Analysis* (Marshall's Translation.)

Courses 1, 2 and 3 in Chemistry are required.

**6. QUALITATIVE ANALYSIS (Lecture course). Dr. Hartman.**

A course of lectures on the principles of *Qualitative Analysis*, supplementary to course 4.

**Freshman year, second semester, one hour weekly.**

**8. QUANTITATIVE ANALYSIS (Laboratory course).**

Dr. Hartman, Mr. Test.

This course (which is the continuation of course 5) consists largely of exercises in Volumetric analysis, and the applications of gravimetric and volumetric methods to commercial requirements. Students are especially drilled to attain speed and capacity, without interfering with accuracy. For these exercises a large number of smelters' and assayers' samples are available.

Among the exercises of the course are acidimetry and alkalimetry, with the use of indicators; assay of bleaching powders and cyanide solutions; the volumetric determination of iron, copper, manganese, zinc, lime, lead and arsenic in ores and furnace products.

**Sophomore year, second semester, two afternoons weekly.**

Courses 1, 2, 3, 4, 5, 6 and 7 in Chemistry are required.

## 10. QUANTITATIVE ANALYSIS (Lecture course).

Dr. Hartman.

A continuation of course 7, bearing chiefly on Volumetric analysis.

Sophomore year, second semester, one hour weekly.

In addition to the regular courses required of candidates for the degree of E. M., the following courses are offered open to graduate students, or regular students who can present credits in the required courses.

## 12. THE ANALYSIS OF IRON AND STEEL (Laboratory course).

Dr. Hartman.

The chemical examination of irons, steels, and "ferro" alloys, according to the latest methods.

Text: *The Chemical Analysis of Iron*. Blair.

Courses 1, 2, 3, 4, 5, 6 and 8 in Chemistry are required.

Hours to be arranged.

## 14. GAS ANALYSIS (Laboratory course).

Dr. Hartman.

The analysis of mine, flue, illuminating, and chamber-gases, according to the methods of Hempel, Bunte, Elliott, Orsat, Lunge, Winkler, and others.

Texts: The works of Hempel and Winkler.

Courses 1, 2, 3, 4, 5, 6 and 8 in Chemistry are required.

Hours to be arranged.

## 16. TECHNICAL CHEMICAL ANALYSIS (Laboratory course.)

Dr. Hartman.

The analysis of lubricating oils, petroleum, asphalt, explosives, fuels, boiler waters, paints, cements, and clay.

Texts: *Stillman's Engineering Chemistry*; *Phillips' Engineering Chemistry*.

Courses 1, 2, 3, 4, 5, 6 and 8 in Chemistry are required.

Hours to be arranged.

## 18. ORGANIC PREPARATIONS (Laboratory course).

Dr. Hartman.

A short course in the study and preparation of some of the more important organic compounds.

Texts: The works of Remsen, Fischer, Levy, and Bender and Erdmann.

Courses 1, 2, 3, and 4 in Chemistry are required.

Hours to be arranged.

20. PHYSICAL CHEMISTRY (Laboratory course).

Dr. Palmer.

A course in Physico-chemical methods, including molecular weight determinations, conductivity determinations, and a study of thermochemical methods.

Courses 1, 2, 3, 4, 5, 6, 8 and 11 in Chemistry are required.

Hours to be arranged.

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All students in laboratory courses must make a deposit with the registrar, in addition to the payment of the regular fees, before receiving supplies and apparatus. In case of excessive withdrawal of apparatus another deposit may be required.

Students are not permitted to do any work outside of that outlined in the regular courses except under the direction of the professor in charge.

## DEPARTMENT OF MACHINE DESIGN AND DRAFTING.

Professor Curtis.  
Assistant Professor Hazard.

Mr. Haldane.  
Mr. Gebhardt.

## FIRST SEMESTER.

## 1. DESCRIPTIVE GEOMETRY.

Assistant Professor Hazard, Mr. Haldane and Mr. Gebhardt.

The course covers the first seventeen problems and the matter between problems seventeen and eighteen of Church's **Descriptive Geometry**. The method of instruction is by lectures and recitations. Each student recites on every problem individually.

Two hours a week during the first semester of the Freshman year.

Must be preceded or accompanied by course 3, Machine Design and Drafting.

Text: Church's **Descriptive Geometry**.

## 3. MECHANICAL DRAWING.

Assistant Professor Hazard, Mr. Haldane and Mr. Gebhardt.

All efforts during the early part of the work are directed towards making the student thoroughly acquainted with, and exercised in, the proper use of his drawing instruments and drafting supplies in general. The work then proceeds with mechanical and free hand lettering, line shading, tinting, shading with tints, and conventional tints for different materials. Great stress is laid on the work in free hand lettering. There are twelve of these mechanical sheets, a title page for the mechanical sheets and a title page for the descriptive geometry sheets. These two title pages may be a part of the second semester's work.

Three afternoons a week during the first semester of the Freshman year.

Texts: Morris' **Geometrical Drawing**; Curtis and Hazard's **Freshman Drawing Data**.

**5. MECHANISM.**

Professor Curtis.

Lectures and recitations. The course consists of the elementary principles of mechanism, including linear and angular velocity, graphic representation of velocity, modes of transmitting motion, velocity ratio, directional relation, motion by rolling contact, classification of gearing, and motion by sliding contact.

One hour a week during the first semester of the Sophomore year.

Courses 1, 3, and 4 in Mathematics are required and it must be preceded or accompanied by course 7, Mathematics, and courses 2 and 4, Machine Design and Drafting.

Text: Stahl & Wood's Mechanism.

**7. MECHANICAL DRAWING.**

Professor Curtis.

This course is intended to acquaint the student with that part of mechanical drawing in which the information comes from rough sketches from which the student is required to work up a thoroughly practical sheet. The work covers the matter of border lines, titles, and other printing, dimension and center lines, dimensions, the use of shaded lines, and the arrangement of the views on the sheet.

The problems given all require the proper application of descriptive geometry for their representation. They include such parts as pipes, flanges, elbows with their developments, bosses, levers, braces, screw threads, springs, nuts, and brackets. There are in all five sheets. The process of blue-printing is also given during this time.

Two afternoons a week during the first semester of the Sophomore year.

This course requires courses 2 and 4, Machine Design and Drafting.

Text: Curtis's Sophomore Drawing Data.

**9. MACHINE DESIGN.**

Professor Curtis.

Lectures and recitations. The course as given is based, on the one hand, on the strength of materials, and on the other, on practical requirements. All formulae are derived and proved

wherever possible, empirical formulae being used only where absolutely necessary. The work of this semester is devoted entirely to fastenings, and includes the proportioning of bolts and nuts of all forms, keys and colters, pipes and pipe joints, and riveted work.

Two hours a week during the first semester of the Junior year.

This course requires courses 5 and 6, Machine design and Drawing, and must be preceded or accompanied by course 1, Mechanics.

Texts: Low and Bevis's *Machine Drawing and Design*.

#### 11. MACHINE DESIGN DRAWING. Professor Curtis.

The first two sheets of this semester are on belting, and are a part of the mechanism drawing. The next work is on the design of assay furnaces; then follows the drawing based on the work in machine design.

This follows closely the work in the class room, the subject of fastenings, as outlined, being covered in this semester.

This course requires courses 7 and 8, and must be preceded or accompanied by courses 9 and 10, Machine Design and Drafting.

### SECOND SEMESTER.

#### 2. DESCRIPTIVE GEOMETRY.

Assistant Professor Hazard, Mr. Haldane, Mr. Gebhardt.

The course covers the tangent problems, intersection problems, shades and shadows, and isometric projections, as given in Church's *Descriptive Geometry*.

Second semester Freshman year, two hours a week.

Course 1, Machine Design and Drafting is required.

Text: Church's *Descriptive Geometry*.

#### 4. DESCRIPTIVE GEOMETRY DRAWING.

Assistant Professor Hazard, Mr. Haldane, Mr. Gebhardt.

This is in connection with the work in Descriptive Geometry, and includes warped surfaces, surfaces of revolution, tangent



surfaces, intersections, shades and shadows, and isometric projections.

Three afternoons a week.

Texts: Church's **Descriptive Geometry**; Curtis and Hazard's **Freshman Drawing Data**.

## 6. MECHANISM.

Professor Curtis.

This course continues with the study of gear-teeth of the cycloidal system, the involute system, approximate system, bevel gearing, cams, worm-gearing, motion by link work, motion by wrapping connectors, belts and pulleys, trains of mechanism, combinations, and straight line motions.

Lectures two hours weekly during the Sophomore year.

Text: Stahl and Wood's **Elementary Mechanism**.

## 8. MECHANISM DRAWING.

Professor Curtis.

This course is given in connection with the course in Mechanism and includes lobed wheels, spur-wheels, bevel-wheels, sprocket-wheels, cams, and worm and wheel.

The smallest possible amount of data is given out so as to place the student on his own responsibility in shaping his sheets.

There are in all seven sheets.

One afternoon weekly, Sophomore year.

This course requires courses 2, 4, and 5, Machine Design and Drafting, and it must be preceded or accompanied by course 6.

## 10. MACHINE DESIGN.

Professor Curtis.

The work of this semester is on that part of machine design pertaining to the transmission of power, and includes the proper proportioning of shafting, shaft couplings, bearings, brackets and hangers, pulleys and belt drives, wire and cotton rope drives, and tooth gearing, also the laying out of shafting for mills, including the arrangement of the necessary parts.

