CATALOGUE

1904-05

1903-1904 was not issued.

CATALOGUE

1904-05

EXHIBIT OF THE COLORADO SCHOOL OF MINES,
ASSAYING AND METALLURGICAL LABORATORY, METAL PAVILION,
LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO

ANNUAL CATALOGUE

OF THE

COLORADO SCHOOL OF MINES.

GOLDEN, COLORADO.

1904-1905.

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COLLEGE CALENDAR.

1904.

August	31	Wednesday	Second Examinations for Entrance to the Class of 1908, and Re-examination of Matriculated Students.
September	1	Thursday	
September	2	Friday	
September	6	Tuesday	Opening of the First Semester of the Academic Year, 1904-5.
November	24	Thursday	Thanksgiving Recess.
November	25	Friday	
December	22	Thursday	Christmas Recess Begins.

1905.

January	3	Tuesday	Christmas Recess Ends.
January	20	Friday	First Semester Ends.
January	23	Monday	Second Semester Begins.
February	22	Wednesday	Washington's Birthday. (A holiday.)
May	26	Friday	Second Semester Ends. Commencement Exercises.
May	29	Monday	Field Surveying Begins.
May	29	Monday	First Examinations for Entrance to Class of 1909.
May	30	Tuesday	
May	31	Wednesday	
June	23	Friday	Field Surveying Ends.
August	30	Wednesday	Second Examinations for Entrance to the Class of 1909, and Re-examination of Matriculated Students.
August	31	Thursday	
September	1	Friday	
September	5	Tuesday	Opening of the First Semester of the Academic Year 1905-06.

BOARD OF TRUSTEES.

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JOHN P. KELLY, Ph. G., M. D., Golden, Colo.
Term expires, 1907.

Secretary,

JAMES T. SMITH, Denver, Colo.
Term expires, 1905.

OTTO F. THUM, Denver, Colo.
Term expires, 1905.

JAMES J. CONE, Canon City, Colo.
Term expires, 1907.

JOSEPH S. JAFFA, LL. B., Denver, Colo.
Term expires, 1907.

Treasurer,

JESSE W. RUBEY, Woods-Rubey National Bank, Golden, Colo.

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

FACULTY.

VICTOR CLIFTON ALDERSON, Sc. D.,
President.

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Professor Emeritus of Mathematics.

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

ARTHUR RANSLEY CURTIS, B. S.,
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Professor of Mechanics.

HERMAN FLECK, Nat. Sc. D.,
Professor of Chemistry.

FRANK WEISS TRAPHAGEN, Ph. D., F. C. S.,
Professor of Metallurgy.

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Professor of Mining.

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Professor of Mathematics.

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Assistant Professor of Electrical Engineering.

EDSON RAY WOLCOTT, B. S.,
Assistant Professor of Physics.

CHARLES DARWIN TEST, B. M. E., A. C.,
Instructor in Analytical Chemistry (absent on leave).

WILLIAM GEORGE HALDANE, B. S.,
Instructor in Metallurgy.

JULIUS WOOSTER EGGLESTON, A. M., S. B.,
Instructor in Geology and Mineralogy.

JOHN CHRISTIAN BAILAR, B. S.,
Instructor in Qualitative Analysis.

GURDON MONTAGUE BUTLER, E. M.,
Instructor in Geology and Mineralogy.

JOHN JOSEPH BROWNE, B. A.,
Instructor in Mathematics.

WILLIAM FRANKLIN ALLISON, B. S., C. E.,
Instructor in Surveying.

STEVE HOWARD WORRELL, B. S.,
Instructor in Quantitative Analysis.

GYULA BENNETT MANSON, S. B.,
Instructor in Descriptive Geometry and Drawing.

T. C. DOOLITTLE,
Registrar.

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

AGNES ESTELLE PRESNELL,
Secretary to the President.

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Professors Burger, Wolcott, and Mr. Bailar.

Catalogue,
Professor Fleck, Mr. Eggleston, and Mr. Browne.

Buildings and Grounds,
Professors Curtis, Patton, and Mr. Allison.

Library,
Professors Young, Curtis, and Miss Shrum.

Athletics,
Professors Patton, Fleck, and Mr. Haldane.

Theses,
Professors Traphagen, Filkins, and Young.

Bulletin,
Professor Filkins and Mr. Butler.

Student Societies,
Professors Hazard, Young, and Mr. Eggleston.

The President is *ex officio* a member of all committees.

SPECIAL LECTURERS.

DR CHARLES R. VAN HISE, Ph. D., LL. D., Madison, Wis.,
President of the University of Wisconsin,
The Qualities that make Seniors.

GEN. O. O. HOWARD, U. S. A. (Retired), Burlington, Vt.,
Character.

DR. JAMES REID, A. M., D. D., Bozeman, Mont.,
President of the Montana State College,
The Mistakes of a Freshman.

MR. C. J. MOORE, Denver, Colo.,
Mining Engineer,
Geology Applied to Mining.

PROF. JOHN D. FLEMING, B. A., LL. B., Boulder, Colo.,
Dean of the Law School, University of Colorado,
Mining Law.

PROF. E. S. PARSONS, A. M., B. D., Litt. D., Colorado Springs, Colo.,
Colorado College,
Starting Aright.

MR. JOHN T. PLUMMER, Denver, Colo.,
Proprietor of the Truax Manufacturing Co.,
Industrial Cars.

MR. ARTHUR LAKES, Denver, Colo.,
Associate Editor of Mines and Minerals,
The Colorado Coal Deposits (Illustrated.)

MR. E. BARTON HACK, E. M., Denver, Colo.,
Mining Engineer,
The Calgoorie and Coolgardie Gold Fields of West Australia.

MR. C. O. POOLE, E. E., Denver, Colo.,
Electrical Engineer for Hendrie and Bolthoff,
The High Tension Transmission Lines of California (Illustrated).

MR. W. G. SWART, Denver, Colo.,
The Blake Electrical Separator.

MR. JAMES UNDERHILL, E. M., Idaho Springs, Colo.,
The General Land Office and Patent Surveys.

HISTORY, ORGANIZATION, FINANCIAL SUPPORT, AND LOCATION.

HISTORY.

The Colorado School of Mines was established by an act of the Territorial Legislature, approved February 9, 1874. After an unsatisfactory experience in temporary quarters the School was permanently housed in the original "building of 1880," upon land given by the citizens of Golden. Since then the School has enjoyed a strong and steady growth in buildings, in equipment, in students, in Faculty, and in the strength and rigor of its courses. Additions were made to the original building of 1880, by the building of 1882, and by the building of 1890. Engineering Hall was erected in 1894, the Stratton Assaying Laboratory in 1900, and the new hall for Mining and Metallurgy, called Stratton Hall, was completed in 1904.

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. They also appoint a Secretary and Treasurer either from their own number, or from other suitable persons as they may deem best. Any three of said Board of Trustees 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 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.

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 by the Colorado and Southern Railroad from the Union Station at the foot of Seventeenth Street, by the Denver and Intermountain Railway, from the Arapahoe Street Station, between Fourteenth and Fifteenth Streets, or by the Denver and Northwestern Railway, from the Loop on Sixteenth Street, between Arapahoe and Lawrence Streets, Denver.

Golden has about three thousand inhabitants and is one of the oldest cities in Colorado. When the Colorado School of Mines was located there 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 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 weekly newspapers, several elevators, a smelter, brick works and other lines of business, 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 altitude of Golden is five thou-

sand 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 regarded 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 Colorado School of Mines is peculiarly well located to give students both a theoretical and practical training. The equipment of the school enables the theoretical side to be well presented. The nearness to mines, mills, and smelters offers unusual opportunities for inspection visits, and enables the student to see in actual operation every variety of mining and metallurgical work. The Independent Pyritic Smelter is located at Golden. In the Clear Creek canon are the numerous gold mills and concentrators of Gilpin and Clear Creek counties. At Argo, near Denver, the Boston and Colorado Smelting Company illustrates the metallurgy of gold, silver, and copper ores. At the Globe plant of the American Smelting and Refining Company the treatment of lead ores and dry ores of gold and silver is illustrated by up-to-date methods. At Denver also are the Colorado Zinc Works, using the most modern methods of magnetic and electric separation, and in addition there are numerous sampling and ore testing works. The many mining and metallurgical machinery plants of Denver also afford an excellent opportunity for becoming acquainted with recent improvements in metallurgical design. At Colorado City are the Portland, Standard, and Telluride mills for the chlorination treatment of gold ores; at Cripple Creek, the Cripple Creek and Homestake mills; and at Florence, the Union and Dorcas mills. The plant of the Colorado Fuel and Iron Company at Pueblo possesses all the recently invented and approved devices for the production of iron and steel and for working these products into marketable forms. At Pueblo there are also three lead smelters, the Pueblo, Eilers and Philadelphia, and the Zinc Smelter of the Colorado Zinc Company. At Canon City are the plants of the Empire

Zinc Company and of the United States Reduction and Refining Company, and at Leadville, the Arkansas Valley Smelter. The Black Hills, where good practice in gold milling and cyanidation is to be found, and the great copper smelters of Montana, are also visited in longer trips.

At or near Golden are numerous clay mines and quarries and extensive coal mines well equipped with hoisting and power machinery. In the Clear Creek canon, within a short ride of Golden, are the mining camps of Central City, Black Hawk, Idaho Springs and Georgetown, and placer mining at Breckenridge. The well-known mining camps of Cripple Creek, Victor, Leadville and Aspen, as well as the San Juan region, including Silverton, Ouray and Telluride, are also easily reached by train from Denver. Besides these there are also available the bituminous mines of the Northern Coal Fields, the anthracite fields of Glenwood Springs, the oil fields of Florence, the iron mines of Wyoming, and the copper regions of Arizona and Montana.

No other mining school in the country has within easy access such a wide variety of mining properties, or such excellent opportunities for observing the latest and best smelting operations.

REQUIREMENTS FOR ADMISSION.

FRESHMAN CLASS.

The following requirements for admission to the Freshman Class of the Colorado School of Mines are in harmony with the Report of the Commission of the North Central Association of Colleges and Secondary Schools, adopted March 28, 1902, and are in harmony with the recommendation of the University and High School Conference held at Boulder, Colorado, December 12, 1903. They are also in harmony with the Report of the Committee of the American Mathematical Society on Definitions of College Entrance Requirements in Mathematics, appointed at the summer meeting of the American Mathematical Society, September, 1902.

REQUIREMENTS FOR THE FRESHMAN CLASS.

Unit Course. A unit course of study is defined as a course covering a school year of not less than thirty-five weeks, with four or five (preferably five) periods of at least forty-five minutes each per week.

Sixteen Units are demanded for entrance, of which twelve are required, and four may be chosen from a list of electives.

REQUIRED UNITS.

Algebra	1½	units
Plane Geometry	1	unit
Solid Geometry	½	unit
Languages, other than English	2	units
English	3	units
History	2	units
Physics	1	unit
Chemistry	1	unit
Required Units	12	
Elective Units	4	
Total Units for Entrance	16	

ELECTIVE UNITS.

The four elective units may be selected from the following list: Drawing, 1; Shop Work, 1; Mathematics, ½ or 1; Greek, 1, 2 or 3; French, 1, 2 or 3; German, 1, 2 or 3; Spanish, 1 or 2; History, 1 or 2; English, 1; Science, 1 or 2; Psychology, ½ or 1; Political Economy, ½ or 1.

In allowing credit for drawing and shop work two forty-five-minute periods will be regarded as equivalent to one forty-five-minute period of classroom work. Half units are accepted in all studies, except in physics and chemistry, provided that not less than one full unit shall be accepted in language.

METHODS OF ENTRANCE.

(a) By Certificate.

Graduates of Accredited High Schools in the State of Colorado will be admitted without examination upon the presentation of proper credentials from the Principal of their High School, provided that the studies they have successfully completed cover the requirements for admission. Blanks for this purpose will be sent on application to the President.

Graduates of Accredited High Schools in other States will be accepted in the same manner as graduates of Accredited High Schools in Colorado.

(b) By Examination.

All other candidates for admission will be required to pass entrance examinations in the specified subjects. These examinations are held in Golden.

For the benefit of students who cannot, on account of the distance, conveniently take the examination at Golden, arrangements will be made so that they may take the examinations under the direction of some responsible person at or near their own homes.

Entrance examinations for the class of 1909 will be held in Golden on Wednesday, Thursday and Friday, August 30 and 31, and September 1, 1905.

It is the opinion of the Faculty of the Colorado School of Mines that every candidate for the Freshman class should have taken a thorough course of at least four years in a good High School or in a Manual Training School, or should have

received an education equivalent to one of these. The work of the school is so exacting that students who are not well prepared cannot expect to succeed after entrance; consequently, students who are deficient in any study are not admitted.

DESCRIPTION OF THE UNITS REQUIRED FOR ENTRANCE.

ENGLISH (3 UNITS).

(a) GRAMMAR. The student should have a sufficient knowledge of English grammar to enable him to point out the syntactical structure of any sentence which he encounters in the prescribed reading. He should also be able to state intelligently the leading grammatical principles when he is called upon to do so.

(b) READING. The books prescribed by the Joint Committee on Uniform Entrance Requirements in English form the basis for this part of the work.

The list is divided into two parts, the first consisting of books to be read with attention to their contents rather than to their form, the second consisting of books to be studied thoroughly and minutely. The lists, thus divided, are as follows:

I. Books prescribed for reading.

For 1905: Shakespeare's *The Merchant of Venice* and *Julius Caesar; The Sir Rodger De Coverley Papers* in the Spectator; Goldsmith's *The Vicar of Wakefield;* Coleridge's *The Ancient Mariner;* Scott's *Ivanhoe;* Carlyle's *Essay on Burns;* Tennyson's *The Princess;* Lowell's *The Vision of Sir Launfal;* George Eliot's *Silas Marner.*

For 1906, 1907 and 1908: Shakespeare's *The Merchant of Venice* and *Macbeth; The Sir Rodger De Coverley Papers* in The Spectator; Irving's *Life of Goldsmith;* Coleridge's *The Ancient Mariner;* Scott's *Ivanhoe* and *The Lady of the Lake;* Tennyson's *Gareth and Lynette, Lancelot and Elaine,* and *The Passing of Arthur;* Lowell's *The Vision of Sir Launfal;* George Eliot's *Silas Marner.*

II. Books prescribed for study and practice.

For 1905: 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.*

For 1906, 1907 and 1908: Shakespeare's *Julius Caesar;* Milton's *Lycidas, Comus, L'Allegro and Il Penseroso;* Burke's Speech on *Conciliation with America;* Macaulay's *Essays on Addison and Life of Johnson.*

(c) Composition. Regular and persistent training in both written and oral composition should be given throughout the entire school course. The topics should be so chosen as to give practice in the four leading types of prose discourse, namely, description, narration, exposition and argument.

(d) Rhetoric. It is expected that the student will be familiar with the essential principles of rhetoric. The instruction in this subject should include the following particulars: choice of words, structure of sentences and paragraphs, the principles of narration, description, exposition and argument. The teacher should distinguish between those parts of rhetorical theory which are retained in text books merely through the influence of tradition and those which have direct bearing upon the composition work. The former may be safely omitted.

HISTORY (2 Units).

Any two of the following may be offered:

I. Ancient History, with special reference to Greek and Roman History, including also a short introductory study of the more ancient nations and the chief events of the early middle ages, down to the death of Charlemagne (814).

II. Mediaeval and Modern European History, from the death of Charlemagne to the present time.

III. English History.

IV. American History, or American History and Civil Government.

PHYSICS (1 Unit).

Physics. The equivalent of Carhart and Chute's *High School Physics,* or Gage's *Principles of Physics,* including systematic laboratory practice such, for example, as is outlined in Crew and Tatnall's *Laboratory Manual in Physics.*

CHEMISTRY (1 Unit).

General Chemistry. The equivalent of Bradbury's *Elementary Chemistry* or Remsen's *Briefer Course in Inorganic Chemistry.*

MATHEMATICS (3 UNITS).