One hour per week of the Junior year.

This course requires course 9, Machine Design and Drafting.

Text: Low and Bevis's **Machine Drawing and Design**.

**12. MACHINE DESIGN DRAWING.** Professor Curtis.

The whole of the work of this semester is done in connection with the class room work in Machine Design and includes such work as is outlined in connection with that subject for the second semester.

**One afternoon per week of the Junior year.**

This course requires course 11, Machine Design and Drafting.

## DEPARTMENT OF SURVEYING.

Professor Stockton. Assistant Professor Weiss and Mr. Berry.

## FIRST SEMESTER.

1. SURVEYING. Assistant Professor Weiss.

Instruction is given in the theory of the adjustment of the transit and level, the principles of land surveying, topographical surveying and railroad work. The theory of the use of the Plane Table and also that of the Aneroid Barometer are given.

Three lectures a week during the first semester of the Junior year.

Courses 1, 2, 3, 4, 5, and 6 in Mathematics and courses 1, 2, 3, 4, 7 in Drawing required.

Texts: Johnson's *Theory and Practice of Surveying*; Hodgman's *Field Manual*; Pence and Ketchum's *Surveying Manual*; Nagle's *Field Manual for Railroad Engineers*; Searles' *Railroad Spiral*.

3. FIELD SURVEYING.

Professor Stockton, Assistant Professor Weiss, and Mr. Berry.

This course consists in adjusting instruments, traverse surveys, calculation of areas and distances, stadia work and the laying out of a short railway line. All the problems are platted in the office and the calculations made in a regular book kept for that purpose.

Field and office work, three afternoons a week during the first semester of the Junior year.

This course accompanies course 1.

## SECOND SEMESTER.

2. MINING SURVEYING. Assistant Professor Weiss.

Under this head will be considered the theory of the determination of the true meridian by means of the various solar attachments and by direct observation of the sun and of a circumpolar star; a careful discussion of the principles and methods used in locating and patenting mining claims, and in underground surveying, will be given. The lectures delivered on these

subjects enter into the detail with which they are connected, and touch upon the Mining Law relating to surveyors and the patenting of mining property. The remaining time will be devoted to the outlines of the subject of geodetic surveying.

Lectures twice a week during the second semester of the Junior year.

This course requires course 1, Surveying.

Texts: Johnson's *Theory and Practice of Surveying*; Morrison's *Mining Rights*.

#### 4. FIELD SURVEYING.

Professor Stockton, Assistant Professor Weiss and Mr. Berry.

This course includes field practice in determining the true meridian by the different methods. Each party undertakes the complete survey of a mining claim for patent, including the making of the Preliminary Plat and the writing up of the Field Notes according to the requirements of the Surveyor General's office.

The surveys of a number of available mines are made, and the proper maps and sections drawn. A base line is measured with a three hundred foot steel tape, and all corrections made so as to eliminate errors of sag, pull, temperature, and grade. On this base rests a quadrilateral whose angles are measured by the repeating method. These measured angles are adjusted and the sides computed.

Field and office work three afternoons a week during the second semester of the Junior year.

This course accompanies course 2, Surveying.

## DEPARTMENT OF GEOLOGY AND MINERALOGY.

Professor Patton.

Mr. Eggleston.

## FIRST SEMESTER.

## 1. GENERAL GEOLOGY.

Professor Patton.

This course embraces (a), Dynamical Geology; (b), Structural Geology; (c), Historical Geology. It is based mainly on text book work which is supplemented by lectures and illustrations, the intent being to give a fair knowledge of the principles of the subject such as an intelligent mining engineer should possess. This class room work later in the year is further supplemented by excursions in the neighborhood of Golden.

Four hours a week during the first semester of the Junior year.

Texts: Le Conte's Text Book of Geology.

## 3. CRYSTALLOGRAPHY.

Professor Patton and Mr. Eggleston.

This course is intended to give a thorough comprehension of the fundamental principles of the subject with a view to utilizing this knowledge for the practical determination of minerals. Instruction is given through lectures, followed by laboratory practice, and through individual quizzes. The material presented covers the six crystal systems and most of the hemihedral and tetartohedral divisions. The practical work embraces the study and determination of wooden crystal models to the number of about twelve hundred, and the identification of crystal forms on about three hundred natural crystals.

Five hours a week until Christmas, during the first semester of the Sophomore year.

Texts: Patton's Lecture Notes on Crystallography.

## 5. BLOWPIPE WORK.

Professor Patton and Mr. Eggleston.

In this course only the most characteristic reactions of the more commonly occurring elements are presented, namely, those which will be found necessary for the proper determination of the minerals presented in the course in Determinative Mineralogy. The blowpipe outfit for this course is furnished by the school, and is paid for by the special fee required for the com-

plete course in mineralogy, and becomes the property of the student.

**Thirty hours altogether, Sophomore year.**

Courses 1, 2, 3, 4 and 6 in Chemistry required.

Texts: Moses and Parson's Mineralogy, Crystallography, and Blowpipe Analysis.

## SECOND SEMESTER.

2. LITHOLOGY. Professor Patton and Mr. Eggleston.

This course is based primarily on lectures which are followed by practical rock determination and by excursions. The intent of the course is to give a familiarity with all the more commonly occurring rock types with ability to determine the same in the field. With this object in view, attention is directed mainly to the macroscopic properties of rocks. For this purpose collections containing over eleven thousand specimens have been arranged and made accessible to the students.

Three hours a week during the second semester of the Junior year.

Courses 1, 2, 3, 4, and 6 in Chemistry and courses 3, 5, and 6 in Geology and Mineralogy are required.

Text: Kemp's Handbook of Rocks.

4. ECONOMIC GEOLOGY. Professor Patton.

This important subject, which has heretofore been presented incidentally in connection with courses in mining and geology, will, after the present school year, be placed under the department of Geology and Mineralogy. Owing to the limited resources of the School of Mines in the past it has been impossible to give this subject the attention it deserves. It will be the policy of the department gradually to extend instruction in Economic Geology, including Ore Deposits, in so far as circumstances will allow.

Courses 1, 2, 3, 5, and 6 in Geology and Mineralogy are required.

6. SYSTEMATIC AND DETERMINATIVE MINERALOGY.

Professor Patton and Mr. Eggleston.

This subject is taught by means of lectures, text books and laboratory practice. Altogether about two hundred and fifty

mineral species are presented. In the laboratory practice each student is expected to determine and recite upon about twenty-five hundred mineral specimens, and he is supposed to become familiar with the characteristic physical properties that enable one to recognize the mineral species wherever met, with the aid of only a magnifying glass and a pocket knife. Two extensive collections have been prepared to be used in this course, one a type collection of thirty-seven hundred specimens, and the other a student's working collection of twenty-one thousand specimens.

Ten hours a week for fifteen weeks during the second semester of the Sophomore year.

Courses 1, 2, 3, 4, and 6 in Chemistry and courses 3 and 5 in Geology and Mineralogy are required.

Texts: Moses and Parson's Mineralogy, Crystallography and Blowpipe Analysis.

## DEPARTMENT OF MECHANICS AND CONSTRUCTION.

Professor Filkins.

## FIRST SEMESTER.

## 1. THEORETICAL MECHANICS. Professor Filkins.

The course consists of the theoretical study of mechanisms and materials. Statics of a material point and of rigid bodies; centers of gravity or centroids; chains, cords and cables; moments of inertia of plane figures; stresses and strains; tension; shearing; compression; torsion; flexure; combined torsion and flexure; elastic curves; safe loads; applications to commercial forms; oblique forces; columns; continuous beams.

Lectures and recitations three times a week during the first semester of the Junior year.

Courses 1, 2, 3, 4, 5, 6, and 7 of Mathematics, and 1 and 2 of Machine Design and Drafting are required.

Texts: Church's *Mechanics of Engineering*.

Church's *Notes and Examples in Mechanics*.

*Cambria Steel*.

Pierce's *Short Table of Integrals*.

Original Problems.

## 3. ADVANCED GRAPHICS. Professor Filkins.

Elective. An application of graphics to the solution of masonry problems. Right arches of masonry. Arch-ring, voussoirs, soffit, intrados, extrados, spandrel, crown, key stone, rise, and span. Mortar. Friction. Resultant and maximum pressure. True linear arch. Load contour. Symmetrical and non-symmetrical loadings on symmetrical arches. Abutments. Arch ribs. Special equilibrium polygon. Thrust. Shear. Moment. Angular Change. Deflections. Graphical arithmetic. Continuous rib, free to slip on abutments. Three-hinged rib. Two-hinged rib. Continuous rib with fixed ends. Applications of Professor Eddy's Graphical method. Temperature. Rib shortening. Variable cross section. Scheffler's theory. Continuous girders by graphics. Thatcher's concrete steel construction with variations. Expanded metal and similar constructions.



Hours to be arranged.

Courses 1, 2, and 4, in Mechanics and Construction are required.

Texts: Church's *Mechanics of Engineering*.

Baker's *Masonry Construction*.

5. (a) STRUCTURAL DETAILS. Professor Filkins.

Theory. Definitions and dimensions of parts. Housing, notching, mortise and tenon, dove-tailing, lag screws, dowels, lugs, keys, brace blocks, nuts and washers, etc. Unit stresses. Loading. Splicing; fishing, scarfing. Deepened beam. Articulated trussed beam solved graphically and by method of "least work." Wooden roof truss; rafters, purlins, upper chord, lower chord, tie-rods, end joint, corbel, anchorage. Pin and riveted steel roof trusses.

Recitations and lectures twice a week during the first semester of the Senior year.

(b) DESIGN. Professor Filkins.

Tabled fish-plate joint. Plain wrought-iron fish-plate joint. Deepened beam. Trussed beam. Wooden roof truss. Steel roof truss. Pin or rivet connections. Steel and masonry buildings. Wood and steel gallows frames.

Two afternoons a week during the first semester of the Senior year.

Courses 1, 2, and 4 in Mechanics and Construction are required.

Texts: Howe's *Roof Trusses in Wood and Steel*.

Merriman and Jacoby's *Roofs and Bridges*.

Fowler's *Specifications for Roofs and Buildings*.

*Cambria Steel*.

Jacoby's *Structural Details*, sheets.

Baker's *Masonry Construction*.

7. TESTING LABORATORY. Professor Filkins.

Determination of the strength and stiffness of building materials. Cast iron, wrought iron, steel and wood in tension. Wood, cast iron and brick in compression. Wood, steel and stone in flexure. Wire and wire rope in tension.

One afternoon per week in squads of ten during the first semester of the Junior year. (Testing Laboratory, Stratton Hall.)

9. CEMENT LABORATORY. Professor Filkins.

Natural and Portland cements. Cement mixing. Cement mortars. Testing cement and cement mortars for tensile and crushing strength; adhesion, soundness, fineness, setting, freezing, effect of chemicals.

One afternoon per week in squads of ten during the first semester of the Senior year. (Cement Laboratory, Stratton Hall.)

SECOND SEMESTER.

2. THEORETICAL MECHANICS. Professor Filkins.

Dynamics of a material point. Impact. Virtual Velocities. Centrifugal and centripetal forces. Moments of inertia of solids. Pendulums. Dynamics of rigid bodies. Work. Power. Energy. Fly-wheels. Friction. Dynamometers. Belts.

Three hours per week, the second semester of Junior year.

Course 1 in Mechanics and Construction is required.

Texts: Same as in Mechanics and Construction, Course 1.

4. GRAPHICS. Professor Filkins.

Definition. Force triangle. Force polygon. Concurrent and non-concurrent forces. Equilibrium polygons. Pole. Rays. Special equilibrium polygon. Resultant of forces. Pier reactions. Equilibrium and force polygons for vertical loads. Vertical dimensions of equilibrium polygon. Applications to simple beams with various loadings; to centers of gravity; to moments of inertia; to articulated cranes, trusses and gallows frames. Graphics of mechanisms. Forward and backward motion. Efficiency. Sliding, journal and "rolling" friction. Mill elevator. Wedge. Jack-screw. Engines. Ore-crusher. Friction Rollers. Chain friction. Tackles and pulleys. Ropes. Spur-gearing. Belting.

Lectures and recitations twice a week and drafting one afternoon a week during the second semester of the Junior year.

Course 1 in Mechanics and Construction is required.

Texts: Church's Mechanics of Engineering.

Church's Notes and Examples in Mechanics.

Howe's Roof Trusses in Wood and Steel.

## DEPARTMENT OF HYDRAULICS.

Professor Hill.

Assistant Professor Hazard.

## 1. HYDRAULICS AND HYDRAULIC MOTORS. Professor Hill.

This course is given partly by lectures, and partly by recitations; it embraces hydrostatics, the flow over weirs, through orifices, through pipes, flumes, ditches, and conduits of various forms. It also includes an elementary study of the various types of hydraulic machinery.

Five times a week for the first nine weeks of the Senior year.

Texts: Merriman's *Hydraulics and References*.

## 2. LABORATORY COURSE IN HYDRAULICS.

Professors Hill and Hazard.

Measurements are made of the flow over weirs, through orifices and through flumes and ditches. The determination of the approximate law of flow in pipes also forms part of the course. Water wheels are tested and the efficiency of the hydraulic ram under various conditions is determined.

Arrangements have been made by which this department is to have the use of the city's water supply for experimental work with water wheels and nozzles. This will make available a very high head (about twelve hundred feet). With the supply available for a few hours' work, tests may be made on wheels developing over three hundred-horse power.

One afternoon each week for twelve weeks of the Senior year.

**DEPARTMENT OF THERMODYNAMICS AND POWER  
TRANSMISSION.**

Professor Hill.

Assistant Professor Hazard.

These courses are supplemented by visits to numerous steam, electrical and hydraulic plants in the state.

**FIRST SEMESTER.**

**1. THERMODYNAMICS.**

Professor Hill.

This is a short course in the Senior year, given by lectures; it also includes the study of the steam engine indicator, injectors, etc. Lectures are also given on the methods of testing steam engines and boilers.

The course requires all of Mathematics and courses 1, 2, 3, and 4 in Physics.

**SECOND SEMESTER.**

**2. STEAM ENGINE.**

Professor Hill.

This course is given mostly by recitations and includes the general description of the various classes of engines with their advantages and disadvantages.

Three times a week for one semester in the Senior year.

The course requires course 1, Thermodynamics and Power Transmission.

**Text:** Hutton's *Mechanical Engineering of Power Plants*.

**4. STEAM LABORATORY.**

Professors Hill and Hazard.

This course includes valve setting, tests of engines, boilers, and pumps, calibration of gauges, indicator springs, etc.

One afternoon a week for twelve weeks in the Senior year.

**6. POWER TRANSMISSION.**

Professor Hill.

This includes the transmission of power by wire rope, by compressed air, and by electricity. The course is given partly by lectures, and partly by recitations.

Five times a week for one semester in the Senior year.

**Texts:** Bell's *Electrical Power Transmission* and references.

**8. ELECTRICAL LABORATORY. Professors Hill and Hazard.**

Tests are made of the efficiency of motors, dynamos and transformers. The calibration of instruments is made a part of the course.

One afternoon a week for twelve weeks in the Senior year.

## DEPARTMENT OF ASSAYING.

## 1. ASSAYING.

Professor Rose.

The principles of fluxing and methods of work are taught by lectures, followed by their application in the laboratory to typical ores, silicious, barytic, pyritic, etc. The course involves thorough work in the assay of rich, medium, and low grade ores of gold, silver, and lead, and the preparation of samples.

Both the scorification and crucible methods, with silver ores, are required and the results compared. The results of assays by the nail, nitre, and roasting methods are also compared. The course includes the assay of furnace products such as mattes, slags, and bullions.

Large numbers of samples, which have been previously checked by prominent metallurgical plants in the state, are given to the students to assay. Accuracy is of first importance, and as much speed is acquired by the student as is compatible with good work.

Sophomore year, first and second semesters, one afternoon weekly.

## 2. ASSAYING.

Professor Rose.

Special courses in assaying to students who have had the equivalent of Course 1.

## DEPARTMENT OF MINING.

Professor Stockton (ad interim).

## FIRST SEMESTER.

## 1. MINING.

Professor Stockton.

This course may be outlined as follows,—hoisting, under which will be considered, motive powers, ropes, gallows-frames, receptacles and safety appliances, and pneumatic hoisting. Haulage; a discussion of the different systems of underground and surface transportation, including aerial ropeways. The drainage, ventilation and lighting of mines. Explosives, the theory of blasting, pointing and charging holes; methods of firing. Methods of breaking ground. Boring, diamond-drill work, and the percussion methods.

Lectures five times a week during the first semester of the Senior year.

Texts: Foster's *Ore and Stone Mining*. Ihseng's *Manual of Mining*. The *Coal and Metal Miner's Pocket Book*.

## SECOND SEMESTER.

## 2. MINING.

Professor Stockton.

Instruction is given in methods of shaft sinking, tunneling, mine timbering and exploitation, hydraulic mining, ore deposits, mine management and the employment of labor, mine examinations, sampling of ore bodies, estimation of the "Ore in Sight," and the valuation of mining properties.

This course is supplemented by trips to mining camps for the practical and detailed study of machinery and mining methods.

Lectures, five times a week during the second semester of the Senior year.

Texts: Posepny's *The Genesis of Ore Deposits*. Kemp's *The Ore Deposits of the United States and Canada*. Bowie's *A Practical Treatise on Hydraulic Mining*.

## 4. MINING LABORATORY.

Professor Stockton.

The mining laboratory time will be devoted to experimental work with explosives, construction and drawing work in connection with mine timbering and mine models, experiments with

mine cars, and the making of blue prints of machinery, etc. Tests of hoisting and haulage plants will be made. This course will vary from year to year as additional apparatus and working space are provided.



## DEPARTMENT OF METALLURGY.

Professor King.

Professor Rose.

The study of Metallurgy begins with the Junior year and continues throughout the remainder of the school course. The subject is taught by illustrated lectures, text-books, appropriate laboratory work, and visits to metallurgical works where the students see and study the operations on a commercial scale.

Visits to the prominent metallurgical plants are of frequent occurrence during the last years of the course. These trips are required of all candidates for the Mining and Metallurgical degree. During the past two years the classes have visited the chlorination and bromination mills at Colorado City, the lead, iron, pyritic, and zinc smelters at Denver, Pueblo and Leadville, the Zinc Paint Works at Canon City and the Cyanide plants of the Cripple Creek district; also the stamp mills of Gilpin county, and many concentration and sampling works throughout the state, including the great variety of reduction works to be found in or near Denver.

On these trips the students are accompanied by the professor in charge and the visits are carefully scheduled. Many of the students work during the summer months in these plants, and though this is not required as a part of the regular course, yet the students in all the classes avail themselves of the many opportunities offered by Colorado.