I. ALGEBRA. (1½ Units.) The four fundamental operations for rational algebraic expressions; factoring, highest common factor; lowest common multiple; complex fractions; the solution of equations of the first degree containing one or more unknown quantities; radicals, including the extraction of the square root of polynomials and numbers; fractional and negative exponents; quadratic equations and equations containing one or more unknown quantities that can be solved by the methods of quadratic equations; problems depending upon such equations; a review of the essentials should be followed by ratio and proportion, and the binominal theorem for positive integral exponents; the progressions; the elementary treatment of permutations and combinations; the use of four and five place tables of logarithms.

II. PLANE GEOMETRY. (1 Unit.) Completed, including the solution of original exercises and numerical problems.

III. SOLID GEOMETRY. (½ Unit.) Properties of straight lines and planes; of dihedral and polyhedral angles; of projections; of polyhedrons, including prisms; of pyramids and the regular solids; of cylinders, cones and spheres; of spherical triangles, and the measurement of surfaces and solids.

The two units required in languages other than English may be offered in Greek, Latin, French, German or Spanish.

ADMISSION TO ADVANCED STANDING.

GRADUATE STUDENTS. Applicants who are graduates of colleges or technical schools of good standing will be admitted upon the presentation of proper credentials and will be permitted to take any subject taught in connection with the regular courses. Each case will be judged on its own merits, but such applicants will be advised to become candidates for a degree and to complete the regular work of the college.

UNDERGRADUATE STUDENTS. Applicants who have partially completed the course in colleges or technical schools of good standing will be admitted on probation upon the presentation of proper credentials. Due credit will be allowed

for the successful completion of work which is equivalent to that given in the Colorado School of Mines. The Faculty reserves the right, however, to examine all such applicants irrespective of the credits brought from another institution. Plates of drawings, laboratory note books, and catalogues of the institution attended, should be submitted with applications for advanced standing. The college does not admit special students. All applicants for advanced standing are expected to enroll in one of the regular classes and to become candidates for a degree. Application blanks for advanced standing will be furnished on request to the President.

DEGREES.

The college offers two four-year courses—Mining Engineering and Metallurgical Engineering—leading up to the degrees of E. M. (Mining Engineer) and E. Met. (Metallurgical Engineer).

THESIS AND GRADUATION.

A thesis upon some suitable subject is a prerequisite to the completion of either course. Each senior shall submit to the Faculty, not later than November 1st, the subject of his thesis, which must be approved by the Professor concerned. Each thesis must be typewritten or printed on eight and one-half by eleven-inch paper, bound in book form and submitted not later than May 1st.

No diploma will be delivered until the thesis is handed in, the full requirements of the course of study are satisfied, and all accounts with the college are settled.

DEPARTMENTS OF INSTRUCTION.

TABULAR VIEW.

MINING ENGINEERING.

Freshman Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
College Algebra [p. 66]	5		Coördinate Geometry [p. 67]	5	
Trigonometry and Determinants [p. 67]	3		Elements of Analysis [p. 67]	3	
General Chemistry [p. 61]	5		General Chemistry [p. 61]	5	
Qualitative Analysis [p. 62]		9	Qualitative Analysis [p. 62]		6
Mechanical Drawing [p. 55]		6	Mechanical Drawing [p. 56]		9
Descriptive Geometry [p. 55]	2		Descriptive Geometry [p. 56]	2	
General Geology [p. 42]	3		Plane Surveying [p. 47]	2	
Geology: Field-Work [p. 43] Four Trips on Saturdays.			Geology: Field-Work [p. 43]. Four Trips on Saturdays		

Plane Surveying: Field-Work [p. 47]. Four weeks in the summer following the regular college year.

General Mining Trips, as follows: [p. 33]

1. Oldtown and Cook Mines, Central City.
2. Gem Mine and Newhouse Tunnel, Idaho Springs.
3. Colorado-Central or others at Georgetown.
4. Leyden Coal Mine.

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Continued.

Sophomore Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Differential and Integral Calculus [p. 68]	5		Integral Calculus [p. 68]	3	
General Physics: Mechanics, Heat, and Sound [p. 64]	4		Differential Equations [p. 69]	2	
Physical Laboratory [p. 65]		3	General Physics: Electricity, Magnetism, and Optics [p. 65]	4	
Quantitative Analysis: Gravimetric [p. 62]	1	9	Physical Laboratory [p. 65]		3
Technical Chemistry [p 63]	2		Quantitative Analysis: Volumetric [p. 62]	1	9
Crystallography and Blowpipe Analysis [p. 44]	2	6	Determinative Mineralogy [p. 45]	2	6
Mine Surveying [p. 29]	2		Mine Surveying [p. 29]	2	
			Technical Chemistry [p. 63]	2	

Mine Surveying: Field-Work [p. 30]. Four weeks in the summer following the regular college year.

Mining Trips, for the study of mining methods, as follows: [p. 34]

1. Cripple Creek and vicinity.
2. Northern Coal Fields.

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Continued.

Junior Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Advanced Geology [p. 43]..	4		Lithology [p. 45]	2	2
Metallurgy:Fuels,Refractory Materials, Iron and Steel [p. 35].....	4		Metallurgy: Lead [p. 36]..	4	
Mining [p. 30]	3		Mining [p. 30]	3	
Mechanics [p. 48]	5		Mechanics [p. 50].....	3	
Testing Laboratory [p. 48]..		3	Construction [p. 50]	2	3
Machine Design [p. 56].....	2		Machine Design [p. 57] ...	2	
Machine Design Drawing [p. 58].....		6	Machine Design Drawing [p. 58]		6
Assaying and Metallurgical Laboratory [p. 36]	1	9	Geology, Advanced Field-Work: Four full days [p. 43]		
Metallurgical Trips, as follows: [p. 40].....			Metallurgical Trips, as follows: [p. 40]		
1. Coking Plant			1. Smelting Plant for the study of furnace types		
2. By-product Plant and Gas Producers.....			2. Iron and Steel Works		
3. Refractory Materials ..			3. Lead Smelter.....		

Mining Trips, [p. 34]. Four during the year, to illustrate shaft sinking, tunneling, and construction work. Mining and Metallurgical Trips to the Black Hills and Montana, four weeks in the summer after the regular college year. [p. 41]

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Concluded.

Senior Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Economic Geology [p. 44]...	3		Economic Geology [p. 44].	3	
Ore Dressing and Metallurgy of Copper [p. 37]...	3		Metallurgy: Gold, Silver and Zinc [p. 39].....	3	
Ore Dressing Laboratory [p. 38].....		3	Metallurgical Practice [p. 40]		3
Structures [p. 51].....	2	6	Contracts and Specifications [p. 53]	2	
Hydraulics and Hydraulic Motors [p. 52].....	2		Steam Laboratory [p. 60].		3
Hydraulic and Cement Laboratories [pp. 51, 52]		3	Electric Power Transmission [p. 59].....	2	
Mining Machinery [p. 31]...	3		Electrical Laboratory [p. 60]		3
Mining [p. 31]	3		Mining Machinery [p. 32].	3	
Mine Examination and Reports [p. 31]	1	3	Mining [p. 32].....	2	3
Thesis			Mine Examination and Reports [p. 33]	2	3
Ore Dressing Trips, as follows: [p. 41]			Thesis		
1. Sampling Works.....			Metallurgical Trips, as follows: [p. 41]		
2. Concentrating Plants..			1. Copper Smelter.....		
3. Magnetic and Electric Separating Plants ...			2. Gold Milling Plant ..		
			3. Cyanide and Chlorination Mills.....		
			4. Zinc Smelter.....		

Mining Trips during the year: One to Leadville, Aspen, and Breckenridge for special study in timbering, pumping, and hydraulic mining; other special trips for inspection and testing of power plants and mine machinery, and examination and sampling of mining properties. [p. 34]

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING.

Freshman Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
College Algebra [p. 66]. . . .	5		Coördinate Geometry [p. 67]	5	
Trigonometry and Determinants [p. 67].	3		Elements of Analysis [p. 67]	3	
General Chemistry [p. 61]. .	5		General Chemistry [p. 61].	5	
Qualitative Analysis [p. 62].		9	Qualitative Analysis [p. 62]		6
Mechanical Drawing [p. 55].		6	Mechanical Drawing [p. 56]		9
Descriptive Geometry [p. 55].	2		Descriptive Geometry [p. 56]	2	
General Geology [p. 42]	3		Plane Surveying [p. 47]. . .	2	
			Geology: Field-Work [p. 43]. Four Trips on Saturdays		

Plane Surveying: Field-Work [p. 47]. Four weeks in the summer following the regular college year.

General Mining Trips, as follows: [p. 33]

1. Oldtown and Cook Mines, Central City.
2. Gem Mine and Newhouse Tunnel, Idaho Springs.
3. Colorado-Central or others, at Georgetown.
4. Leyden Coal Mine.

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Continued.

Sophomore Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Differential and Integral Calculus [p. 68]	5		Integral Calculus [p. 68]	3	
General Physics: Mechanics, Heat and Sound [p. 64]	4		Differential Equations [p. 69]	2	
Physical Laboratory [p. 65]		3	General Physics: Electricity, Magnetism and Optics [p. 65]	4	
Quantitative Analysis: Gravimetric [p. 62]	1	9	Physical Laboratory [p. 65]		3
Technical Chemistry [p. 63]	2		Quantitative Analysis: Volumetric [p. 62]	1	9
Crystallography and Blowpipe Analysis [p. 44]	2	6	Technical Chemistry [p. 63]	2	
Mine Surveying [p. 29]	2		Determinative Mineralogy [p. 45]	2	6
			Mine Surveying [p. 29]	2	

Mine Surveying: Field-Work [p. 30]. Four weeks in the summer following the regular college year.

Mining Trips, for the study of mining methods, as follows: [p. 34]

1. Cripple Creek and vicinity.
2. Northern Coal Fields.

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING – Continued.

Junior Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Advanced Geology [p. 43]..	4		Lithology [p. 45]	4	
Metallurgy: Fuels, Refractory Materials, Iron and Steel [p. 35].....	4		Metallurgy: Lead [p. 36]..	4	
Mining [p. 30]	3		Mining [p. 30].....	3	
Mechanics [p. 48]	5		Mechanics [p. 50].....	3	
Testing Laboratory [p. 48]..		3	Construction [p. 50]	2	3
Machine Design [p. 58].....	2		Assaying and Metallurgical Laboratory [p. 36]...	1	9
Machine Design Drawing [p. 59].....		3	Machine Design Drawing [p. 59]		3
Metallurgical Chemistry [p. 63].....		9	Geology, Advanced Field Work: Four full days [p. 43]		
Metallurgical Trips, as follows: [p. 40]			Metallurgical Trips, as follows: [p. 40]		
1. Coking Plant.....			1. Smelter Plant for the study of furnace types		
2. By-product Plant and Gas Producers.....			2. Iron and Steel Works		
3. Refractory Materials..			3. Lead Smelter.....		

Mining Trips [p. 34]. Four during the year to illustrate shaft sinking, tunneling, and construction work. Metallurgical and Mining Trips to the Black Hills and Montana, four weeks in the summer after the college year. [p. 41]

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Concluded.

Senior Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Economic Geology [p. 44]...	3		Economic Geology [p. 44].	3	
Ore Dressing and Metallurgy of Copper [p. 37]...	3		Metallurgy: Gold, Silver and Zinc [p. 39]	3	
Electro-Metallurgy [p. 38]..		3	Metallurgy: Aluminum, Nickel [p. 39].....	3	
Ore Dressing Laboratory [p. 38].....		3	Metallurgical Laboratory [p. 40]		3
Structures [p. 51].....	2	6	Metallurgical Practice [p. 40]		6
Hydraulics and Hydraulic Motors [p. 52]	2		Contracts and Specifications [p. 53]	2	
Hydraulic and Cement Laboratories [pp. 51, 52].....		3	Mining [p. 31].....	2	
Mining [p. 31]	3		Mine Examination and Reports [p. 33]	2	3
Mine Examination and Reports [p. 31]	1	3	Electric Power Transmission [p. 59].....	2	
Thesis			Electrical Laboratory [p. 60]		3
			Thesis.....		
Ore Dressing Trips, as follows: [p. 41]			Metallurgical Trips, as follows: [p. 41]		
1. Sampling Works			1. Copper Smelter		
2. Concentrating Plants..			2. Gold Milling Plant..		
3. Magnetic and Electric Separating Plants			3. Cyanide and Chlorination Mills.....		
			4. Zinc Smelter.....		

Mining Trips during the year: One to Leadville, Aspen and Breckenridge, for special study in timbering, pumping, and hydraulic mining; other special trips for inspection and testing of power plants and mine machinery, and examination and sampling of mining properties. [p. 34]

The courses are described on the pages indicated after each course.

MINING.

PROFESSOR LEWIS EMANUEL YOUNG.

The courses in this department are designed to instruct the student in the theory and practice of mineral claim and underground surveying; in the application of the sciences to the art of mining; in the principles and applications of the power machinery used in the mineral industry; in the best methods and practices of mining engineers and mine managers.

I. MINE SURVEYING.

This course includes instruction in the practices of underground surveying and the platting of the various maps and sections necessary to show the workings of a mine. The various methods of coal, copper, iron, and precious metal districts are discussed in detail. Special attention is given to the use of the auxiliary telescope and the calculations which its use necessitates. Other subjects emphasized are: surveying with the hand transit; the estimation of the tonnage in ore bodies; surveys for underground connections; the organization of the drafting room and office.

Prerequisite: The completed work of the Freshman year.

Text: Johnson, *Theory and Practice of Surveying.*

Two hours per week during the first semester of the Sophomore year.

(Young.)

II. MINE SURVEYING.

The methods used in locating and patenting mining claims, together with the most important divisions of the law relating to surveys, are taught in this course. Methods used in the United States receive especial attention, while the practice in Mexico, British Columbia, South Africa, and Australia is described in some detail.

Prerequisite: Course I.

Texts: Johnson, *Theory and Practice of Surveying*.
Morrison, *Mining Rights*.

Two hours per week during the second semester of the Sophomore year.

(Young.)

III. MINE SURVEYING. FIELD-WORK.

Each student is given personal instruction and practice in the survey of mines and mining claims. The squads are limited in size in order that each man may learn all the details of the work and appreciate the importance of every phase of the subject. Among the problems assigned are the following: the complete survey of a mining claim; the survey and mapping of a coal or clay mine; the survey and mapping of a metal mine; the complete survey and mapping of a property, including claims, buildings, and mine workings.

Prerequisites: Courses I. and II.

Four weeks in the summer following the regular work of the Sophomore year.

(Young.)

IV. MINING.

This course is preliminary to the lectures on mining methods, and includes excavating and breaking ground, prospecting, boring, tunneling, and shaft sinking. The various tools used in excavating, boring, and drilling, the use of explosives in breaking ground, the methods and tools of prospecting and the general and special methods of tunneling and shaft sinking are described in detail in the classroom.

Prerequisites: The completed work of the Sophomore year.

Texts: Gillette, *Earthwork and Its Cost*.
Ihlseng and Wilson, *A Manual of Mining*.

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

(Young.)

V. MINING.

A study of methods used in securing the various mineral products comprises the work of this course. The economical

systems developed in coal, copper, iron and low-grade gold and silver mines are studied in detail. The application of these systems to the various types of deposits is emphasized throughout the lectures.

Prerequisite: Course IV.

Text. Ihlseng and Wilson, *A Manual of Mining.*

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

(Young.)

VI. MINING.

In this course the following topics receive attention: systems of transporting the mineral product underground, of bringing it to the surface, of carrying it to the mills and railroads, and of draining and unwatering mines. The detailed study of the machinery necessary in these operations is included in Courses VII. and X.

Prerequisite: The completed work of the Junior year.

Text: Ihlseng and Wilson, *A Manual of Mining.*

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

(Young.)

VII. MINING MACHINERY.

This course includes a study of the steam engine and boiler, the steam turbine, the injector, and the steam engine indicator. Such types of engines as are used in mining operations are studied in detail. The lectures emphasize the economies possible in the application of power in mining.

Prerequisite: The completed work of the Junior year.

Texts: Hutton, *The Mechanical Engineering of Power Plants.*

Kent, *Mechanical Engineers' Pocketbook.*

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

(Young.)