## FIRST SEMESTER.

## 1. (a) GENERAL PRINCIPLES OF METALLURGY.

Professors Rose and King.

Historical sketch. The relations of Metallurgy to Chemistry. Properties of the metals, alloys, brasses and bronzes. Thermo-treatment of metals. Fuels in the solid, liquid, and gaseous state; their occurrence and manufacture.

Refractory materials, their occurrence, properties, manufacture and uses. Pyrometry and Calorimetry. Furnaces, different types used for various metallurgical operations. Blowing apparatus. Hot blast stoves. Typical metallurgical processes. Sampling of ores and metallurgical products. Roasting of gold, silver, copper, lead, zinc and iron ores.

## (b) ORE DRESSING.

Three hours per week during the first semester of the Junior year.

One afternoon per week in the Laboratory.

This course requires courses 1, 2, 3, 4, 5, 6, 7, 8, 10 in Chemistry, courses 3, 5 and 6 in Mineralogy and Geology, and 1 and 2 in Assaying.

Texts and references: Roberts-Austin, *Introduction to Metallurgy*.

## 3. METALLURGY OF GOLD AND SILVER.

Professors King and Rose.

## (a) Metallurgy of gold.

Occurrence and properties. Various processes of extraction. Stamp Milling. Extraction by amalgamation. Extraction by Chlorination. Extraction by Cyaniding. Arrangements of plants and typical mills. Melting and refining of gold and parting of gold and doré bullion.

## (b) The Metallurgy of silver.

Occurrence and properties. A general discussion of various processes for the extraction from ores. The Patio process. The Washoe process. The Combination process. Chlorination roasting and pan amalgamation. The Boss process. Wet processes. Refining of silver bullion. Purchasing, sampling, and testing of gold and silver bullion.

Lectures four hours per week, and one afternoon per week in the metallurgical laboratory, during the first semester of the Senior year.

This course requires courses 1 and 2, Metallurgy.

Texts and References:

T. K. Rose, *The Metallurgy of Gold*.

Collins, *The Metallurgy of Silver*.

Eggleston, *The Metallurgy of Silver*.

Schnabel, *Hand Book of Metallurgy*.

Richards, *Stamp Milling of Gold Ores*.

## SECOND SEMESTER.

## 2. THE METALLURGY OF COPPER.

Professors King and Rose.

Smelting in reverberatory and blast furnaces. Pyritic matte smelting. Concentration of mattes by various processes. Wet processes of treating mattes and ores. The study and calculation of furnace charges, and slags. Bessemerizing. Processes of refining in reverberatories and electrolytic refining.

Lectures three hours per week, and one afternoon per week in the metallurgical laboratory, during the second semester of the Junior year.

This course requires course 1 in Metallurgy and course 1 Assaying.

Texts and References:

Schnabel, *Hand Book of Metallurgy*.

Peters, *Modern Copper Smelting*.

Lang, *Matte Smelting*.

## 4. METALLURGY OF IRON, LEAD, ZINC, Etc.

Professors King and Rose.

## (a) Metallurgy of iron and steel.

Ores of iron and their impurities. The metals iron and steel; their chemical and physical properties as affected by process of manufacture, and by the presence of impurities. The blast furnace. The puddling furnace. Bessemerizing. The open hearth. The crucible process. Metallography.

## (b) The metallurgy of lead.

Smelting in reverberatory furnaces, in the American ore hearth and blast furnaces. Softening and refining. The Pattinson Process. The Parkes process. Cupellation.

## (c) The metallurgy of zinc, tin, aluminum, mercury, antimony, and platinum.

Lectures four hours per week and one afternoon in the metallurgical laboratory, during the second semester of the Senior year.

This course requires courses 1, 2 and 3 in Metallurgy.

Texts and References:

Howe, Metallurgy of Steel.

Greenwood, Metallurgy of Iron and Steel.

Collins, Metallurgy of Lead.

Hofman, Metallurgy of Lead.

Schnabel, Handbook of Metallurgy.

Turner, Metallurgy of Iron.

## ENROLLMENT OF STUDENTS.

### SENIOR CLASS.

Coleman, R. Prewitt.....	<i>City of Mexico, Mex.</i>
Cox, Augustus D.....	<i>Golden, Colo.</i>
Devinney, George V.....	<i>Edgewater, Colo.</i>
Dunkle, Fred. W.....	<i>Indianapolis, Ind.</i>
Emeis, Walter H.....	<i>Davenport, Ia.</i>
Emrich, Horace H.....	<i>Pueblo, Colo.</i>
Fleming, William L.....	<i>Cripple Creek, Colo.</i>
Foster, George C.....	<i>Chillicothe, O.</i>
Fry, Louis D.....	<i>Denver, Colo.</i>
Funk, Walter A.....	<i>West New Brighton, S. I., N. Y.</i>
Hyder, Frederick B.....	<i>Denver, Colo.</i>
Izett, Glenn.....	<i>Denver, Colo.</i>
King, Henry E.....	<i>Colorado Springs, Colo.</i>
Liddell, Charles A.....	<i>Golden, Colo.</i>
Liddell, T. Parker.....	<i>Golden, Colo.</i>
McDermutt, Grace C. U.....	<i>Denver, Colo.</i>
McElvenny, Robert F.....	<i>Denver, Colo.</i>
Merwin, Eugene W.....	<i>Los Angeles, Cal.</i>
Nagel, Frank J.....	<i>Denver, Colo.</i>
Palsgrove, Harry G.....	<i>Denver, Colo.</i>
Parsons, H. F.....	<i>Wamego, Kas.</i>
Rhodes, William B.....	<i>Denver, Colo.</i>
Sloan, W. Arthur.....	<i>Denver, Colo.</i>
Taggart, George K.....	<i>Dallas, Tex.</i>
Ward, William F.....	<i>Denver, Colo.</i>
Wattles, William C.....	<i>Denver, Colo.</i>
Wells, Frank B.....	<i>Los Angeles, Cal.</i>
Wolf, Harry J.....	<i>Golden, Colo.</i>

### JUNIOR CLASS.

Anderson, Axel E.....	<i>Denver, Colo.</i>
Carney, Hugh J.....	<i>Ouray, Colo.</i>
DeSollar, Tenney C.....	<i>Denver, Colo.</i>

Fillius, Lee L.....	<i>Georgetown, Colo.</i>
Franck, Albert C.....	<i>Kansas City, Mo.</i>
Franck, Robert P.....	<i>Kansas City, Mo.</i>
Friend, Frank V.....	<i>Deceased.</i>
Goodale, Stephen L.....	<i>Colorado Springs, Colo.</i>
Hill, Frank C.....	<i>Carthage, Mo.</i>
Johnson, L. G.....	<i>Denver, Colo.</i>
Kimball, Harlow M.....	<i>Evanston, Ill.</i>
Larsh, Walter S.....	<i>Denver, Colo.</i>
Lee, Wallace.....	<i>Kansas City, Mo.</i>
Nagel, Henry P.....	<i>Denver, Colo.</i>
Prier, Truman D.....	<i>Golden, Colo.</i>
Robinson, George P.....	<i>Denver, Colo.</i>
Sherman, Scott H.....	<i>Denver, Colo.</i>
Spencer, W. Irving.....	<i>Portland, Ore.</i>
Tescher, Samuel.....	<i>Denver, Colo.</i>
Thayer, Harry Stanley.....	<i>Greeley, Colo.</i>
Thomas, John S.....	<i>Denver, Colo.</i>
Trumbull, L. W.....	<i>Golden, Colo.</i>
Vaughn, Robert M.....	<i>Clearfield, Ia.</i>
Wackenhut, George J.....	<i>Colorado Springs, Colo.</i>
Wallace, Howard J.....	<i>Algona, Ia.</i>
Washburn, H. G.....	<i>Denver, Colo.</i>
Weil, Jacob.....	<i>Chicago, Ill.</i>
Wells, Ben T.....	<i>Pueblo, Colo.</i>

#### SOPHOMORE CLASS.

Allen, Carl A.....	<i>La Junta, Colo.</i>
Arnold, Lawrence S.....	<i>Manchester, Engl.</i>
Austin, Arthur.....	<i>Denver, Colo.</i>
Bailey, Elbert W.....	<i>Denver, Colo.</i>
Berry, Albert.....	<i>Leadville, Colo.</i>
Blair, E. Verne.....	<i>Springfield, Ill.</i>
Breeden, Roscoe D.....	<i>Charlestown, Ill.</i>
Brown, Robert L.....	<i>Denver, Colo.</i>
Buell, Arthur W.....	<i>Golden, Colo.</i>
Busey, Alfred P., Jr.....	<i>Pueblo, Colo.</i>
Carstarphen, Fred C.....	<i>Denver, Colo.</i>