VIII. MINE EXAMINATION AND REPORTS.

This course is given in order to prepare students for general field-work, the preparation of reports, and the examination of mining properties. The lectures comprise the presen-

tation and discussion of the different types of reports which a mining engineer may be called upon to make, the facts which should be included in such reports, and the form and style in which they should be written and illustrated. Each student studies and criticizes various reports preparatory to submitting any original work. Reports on prospects and machinery are then submitted by each student.

Prerequisite: The completed work of the Junior Year.

One lecture and one afternoon per week during the first semester of the Senior year.

(Young.)

IX. MINING.

This course is a continuation of Course VI., and includes lectures on mine ventilation, safety appliances in mines, mine laws and regulations, and mine management and accounts. Each of these topics is given such attention as its importance warrants. The gases present in coal and metalliferous mines, the economy of ventilating machinery at metal mines, accidents and their prevention, first aid to the injured, the regulations governing workmen and the use of machinery, are studied carefully. The general organization, design, and management of mining plants is presented in the drafting room, supplementing the lectures on the machinery in detail. Typical plants of precious metal, copper, iron, and coal mines are examined and studied in order to emphasize the varying requirements.

Prerequisites: Courses VI. and VII.

Text: Ihlseng and Wilson, *A Manual of Mining.*

Two hours per week and one afternoon during the second semester of the Senior year.

(Young.)

X. MINING MACHINERY.

The work of this course includes the application of machinery to mining operations, the possible economies and a detailed study of the most important machines used in mining. The following machines are studied: power drills, coal cutting machines, steam shovels, dredges, motors, hoists, pumps, mechanical ventilators, conveyors, and tramways.

Numerous catalogues are introduced to show the best types of machines.

Prerequisites: Courses VI. and VII.

Three hours per week during the second semester of the Senior year.

(Young.)

XI. MINE EXAMINATION AND REPORTS.

The lectures of this course discuss in detail the field methods of the best engineers in preparing the various reports outlined in Course VIII. The methods of sampling and estimating ore bodies are studied carefully, and each student is required to sample several properties and to make complete reports.

Prerequisite: The completed work of the first semester of the Senior year.

Two lectures and one afternoon per week during the second semester of the Senior year.

(Young.)

MINING TRIPS.

Throughout the four years the classes make many trips to mines in order to see the varying practice and the operations and machinery described in the class room. The trips are planned to illustrate definite operations, to develop the power of observation and the ability to report concisely such observations. Each new student is encouraged to make a study of some district and, whenever possible during his college course, to apply principles, methods, and criticisms to that district.

Freshman Year. During this year the following mines are visited: the Cook, or Oldtown Mines, at Central City; the Gem Mine and Newhouse Tunnel at Idaho Springs, and the Colorado Central Mine at Georgetown. These trips bring before the student methods of shaft sinking, tunneling, drifting and stoping, and illustrate practice in haulage, hoisting, and pumping. A general report, including

sketches of various assigned subjects, is required of each student.

Sophomore Year. The Cripple Creek District is visited in order to illustrate underground operations in general, and special methods of mining, timbering, and drainage. Numerous maps and models of mines emphasize topics discussed in the lectures on mine surveying. The class also visits in the Northern Coal Fields mines which illustrate methods of mining, ventilation, haulage, and timbering.

Junior Year. During the Junior year several trips are made in order to illustrate local practice in shaft sinking and tunneling and other important operations. After the regular college year an extended trip is made to South Dakota and Montana. Methods of mining and handling low-grade ore are well illustrated on this trip. The equipment of mine plants is studied carefully, and available data are collected by each student in order to furnish practical examples in the study of mine plants during the Senior year. Carefully prepared reports are required at the end of the trip.

Senior Year. The trips of the Senior year include, whenever possible, illustrations of mining operations, construction work, and power machinery. Leadville, Aspen, and Breckenridge are visited and furnish illustrations of timbering, pumping, and placer mining. The course in mine examination and reports requires each student to make several additional trips for the examination of properties.

METALLURGY.

Professor Frank Weiss Traphagen.
Instructor William George Haldane.
Instructor John Christian Bailar.

The aim of this department is to provide a foundation for practical work in metallurgy. In the lecture room attention is constantly directed to the principles involved in the treatment of ores, especially to chemical reaction and the in-

fluence of mass, temperature and other conditions upon these changes. In the laboratory, metallurgical operations are given a critical study, and all the resources of the chemical and of the assay laboratories are drawn upon. The purpose is to equip the college with working size apparatus, illustrating the different types of metallurgical and ore dressing plants, and to have these operated by students, who will check up each operation by careful tests in the laboratories.

1. METALLURGY. *Fuels, Refractory Materials, Furnaces, Iron and Steel.*

Fuels. This course begins with the study of combustion, which includes the questions of flames, of complete combustion, luminosity and of amounts of air required, many of the points being considered mathematically. The various fuels of metallurgical importance are given very careful consideration. Artificial fuels, coke, charcoal, producer gas and briquetting are dwelt upon at considerable length. The question of by-products receives the special attention demanded by its importance and its future certain wide use in this country. Furnaces of various types are, at this point, given a preliminary study as a foundation for the more detailed study to be given under the particular metals.

Refractory Materials. Their source, preparation, properties and application.

Iron and Steel. The development of the metallurgy of iron, together with the general application of labor-saving devices, makes this the metal the study of which should be taken up first, especially because of its wide use for structural purposes and for the machinery so generally used in ore dressing and metallurgical plants. The order of treatment is indicated by the following subdivisions of the subject: the ores of iron; metallurgical chemistry of iron; the production of pig iron; the blast furnace, hot blast stoves; fuel, blast charges, yield and waste gases of the blast furnace; castings of iron; wrought iron; the production of wrought iron direct from the ore; the production of wrought iron in open hearth furnaces; refining of pig iron; puddling; forge and mill machinery;

steel and ingot iron, and the production of steel by various methods.

Prerequisite: The completed work of the Freshman and Sophomore years.

Texts: Sexton, *Fuel and Refractory Materials.*
Greenwood, *Steel and Iron.*

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

(Traphagen, Haldane.)

II. METALLURGY.

Lead. This course is considered under the following subdivisions: properties of lead and its compounds; ores of lead; receiving, sampling, and purchasing ores, fluxes and fuels; smelting in the reverbatory furnace; smelting in the ore hearth; smelting in the blast furnace; furnace products; desilverization; Pattinson process; Parkes process; German and English cupellation. At the proper place in this course considerable attention is given to the calculation of furnace charges.

Prerequisite: Course I.

Text: Hofman, *The Metallurgy of Lead.*

Four hours per week during the second semester of the Junior year.

(Traphagen, Haldane.)

III. ASSAYING AND METALLURGICAL LABORATORY.

Special attention is directed toward making this course as practical as possible, and, while the importance of accurate work is at no time lost sight of, constant efforts are made to enable the student to handle a large amount of work in as short a time as possible. As nearly as may be the student is put under smelter conditions, and is early made familiar with the system prevailing in the best conducted laboratories, so that in the end he may be able to take his place at once in such a laboratory without undergoing a "breaking-in" course after leaving school.

The work includes all the assays called for in the laboratory of mine, mill or smelter, and the methods, besides those

in use so satisfactorily for many years, include also such "short cuts" as have been introduced by assayers having several hundred assays to make daily. The course covers the following: the fusibility of slags of definite composition made up by careful calculation; the fluxing of a limestone ore and a silicious ore for practice; the running of lead mixtures of known lead, silica and base content, to determine the influence of foreign elements; the assay of sulphide and oxide ores of lead; the assay of gold and silver ores of different types by various methods, with a comparison of results; the assay of zinciferous and cupriferous gold and silver ores, of arsenical and antimonial ores; the crucible and scorification assay of mattes and concentrates; the assay of gold, silver and base bullions, of tin and antimony ores and special assays.

In connection with the assaying a preliminary course in the metallurgical laboratory is given. The following points are studied: the fusibility of silicates; corrosion of refractory materials; pyrometry; calorimetry; heat treatment of steel; roasting of copper sulphide ores; Parkes desilverizing.

Prerequisites: Course I. and the completed work of the Freshman and Sophomore years.

Laboratory Manual: Howe, *Metallurgical and Laboratory Notes.*

One lecture and nine hours laboratory work per week during one semester of the Junior year.

(Traphagen, Haldane.)

IV. ORE DRESSING AND METALLURGY OF COPPER.

Ore Dressing. The following represent the main divisions under which this subject is studied: jaw and gyratory breakers; rolls; stamps, gravity, steam and pneumatic; special crushing and fine grinding apparatus; apparatus for sizing, including the various types of screens and classifiers; the actual concentrating machines, including jigs, tables and vanners.

Copper. This subject is considered under the following sub-heads: copper and its ores; distribution of the ores of copper; the sampling and assaying of copper; the chemistry of the calcining process; the preparation of ores for

roasting; the roasting of ores in lump form; the roasting of ores in pulverized condition; automatic reverberatory calciners; the smelting of copper; the chemistry of the blast furnace; blast furnaces constructed of brick; blast furnace smelting; pyritic smelting; reverberatory furnaces; the bessemerizing of copper mattes; the electrolytic refining of copper, and the selection of process and arrangement of plant.

Prerequisites: Courses I. II. and III.

Reference: Richards, *Ore Dressing.*

Text: Peters, *Modern Copper Smelting.*

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

(Traphagen, Bailar.)

V. ORE DRESSING LABORATORY.

This laboratory is equipped with laboratory classifiers of different types, small and large jigs, laboratory slime tables, sizing screens, various types of crushers, and a Wilfley table. The work consists of sizing tests of the products of various crushers and operations, concentrating by panning and by various mechanical devices, and comparative studies of the different forms of commercial concentrating devices.

Prerequisites: Courses I. II. and III.

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

(Traphagen, Haldane.)

VI. ELECTRO-METALLURGY.

The growing application of the electric current to metallurgy for electrolysis, especially in refining, and for electric smelting, renders a knowledge of these subjects by the present day metallurgist imperative. The general principles of electrolysis is taken up. This includes a careful study of the quantitative relationship between the current and the amount of metal deposited, illustrated by numerous problems, together with studies of the installation of the various electrolytic plants under different systems. Laboratory work accompanies this course.

Prerequisites: Courses I. II. and III.

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

(Traphagen.)

VII. METALLURGY. *Gold, Silver and Zinc.*

Gold and Silver. This course covers the following: metallurgy of gold and silver, including stamp milling, cyanidation, and chlorination of gold ores; chloridizing, roasting, and amalgamation of silver ores; the Russell process and other wet methods for silver; the parting of gold and silver bullion by various commercial methods, with special attention to electrolysis and the sulphuric acid treatment. The various modifications of the cyanide process receive particular attention, especially the treatment of the slimes from zinc precipitation; the Moore filter process; the regeneration of the cyanide; the different methods proposed for precipitating the dissolved gold and the recent attempts to apply the process to silver ores.

Zinc. The present great interest in this metal, together with a growing demand, is the reason why a course of lectures is to be devoted to this metal. These lectures deal with the dressing of the various ores of zinc, which involve wet concentration by the usual form of tables or vanners, and dry treatment by magnetic or electro-static separators. The various methods for the smelting of zinc ores will be considered in detail, especially those for the production of the zinc-lead paint, those using wet methods and those using regenerative furnaces in connection with the old Belgian method.

Prerequisites: Courses I. II. III. IV. V. and VI.

Reference: Ingalls, *The Metallurgy of Zinc.*
Park, *The Cyanide Process.*

Three hours per week during the second semester of the Senior year.

(Traphagen.)

VIII. METALLURGY. *Aluminum, Nickel and Metals not elsewhere considered.*

This course covers the general metallurgy of the metals not previously considered. A study of alloys is made here, and various alloys, especially those of the rarer metals with iron, are given particular attention.

Prerequisites: Courses I. II. III. IV. V. and VI.

Three hours per week during the second semester of the Senior year.

(Traphagen.)

IX. METALLURGICAL LABORATORY.

This course includes optical pyrometers; Juncker calorimeter; testing refractory materials for fusibility; influence on refractory power of various elements; thermal gradient; various experiments with iron and steel; microstructure of steel; copper selecting process and chloridizing roasting.

Prerequisites: Courses I. II. III. IV. V. and VI.

Laboratory Manual: Howe, *Metallurgical Laboratory Notes.*

Three hours per week during the second semester of the Senior year.

(Traphagen, Haldane.)

X. METALLURGICAL PRACTICE.

This course covers the operation of working machines of the various types used in practical metallurgy, including stamp milling, roasting and smelting ores, cyanide and chlorination practice. The aim in equipping the school is to follow the best modern practice in the installation of metallurgical devices, and to endeavor, whenever possible, to secure full size commercial units in place of small model plants.

Prerequisites: Courses I. II. III. IV. V. and VI.

Six hours per week during the second semester of the Senior year.

(Traphagen.)

METALLURGICAL TRIPS.

Immediately after taking up the study of metallurgy, trips extending throughout the Junior and Senior years are begun. These trips, intended to illustrate the lectures, are taken while the particular topics are under discussion, and tend to aid greatly in an appreciation of approved machinery and practice. By means of outlines furnished the student, which he is required to fill out, care is taken that all the important points in connection with each plant visited are studied and reported upon.

Junior Year. The gas producing and coking plant of the Denver Gas and Electric Company at Denver is first

visited, and a general study of artificial fuels is made. The manufacture of refractory materials is then taken up, followed by a visit to the Globe plant of the American Smelting & Refining Company at Denver, and the Pyritic Smelter at Golden, for the study of furnaces of various types. Near the conclusion of the lectures on iron and steel, several days are spent in the immense modern plant of the Colorado Fuel and Iron Company at Pueblo. The various practices in the treatment of lead ores are studied at the smelters of the American Smelting and Refining Company at Denver and Pueblo, including the Globe, Eilers, Philadelphia, and Pueblo plants. During the summer succeeding the Junior year the gold milling and cyaniding plants of the Black Hills and the copper smelters and refineries at Butte and Anaconda are visited.

Senior Year. The early part of the year is devoted to studies and reports upon the sampling mills and ore dressing plants of Gilpin and Clear Creek counties. This is followed by a study of pyritic and copper smelting at the Pyritic Smelter near Golden and at the Philadelphia plant of the American Smelting and Refining Company at Pueblo. The applications of magnetic separators are illustrated by visits to the works of the Colorado Zinc Company at Denver, and at other plants where various separators are used. The application of the electro-static current to ore separation is shown in practical operation in the experimental and commercial plants at Denver operating the Blake Morscher machines. The milling of gold ores at Idaho Springs, the operation of chlorination at the Portland and Telluride Mills in Colorado, the Economic Mill at Victor, and cyanidation at the Dorcas Mill, Florence, furnish excellent studies in the metallurgy of this important metal. A study of the metallurgy of zinc is made possible by the plants of the Empire Zinc Company and United States Smelting Company at Canon City, and the plant of the American Smelting and Refining Company at Pueblo. In addition to all this Denver is usually selected for the exploitation of new methods in ore dressing and metallurgy, and opportunities to see these demonstrations are open to students.

GEOLOGY AND MINERALOGY.

Professor Horace B. Patton.
Instructor Julius Wooster Eggleston.
Instructor G. Montague Butler.

The Colorado School of Mines is very fortunately situated from the view point of the geologist. The surrounding formations not only present the strikingly clear features so characteristic of the West, but occur in great profusion and variety. In addition certain features peculiar to this particular location afford sufficiently complicated problems to be of great value to the student of geology. It is possible, therefore, without going more than a mile or two from the school to illustrate very effectively most geological problems; and field geology can be carried on at the same time with class instruction.

The subjects presented are classified under three heads: A, Geology; B, Mineralogy; C, Lithology.

A. GEOLOGY.

I. GENERAL GEOLOGY.

This course is intended as a preliminary one and is a preparation for the more advanced course given in the Junior year. It discusses general geological principles more particularly in connection with dynamical, structural, and physiographic geology. The course is essentially a lecture course based on a text book.

Prerequisite: Entrance requirements.

Text: Chamberlin and Salisbury, *Geology (Vol. I, Processes and Their Results.)*

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

(Eggleston.)