Chase, William C.....	<i>El Paso, Tex.</i>
Coffin, Roy G.....	<i>Longmont, Colo.</i>
Colburn, Clare L.....	<i>Denver, Colo.</i>
Collins, Wales S.....	<i>Denver, Colo.</i>
Collom, Roy Edward.....	<i>Denver, Colo.</i>
Cory, John J.....	<i>Denver, Colo.</i>
Cuno, Albert F.....	<i>Denver, Colo.</i>
D'Arcy, Richard L.....	<i>Denver, Colo.</i>
Duer, Charles L.....	<i>Denver, Colo.</i>
Eames, Luther B.....	<i>Pueblo, Colo.</i>
Filteau, Charles A.....	<i>Idaho Springs, Colo.</i>
Flint, Fred F.....	<i>Greeley, Colo.</i>
Ford, Homer D.....	<i>Denver, Colo.</i>
Gardner, John I.....	<i>Denver, Colo.</i>
Grider, Richard L.....	<i>Seiad Valley, Cal.</i>
Hallett, Robert L.....	<i>Denver, Colo.</i>
Hallett, William J.....	<i>Denver, Colo.</i>
Harrison, Thomas S.....	<i>Evansville, Ind.</i>
Haynes, Carey D.....	<i>Chicago, Ill.</i>
Hensley, James H., Jr.....	<i>Denver, Colo.</i>
Hewitt, Arthur F.....	<i>Denver, Colo.</i>
Hornbein, Julius.....	<i>Denver, Colo.</i>
Hunt, Thacher R.....	<i>Denver, Colo.</i>
Hyder Charles A.....	<i>Denver, Colo.</i>
Larison, Elden L.....	<i>Golden, Colo.</i>
Lee, Robert P.....	<i>Denver, Colo.</i>
Lennox, Luther W.....	<i>Colorado Springs, Colo.</i>
Lewis, Alfred F.....	<i>Manitou, Colo.</i>
Libby, James L.....	<i>Cheyenne, Wyo.</i>
Lonergan, Phillip J., Jr.....	<i>Colorado Springs, Colo.</i>
Lyneman, Emanuel J.....	<i>Deceased.</i>
Marrs, William M.....	<i>Denver, Colo.</i>
McCart, Robert.....	<i>Ft. Worth, Tex.</i>
Metcalf, Bradley B.....	<i>Denver, Colo.</i>
Middelkamp, Leroy L.....	<i>Pueblo, Colo.</i>
Muir, Douglas.....	<i>Sun Antonio, Tex.</i>
Neville, John B.....	<i>Denver, Colo.</i>
O'Byrne, Joseph F.....	<i>Cripple Creek, Colo.</i>
Oliver, Thomas C.....	<i>Charlotte, N. C.</i>

Paredes, Evaristo.....	<i>Culiacan, Mexico.</i>
Pfeiffer, Guy N.....	<i>O'Fallon, Ill.</i>
Pilger, Newton W.....	<i>Loup City, Neb.</i>
Plant, Francis B.....	<i>Covina, Cal.</i>
Pressler, Louis P.....	<i>Golden, Colo.</i>
Putnam, George B.....	<i>Denver, Colo.</i>
Rabb, Edward M.....	<i>Denver, Colo.</i>
Rath, Charles M.....	<i>Telluride, Colo.</i>
Reeve, Tracy.....	<i>Denver, Colo.</i>
Reinhard, Frank J.....	<i>Denver, Colo.</i>
Rice, George B.....	<i>Denver, Colo.</i>
Richards, Edwin R.....	<i>Montrose, Colo.</i>
Ryan, Will E.....	<i>Denver, Colo.</i>
Shiach, James W.....	<i>Houghton, Wash.</i>
Smith, Eric M.....	<i>Montrose, Colo.</i>
Spangler, Howard.....	<i>Denver, Colo.</i>
Spicer, Carroll A.....	<i>Colorado Springs, Colo.</i>
Stillman, Charles C.....	<i>Monte Vista, Colo.</i>
Stoeckley, Ernst F.....	<i>Canon City, Colo.</i>
Terrill, Arthur C.....	<i>Colorado Springs, Colo.</i>
Thomson, Arthur T.....	<i>Pueblo, Colo.</i>
Waddey, Albert Y.....	<i>Richmond, Va.</i>
Weems, Thomas B.....	<i>Denver, Colo.</i>
West, Louis C.....	<i>Evanston, Ill.</i>
Wright, Wm. H.....	<i>Denver, Colo.</i>
Zulch, Herman C.....	<i>Denver, Colo.</i>

#### FRESHMAN CLASS.

Abel, Walter D.....	<i>Denver, Colo.</i>
Aldrich, Harold W.....	<i>Denver, Colo.</i>
Allen, Maynard C.....	<i>Denver, Colo.</i>
Armington, Howard C.....	<i>Leadville, Colo.</i>
Anderson, George S.....	<i>Kearney, Neb.</i>
Badgley, C. W., Jr.....	<i>Denver, Colo.</i>
Ball, Max W.....	<i>Golden, Colo.</i>
Beale, James L.....	<i>Denver, Colo.</i>
Bell, Charles N.....	<i>Denver, Colo.</i>
Brown, John B.....	<i>Topeka, Kas.</i>



Brown, Osborne E.....	Golden, Colo.
Brown, William E.....	Greelcy, Colo.
Brunel, Rene L.....	Golden, Colo.
Chapman, Thomas.....	Aspen, Colo.
Clark, Levert L.....	Washington, Ind.
Dexter, Albert J.....	Cripple Creek, Colo.
Dietz, Walter P.....	Denver, Colo.
Dow, William G.....	Denver, Colo.
Eddy, Harold C.....	Denver, Colo.
Ellis, Thomas C.....	Denver, Colo.
Ellis, Thomas P.....	Denver, Colo.
Emens, Ray B.....	Victor, Colo.
Finigan, William H.....	St. Louis, Mo.
Freeland, William H.....	Denver, Colo.
Freidhoff, William.....	Anaconda, Colo.
Franck, Edwin L.....	Canon City, Colo.
Frank, Morton E.....	Chicago, Ill.
Gerity, Thos. C.....	Denver, Colo.
Gilbert, Arthur K.....	Denver, Colo.
Gilbert, William J.....	Denver, Colo.
Goodale, F. Augustus.....	Trinidad, Colo.
Goodell, Robert H.....	South Framingham, Mass.
Gordon, John G., Jr.....	St. Louis, Mo.
Griffiths, Guy D.....	Gloucestershire, Eng.
Hague, Harry.....	Salt Lake City, Utah.
Harkison, Chas. W.....	Golden, Colo.
Hazlehurst, Lindley M.....	Winnetka, Ill.
Heitz, George.....	Denver, Colo.
Hollis, Don D.....	Silverton, Colo.
Hughes, Gideon.....	Los Angeles, Cal.
Ingersoll, J. Curtis.....	Harman, Colo.
Isom, Edward W.....	Kenilworth, Ill.
Jackson, Orin W.....	Canon City, Colo.
Jaquette, Charles M.....	Grand Junction, Colo.
Jones, Will E.....	Monte Vista, Colo.
Kampman, E. A.....	San Antonio, Tex.
Kell, Wayne S.....	Denver, Colo.
Killgore, Thomas B.....	Bloomington, Ill.
Kleff, Marvin.....	Denver, Colo.

Koerner, Albert J.....	<i>St. Louis, Mo.</i>
Ladd, Howard W.....	<i>Ottumwa, Ia.</i>
Levell, Alexander.....	<i>Victor, Colo.</i>
Neugebauer, K. E.....	<i>Pueblo, Colo.</i>
Norton, Albert C.....	<i>La Junta, Colo.</i>
Nyberg, H. Edward.....	<i>Pueblo, Colo.</i>
Orr, Owen C.....	<i>St. Joseph, Mo.</i>
Parks, George A.....	<i>Denver, Colo.</i>
Philpott, Roy C.....	<i>Cripple Creek, Colo.</i>
Pomeroy, Charles L.....	<i>El Paso, Tex.</i>
Pope, Worden.....	<i>Denver, Colo.</i>
Pray, Harry G.....	<i>Golden, Colo.</i>
Pusey, William J.....	<i>Germantown, Pa.</i>
Ricketts, Hugh C.....	<i>Charlestown, Ill.</i>
Ripley, G. Clinton.....	<i>New York City, N. Y.</i>
Roberts, Richard.....	<i>Boulder, Colo.</i>
Schlereth, C. Quinby.....	<i>Denver, Colo.</i>
Sebree, John P.....	<i>La Junta, Colo.</i>
Shields, James C.....	<i>Highland Park, Ill.</i>
Siil, Rush T.....	<i>Colorado Springs, Colo.</i>
Smith, James E.....	<i>South Pass, Wyo.</i>
Smith, Reuben W.....	<i>Golden, Colo.</i>
Smith, Weston M.....	<i>Edgewater, Colo.</i>
Stephenson, Tiffany.....	<i>Ft. Morgan, Colo.</i>
Stewart, Ed. M.....	<i>Denver, Colo.</i>
Stotesbury, Harold W.....	<i>Leadville, Colo.</i>
Thum, E. E.....	<i>Denver, Colo.</i>
Vredenburg, John V.....	<i>Jersey City, N. J.</i>
Warfel, Chester G.....	<i>Golden, Colo.</i>
Wegeforth, C. Parker.....	<i>Chicago, Ill.</i>
White, J. Lansing.....	<i>Denver, Colo.</i>
Whitehouse, Howard D.....	<i>Denver, Colo.</i>
Zeiger, Robert L.....	<i>Pueblo, Colo.</i>

## STUDENTS, 1902-1903.

Seniors .....	28
Juniors .....	28
Sophomores .....	76
Freshmen .....	82
Total .....	<u>214</u>

## SUMMARY BY STATES AND COUNTRIES.

Colorado .....	152	New York .....	2
Illinois .....	14	Wyoming .....	2
Missouri .....	8	Massachusetts .....	1
Texas .....	6	New Jersey .....	1
Iowa .....	5	North Carolina .....	1
California .....	5	Ohio .....	1
Indiana .....	3	Oregon .....	1
England .....	2	Pennsylvania .....	1
Kansas .....	2	Utah .....	1
Mexico .....	2	Virginia .....	1
Nebraska .....	2	Washington .....	1

From Colorado, seventy-one per cent. All others, twenty-nine per cent.