II. GEOLOGICAL FIELD-WORK.

In connection with Course I. a certain amount of field work is required. It is intended to illustrate the general principles of geology, including training in the recognition of the simpler types of rocks and in the observation of their attitude and structure; in the use of simple field instruments; in note taking and making of reports; in mapping and section drawing. The work is continued in the second semester, when particular problems are assigned to individual students or squads. These problems are mainly structural in character, such as the tracing and mapping of veins and contacts; the location and study of faults; the mapping and reporting upon clay pits.

Prerequisite: Geology, Course I.

Eight afternoons, or their equivalent; four during each semester of the Freshman year.

(Eggleston, Patton, Butler.)

III. ADVANCED GEOLOGY.

This course is a continuation of Course I., and is given by means of lectures and text-book work. It deals mainly with historical and stratigraphic geology, with special reference to American areas.

Prerequisites: Mineralogy, Courses I. II. and III.
Geology, Course I.

Text: Chamberlin and Salisbury, *Geology (Vol. II).*

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

(Eggleston.)

IV. ADVANCED GEOLOGICAL FIELD-WORK.

This course embraces mainly field work in areal geology. Each student is assigned a particular section which he is to study, map, and report upon. This throws the student upon his own resources and gives him not only further practice in geological observation, but also the necessary training for preparing reports based upon his own observations.

Prerequisites: Courses I. II. and III.

Four full days in the field, or their equivalent, during the second semester of the Junior year.

(Eggleston, Patton, Butler.)

V. ECONOMIC GEOLOGY.

This course discusses the matter of ore deposits, their nature, occurrence and origin, especially the ores carrying the precious metals. Attention is also given to other natural products of economic value, such as coal, petroleum, and building stones.

Prerequisites: Geology, Courses I. II. III. and IV.
Mineralogy, Courses I. II. and III. and
Lithology, Course I.

Three hours per week throughout the Senior year.

(Patton.)

B. MINERALOGY.

I. CRYSTALLOGRAPHY.

This course is treated as an essential part of the general work in mineralogy, and only such portion of the subject is especially emphasized as is of practical value in the determination and the proper understanding of minerals. A very thorough drill, however, is given in the more practical portions of the subject. The course is presented through lectures, text books, and practical laboratory work; also by individual quizzes. In connection with the laboratory work each student is required to become thoroughly familiar with crystal forms and combinations such as are found on the usual wooden crystal models, and to determine with the aid of a pocket lens and contact goniometer the crystal forms of three hundred crystals.

Prerequisites: Chemistry, Courses I. and II.

Text: Patton, *Lecture Notes on Crystallography.*

Lectures two hours, laboratory six hours per week, during the first semester of the Sophomore year (ten weeks).

(Patton, Eggleston, Butler.)

II. BLOWPIPE ANALYSIS.

This course is not intended as an independent one, but merely as preliminary to determinative mineralogy. Special attention is devoted to a few of the most useful tests for

the common mineral elements, and the student is expected to become expert in the use of the blowpipe within this limited range.

Prerequisites: Mineralogy, Course I.
Chemistry, Courses I. and II.

Text: Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

Lectures two hours, laboratory six hours per week, from the close of Course I. to the Christmas holidays of the Sophomore year (five weeks).

(Patton, Eggleston, Butler.)

III. DETERMINATIVE MINERALOGY.

In this course about two hundred fifty of the most important mineral species are presented by lectures, in which special emphasis is laid on the most ready means for recognizing minerals by means of their physical properties and crystal forms. The object constantly kept in mind is not the training that will enable one to determine any mineral whatever, but rather to recognize at sight such minerals as are likely to be met with in connection with mining operations. This is what the average mining engineer is expected to do. With this object in view, as thorough a drill as the time will allow is given in the actual handling and determining of minerals in the laboratory. In this work each student is expected to handle, determine, and be examined on, approximately two thousand five hundred individual specimens.

Prerequisites: Chemistry, Courses I. and II.
Mineralogy, Courses I. and II.

Text: Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

Lectures two hours, laboratory six hours per week, from the close of the Christmas holidays to the close of the second semester of the Sophomore year (twenty-two weeks).

(Patton, Eggleston, Butler.)

C. LITHOLOGY.

I. LITHOLOGY.

This is a lecture course supplemented by laboratory work. The object is to present all the more commonly occurring

rocks in such a way as to render their identification at sight reasonably accurate. The methods pursued are purely those applicable to the hand specimen without the aid of microscopic sections. The collection of the school is especially rich in those rocks that are usually encountered in mining operations in Colorado and adjacent states. Special emphasis, therefore, is laid upon such rocks and upon their various alteration forms.

Prerequisites: Geology, Courses I. II. and III.
Mineralogy, Courses I. II. and III.

Text: Kemp, *Handbook of Rocks.*

Four hours per week during the second semester of the Junior year.

(Patton, Eggleston, Butler.)

CIVIL ENGINEERING.

Professor Claude William Leroy Filkins.
Assistant Professor William Jonathan Hazard.
Instructor William Franklin Allison.

The aim of this department is to prepare the student to make all the necessary surveys, calculations, and estimates that the mining and metallurgical engineer may be called upon to make, and at the same time to give him such a knowledge of plane surveying as will enable him to undertake any of the work that the surveyor is called upon to do in land, city, topographical, and railroad surveying. The practical is constantly emphasized, and to that end the work assigned to the student is such work as the surveyor meets in practice. The many advantages offered by the mineral, coal and clay mines in actual operation near Golden, together with the interest taken by the operators of these mines, as is shown by their willingness to give classes right of way for practicing surveying, make the college particularly strong in this kind of work. This department also aims to perfect the engineering student in the theoretical discussion of strains and stresses in mechanisms and structures. It teaches the practical application of the theory in the design of machinery in general and of

structures in detail. The course in hydraulics and hydraulic motors develops the theoretical, empirical, and practical sides of hydraulics. Thorough laboratory practice is required in connection with the courses, thus providing concrete applications of elementary and involved principles.

I. PLANE SURVEYING.

Instruction is given by lectures and recitations in the theory of the construction, use and care of the surveyor's instruments of precision. The work includes the adjustment of instruments; the theory and use of the barometer, planimeter and plane-table; the principles of land, city, topographical, and railroad surveying, and the determination of the true meridian by means of various solar attachments and by direct observation of the sun and of circumpolar stars.

Prerequisites: Mathematics, Courses I. and II.
Machine Design, Courses I. and II.

Text: Johnson, *Plane Surveying.*

Two hours per week during the second semester of the Freshman year.

(Allison.)

II. SURVEYING. FIELD-WORK.

This course includes adjusting instruments; traverse surveying; observations and calculations for determining distances, areas and volumes; observations for the location of the true meridian; the ordinary problems in city surveying; stadia work in connection with a topographical survey of some section near Golden. A short railway line is located, cross-sectioned, and the earthwork computed.

Prerequisites: Course I.
Mathematics, Courses I. II. III. and IV.
Machine Design, Courses I. II. III. and IV.

Texts: Pence and Ketchum, *Field Manual for Surveyors.*
Searles, *Manual for Railroad Engineers.*

This course occupies the four full weeks following the completion of the Freshman year.

(Allison.)

III. MECHANICS.

The course consists of the theoretical study of mechanisms and materials, embracing statics of a material point and of rigid bodies; centers of gravity or centroids; chains, cords and cables; moments of inertia and radii of gyration of plane figures; stresses and strains; tension, shearing, compression; torsion, flexure; combined torsion and flexure; elastic curves; safe loads; oblique forces; long columns and continuous beams. Much emphasis is placed upon the rapid and accurate application of principles to commercial forms of materials and mechanisms. The course also introduces the student to the fundamental ideas of the motions of bodies, initially treating the dynamics of a material point with extensions of the theory to finite bodies. The fundamental differential equations of rectilinear motion are developed, and practical applications are found in the cases of falling bodies, upward throw and uniformly and variably accelerated bodies. Newton's laws are the basis of these latter items and also of the hypothetical "Engineers' Mass." The principles of harmonic motion are derived and discussed fully in connection with the Scotch Yoke, and the steam engine receives its preliminary introduction to the student. Colliding bodies receive attention in the discussion of the principles of impact.

Prerequisites: Mathematics, Courses I. II. III. IV. V. VI. and VII.
Machine Design, Courses I. II. III. and IV.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*
Pierce, *Short Table of Integrals.*
Problem Sheets.
Cambria Steel.

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

(Filkins, Allison.)

IV. TESTING LABORATORY.

This course acquaints the student with the difficulties attending the practical application of theory. It emphasizes

systematic and logical presentation, shows the importance of small details, secures data for future use, and provides a criterion as to the value of a student in his profession. Tests are made to determine the strength and stiffness of building materials such as cast-iron, wrought-iron, steel, and wood in tension, compression, shearing, and flexure. Wire, wire-rope and cables are also investigated for strength. Stone and brick are examined for strength, absorption, disintegration, and other qualities which decide their economic values. The correct dimensioning and surfacing of specimens also forms an integral part of the course. Steel forms are submitted to the students for the determination of the centers of gravity and the moments of inertia. Written reports covering the apparatus, procedure, data, computation, results, and conclusions are required from each student. The tests upon different materials are discussed in independent articles written on standard size paper, eight and one-half inches by eleven inches, properly bound together and titled.

Prerequisite: This course must be taken in conjunction with Course III.

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

(Hazard.)

V. MECHANICS.

This course is an extension of Course III. Virtual velocities introduce the first elements of the principles of work and energy and serve as a basis of discussion in the treatment of the curvilinear motion of a material point which follows. Under this latter head the general equations and principles of curvilinear motion are derived and then applied to simple and cycloidal pendulums, to planetary motion, to a projectile in vacuo, to a body on smooth curved guide, and to absolute and relative velocities. For use in the motion of rigid bodies, the moments of inertia of the common geometrical solids are derived, after which the dynamics of rigid bodies are studied. The conceptions of equivalent and of equilibrating systems are involved in the study of rotating bodies, compound pendulums, rudimentary engines, fly-wheels, eccentric pulleys, rolling bodies, parallel rod of locomotive,

hoisting in mines, and the like. Following these, the principles of work and energy are derived and emphasized in the study of problems involving fly-wheels and stationary engines, friction, dynamometers, belting, trains and locomotives, and hoisting apparatus. The course is concluded by a short reading in the graphics of mechanisms.

Prerequisites: Mechanics, Courses III. and IV.
Machine Design, Course V.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*
Pierce, *Short Tables of Integrals.*
Problem Sheets.
Cambria Steel.

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

(Filkins, Allison.)

VI. CONSTRUCTION.

In this course instruction is given in graphics, which involves a close study of the force triangle and polygons, pole, ray, special equilibrium polygon, resultant of forces, pier reactions, vertical dimensions of equilibrium polygons, together with applications to simple beams, centers of gravity, moments of inertia, articulated cranes, trusses, and gallows frames. The formulae for rigidity of frames are derived and applied to the various types of frames in planes and in space. The course also embraces the computation of loads to be borne by frames, from the weights of the parts and elements involved. The general forms of mill buildings are discussed and elementary ideas of ventilation, lighting, coverings, and the like are obtained.

Prerequisites: Mechanics, Courses III. and IV.

Texts: Ketchum, *Steel Mill Buildings.*
Jacoby, *Structural Details Plates.*
Filkins, *Mimeograph Notes on Wooden Construction.*

Lectures and recitations two hours per week and drafting three hours per week during the second semester of the Junior year.

(Filkins.)

VII. STRUCTURES.

This course is a study of the theory and practical design of wooden and steel structures. The student is instructed in the definitions and dimensions of parts such as housing, notching, mortise and tenon, dovetailing, lag-screws, dowels, lugs, keys, brace blocks, nuts, and washers. From accepted unit stresses for given materials, the student is led to design wooden fished or scarfed splices, and various joints. The design of the deepened beam is given to emphasize the relation between the stress couple and the vertical shear and also the distribution of shear in horizontal plane sections. The trussed beam as an important factor in construction receives due attention and is followed by a detailed design of a wooden roof truss, including roof covering, rafters, purlins, upper and lower chords, struts, tie-rods and miscellaneous joints, together with splices, corbels, anchorage, and laterals. Steel mill buildings are thoroughly discussed, and a complete design is required from each student. The student also receives instruction in masonry materials and construction.

Prerequisites: Courses III. IV. and VI.

Texts: Ketchum, *Steel Mill Buildings.*
Jacoby, *Structural Details Sheets.*
Filkins, *Mimeograph Notes on Wooden Structures and Masonry.*
Cambria Steel.

Recitations and lectures two hours and design six hours per week during the first semester of the Senior year.

(Filkins.)

VIII. CEMENT LABORATORY.

The intent of this course is to so familiarize the student with the properties of cement that he may not hesitate to utilize this material in his professional work. The laboratory also provides extensive opportunities for research and investigation. The course covers tests of natural and Portland cement and cement mortars for tensile, crushing, and transverse strength, adhesion, soundness, fineness, setting, freezing, and effect of chemicals. The course also embraces the mixing of cement into mortar and concrete.

Prerequisites: Mechanics, Courses III. and IV.

Texts: Seminary assignments to various works.

Three hours per week during the first semester of the Senior year, in connection with Course VIII.

(Filkins, Hazard.)

IX. HYDRAULICS AND HYDRAULIC MOTORS.

The course deals with the theory and practical application of the properties of fluids at rest and in motion, embracing hydrostatic pressure, manometers, strength of pipes, pressures in tanks and against walls and dams; immersion and flotation; steady flow of liquids through pipes and orifices and over weirs; fluid friction and losses of head; time of emptying vessels; steady flow of water in open channels and Kutter's formula; impulse and resistance of fluids; the Pelton water motor; overshot, breast and undershot water-wheels; backwater; theorem for flow in a revolving pipe; turbine and reaction wheels; theory of turbine testing.

Prerequisites: Courses III. IV. V. and VI.

Machine Design, Courses VI. and VII. or VIII.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes on Hydraulic Motors.*

Two hours per week during the first semester of the Senior year.

(Filkins.)

X. HYDRAULIC LABORATORY.

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 water supply for experimental work with wheels and nozzles. This will make available a head of 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.

Prerequisite: This course can be taken only in conjunction with Course IX.

Three hours per week throughout the first semester of the Senior year, in connection with Course VI.

(Hazard.)

XI. ADVANCED MECHANICS.

This course is essentially for graduates, but may be taken by seniors who have the time. It consists of an application of graphics to the solution of masonry problems, including right arches of masonry, arch-ring, voussoirs, soffit, intrados, extrados, spandrel, crown, keystone, rise and span, mortar, friction, resultant and maximum pressure, true linear arch, load contour, symmetrical and non-symmetrical loadings on symmetrical arches, abutments and retaining walls, arch ribs, special equilibrium polygon, thrust, shear, moment, angular change and deflections; theorems of least work developed and applied to the above; 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 and rid shortening; variable cross section; Scheffler's theory of the arch; continuous girders by graphics; Thatcher's concrete steel construction with variations; expanded metal and similar constructions; design of high masonry arched and gravity dams.

Prerequisites: Courses III. to X., inclusive.

Texts: Church, *Mechanics of Engineering.*
Baker, *Masonry Construction.*
Miscellaneous References.

Hours to be arranged.

(Filkins.)

XII. CONTRACTS AND SPECIFICATIONS.

This course is given to familiarize the student with the forms and the legality of contracts, together with the parties having power to make them and to carry them out. The student also becomes acquainted with the common forms of specifications. A synopsis of the law of contracts is first taken up, dealing with competency; the agreement and its legality; the consideration; sealed and parole contracts; assignment; con-

struction; subsequent changes; discharge and remedies for breach of contract. This is followed by a study of engineering specifications and accompanying documents dwelling upon advertising, instructions to bidders, forms of proposals, general and specific clauses in engineering specifications, together with illustrative examples of complete contracts and specifications. Lectures by members of the legal and technical professions will also assist the student in more fully understanding the subject.

Prerequisite: The completion of all work preceding the second semester of the Senior year.

Text: Johnson, *Engineering Contracts and Specifications.*

Two hours per week during the second semester of the Senior year.

(Filkins.)

MACHINE DESIGN.

Professor Arthur Ransley Curtis.
Assistant Professor William Jonathan Hazard.
Instructor William George Haldane.
Instructor Gyula Bennett Manson.