## REGISTER OF THE ALUMNI BY CLASSES.

1883.

Middleton, Wm. B.....*Denver, Colo.*  
*Mining Engineer.*

Wiley, Walter H.....*Idaho Springs, Colo.*  
*Mining Engineer.*

1886.

van Diest, Edmund C.....*San Luis, Colo.*  
*Superintendent Maxwell Land Grant.*

Gehrmann, Chas. A.....*Idaho Springs, Colo.*  
*Superintendent Consolidated Stanley Mining Co.*

1888.

Ambrosius, Carl E.....*Guanacevi, Durango, Mex.*  
*Mining Engineer.*

\*Floyd, John A.....

\*Kingman, Jerry.....

\*Lorah, Bela I.....

1889.

Bellam, Henry L.....*Anaconda, Mont.*  
*Chemist, Anaconda Mining Co.*

Craigue, Wm. H.....*Colorado Springs, Colo.*  
*Mining Engineer.*

\*Wertheim-Salomonson, F. M. G. A.

1890.

Comstock, Chas. W.....*Boston Bldg., Denver, Colo.*  
*Civil and Mining Engineer, Engineering Co. of America.*

1891.

Johnson, Edward W.....*Murray, Utah.*  
*Assistant Superintendent Murray Plant, Am. S. & Ref. Co.*

Smith, Chas. D.....*Atacama, Peru, S. A.*  
*Metallurgist.*

\*Deceased.

## 1892.

- Aller, Frank B. . . . . *Peru, S. A.*  
*Metallurgist with M. Guggenheim.*
- Brown, Norton H. . . . . *Denver, Colo.*  
*Surveyor General's Office.*
- Budrow, Wm. B. . . . . *Pueblo, Colo.*  
*Assistant Superintendent, Philadelphia Smelter.*
- Cole, Burt. . . . . *Los Angeles, Cal.*  
*Engineer.*
- Hindry, Willis E. . . . . *El Oro, Mexico*  
*Superintendent, Esperanza Mine.*
- Kimball, Geo. K., Jr. . . . . *Idaho Springs, Colo.*  
*Superintendent, Old Town Mining Co.*
- Kimball, Jos. S. . . . . *Golden, Colo.*
- Lewis, Wm. B. . . . . *Denver, Colo.*  
*Manager, Denver Sulphite Fibre Co.*
- McMahon, Chas. H. . . . . *Sombrerete, Zacatecas, Mexico*  
*General Superintendent, Sombrerete Mining Co.*

## 1893.

- Collins, Phillip M. . . . . *Colorado City, Colo.*  
*Superintendent, Portland Mill.*
- Hawley, R. Howard. . . . . *Monterey, Mexico*  
*Chemist, National Mex. Smelting Co.*
- Jewell, Gilbert E. . . . . *Chartres Towers, Queensland, Australia*  
*Metallurgist.*
- Milliken, Wm. B. . . . . *Deadwood, S. Dak.*  
*Mining Engineer.*
- Osborne, Arthur H. . . . . *Georgetown, Colo.*  
*Surveyor.*
- Stephens, Wallace A. . . . . *Denver, Colo.*  
*Metallurgist.*

## 1894.

- Atkins, Horace H. . . . . *711 17th Ave., Denver, Colo.*  
*Assayer, Grant Plant American S. & R. Co.*

- Bowie, Jas. W.....Gallup, *New Mex.*  
*Mine Superintendent, Caledonia Coal Co.*
- Post, George M..... 1030 W. 14th Ave., *Denver, Colo.*  
*Lawyer.*
- Saint Dizier, Julius L.....*San Luis Potosi, Mexico*  
*Engineer, Compania Metalurgica Mexicana.*
- Schneider, Geo. W.....*Central City, Colo.*  
*Deputy Commissioner of Mines.*
- Wheeler, Chas. E.....*Lampazos, Mexico*
- 1895.
- Arthur, Ed. P.....*Cripple Creek, Colo.*  
*Mining Engineer and U. S. Deputy Mining Surveyor.*
- Davis, Carl R.....*Rossland, B. C.*  
*Superintendent, War Eagle and Central Star M. Co.*
- Dockery, Love Atkins.....*Chihuahua, Mexico*  
*Ashton & Dockery, Mining Engineers.*
- Durell, Chas. T.....*Gilt Edge, Fergus Co., Mont.*  
*Manager Central Montana Mines Co.*
- Eaton, Albert L.....*Leadville, Colo.*  
*Assayer, Penn M. & L. Co.*
- Eye, Clyde M.....*Georgetown, Cal.*  
*Superintendent and Local Manager, Alpine Mine*
- Field, Fred M..... . . . . .*Pony, Montana*  
*Metallurgist (Cyanide).*
- Gray, Latimer D.....*Rock Springs, Wyo.*  
*Electrical Engineer, Union Pacific Coal Co.*
- Hartzell, Lester J.....729 W. Quartz St., *Butte, Mont.*  
*Assayer Butte & Boston Smelter.*
- Kennedy, Geo. A.....2709 Boulevard F., *Denver, Colo.*  
*Mining Engineer.*
- Limbach, Edmund C.....*Gilt Edge, Mont.*  
*Surveyor, Central Montana Mines Co.*
- Maxwell, Fred A. G.....*Randfontein, Transvaal, S. Africa*  
*Metallurgist, Porges Randfontein G. M. Co.*
- Merryman, Herbert E.....*Cripple Creek, Colo.*  
*Surveyor.*

- Parker, Jas. H.....*New York, N. Y.*  
*Student, Columbia University.*
- Rowe, Edmund E.....*Denver, Colo.*  
*Manufacturer, E. E. Rowe & Co., Pressed Brick.*
- \*Shetler, Waverly.....
- Skinner, Lewis B.....*Colorado Springs, Colo.*  
*Superintendent, Standard Mill, Colo.-Phila. Reduction Co.*
- Stannard, Burt C.....*Everett, Wash.*  
*Chemist, Puget Sound Reduction Co.*
- Stockton, Robt. S.....*Golden, Colo.*  
*Professor of Mathematics and Surveying, Colo. School of Mines.*
- Suhr, Otto B.....*Niagara Falls, Ontario*  
*General Superintendent, Niagara Falls Power Co.*
- Titsworth, Frederick S.....*Denver, Colo.*  
*Engineer, 207 Boston Building.*
- Wallace, Lewis R.....*Morenci, Ariz.*  
*Superintendent, Detroit Copper Co.*
- Young, Frank B.....*Gilt Edge, Mont.*  
*Superintendent, Central Montana Mines Co.*

1896.

- Atkinson, Walter J.....*Chicago, Ill.*  
*Civil Engineer.*
- Barensheer, Wm. J.....*Taylor and Bert Sts, Denver, Colo.*  
*Assayer.*
- Barnes, Corrin.....*325 Xenia St., Cripple Creek, Colo.*  
*Assayer and Chemist.*
- Beeler, Henry C.....*Cheyenne, Wyo.*  
*Wyoming State Geologist.*
- Dwelle, Jesse E.....*1716 Blake St., Denver, Colo.*  
*Chemist, Gold & Silver Extraction Co., Ltd.*
- Griswold, Geo. G.....*1260 Race St., Denver, Colo.*  
*Chemist, Globe Smelter.*
- Hoyt, Geo. F.....*Mapimi, Durango, Mexico*  
*Assistant Superintendent, Smelter Minera de Pcnoles.*
- Maynard, Rea E.....*Honolulu, Hawaiian Islands*

\*Deceased.

- Mitchell, Geo. B.....67 Dubord St., Montreal, Canada  
*Assistant Engineer, Canadian Pacific Railway.*
- Milliken, John T.....Deadwood, S. Dak.  
*Imp. M. & M. Co.*
- Nance, Wm. H.....St. Louis, Mo.  
*St. Louis Smelting & Refining Co.*
- Newnam, Wm. E.....Omaha, Neb.  
*Chemist, Omaha & Grant Smelter.*
- Paul, Wm. H.....Central City, Colo.  
*Manager, Mammoth Gold Mining Co.*
- Strout, Fred McL.....Cripple Creek, Colo.  
*Assayer, Stratton's Mines (Strout & Son).*

## 1897.

- Buck, Arthur H.....Miniaca, Chihuahua, Mexico  
*Engineer, Sunset Mining Co.*
- Bussey, Edwin E.....Denver, Colo.
- Canning, Herbert A.....Aspen, Colo.  
*Deputy Commissioner of Mines.*
- Cohen, Louis.....Sombrecete, Zacatecas, Mexico  
*Assayer, Sombrecete Mining Co.*
- Draper, Marshall D.....Barth Block, Denver, Colo.  
*American Exploitation Co.*
- Febles, John C.....Butte, Mont.  
*Anaconda Copper Co.*
- Gross, John.....Deadwood, S. Dak.  
*Engineer, Penobscot Mining Co.*
- Hazard, W. J.....Golden, Colo.  
*Asst. Professor in Physics and Descriptive Geometry, Colo.  
School of Mines.*
- Jarvis, R. P.....Torrcon, Coah., Mexico  
*Compania Metallurgica de Torrcon, S. A.*
- Kelley, W. A.....Denver, Colo.  
*Chemist, McArthur-Forest Co.*
- Lerchen, F. H.....Modoc, Dona Anna Co., New Mexico  
*Superintendent of the Modoc M. Co. and the Torpedo M. Co.*
- Logue, N. W.....Aspen, Colo.



- McLeod, J. Norman.....*Black Hawk, Colo.  
Miners Ore Sampling Co.*
- McGregor, Geo. H.....*Central City, Colo.  
Superintendent of Mines for Rocky Mt. G. & M. Co.*
- Nelson, H. E.....*711 Fifth Ave., Spokane, Wash.  
Engineer for Bradley Eng. & Mach. Co.*
- Nye, Robert.....*Placerville, Idaho  
Manager of the Moline Mining Co.*
- Powell, Geo. F.....*Santa Isabel, Chihuahua, Mexico  
Superintendent, Magistral Mine.*
- Roller, Arthur H.....*Idaho Springs, Colo.  
Superintendent, Shafter Mining Co.*
- Schumann, Enrique A.....
- Starbird, H. B.....*Victor, Calif.  
Lessee, Rose Mine.*
- Warnecke, Carl M.....*Sherman, Cal.  
Chief Electrician, Los Angeles-Pac. Railway Co.*
- Weed, Floyd.....*Kimberly, Utah  
Care Annie Laurie Mine.*
- Woods, Thos. H.....*Ouray, Colo.  
Superintendent, Camp Bird Mill.*

## 1898.

- Barbour, Percy P.....*Idaho Springs, Colo.  
Surveyor of Stephens & Barbour.*
- Bertschy, Perry H.....*Gilt Edge, Mont.  
Chemist, Great Northern M. & D. Co.*
- Blumenthal, Emil E.....*Philipsburg, Mont.  
Chemist, with the Grant Bi-metallic Cons. Mining Co.*
- Caldwell, Florence H.....*Denver, Colo.*
- Church, Myron J.....*Ojuela, Mapimi, Durango, Mexico*
- Clark, Winfred N.....*Victor, Colo.  
Electrical Engineer, with Pike's Peak Power Co.*
- Corry, Arthur V.....*Butte, Mont.  
Manager, Mont d' Or Mine.*

- Davey, Wm. R.....*Lake City, Colo.*  
*Assayer.*
- Dollison, Jas. E.....*Alma, Colo.*  
*Assayer.*
- Hamilton, Frank R.....*Ouray, Colo.*  
*Assayer with "Camp Bird" Mine.*
- Harrington, Orville.....*1650 Grant Ave., Denver, Colo.*
- Ingols, J. August.....*Idaho Springs, Colo.*  
*Surveyor.*
- Johnson, Fred.....*Torreón, Coahuila, Mexico*  
*Chemist, Campania Metallurgica de Torreón, S. A.*
- Jones, Frank H.....*Denver, Colo.*  
*Surveyor C. F. & I. Co.*
- Kraemer, Edw. L.....*Shanghai, China*  
*Care H. Mandl & Co.*
- Lampe, Oscar A.....*Parral, Mexico*  
*Assayer.*
- Lucy, Richard W.....*Room 5 Union Depot, Pueblo, Colo.*  
*Surveyor with D. & R. G. Railway.*
- Magenau, Wm.....*Frederickstown, Mo.*  
*Superintendent, Catherine Lead Co.*
- Norman, Jno. Edw.....*302 Mining Exchange Bldg., Denver, Colo.*  
*Mining Engineer.*
- Rodriguez, J. Crisostomo.....*Saltillo, Mexico*  
*Mining Superintendent.*
- Smith, Harry C.....*1046 Corona St., Denver, Colo.*
- Stephens, Chas. N.....*Denver, Colo.*  
*Draftsman for Colorado Telephone Co.*
- Valentine, Malvern R.....*Victor, Colo.*  
*Manager of the Taylor & Brunton Sampler.*
- Whitaker, Orvil R.....*San Juancito, Honduras*  
*Superintendent, New York & Honduras Rosario Mining Co.*

1899.

- Adami, Chas. J.....*Box 612 Butte, Mont.*  
*Engineer for the Anaconda G. M. Co.*

- Bruce, Stuart S.....Leadville, Colo.  
*With the Arkansas Valley Smelter.*
- Cramer, Curtis P.....Tierro, New Mexico  
*Assayer for Gilchrist & Dawson Co.*
- Davis, Gilbert L.....Room 7 Evans Blk., Denver, Colo.  
*Assistant Engineer with Denver Tramway Co.*
- Grant, Lester S.....214 W. Eaton Ave., Cripple Creek, Colo.  
*With the Isabella Gold Mining Co.*
- Hodgson, Arthur.....Denver, Colo.  
*Assayer for the Denver Mint.*
- Johnson, Gilbert.....Kennett, Cal.  
*Engineer with the Trinity Copper Co.*
- Kelley, Fred G.....Black Hawk, Colo.  
*Surveyor of the Cook Mining Co.*
- Muir, David.....Kennett, Cal.  
*Engineer with the Trinity Copper Co.*
- Rising, Arthur F.....79 Water St., Perthamboy, N. J.  
*Chemist for the Delamar Copper works.*
- Royer, Frank W.....4003 W. 35th Ave., Denver, Colo.  
*Mining Engineer.*
- Smith, Thos. G.....Denver, Colo.  
*Assistant Supt., Grant Plant American Sm. & Ref. Co.*
- Steinhauer, Fred C.....Tabasco, Colo.  
*Superintendent of the Tabasco Mine of the C. F. & I. Co.*
- Thompson, Jas. S.....Sopris, Colo.  
*Superintendent of the C. F. & I. Co. Mines.*
- Townsend, Arthur R.....117 East 57th St., New York City  
*Mining Engineer.*
- Tyler, Sydney B.....Panueo de Coronado, Durango, Mexico  
*Surveyor with the San Luis Mining Co.*
- Waltman, Will D. ....214 E. Kiowa St., Colorado Springs, Colo.  
*Assistant City Engineer.*
- Weiss, Andrew.....Golden, Colo.  
*Ass't Prof. in Mathematics and Surveying in the Colo. S. of M.*
- Williams, Wakely A.....Grand Forks, British Columbia  
*Assistant Superintendent, Granby Cons. M. & Sml. Co.*

1900.

- Adams, Wilber E. . . . . 36 *Adams Block, Lewiston, Idaho  
Mining Engineer.*
- Benwell, Geo. A. . . . . 205 *Century Bldg., Denver, Colo.  
Mining Engineer.*
- Bruce, Harry F. . . . . *Thunder Mountain, Idaho*
- Crowe, Thos. B. . . . . *Cripple Creek, Colo.  
Assistant Manager, Gold Exploration Co.*
- Drescher, Frank M. . . . . *Clifton, Ariz.  
With the Valverd Copper Mine.*
- Evans, Henry R. . . . . *Reno, Nevada  
U. S. Government Survey.*
- Ewing, Chas. R. . . . . *Atlanta, Idaho  
With the Atlanta Mines.*
- Giddings, Donald S. . . . . *Morenci, Ariz.  
Assistant Surveyor with the Detroit Copper Mining Co.*
- Harrington, Daniel. . . . . *Sunnyside, Utah  
With the Pleasant Valley Coal Co.*
- Jones, Edward B. . . . . *Box 1332, Denver, Colo.  
Mining Engineer.*
- Jones, Fred. . . . . *Box 818, Cripple Creek, Colo.  
Engineer, Stratton Consolidated Mines.*
- Lemke, Carl. . . . . *Silverton, Colo.  
With the "Grand Mogul" Mine.*
- Malmstrom, Clarence C. . . . . *400 Main St., Cripple Creek, Colo.  
Assayer for Stratton's Mines.*
- Moynahan, Ambrose E. . . . . *Alma, Colo.*
- Nicolson, Geo. W. . . . . *Box 304, Silverton, Colo.  
With the "Contention" Mining Co.*
- Pendery, John M. . . . . *Leadville, Colo.*
- Platt, Edwin H. . . . . *Denver, Colo.  
Denver Engineering Works.*
- Price, Lyttleton, Jr. . . . . *Boise, Idaho  
In Surveyor General's Office.*

- Prout, Jno.....*Frederickstown, St. Francis Co., Missouri*  
*With Columbia Lead Co.*
- Robey, Lloyd.....*Telluride, Colo.*  
*With the "Liberty Bell" Mine.*
- Rudd, Arthur H.... .*522 Mining Exchange Bldg., Denver, Colo.*  
*Surveyor.*
- Slater, Amos.....*408 Boston Bldg., Denver, Colo.*  
*Assistant Geologist with the C. F. & I. Co.*
- \*Smith, Claude H.....
- Steele, Jas. H.....*Denver, Colo.*  
*Instructor in Mathematics and Drafting in the M. T. H. S.*
- Taylor, Henry Picotte.....*Tuscarora, Nevada*  
*General Manager of the Leonard Taylor Mining Co.*
- Utley, Howard Harris.....*415 W. Jefferson St., Louisville, Ky.*  
*Engineer with the North Jellieo Coal Co., Taylor Coal Co. and*  
*Williams Coal Co.*

## 1901.

- Atwater, Maxwell W.....*Box 573, Telluride, Colo.*  
*With the "Liberty Bell" Gold Mining Co.*
- \*Bishop, Raymond.....
- Bowman, Frank C.....*Central City, Colo.*  
*With Cyclops Assay Office.*
- Bradley, Joseph M.....*Box 778, Florence, Colo.*
- Breed, Chas. Francis.....*817 Boston Bldg., Denver, Colo.*  
*With the C. F. & I. Co.*
- Brinker, Arthur C.....*1736 Lawrence St., Denver, Colo.*  
*With E. E. Burlingame, Assayer.*
- Bruce, Jas. L.....*Cripple Creek, Colo.*  
*Surveyor with Hills & Willis.*
- Bumsted, Edward L.....*Box 336, Guayaquil, Equador*  
*With the South America Development Co.*
- Burlingame, Walter E.....*1736 Lawrence St., Denver, Colo.*  
*Chemist and Assayer with E. E. Burlingame & Co.*
- Chandler, John Winthrop, Jr.....*122 Twelfth St., Oakland, Cal.*

\*Deceased.