In the drawing course stress is first laid upon the proper care and use of drawing instruments and drawing materials. Effort is made to see that the student acquires such habits of work as are in keeping with the best practice. Emphasis is first placed upon how to do good drawing rather than upon what is drawn. Again, as soon as the more advanced work is taken up, emphasis is transferred from simply making good drawings and placed on proper design. The student is led into this through a short series of sheets which show him the connection to be made between elementary drawing and descriptive geometry on the one hand and practical shop drawing on the other. All of the advanced drawing is based directly on and is a part of the work in machine design. The work in machine design is intended to acquaint the student

with all forms of fastenings and other common devices used about machines and similar pieces of engineering, and more particularly all ways of transmitting motion and power, together with the correct methods for installation. Very little actual design of machines is undertaken, because students in the mining and metallurgical courses can best be served by being taught how to determine what is necessary and to select, install and run power-using apparatus in general, rather than by being taught their actual design. This, of course, does not apply to that part of drawing pertaining to metallurgical design.

I. MECHANICAL DRAWING.

The work begins with lectures on the selection and use of drawing instruments and other materials. It then leads through exercises to give the student the proper amount of skill involving the drawing of plane curves and figures. Following this comes tinting, shading with tints, line shading, mechanical and freehand lettering. The work on freehand lettering is begun early in the term and continued until the student is proficient.

Prerequisite: Entrance requirements.

Text: Curtis and Hazard, *Freshman Drawing Data.*

Six hours per week during the first semester of the Freshman year.

(Haldane, Manson.)

II. DESCRIPTIVE GEOMETRY.

The course begins with general definitions and the solution of the elementary problems relating to the point, to the right line, and to planes. Following these a general study is made of lines of single and double curvature, surfaces of single and double curvature, and warped surfaces. The solution of the tangent problems completes the work of the term.

Prerequisite: Entrance requirements.

Text: Church, *Descriptive Geometry and Shades and Shadows.*

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

(Curtis, Hazard, Haldane, Manson.)

III. MECHANICAL DRAWING.

The early work is based directly on the work in descriptive geometry involving varied problems in intersections. It then proceeds with work in shades and shadows in general and as applied to shaded lines for shop drawings, isometric and other mechanical perspectives, all drawn to scale and fully dimensioned. The last work is on regular shop drawings, rough sketches being given, from which accurate and complete working drawings are made.

Prerequisites: Courses I. and II.

Text: Curtis and Hazard, *Freshman Drawing Data.*

Nine hours per week during the second semester of the Freshman year.

(Haldane, Manson.)

IV. DESCRIPTIVE GEOMETRY AND SHADES AND SHADOWS.

This course is a continuation of Course II. The solution of problems relating to the intersections of surfaces is covered very thoroughly. This is followed by work in shades and shadows, with their application to shaded lines; isometric and other mechanical perspectives. Following the work on descriptive geometry proper there is a short series of lectures on the application of descriptive geometry methods to practical drawing and to such subjects as titles, borders, scales, lettering of drawings, necessary views, center and dimension lines.

Prerequisite: Course II.

Text: Church, *Descriptive Geometry and Shades and Shadows.*

Two hours per week during the second semester of the Freshman year.

(Curtis, Hazard, Haldane, Manson.)

V. MACHINE DESIGN. (Mining.)

As an introduction to the machine design proper, a study is first made of the different ways found in practice of communicating motion from one part to another without regard to the forces or stresses that may be involved. The methods investigated are the following: rigid and flexible connectors;

rolling cylinders and cones; toothed gearing, involute and cycloidal, spur and bevel; cams; link work; chain gearing and belting. Screws, nuts and bolts are first taken up, and then follow keys and cotters and cottered joints in general; pipes and pipe joints; standard fittings and expansion of pipes; riveted joints, stays and stayed surfaces.

The greater part of the work of this semester comes under the general head of fastenings. All proportions of parts are analyzed and tested by use of the mechanics of materials, and as far as is possible the student is made to see how by correct ways of working he can apply the principles and knowledge gained in this subject to the proper proportioning of machine parts in general. The work is given with the object always in view of making direct application in the drawing room. Freehand sketching to scale is also an integral part of the course.

Prerequisites: Courses I. II. III. and IV. This course must be preceded by or accompanied by Mechanics, Course III.

Text: Low and Bevis, *A Manual of Machine Design and Drawing.*

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

(Curtis.)

VI. MACHINE DESIGN. (Mining.)

This is a continuation of the work of the first semester. The whole time is devoted to the different ways of transmitting power, together with the best methods of determining what is required for the same. A close study is first made of the forces and moments set up by the single elements of machines and also of the different ways of expressing the horsepower developed. Then follow shafting and shaft couplings, including work with combined bending and twisting, hollow and square shafts, proper spacing of bearings; belting, including different kinds of belts and belt fastenings and pulleys; cotton rope drives; wire rope drives; friction gearing, both spur and bevel; shrouding and other ways of affecting the strength of gears.

Prerequisite: Course V.

Text: Low and Bevis, *A Manual of Machine Drawing and Design.*

Two hours per week during the second semester of the Junior year.

(Curtis.)

VII. MACHINE DESIGN DRAWING. (Mining.)

The work in drawing depends directly upon the classroom work. As far as possible the data for the drawing are determined by calculations or such other considerations as are necessary in practical work. Care is also used to have the student shape up his sheets in accordance with the best drawing office practices. The drawing work of this term follows closely the work in the machine design for this term.

Prerequisites: Courses I. II. III. and IV. This course must be preceded by or accompanied by Course V.

Text: Data given.

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

(Curtis.)

VIII. MACHINE DESIGN. (Metallurgical.)

The course in machine design for the metallurgical students has the same general outline as that for the mining students, but will be more of an empirical nature. The study will be more of engineering appliances as made than of their design.

Prerequisites: Courses I. II. III. and IV. This course must be preceded by or accompanied by Mechanics, Course III.

Text: Low and Bevis, *A Manual of Machine Drawing and Design.*

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

IX. MACHINE DESIGN DRAWING. (Mining.)

This is a continuation of Course VII, and follows closely the classroom work in machine design for this term. The

greater part of the time is consumed in the laying out, and in the design where necessary, of the complete power transmitting equipment for a mill or other plant involving the installation of all forms of mechanical apparatus for transmitting power.

Prerequisite: Course VII.

Text: Data given.

Six hours per week during the second semester of the Junior year.

(Curtis.)

X. MACHINE DESIGN DRAWING. (METALLURGICAL.)

The drawing for the students in metallurgy is of the same nature as that for the mining students, except that the application of the work of the classroom will be, as far as possible, in connection with machinery used in connection with metallurgical operations. Also more use is made of freehand sketches and similar work, and less stress is laid upon the making of completely finished drawings. The drawing that is done, however, is of the same quality as that done by the students in mining.

Prerequisite: Course VIII.

Text: Data given.

Three hours per week throughout the Junior year.

ELECTRICAL ENGINEERING.

ASSISTANT PROFESSOR WILLIAM JONATHAN HAZARD.

I. ELECTRIC POWER TRANSMISSION.

The object of this course is to familiarize the student with the practical applications of electricity and to enable him to make intelligent selection of apparatus found in the market which will best fulfil his requirements. It deals with the generation, measurement, transmission, and utilization of direct and alternating currents. The various systems of

lighting are discussed. Direct and alternating current motors with their auxiliaries are studied in some detail to enable the user to adapt machines to altered conditions of use, where such changes are possible. Many problems are given to fix in the mind the principles studied. The course is given by text-book and lectures, supplemented by laboratory work and visits to various power plants.

Prerequisites: Physics, I. II. and III.

Text: Bell, *Electric Power Transmission.*

Two hours per week during the second semester of the Senior year.

(Hazard.)

II. ELECTRICAL LABORATORY.

This is the laboratory course accompanying Course I. It includes the measurement of the resistances of motors, finding the saturation curves, characteristic curves and efficiency of machines and determining the character and effectiveness of speed control of motors by several systems.

Prerequisites: Physics, I. II. and III.

One afternoon per week during the second semester of the Senior year.

(Hazard.)

III. STEAM LABORATORY.

This is a practical course in the use of the indicator, valve setting, testing of pressure gages, and the testing of engines, boilers and pumps.

Prerequisites: Physics, I. II. and III.

One afternoon per week during the second semester of the Senior year.

(Hazard.)

CHEMISTRY.

Professor Herman Fleck.
Instructor Charles Darwin Test.
Instructor John Christian Bailar.
Instructor Steve Howard Worrell.

The courses in chemistry are arranged especially for the needs of the mining and metallurgical engineer. The demands made upon chemistry by these branches of engineering require a broad knowledge of inorganic chemistry, of the theories underlying the science, and a close acquaintance with the properties of the elements, their reactions, detection, and separation.

I. GENERAL CHEMISTRY.

The course begins with a historical sketch of the development of the science of chemistry up to the atomic era. Thereafter history is introduced only as occasion demands. While the course rests on a structure of inorganic chemistry, the development and application of modern theories and of organic chemistry are taught as the work advances through the non-metallic elements during the first semester. Simultaneously a closer inspection of these elements is offered in the laboratory.

The second semester proceeds with the metals, which follow in the order of their periodicity, the periodic law having been previously expounded. Elementary metallurgy is introduced as the commercially important metals are considered.

Prerequisite: Entrance requirements.

Texts: Richter, *Inorganic Chemistry.*
Smith and Keller, *Experiments.*

Five hours per week throughout the Freshman year.

(Fleck.)

II. QUALITATIVE ANALYSIS.

This course begins with a short review in the laboratory of the non-metals. The student, equipped with a working knowledge of experimental manipulation, undertakes the study of the reactions of the bases and acids and their separation. Later more complex substances are given for analyses and the decomposition and solution, and examination of refractory substances follow.

Prerequisite: Entrance requirements.

Text: Medicus, *Qualitative Analysis.*

Lecture, one hour per week throughout the year.

Laboratory, nine hours per week during the first semester and six hours per week during the second semester of the Freshman year.

(Fleck, Bailar, Worrell.)

III. QUANTITATIVE ANALYSIS. (Gravimetric.)

The work begins with the analysis of simple salts. By this means the practice of manipulation and the observance of necessary precautions are learned. Gradually the analyses of substances of more complex nature are introduced in the form of salts and minerals. The various methods of decomposition and solution of refractory and complex material such as slags, mattes and alloys are practiced, and their constituents are determined by various methods.

Prerequisites: Courses I. and II.

Text: Cairns, *Quantitative Analysis.*

Lectures, one hour per week, laboratory nine hours per week, during the first semester of the Sophomore year.

(Fleck, Bailar, Worrell.)

IV. QUANTITATIVE ANALYSIS. (Volumetric.)

This course undertakes instruction in the use of standard solutions and a study of the reactions involved. In due time the methods commonly used in metallurgical industries are introduced. A knowledge of the preparation of standard solutions and their use is acquired by a course in acidimetry and alkalimetry. The preparation of standard solutions and their use in the wet assays of ores and products containing iron,

manganeze, lead, zinc, copper, and other metals are practiced. Attention is given throughout to skill and speed of manipulation. One hour a week is devoted to the theory of quantitative analysis.

Prerequisites: Courses I. II. and III.

Text: Bailar, *Laboratory Notes.*

Lecture, one hour per week, laboratory nine hours per week, during the second semester of the Sophomore year.

(Fleck, Bailar, Worrell.)

V. TECHNICAL CHEMISTRY.

A broader acquaintance with industrial methods of chemistry, especially in the inorganic field, is an essential in the education of the engineer. The course is intended to supply this by illustrated lectures on chemistry applied to the arts and the apparatus used therein. Among the industries considered are: acids; alkalies; chlorine and its products; cements; coal and its products; petroleum; the electric furnace and its products, and the technical extraction of the less common elements. When possible, excursions are made to localities where such processes are in operation.

Prerequisites: Courses I. and II.

Lectures, two hours per week throughout the Sophomore year.

(Fleck.)

VI. METALLURGICAL CHEMISTRY.

This course, essentially a laboratory course, embraces work requiring skill, accuracy, and experience acquired in the preliminary courses. The student performs operations which bring him into touch with the products of less common metallurgical processes, and also acquires a good idea of chemical practice used in conjunction with common metallurgical operations which he himself performs or observes. Naturally this adds to the knowledge, speed, and accuracy expected of him in actual practice. Among the tasks imposed are the estimation of arsenic, antimony, bismuth, nickel, cobalt, mercury, cadmium, tin, the examination of electrolytic slimes, the application of previously acquired knowledge in checking

actual metallurgical operations, especially with regard to perfection in speed and manipulation, and the study of electrolytic methods of analysis.

Prerequisites: Courses I. II. III. IV. and V.

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

(Fleck, Traphagen.)

PHYSICS.

Assistant Professor Edson Ray Wolcott.

In arranging the courses of this department the aim has been to make them as practical as possible, emphasizing those phenomena that bear directly on engineering problems, and yet not neglecting those facts which, though not so important of themselves, still are highly valuable in showing the close relationship that exists between physical laws. Special attention is given to problems involving the use of these laws, to actual demonstrations of their validity, and, as far as possible, to laboratory work verifying them quantitatively.

I. GENERAL PHYSICS.

This course consists of lectures, illustrated by experiment, and recitations with assigned problems. The subjects treated are as follows: mechanics, including the elements of kinematics, dynamics and hydrostatics; the properties of matter; heat, including thermometry and expansion, calorimetry, change of state, conduction, radiation, and the elements of thermodynamics; sound, including wave motion in general, production and propagation of sound waves, pitch, reflection, refraction, interference and resonance.

Prerequisites: Mathematics, Courses I. II. III. and V.

Text: Watson, *A Text-Book of Physics.*

Three lectures and one recitation per week during the first semester of the Sophomore year.

(Wolcott.)

II. GENERAL PHYSICS.

This course is a continuation of Course I. The subjects treated are as follows: light, including propagation, reflection, refraction, dispersion, interference, emission, absorption, and polarization; electricity and magnetism, including electro-statics, electro-kinematics, thermo-electricity, magnetic induction, electro-magnetism, electrolysis, the electro-magnetic theory, and electric oscillations.

Prerequisite: Course I.

Text: Watson, *A Text-Book of Physics.*

Three lectures and one recitation per week during the second semester of the Sophomore year.

(Wolcott.)

III. PHYSICAL LABORATORY.

This course is arranged to accompany Courses I and II. Its aim is to teach the student the necessity of careful work as well as to acquire skill in physical measurement so that the important physical laws can be quantitatively verified.

Prerequisites: Mathematics, Courses I. II. III. and IV.
Physics, Courses I. and II. taken in conjunction with this course.

Text: Ames and Bliss, *A Manual of Experiments in Physics.*

Three hours per week throughout the year.

(Wolcott.)

MATHEMATICS.

President Victor Clifton Alderson.
Professor Charles Roland Burger.
Instructor William George Haldane.
Instructor John Joseph Browne.

The courses in this department have been arranged to meet the extensive needs of students in the various branches of engineering. The subjects are treated so as to give the student both logical training and power of application. The principles which are of greatest value in engineering work are particularly emphasized. The courses offered serve as a sufficient prerequisite for the work in mathematical physics, physical chemistry, engineering and applied mechanics; and they mark the minimum of mathematical attainments that an engineer ought to possess. A special feature of the work is the early introduction of the calculus. By this means the principles of this subject are allowed to develop slowly, their sphere of usefulness is widened, and the student is able, early in the course, to make direct application of his knowledge of mathematics to practical problems.

I. COLLEGE ALGEBRA.

The course begins with a comprehensive treatment of quadratics. Graphic representation of equations, discussion of elementary problems on maxima and minima, and the application of algebra to analytic geometry are introduced. The progressions and other series, variation, binomial theorem for any index, partial fractions, exponentials, logarithms, expansion of functions in series, and the most useful propositions in the theory of equations receive thorough treatment.

Prerequisite: Entrance requirements.

Text: Wells, *Advanced Course in Algebra.*

Five hours per week during the first semester of the Freshman year.

(Burger, Browne.)

II. TRIGONOMETRY AND DETERMINANTS.

The general formulae of trigonometry are developed. The subject includes practice in the use of logarithmic tables and the application of trigonometry to mensuration in general. Emphasis is given to the graphic representation of trigonometric, inverse trigonometric, and hyperbolic functions; to the recognition of the rigorous ideas of modern mathematics in dealing with the fundamental series of trigonometry, and to the natural treatment of the complex number and the hyperbolic functions. The elementary properties of Determinants are also considered.