- Clark, George B. . . . . 573 S. Washington Ave., Denver, Colo.  
*Engineer.*
- Collins, Shrive B. . . . . Box 94, Amethyst P. O., Creede, Colo.
- \*Crow, Wade L. . . . .
- DeCou, Ralph E. . . . . Table Mountain, Mammoth P. O., Ariz.  
*With the Table Mountain Copper Co.*
- Downer, Roger H. . . . . *Engineer.*  
*Care of A. Chester Beatty, 523 McPhee Bldg., Denver, Colo.*
- Ehle, Mark, Jr. . . . . Rapid City, S. Dak.  
*Professor of Engineering in the S. Dakota School of Mines.*
- Frank, Harry L. . . . . Dedrick, Trinity Co., Cal.  
*Engineer, Trinity Co. Gold Mining Co.*
- Harris, Willard F. . . . . Ouray, Colo.  
*With the "Camp Bird" Mine.*
- Jackson, Walter H. . . . . San Juancito, Honduras  
*Engineer, New York & Honduras Rosario Mining Co.*
- Johnson, Junius W. . . . . 1038 Penn. Ave., Denver, Colo.  
*Surveyor for Denver & Northwestern Railway.*
- Lewis, Frank E. . . . . 1224 Stout St., Denver, Colo.  
*Surveyor with the Colorado Telephone Co.*
- Lovering, Ira G. . . . . Jamestown, Colo.  
*Assayer with the Longfellow Mine.*
- Lucy, Frank Allen. . . . . Idaho Springs, Colo.
- McDaniel, Alexander K. . . . . Butte, Mont.  
*Engineer for Boston & Montana Cons. C. & S. Mining Co.*
- Marrs, George Oliver. . . . . Golden, Colo.  
*Assistant Superintendent, Carpenter Smelter.*
- May, John G. . . . . Velardina, Durango, Mexico  
*With the Velardina Mining & Smelting Co.*
- Millard, Frank W. . . . . Box 595, Telluride, Colo.  
*Engineer with the "Ella" Gold Mining Co.*
- Parrish, Karl C. . . . . Tuolumne, Cal.  
*Superintendent, New Era Mining Co.*
- Pray, Winfred A. . . . . Georgetown, Colo.  
*Surveyor with F. A. Maxwell, U. S. Deputy Mineral Surveyor.*

\*Deceased.

- Sale, Andrew J.....2312 Marion St., Denver, Colo.
- Scheble, Max C.....Rock Springs, Wyo.  
*Surveyor with the Union Pacific Coal Co.*
- Simpson, William P.....Monterrey, Mexico  
*Head Assayer with "Montercy Plant" A. S. & R. Co.*
- Small, Harvey B.....Ojucla, State of Durango, Mexico  
*Engineer with the Compania Minera de Penoles.*
- Starbird, Edwin P.....Victor, California  
*Superintcndent of Rose Mine and Mill.*
- Street, Gerald B... ..56 W. Fourth So. St., Salt Lake, Utah  
*With the Samuel Newhouse Co.*
- Watson, Hugh C.....San Juancito, Honduras  
*Engineer, New York & Honduras Rosario Mining Co.*
- Williams, Fred Tuttle.....Victor, Colo.  
*Surveyor with Portland G. M. Co.*

## 1902.

- Anderson, Neil A.....Union, Idaho
- Badger, Herbert E.....Greeley, Colo.
- Barron, Chauncey T.....El Paso, Texas
- Bergh, John Evans.....Bingham, Utah  
*Carc Dalton & Lark.*
- Bucher, John William.....Ely, White Pine Co. Nevada  
*Chemist and Surveyor with New York & Nevada Copper Co.*
- Butler, G. Montague.....Box 448, Idaho Springs, Colo.  
*Engineer with "Big 40" Tunnel Co.*
- Charles, Lavern J.....Montrose, Colo.  
*With the U. S. Geological Survey of the Gunnison Tunnel.*
- Christensen, Walter.....Mercur, Utah  
*With the Mercur Cons. Mining Co.*
- Collbran, Arthur Harry.....Seoul, Korea
- Cox, W. Ray.....Denver, Colo.  
*Draftsman with Denver Tramway Co., Evans Blk., Denver, Colo.*
- Ehrich, Walter L.....320 Sansome St., San Francisco, Cal.  
*Mining Engineer.*

- Ellis, William Witty.....*Victor, Colo.*  
*Assayer with Taylor & Brunton Sampler.*
- Estes, Frank M., Jr.....*Kelner, Boone Co., Ark.*  
*Draughtsman with the Missouri Pacific Railroad.*
- Ickis, Harry M.....*Creston, Iowa*
- Lehmer, Frank Welton.....*1160 Sherman Ave., Denver, Colo.*  
*Engineer, National Development Co.*
- Montrose, James Fay.....*Lead, S. Dak.*  
*Assayer with "Hidden Fortune."*
- Moss, Cleveland Osgood.....*Box 1832, Denver, Colo.*  
*With the Utah Fuel Co.*
- Paul, Russell B.....*Box 596, Denver, Colo.*  
*Surveyor in Idaho Springs, Colo.*
- Powers, Oliver.....*Telluride, Colo.*  
*With the "Telluride Power Transmission Co."*
- Reno, Horace Thornton.....*Arvada, Colo.*
- Richards, John V.....*1725 First Ave., Spokane, Wash.*  
*With Standard Mining Co., Mace, Idaho.*
- Rowe, Charles Elmer.....  
*Mining and Civil Engineer for Victor Fuel Co., Hastings, Colo.*
- Storm, Lynn W.....*Salt Lake City*  
*Engineer National Development Co.*
- Watts, Alfred C.....*817 Boston Bldg., Denver, Colo.*  
*With the C. F. & I. Co.*

## ALUMNI.

The record of the graduates, as a body, is perhaps the most gratifying feature in the history of the Colorado School of Mines. Numbering at present over two hundred, and occupying, as most of them do, positions demanding skill and responsibility, they form the best evidence that the institution has its place among technical schools of the first rank.



THE ALUMNI ASSOCIATION.

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The Association of the Alumni of the Colorado School of Mines was organized by the class of 1895, and the first banquet held at the Windsor Hotel in Denver on June 7th, 1895.

The association holds its annual reunion and banquet on the day following the commencement exercises, unless otherwise provided by the Executive Committee.

The graduates of the school are cordially urged to join the association and attend the reunions when possible. It is worth considerable to you and to the school to keep in close touch and to cultivate and maintain the feeling of loyalty which should always exist between the graduate and his old school. In this connection it is well to remind every Alumnus to keep the secretary of the association informed in regard to his address and occupation.

The aim of the Alumni Association is to promote acquaintance and friendship among the graduates, to encourage them to aid each other, and to make an organized effort to elevate and uphold the reputation and standard of the Alma Mater.

The presidents of the Association in order, have been Wm. B. Middleton '83, W. B. Milliken '93, E. E. Rowe '95, C. W. Comstock '90, and Edward P. Arthur, Jr., '95.

## OFFICERS OF THE ASSOCIATION

For the Year Ending June 1st, 1903:

PRESIDENT—Arthur R. Hodgson '99.

VICE-PRESIDENT—Frederick S. Titsworth '95.

SECRETARY—Robert S. Stockton '95.

TREASURER—Wm. J. Hazard '97.

EXECUTIVE COMMITTEE.....	{	M. D. Draper '97.
		Chas. J. Adami '99.
		Robert Nye '97

## STANDING COMMITTEES.

COMMITTEE ON ATHLETICS...	{	James S. Thompson '99.	
		Amos Slater '00.	
		A. H. Roller '97	
		O. R. Whitaker '98.	
COMMITTEE ON INSTRUCTION	{	H. A. Canning '97.	
		Edward P. Arthur, Jr., '95	
		Thos. G. Smith, '99.	
		Edward E. Rowe '95.	
COMMITTEE ON NOMINATIONS	{	J. E. Dwelle '96.	
		Lyttleton Price '00.	
		Andrew Weiss '99.	
		Henry C. Beeler, 96.	
		{	J. N. McLeod '97.
		{	E. H. Platt '00.
		{	M. C. Scheble '01.

APPENDIX.  

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## LECTURES.

In certain lines, there are given to the older classes extra lectures on special subjects.

**Law.** The lectures on the relation of law to mining are given by some prominent member of the bar, and cover many of the main points of mining and corporation practice.

**Mining, Milling and Metallurgy.** Several lectures (sampling), have been given by Mr. Henry Vezin (recently deceased). Others on crushing, cyaniding, etc., have been secured from the well known mining and metallurgical expert, Mr. Philip Argall. These lectures add greatly to the course, not only in interest, but also in practical value, coming as they do in a timely way from those who are actively engaged in the profession.

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