Prérequisite: Entrance requirements.

Texts: Wells, *Complete Trigonometry.*
Jones, *Logarithmic Tables.*

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

(Alderson, Burger, Haldane.)

III. ELEMENTS OF ANALYSIS.

This is a practical course in advanced algebra and in the elements of the differential calculus. The language, the symbols and the first processes of infinitesimal calculus, both in the pure and applied form, are explained. Many illustrations in geometry, physics, engineering, and applied mechanics are introduced. The fundamental principles of continuity, limiting values, theory of infinitesimals, and the differentiation of the elementary forms are established. Application is made to problems involving maxima and minima, rates, and to theorems in coördinate geometry. Many simple problems are frequently assigned to acquaint the student with the fundamental operations of the calculus.

Prerequisites: Courses I. and II.

Text: Murray, *First Course in Infinitesimal Calculus.*

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

(Alderson, Burger, Haldane.)

IV. COÖRDINATE GEOMETRY.

The analytic geometry of the straight line, circle and conic sections, including a discussion of the general equation

of the second degree, is amply treated. Methods of the calculus are introduced. In the solid analytic geometry, besides the plane and the straight line, the cylinders and the surfaces of revolution are treated, and all the quadric surfaces are studied from the simplest forms of their equations.

Prerequisites: Courses I. and II.

Text: Bailey and Woods, *Analytic Geometry.*

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

(Burger, Browne.)

V. DIFFERENTIAL AND INTEGRAL CALCULUS.

This course is a continuation of Course III, in which students are made familiar with the ordinary processes and applications of the calculus. A principal feature of this subject consists in carrying on the development of the differential and of the integral calculus together. This method of instruction enables the student to grasp the more difficult notions of the subject in their inherent relations, and at the same time to apply this knowledge, early in the course, to the solution of engineering problems.

Prerequisites: Courses I. II. III. and IV.

Text: Murray, *First Course in Infinitesimal Calculus.*

Five hours per week during the first semester of the Sophomore year.

(Burger, Browne.)

VI. INTEGRAL CALCULUS.

This course is a continuation of Course V. The notion of a definite integral is stated in its fundamental and most comprehensive form. The aim is to make clear the *rationale* of each process, and to encourage the student to become independent of formulæ of integration. The theory of single and multiple integration is applied to the principal methods of rectification and quadrature, and to the calculation of the surfaces and volumes of solids of revolution. The student is also given many useful and practical applications of the integral calculus. These include the general method to be employed in obtaining the position of a centroid, the value of a moment of inertia, and other practical problems in physics, engineering, and applied mechanics.

Prerequisites: Courses I. II. III. IV. and V.

Text: Murray, *First Course in Infinitesimal Calculus.*

Three hours per week during the second semester of the Sophomore year.

(Burger, Browne.)

VII. DIFFERENTIAL EQUATIONS.

Prominence is given in this subject to the geometrical illustrations which arise when the variables are regarded as the rectangular coördinates of a point. For the sake of students in engineering, who wish to use differential equations as a tool, and have little time to devote to general theory, the theoretical explanations are made as brief as is consistent with clearness and sound reasoning. Practical applications dealing with geometrical, physical, and mechanical problems are constantly kept in mind.

Prerequisites: Courses I. II. III. IV. V. and VI.

Text: Murray, *Differential Equations.*

Two hours per week during the second semester of the Sophomore year.

(Burger, Browne.)

MATHEMATICAL SEMINAR.

Conferences are held from time to time, by members of the departments of pure and applied mathematics, for the discussion of questions related to their respective subjects. Members report on noteworthy articles in current journals, and on the results of reading and investigation.

BUILDINGS.

Main Building. This is a continuous group of brick structures, including the buildings of 1880, of 1882, and of 1890. The first two are practically thrown together, and with one large and one small laboratory, three private laboratories, stock room, two balance rooms, and two lecture rooms, accommodate chiefly the students in chemistry. In the basement of the building of 1882 are the cement and testing la-

boratories. In the building of 1890 are located the President's office, the Registrar's office, the library, and the geological cabinet and lecture room. On the second floor are lecture rooms for mathematics, two private offices, a geological work room, and a geological cabinet. The third floor is devoted to the Freshman drafting room, and the basement to the temporary heating plant, the gymnasium lockers, the bathrooms, and the gymnasium. The total floor space of the buildings of 1880, 1882, and 1890 is forty thousand square feet.

Hall of Engineering. This building, constructed of red pressed brick, consists of two floors and a basement, and was completed in the fall of 1894. The upper floor contains the Junior and Sophomore drafting rooms, the blue print room, and a private office. The physics lecture and apparatus room, the photometry room, the physical laboratory, the balance room, and the apparatus rooms, as well as the private office, occupy the first floor. The basement contains the dynamo and the engine room, three electrical laboratories, a battery and switchboard 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 by ninety-two feet, without cellar, and is well equipped with offices, balance, store, and parting rooms. There are thirty-two large muffle furnaces, each with its work desk and coal bin. 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. The corner stone of this building was laid by the A. F. & A. M. of Colorado, on November 20, 1902, and was completed in January, 1904. The basement wall and first story are of Lyons sandstone, in broken ashlar, topped by a story of gray Golden brick. The building is finished on the interior with red pressed brick, and little wood is used, except that in the floors and staircases. The basement accommodates the metallurgical laboratories. The first floor contains two large lecture rooms, each with apparatus room and private office for metallurgy and mining. The second

floor, in one-half, accommodates the surveying and mechanics in one large lecture room, with apparatus room and private office, and in the other half a drafting room. The third floor is devoted entirely to a large drafting room for the Senior class. The structure was named in honor of the late W. S. Stratton, whose gift of twenty-five thousand dollars made this building possible.

Residence of the President. This is a brick building of two and one-half stories. It was built in 1888.

Carpenter Shop. This is well equipped for the special demands which are continually arising in a technical school. The work varies from ordinary repair work to the careful construction of special apparatus needed in the various departments of the school.

Machine Shop. What has been said of the carpenter shop is equally true of the machine shop. It is imperative that the school have one of its own, in order to keep its mechanical apparatus in proper 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. Both shops are fully equipped with the necessary benches and hand tools. They occupy a building sixteen by fifty feet, in addition to the storeroom for lumber.

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, and auxiliaries of a power plant.

LABORATORIES AND EQUIPMENT.

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. 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), 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 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
Summary of specimens	42,491

EXCHANGES.

The college has prepared a printed list of exchange material, covering both minerals and rocks. The 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 Professor H. B. Patton, Golden, Colo.

CHEMICAL LABORATORIES.

The chemical laboratories, lecture rooms and equipment of the department of chemistry occupy almost all of the space of the buildings of 1880-1882. The main laboratory is situated on the first floor of the buildings mentioned, which have been thrown together for the purpose, yielding a working space of three thousand eight hundred forty-four square feet. It is equipped with especially designed tile topped desks of oak, provided with low reagent shelves, gas, water and filtering apparatus. This laboratory will accommodate one hundred twenty-eight students at one time. There is ample light and ventilation, and the numerous hoods, arranged along the walls at the ends of each row of desks, are connected with a large Sturtevant blower, which discharges from a high brick stack. The tiled hoods are also fitted with gas attachments,

and a number are fitted with connections for supplying hydrogen sulphide gas to the laboratory from a large generator which is situated in a separate compartment outside the building. There are on this floor, in connection with the main laboratory, the issue room for supplies, two private laboratories, and a balance room equipped with standard Sartorius balances.

On the second floor of the building of 1880 is a laboratory of one thousand five hundred thirty-two square feet, provided with suitable light, heat, and ventilation. It will accommodate fifty-six students. There are also a balance room and a private laboratory in connection with this department. The chemical lecture room is on the second floor of the building of 1882, and has a seating capacity of about one hundred twenty. A long lecture table for experimental work, a projection lantern connected with the storage battery, screen, complete the equipment of this lecture room. The two issue rooms and the store rooms in the basement are stocked with a supply of apparatus and chemicals for general use, and also with apparatus designed for use in the more advanced courses. A gas machine room in the basement supplies the gas for laboratory use from a 300-light Detroit Gas Machine, which is connected with buried supply tanks outside of the building.

PHYSICAL LABORATORIES.

The physical laboratory is located on the first floor and basement of the Hall of Engineering, and includes, besides the lecture room and general laboratory, several special rooms fitted up with heavy piers for advanced work. The equipment is arranged especially for the instruction of students of engineering, and includes, besides the ordinary demonstration and laboratory apparatus, a Kater pendulum, a Parr coal calorimeter, electrical apparatus for the determination of the mechanical equivalent of heat and the expansion of metals, and a complete Lummer-Brodhun photometer. The electrical laboratories are well equipped with galvanometers, standard resistances, condensers, ammeters, voltmeters, dynamometers, permeameters, standard cells, a Kelvin balance, and special apparatus for practice in electrolysis.

STEAM LABORATORY.

The tubular boiler and high speed automatic engine which are in use at present for power, are also used for testing purposes. There is also a fifteen horse-power throttling engine, and a small slide valve engine, which is used chiefly in illustrating valve setting. Seven pumps are included in the equipment. The laboratory is provided with continuous counters, recording counters, indicators, gages, gage testers, steam calorimeters, measuring tanks, and scales.

ELECTRICAL LABORATORY.

This laboratory is equipped with standard voltmeters and ammeters, inductive and non-inductive resistances for artificial loads, and a number of transformers. About twenty generators and motors are in use or available about the college for testing purposes. A new "Chloride Accumulator" of fifty-four cells has been added to the equipment this year. This doubles the battery capacity and greatly improves the current supply for instrument testing, photometry, and all work to which a battery is especially adapted.

ASSAY LABORATORY.

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 LABORATORY.

The college has the advantage of a fine collection of models from the works of Theodore Gersdorf, Freiberg, Sax-

ony, illustrating the best type of furnaces in this and other countries. Each model is made to a scale and is complete in every detail. 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 completed set used in the famous Keyes and Arents lead-well suit.

There is a collection of ores and metallurgical products which is constantly being augmented. The laboratory also contains machinery for amalgamating, chlorination, and cyanidation of ores.

ORE DRESSING LABORATORY.

Besides taking full advantage of the location of the college for the practical study of ore dressing, the college has considerable apparatus for experimental work on both the small and the large scale. This includes crushing machines of several types, classifiers, slime tables, jigs, and concentration tables.

TESTING LABORATORY.

The laboratory is provided with a 100,000-pound Riehle testing machine arranged for experiments in tension, compression, shearing, and flexure of materials of construction. Extensometers for measuring elongations, and electrical contact micrometers for measuring deflections and compressions, are employed. Simplified apparatus for testing columns of small dimensions and beams in flexure is being prepared. Numerous steel sections provide useful problems in determining centers of gravity and moments of inertia.

CEMENT LABORATORY.

The apparatus in this laboratory consists of a 1,200-pound Richle testing machine for testing briquettes in tension. A nest of sand sieves gages the sand used in tests. Scales and volumeters are provided for measuring quantities in bulk. The specific gravity of cement is determined by means of Le Chatelier apparatus. A nest of fineness sieves and a very sensitive set of scales, equip the student for the fineness test. Setting is determined by means of the complete Vicat apparatus. Trowels, spatulas, large slate mixing boards, beakers, moulds, and immersing vats, provide apparatus for the making and setting of briquettes and for the soundness tests. Glass baths for chemical tests, trays for heaviness tests, and other general facilities, permit the most extensive tests and investigations.

MINING EQUIPMENT.

The mining equipment consists of models, maps, photographs, and lantern slides, illustrating mines and mining operations; safety lamps; instruments for measuring ventilation; an explosive tester; an electric firing apparatus, and models of timbering. The character of material mined is shown by an extensive collection of ores and rocks. Models of machinery and appliances, samples of rope, valves and injectors, supplement the college power plant in illustrating the essentials of mine plants. Numerous reports on mines and plants have been collected to illustrate the practice of engineers and the economy in the operation of power machinery.

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 containing steel measuring tapes, marking pins, hatchet, plumb bob, and other essentials. For transit work there are six light mountain transits, all of which are provided with solar attachments for determining the meridian and latitude and four of them are provided with auxiliary telescopes for

underground work. There are also two heavy transits, one of which is of English make.

For leveling, six wye levels of standard manufacture are used. The department is well supplied with leveling rods of various makes and types, stadia rods, hand levels, clinometers, flagpoles, and other accessories.

The instruments noted above are manufactured by such well-known firms as C. L. Berger and Sons, Heller and Brightly, W. and L. E. Gurley, Keufel and Esser, Young and Sons, and Negretti and Zambra (English). Additions are constantly being made, keeping pace with the growth of the school and replacing worn-out instruments.

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 twenty-five students.

Junior. The second floor of the Hall of Engineering is used for the Junior drawing, in connection with the subject of mechanism and machine design. There are two drawing rooms, 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 accommodates 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. The drafting of the Senior year is given in the drafting room on the second floor of Stratton Hall.

EXPENSES.

TUITION.

The Statutes of Colorado provide as follows:

"The said School of Mines shall be open and free for instruction to all bona fide residents of this State, without regard to sex or color, and, with the consent of the Board, students from other states and territories may receive education thereat upon such terms and at such rates of tuition as the Board may prescribe."

The tuition for non-residents is one hundred dollars per year. This is payable in two instalments—fifty dollars at the beginning of each semester.

FEES AND DEPOSITS.

Deposits are required to cover the cost of supplies consumed, and any unused balance is returned. Fees are charged to cover not only the cost of materials furnished, but also the wear on apparatus and supplies. No part of a fee is returnable.

Matriculation Fee (Paid once only)	$5.00
Locker Deposit (Paid once only)	1.00
Drawing Deposit (Paid once only)	2.00

Freshman Year.

First Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00
Qualitative Analysis Deposit	15.00

Second Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00
Surveying Fee	5.00

Sophomore Year.

First Semester.

Athletic Fee	$ 5.00
Quantitative Analysis Fee	10.00
Quantitative Analysis Deposit	15.00
Mineralogy and Blowpipe Fee	15.00
Physics Laboratory Fee	3.00

Second Semester.

Athletic Fee	$ 5.00
Quantitative Analysis Fee	10.00
Physics Laboratory Fee	3.00
Surveying Fee	5.00

Junior Year.

First Semester.

Athletic Fee	$ 5.00
Quantitative Analysis Fee (Metallurgical Engineering only)	10.00
Drawing Fee	.50
Testing Laboratory Fee	2.00
Assaying Deposit (Mining Engineering only)	25.00
Assaying Fee (Mining Engineering only)	20.00

Second Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Assaying Deposit (Metallurgical Engineering only)	25.00
Assaying Fee (Metallurgical Engineering only)	20.00

Senior Year.

First Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Ore Dressing Fee	5.00
Ore Dressing Deposit	10.00
Electro-Metallurgy Lab. Fee (Metallurgical Engineering only)	3.00
Hydraulic Laboratory Fee	2.00
Cement Laboratory Fee	2.00

Second Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Electrical Laboratory Fee	2.00
Metallurgical Laboratory Fee (Metallurgical Engineering only)	5.00
Metallurgical Laboratory Deposit (Metallurgical Engineering only)	10.00
Metallurgical Practice Fee (Mining Engineering only)	5.00
Metallurgical Practice Fee (Metallurgical Engineering only)	10.00
Steam Laboratory Fee (Mining Engineering only)	2.00
Graduation Fee	6.00

TEXT BOOKS AND STUDENT SUPPLIES.

The cost of text-books and students' supplies necessarily varies, but the following is a fair estimate:

Freshman Year:	Text-Books	$15.00
	Drawing Supplies	20.00
Sophomore Year:	Text-Books	15.00
Junior Year:	Text-Books	35.00
Senior Year:	Text-Books	17.50

BOARD AND LODGING.

The college has no dormitory. Board can be obtained in private families at from four dollars to six dollars per week. Students' clubs furnish board at about fourteen dollars per month. Rooms can be obtained from six dollars to twelve dollars per month.

OTHER EXPENSES.

There are other expenses incidental to the mining, metallurgical, and geological trips, which vary so widely that they cannot be estimated. The preparation of the Senior theses also involves expenses which vary with 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 severe protracted sickness, are not entitled to the return of fees or tuition. All charges of the college are payable strictly in advance. No student is allowed to be graduated while indebted to the school. The Trustees reserve the right to make incidental charges in fees and deposits without printed notice, as new and unforeseen emergencies may arise.

Students who desire to earn money to defray their college expenses are advised to limit their work to the summer vacation. The course of study is too exacting to allow much time during the college year for outside work.

The total expenses of the college year, exclusive of tuition, need not exceed four hundred dollars, and may, by strict economy, be considerably reduced.

GENERAL INFORMATION.

ATHLETIC ASSOCIATION.

By virtue of the athletic fee required 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 college. 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.

Officers.

LEROY L. MIDDELCAMP, '05, President.
GEORGE C. RIPLEY, '06, Secretary.
PROFESSOR H. B. PATTON, Treasurer.

Directors.

Class of '05.
LEROY L. MIDDELCAMP.
JOHN J. CORY.

Class of '06.
GEORGE C. RIPLEY.
TIFFANY STEPHENSON.

Class of '07.
H. D. WHITEHOUSE.
ALLAN PATTERSON.

Class of '08.
JOHN CULBERTSON.
MAURICE HOYT.

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 feet) 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 pulley 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 dumb-bells, and many other pieces.

The gymnasium is open every school afternoon, and till seven o'clock evenings. Hot and cold shower baths adjoin the gymnasium. Each student pays a fee of ten dollars a year to the Athletic Association and deposits one dollar for his locker.

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

LIBRARY.

The Colorado School of Mines library numbers about seven thousand five hundred volumes and four thousand pamphlets, selected with special reference to the instruction here given. Students and faculty are allowed free access to

shelves, and may draw books, which are not reserved for a special purpose, for home use. The card catalogue, which is arranged on the dictionary plan, is an adaptation of the Dewey decimal system to the needs of a technical library.

The library receives the publications of the leading scientific societies of the world, and the chief literary and scientific periodicals. It is especially rich in files of journals relating to the various branches of mining engineering, and receives as gifts the maps and various publications of the United States Geological Survey, a number of other United States documents, and reports of various state geological surveys and mining bureaus.

The library is open from 8 to 12 a. m., 1 to 5 p. m., and 7 to 10 p. m., with the exception of Sundays and legal holidays.

METHODS OF GRADING.

The following system of grading is used:

A=Excellent.
B=Good.
C=Fair.
D=Conditioned.
E=Failed.

A, B and C are passing grades.

D (Conditioned) means that the student is not passed. The deficiency may be removed by passing an examination or otherwise completing his work. Unless a condition is removed before the beginning of the school year following the year in which the condition is given, it becomes an E, and the subject must be taken again in class.

E (Failed) means that the subject must be taken again in class, and no advanced subject which depends on this one can be taken until the E is removed.

HONOR SYSTEM.

By the action of the student body on May 27, 1904, a Constitution was adopted and the Honor System inaugurated. The Constitution was approved by the Faculty June 4, 1904. The object of this movement is to place in the hands of a

Senate elected by the students, the trial, and the recommendation for punishment, of any student detected in unfair practices in his school work. The Senate is composed of the following students:

CLASS OF 1905.

Arthur F. Hewitt.
William E. Ryan.
George B. Rice.
Alternate, Arthur T. Thomson.

CLASS OF 1906.

Ernest E. Thum.
Wayne S. Kell.
Tiffany Stephenson.
Alternate, William G. Dow.

CLASS OF 1907.

William W. Blackburn.
Theodore W. Quayle.
Howard C. Armington.
Alternate, William M. Johnston.

CLASS OF 1908.

John T. Boyd.
L. P. Curtis.
William R. Kilgore.
Alternate, John V. Hubbard.

COLLEGE Y. M. C. A.

The Young Men's Christian Association is represented in the college by a branch organization which maintains a reading room in the center of the city. This room is open Friday and Saturday evenings for social purposes. An effort is made to receive incoming students and to assist them in finding rooms and board. They are encouraged to form high standards of Christian character and are helped maintain such standards. A reception at the opening of the college year gives new men an opportunity to meet faculty and

students in a social way. A hand book of information is issued annually by the Association, and can be obtained on application to the corresponding secretary.

The officers are:

A. C. Terrill, President.
W. S. Kell, Vice President.
D. Muir, Treasurer.
C. M. Rath, Recording Secretary.
C. L. Colburn, Corresponding Secretary.

SCIENTIFIC SOCIETY.

The Scientific Society of the Colorado School of Mines has for its object the presentation and discussion of technical and engineering subjects. Original papers are prepared and read before the society by its active members. The editorial staff has in operation a comprehensive system for the review of current technical literature and the bringing before the society of the noteworthy and salient questions of the day. The addressing of an assembly by the students insures the stimulation of confidence, which is so essential to the technical and professional man in his career. From time to time lectures are delivered before the society by the leading authorities on various topics of primary interest to its members and friends. The proceedings of the society are printed in its official publication, "The Bulletin," which is issued twice during the school year. The Alumni, Faculty, Senior and Junior classes of the college constitute the active members of the organization, while the Sophomores and Freshmen are associates.

Meetings are held at least once a month, often more frequently, in the Hall of Engineering.

Officers for the year 1904-05 are as follows:

Fred C. Carstarphen, President.
Wm. J. Hallett, Vice President.
Geo. B. Putnam, Secretary.
Arthur C. Terrill, Treasurer.
Arthur T. Thompson. Manager of the Bulletin.
Julius Hornbein, Editor of the Bulletin.

SPANISH.

In response to the demand from students who expect to pursue their vocation in Mexico, a private class in Spanish is conducted by Mr. Evaristo Parades, a native of Mexico and a student of the college, and by Mr. H. R. Van Wagenen.

GIFTS TO THE COLLEGE.

C. M. Fuelleр, E. M., Denver, Colo.
Plans of two recent cyanide mills and the preliminary plan of a 500-ton concentration plant.

United States Colortype Company, Denver, Colo.
Pictures illustrating Color Photography.

Mr. George S. Clason, Denver, Colo.
Maps of
San Juan Triangle,
Gunnison County,
North Gilpin County,
Grand County,
Larimer County,
The Gregory-Buell Consolidated Gold Mining & Milling Company's properties.

Denver Gas and Electric Company, Denver, Colo.
Four 40-light Westinghouse transformers.

Capt. E. L. Berthoud, Golden, Colo.
Map of
South Africa, and
Geological Map of France.

Mr. James Underhill, Idaho Springs, Colo.
Maps of Lower Clear Creek and Gilpin Counties, showing mining claims in the vicinity of Idaho Springs.

Cambria Steel Company, Johnstown, Pa.
Set of steel sections, rivets, and bolts.

Sullivan Machine Company, Chicago, Ill.
Pictures of four-stage air compressor.

Colorado & Southern Railway Company.
Pictures of Clear Creek Canon.

Colorado Midland Railway Company.
Pictures of Hagerman Pass and other points in the Rocky Mountains.

Pennsylvania, New York and Long Island R. R. Co.
Specifications and contract drawings.

Stearns-Rogers Manufacturing Company, Denver, Colo.
Pictures of machinery.

Mine and Smelter Supply Company, Denver, Colo.
Thirty-one drawings of mining and metallurgical machinery.

Colorado Portland Cement Company, Denver, Colo.
Barrel of cement for Cement Laboratory.

Boston and Montana Consolidated Copper and Silver Mining Company.
A full set of specimens illustrating the metallurgy of the sulphide ores of copper.

Butte and Boston Consolidated Mining Company.
Four hundred samples of gold and silver bearing ores and furnace products for assaying.

American Smelting and Refining Company.
One thousand pulp samples of gold, silver, and copper ores for assaying.

Duplex Hanger Co., Cleveland, Ohio.
Samples of hangers and wall plates.

Bronze Memorial Tablet in memory of Wade Lawrence Crow, Class of 1901, by his family.

Bronze Memorial Tablet in memory of Raymond Bishop, Class of 1901, by his family.

Granite Memorial Tablet in memory of Professor Robert Nelson Hartman, by his colleagues, pupils, and friends.

The B. L. James M. and M. Co. Denver.
Calculating slide rule.

Rand Drill Co., New York.
Pictures of air compressors.

GIFTS TO THE LIBRARY.

	Books.	Pamphlets.
Agricultural College of Utah	..	1
Alabama Geological Survey	..	1
Alderson Prcs. V. C.	50	13
American Book Co.	1	..
American School of Correspondence	13	5
American Swedenborg Publishing Co.	3	..
Amherst College	..	1
Armour Institute of Technology	..	1
Bailar, J. C.	..	1
Blake, W. P.	..	1
Bridge, J. H.	1	..
Chemical and Metallurgical Society of South Africa	1	2
Colgate University	..	1
Colorado Agricultural College	..	2
Colorado Normal School	..	1
Creighton University	..	1
Crosby Steam Gage & Valve Co.	1	..
Denver Public Library	..	2
Doane College	..	1
Doherty, H. L.	1	..
General Electric Co.	1	20
Ginn & Co.	4	..
Heath, D. C. & Co.	2	..
Holy Cross College	..	2
Ickis, H. M.	..	1
Indiana University	..	1
International School of Correspondence.	11	..
John B. Stetson University	..	1
John Crerar Library	..	2
Johns Hopkins University	..	1
Lewis Foundry & Machine Co.	..	1
Lewis Institute	..	1
Louisiana State University	..	2
Macmillan Co.	4	..
Massachusetts Institute of Technology.	..	2
Meyer, Dr. Paul	1	..
Mine & Smelter Supply Co.	1	..

Missouri School of Mines	..	1
Missouri University	..	1
Montrose County High School	..	1
New York State Museum	1	5
North Carolina University	..	1
Notre Dame University	..	2
Patton, Prof. H. B.	18	16
Purdue University	..	1
Rose Polytechnic Institute	..	1
Ross, David	1	..
Simpson College	..	1
Texas Christian University	..	1
Transcontinental Transportation & Mining Co.	1	..
Transvaal Technical Institute	..	2
Traphagen, Prof. F. W.	..	2
United States Government	325	185
University of Cincinnati	..	1
University of Colorado	..	7
University of Denver	..	1
University of Illinois	..	2
University of Michigan	..	1
University of Oregon	..	1
University of Utah	..	1
University of Vermont	..	1
University of Wisconsin	..	9
Ursimus College	..	3
Walker, Prof. L. C.	..	1
Washburn College	..	2
Washington University	..	1
Western Australia School of Mines	..	1
Whitman College	..	1
Wolcott, Prof. E. R.	..	1

PRIZES.

Mr. A. B. Frenzel, of Denver, has offered through the Colorado Scientific Society a prize of two hundred and fifty dollars to the student of the Colorado School of Mines who submits the best paper on "Tungsten in Colorado." The Colorado Scientific Society has appointed Mr. W. F. Ed-

wards, Dr. W. P. Headden and Prof. Horace B. Patton as a committee to represent it in the matter.

Mr. A. B. Frenzel has also offered the college the following prizes:

I. Twenty-five dollars in books to be awarded to the best student in crystallography, blow-pipe analysis, and determinative mineralogy of the Sophomore year.

II. Twenty-five dollars in books to be awarded to the best student in general geology, lithology, and field geology of the Junior year.

III. Twenty-five dollars in books to be awarded to the best student in economic and field geology of the Senior year.

IV. Twenty-five dollars in books to be awarded for the best thesis of the Senior year.

A friend of the college has offered a cash prize of fifty dollars for the best thesis submitted by any member or members of the Senior class.

These prizes will be awarded at Commencement, May 26, 1905.

ASSAYING AND METALLURGICAL EXHIBIT AT THE LOUISIANA PURCHASE EXPOSITION.

The college has maintained during the period of the Exposition a working assay and metallurgical laboratory in the Metal Pavilion. It has been under the immediate supervision of the President and Professors Traphagen and Fleck, assisted by the students of the college, who have been sent to the exhibit in groups of four, each group spending three or four weeks in charge of the work. The exhibit was made possible by a Legislative appropriation of $3,000, supplemented by the liberality of the following firms in supplying the needed equipment: Denver Fire Clay Company, Denver, Colo.; Ainsworth and Sons, Denver, Colo.; Colorado Portland Cement Company, Denver, Colo.; American Gas Furnace Company, Elizabeth, N. J.; and the State Department of Mines of Colorado. It is believed that this is the first instance in the United States of a mining school making a practical working exhibit of the assaying and metallurgical processes as taught in school. The exhibit was awarded a gold medal.

SOCIAL CLUB.

Social life in the college is fostered by a regularly appointed body of students consisting of three members from each class. Several receptions during the year are given under their management.

CLASS OF '05.

WILLIAM E. RYAN, President.
LUTHER W. LENNOX, Secretary and Treasurer,
Eldon L. Larison.

CLASS OF '06.

William H. Freeland,
Rush T. Sill,
Martin Kleff.

CLASS OF '07.

William W. Blackburn,
Franklin P. Lannon,
Philo D. Grommon.

CLASS OF '08.

William C. Rambo,
Arthur G. Jaffa,
Charles T. Kennedy.

ENROLMENT OF STUDENTS
CLASS OF 1905.

SENIOR.

OFFICERS.

President, LUTHER W. LENNOX.
Vice-President, GEORGE B. PUTNAM.
Secretary, JULIUS HORNBEIN.
Treasurer, EVARISTO PAREDES, JR.

Allen, Carl A.....*La Junta, Colo.*
Austin, Arthur.....*Denver, Colo.*
Bailey, Elbert W.....*Denver, Colo.*
Berry, Albert.....*Leadville, Colo.*
Brown, Robert L.....*Denver, Colo.*
B. S., Beloit College.
Busey, Alfred P., Jr.....*Pueblo, Colo.*
Carstarphen, Frederiek C.....*Denver, Colo.*
Chamberlin, W. O.....*Denver, Colo.*
Cory, John J.....*Golden, Colo.*
Cuno, Albert F.....*Denver, Colo.*
D'Arey, R. L.....*Denver, Colo.*
Duer, Charles L.....*Denver, Colo.*
Eames, L. B.....*Pueblo, Colo.*
Flint, Fred F.....*Greeley, Colo.*
Ford, Homer D.....*Denver, Colo.*
Garza, J. M.....*Torreon, Coahula, Mexico.*
E. M., Stevens Institute of Technology.
Greve, Edgar E.....*Brooklyn, N. Y.*
E. M., Stevens Institute of Technology.
Grider, R. L.....*Seiad Valley, Colo.*
Hallett, Robert L.....*Denver, Colo.*
Hallett, William J.....*Denver, Colo.*
Harrison, Thos. S.....*Evansville, Ind.*
Hewitt, Arthur F.....*Denver, Colo.*
Hornbein, Julius.....*Denver, Colo.*
Hunt, T. R.....*Denver, Colo.*
Hyder, Charles A.....*Denver, Colo.*
Larison, Eldon L.....*Golden, Colo.*
Lee, Robert P.....*Denver, Colo.*

Lennox, Luther W.....*Colorado Springs, Colo.*
Lewis, Alfred S.....*Denver, Colo.*
Lonergan, Philip J.....*Colorado Springs, Colo.*
McCart, Robert.....*Denver, Colo.*
Middelkamp, Leroy L.....*Pueblo, Colo.*
Muir, Douglas.....*San Antonio, Texas.*
Neville, John B., Jr.....*Denver, Colo.*
O'Byrne, Joseph F.....*Cripple Creek, Colo.*
Paredes, Evaristo, Jr.....*Culiacan, Sin, Mexico.*
Pfeiffer, G. N.....*O'Fallon, Ill.*
Pressler, Louis P.....*Golden, Colo.*
Putnam, George B.....*Denver, Colo.*
Rabb, Edward M.....*Denver, Colo.*
Rath, Charles M.....*Telluride, Colo.*
Reinhard, Frank J.....*Golden, Colo.*
Rice, George B.....*Denver, Colo.*
Richards, Edwin R.....*Montrose, Colo.*
Ryan, William E.....*Denver, Colo.*
Smith, Eric M.....*Montrose, Colo.*
Spangler, Howard.....*Denver, Colo.*
Stoeckley, Ernest F.....*Canon City, Colo.*
Terrill, Arthur C.....*Colorado Springs, Colo.*
Thomson, Arthur T.....*Pueblo, Colo.*

CLASS OF 1906.

JUNIOR.

OFFICERS.

President, RUSH T. SILL.
Vice-President, CHARLES N. BELL.
Secretary, WILLIAM H. FINIGAN.
Treasurer, WAYNE S. KELL.

Abel, Walter D.....*Denver, Colo.*
Aldrich, Harold W.....*Boulder, Colo.*
Allen, Maynard C.....*Denver, Colo.*
Armold, Clarence S.....*Golden, Colo.*
Badgley, Charles W.....*Denver, Colo.*
Ball, Max W.....*Golden, Colo.*
Barker, Franklin L.....*Golden, Colo.*
A. B., Colgate University.
Bartholomew, Tracy .....*Denver, Colo.*
Bell, Charles N.....*Denver, Colo.*
Braun, Arthur P.....*Toledo, Ohio.*
Brown, John B.....*Denver, Colo.*
Brown, Osborne E.....*Golden, Colo.*
Brunel, Rene L.....*Golden, Colo.*
Buell, Arthur W.....*Golden, Colo.*
Chapman, Thos. L.....*Aspen, Colo.*
Colburn, Clare L.....*Denver, Colo.*
Dow, William G.....*Denver, Colo.*
Ellis, Thomas P.....*Denver, Colo.*
Ellsworth, Alfred C.....*Chicago, Ill.*
B. S., University of Chicago.
Emens, Ray .....*Victor, Colo.*
Finigan, William H.....*St. Louis, Mo.*
Frank, M. E.....*Chicago, Ill.*
Freeland, William H., Jr.....*Denver, Colo.*
Friedhoff, William H.....*Pueblo, Colo.*
Gilbert, Arthur K.....*Denver, Colo.*
Gilbert, William J.....*Denver, Colo.*
Goodale, F. Augustus.....*Trinidad, Colo.*
Gordon, John Gardner, Jr.....*Maplewood, Mo.*
Harkison, Charles W.....*Golden, Colo.*

Hazlehurst, Lindley M.....*Winnetka, Ill.*
Heitz, George H.....*Denver, Colo.*
Hensley, James H., Jr.....*Denver, Colo.*
Hollis, Don D.....*Golden, Colo.*
Ingersoll, J. Curtis.....*Denver, Colo.*
Kell, Wayne S.....*Denver, Colo.*
Kleff, J. Marvin.....*Golden, Colo.*
Koerner, Albert J.....*St. Louis, Mo.*
Levy, Archibald L.....*Denver, Colo.*
B. S. in C. E., Purdue University.
Libby, Jas. L.....*Cheyenne, Wyo.*
McKee, M. D.....*Minersville, Pa.*
A. B., Yale University.
Munroe, H. S.....*Joliet, Ill.*
Neugebauer, Karl E.....*Pueblo, Colo.*
Norton, Albert C.....*La Junta, Colo.*
Nyberg, H. E.....*Pueblo, Colo.*
Parks, George A.....*Denver, Colo.*
Patterson, Seely B., Jr.....*Allentown, Pa.*
Ripley, G. Clinton.....*New York, N. Y.*
Schlereth, C. Quinby.....*Denver, Colo.*
Sill, Rush T.....*Colorado Springs, Colo.*
Speer, Alexander.....*Golden, Colo.*
C. E., Princeton University.
Stephenson, Tiffany.....*Ft. Morgan, Colo.*
Stotesbury, Harold W.....*Leadville, Colo.*
Thum, Ernest E.....*Denver, Colo.*
Van Wagenen, Hugh R.....*Denver, Colo.*
Waddey, Albert Y.....*Richmond, Va.*
Wegeforth, C. Parker.....*Chicago, Ill.*
Whipple, Charles R.....*Brownsburg, Va.*
A. B., Washington and Lee University.
Zulch, Herman C.....*Denver, Colo.*

CLASS OF 1907.

SOPHOMORE.

OFFICERS.

President, FRANKLIN P. LANNON, JR.
Vice-President, BENJAMIN W. PURDY.
Secretary, CHARLES E. NEWTON.
Treasurer, GEORGE P. MOORE.

Alsip, Albert A.....*Chicago, Ill.*
Armington, Howard C.....*Leadville, Colo.*
Bailey, W. G.....*Paterson, N. J.*
Barker, Pierce.....*Philadelphia, Pa.*
Bastanchury, Gaston.....*Fullerton, Cal.*
Benjovsky, Theo. D.....*Del Norte, Colo.*
Benton, Josiah H.....*Branford, Conn.*
A. B., Yale University.
Blackburn, William W.....*Denver, Colo.*
Brandt, Arthur R.....*Denver, Colo.*
Broughton, Laurence L.....*St. Paul, Minn.*
Brown, Charles L.....*Golden, Colo.*
Brown, William E.....*Greeley, Colo.*
Brown, James B.....*Denver, Colo.*
Carpenter, Cranston H.....*Denver, Colo.*
Cater, George H.....*Golden, Colo.*
B. S., Northwestern University.
Corson, Norman G.....*Del Norte, Colo.*
Curtis, Ben. K.....*Canon City, Colo.*
Ebersole, Dale G.....*Cincinnati, Ohio.*
Ehnbom, Lasse.....*Boulder, Colo.*
French, Burr J.....*Denver, Colo.*
French, Sidney W.....*Denver, Colo.*
Geisel, Clarence R.....*Ouray, Colo.*
Golden, John P.....*O'Neill, Neb.*
B. S., University of Nebraska.
Gow, Paul A.....*Golden, Colo.*
Grommon, Philo D.....*Denver, Colo.*
Head, F. L. R.....*Denver, Colo.*
Headech, William.....*Nenaugh Co., Tipperary, Ireland*
Hemberger, Charles.....*Golden, Colo.*

Howat, Andrew M. ..... *Salt Lake City, Utah*
Ireland, Carrol B. ..... *Golden, Colo.*
Isom, Edward W. ..... *Kenilworth, Ill.*
Iyengar, Krishnasami S. ..... *Bangalore, India*
Jacques, H. J. ..... *Denver, Colo.*
James, James S. ..... *La Crosse, Wis.*
Jacquette, Charles M. ..... *Grand Junction, Colo.*
Jess, John A. ..... *Springfield, Ill.*
C. E., Princeton University.
Johnston, William M. ..... *Hygiene, Colo.*
Keene, Lewis M. ..... *Minneapolis, Minn.*
Kenner, Alvin R. ..... *Chicago, Ill.*
Kishman, Maurice W. ..... *Pueblo, Colo.*
Knight, Ruben E. ..... *Denver, Colo.*
Krueger, George S. ..... *Berthoud, Colo.*
Lannon, Franklin P., Jr. ..... *Pueblo, Colo.*
Lehman, Warren L. ..... *Chicago, Ill.*
Lehmer, Herman K. ..... *Omaha, Neb.*
Levell, Alexander ..... *Victor, Colo.*
Link, Karl G. ..... *Denver, Colo.*
Lyneman, Felix A. ..... *Denver, Colo.*
Maddux, Richard H. ..... *Golden, Colo.*
Martin, Jacob A. ..... *Golden, Colo.*
Merewether, Edward ..... *Hereford, England*
Merz, Julius H. ..... *Laramie, Wyo.*
A. B., University of Wyoming.
Moore, Charles F. ..... *Denver, Colo.*
Moore, George P. ..... *Winsted, Conn.*
Newton, Charles E. ..... *Denver, Colo.*
Nova, Harry ..... *Brooklyn, N. Y.*
Overman, Benton ..... *Denver, Colo.*
Parsons, Fletcher H. ..... *Paterson, N. J.*
A. B., Wesleyan University.
Patterson, Allan ..... *Walden, North Park, Colo.*
Phelps, William B. ..... *Los Angeles, Cal.*
B. S., St. Vincent College.
Pray, Milton A. ..... *Golden, Colo.*
Prosser, Warren C. ..... *Silverton, Colo.*
Purdy, Benj. W. ..... *Durango, Colo.*
Quayle, Theodore W. ..... *Denver Mills, Colo.*
Reed, Thomas H. ..... *Kansas City, Mo.*
Reno, Charles A. ..... *Golden, Colo.*
Richards, A. F. ..... *Montrose, Colo.*
Ross, George M. ..... *Golden, Colo.*
Rudge, Harry ..... *Denver, Colo.*
Sandusky, Samuel C. ..... *Salida, Colo.*
Schilling, William B. ..... *Laramie, Wyo.*
Seltzer, Andrew J. ..... *Denver, Colo.*

Shaver, Francis J.....*San Jacinto, Cal.*
Shields, Jas C.....*Highland Park, Ill.*
Shumway, Ralph W.....*University Park, Colo.*
Starnes, X. B.....*Asheville, N. C.*
Stuart, Malcolm M.....*Denver, Colo.*
Taylor, Robert M.....*Golden, Colo.*
Trott, Maynard J.....*Golden, Colo.*
Wherry, Lindley P.....*Denver, Colo.*
White, J. L.....*Denver, Colo.*
White, Dudley A.....*Colorado Springs, Colo.*
Whitehouse, H. D.....*Golden, Colo.*
Wolf, Albert G.....*Golden, Colo.*
Wright, George T.....*Paris, Texas*
Zeiger, Robert L.....*Pueblo, Colo.*

CLASS OF 1908.

FRESHMAN.

OFFICERS.

President, WILLIAM C. RAMBO.
Vice-President, VAL DE CAMP.
Secretary, JOHN P. ADAMS.
Treasurer, ROBERT ELDER.

Adams, John P.....*Greeley, Colo.*
Anfenger, Max. B.....*Denver, Colo.*
Ashton, Millard H.....*Rutherford, N. J.*
Atkins, J. William.....*Evanston, Ill.*
Baird, George K.....*Golden, Colo.*
Block, Gary E.....*Prescott, Arizona*
Bosquet, H. Fred.....*Ouray, Colo.*
Bowman, Reginald G.....*Peru, Ind.*
Boyd, Jesse T.....*Silver Springs, Pa.*
Brinker, Albert W.....*Denver, Colo.*
Brown, Thomas G.....*Ophir, Colo.*
Brueggemann, Fritz.....*Denver, Colo.*
Bryan, Russel R.....*Denver, Colo.*
Bunger, Milne E.....*Wheatridge, Colo.*
Burgess, Charles W.....*Denver, Colo.*
Burlew, George L.....*Denver, Colo.*
Butler, Reginald H. B.....*Leeds, England*
Chedsey, William R.....*Denver, Colo.*
Clapp, Harry B.....*Denver, Colo.*
Clarke, Melvin W.....*Denver, Colo.*
Crane, Francis J., Jr.....*Denver, Colo.*
Culbertson, John.....*Bellevue, Pa.*
Curtis, Leroy P.....*Littleton, Colo.*
DeCamp, Val.....*Denver, Colo.*
De Lescaille, Ray.....*Davenport, Iowa*
Dilts, Ira J.....*Ft. Collins, Colo.*
Dunlevy, Forrest S.....*Denver, Colo.*
Elder, Robert B.....*Denver, Colo.*
Ellsworth, Huber H.....*Chicago, Ill.*
Emrich, Clarence T.....*Golden, Colo.*
Evans, Willis.....*Golden, Colo.*

Fahey, William C.....*San Antonio, Texas*
Feldman, Samuel A.....*Denver, Colo.*
Flanders, Harvey H.....*Glencoe, Ill.*
Fleischer, Ben.....*Denver, Colo.*
Fletcher, Thomas S.....*Beatrice, Neb.*
Frick, Frederick F.....*Peru, Ind.*
Goe, Harold H.....*Colorado Springs, Colo.*
Grant, Dabney.....*Kansas City, Mo.*
Greenewald, William E.....*Denver, Colo.*
Halter, Richard G.....*San Antonio, Texas*
Hemphill, Earl A.....*Denver, Colo.*
Holderer, George B.....*Denver, Colo.*
Hoyt, Maurice.....*Golden, Colo.*
Hubbard, John V.....*Colorado Springs, Colo.*
Hughes, Charles B.....*Peru, Indiana*
Hughes, Grant.....*Durango, Colo.*
Hull, Cecil B.....*Denver, Colo.*
Jaffa, Arthur G.....*Trinidad, Colo.*
Jensen, Anton.....*Denver, Colo.*
Johnson, Walter.....*Golden, Colo.*
Kemble, Jesse B.....*Golden, Colo.*
Kennedy, Charles T.....*Denver, Colo.*
Kilgore, William R.....*La Junta, Colo.*
Knowles, Benjamin W.....*Denver, Colo.*
Knox, Edgar C.....*Independence, Mo.*
Koenig, George N.....*Golden, Colo.*
Krowell, Andrew W.....*Chicago, Ill.*
Lada, Paul F.....*Golden, Colo.*
Lakes, Arthur, Jr.....*Denver, Colo.*
Lesher, Carl E.....*La Junta, Colo.*
Linderfelt, Robert J.....*Golden, Colo.*
Linderfelt, Thomas C.....*Golden, Colo.*
Meldrum, David T.....*Oregon City, Ore.*
Morrison, Claude B.....*Denver, Colo.*
Morrison, John.....*Golden, Colo.*
Murch, Clarence H.....*Denver, Colo.*
Nickerson, Chester.....*Warsaw, Wis.*
Norris, Don R.....*Denver, Colo.*
O'Byrne, Will H.....*Cripple Creek, Colo.*
Olmstead, Fred J.....*Golden, Colo.*
Page, Lawrence C.....*Norfolk, Va.*
Pfeil, Walter H.....*Pittsburg, Pa.*
Rambo, Wm. C.....*Montclair, Colo.*
Roehrig, George F.....*Denver, Colo.*
Rogers, Harry H.....*Denver, Colo.*
Rood, Albert B.....*Grand Junction, Colo.*
D. D. S. Northwestern University.
Root, Charles D.....*Denver, Colo.*

Ross, Harry B.	*Denver, Colo.*
Russell, Carl L.	*La Porte, Ind.*
Sauter, Frank J.	*Golden, Colo.*
Shaffer, Byron L.	*Del Norte, Colo.*
Shellenberger, Henry N.	*Colorado Springs, Colo.*
Shonyo, Dwight E.	*Salida, Colo.*
Tennant, M. Roy.	*Littleton, Colo.*
Thurston, Ralph V.	*Payette, Idaho*
Tuttle, Hiram H.	*Golden, Colo.*
Vaughn, Harold S.	*Denver, Colo.*
Vidler, S. Goring.	*Georgetown, Colo.*
Watson, Scott	*Greenville, Miss.*
Weinig, Arthur J.	*Durango, Colo.*
Wheeler, Robert M.	*Denver, Colo.*
Wilson, Dudley M.	*Golden, Colo.*
Wilson, Raymond C.	*Pueblo, Colo.*
Wolfe, George T.	*Cripple Creek, Colo.*
Wood, Ernest B.	*Denver, Colo.*

ENROLMENT BY CLASSES.

Senior Class	50
Junior Class	58
Sophomore Class	86
Freshman Class	96
Total	290

GEOGRAPHICAL DISTRIBUTION.

Colorado	214
Illinois	16
Pennsylvania	6
Missouri	6
Indiana	5
Texas	4
New Jersey	3
Nebraska	3
Virginia	3
New York	3
California	3
Wyoming	3
Wisconsin	2
Connecticut	2
Minnesota	2
Ohio	2
Iowa	1
Oregon	1
Idaho	1

Mississippi	1
Arizona	1
Utah	1
North Carolina	1
England	2
Mexico	2
India	1
Ireland	1
Total	290

THE ALUMNI BY CLASSES.

Those marked with an asterisk are deceased.

1883.

Middleton, William 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, Charles 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, William H.....*Colorado Springs, Colo.*
Mining Engineer.
*Wertheim-Salomonson, F. M. G. A.....

1890.

Comstock, Charles W.....*213 Boston Bldg., Denver, Colo*
Civil and Mining Engineer

1891.

Johnson, Edward W.....*Murray, Utah*
Assistant Superintendent Murray Plant, Am. S. & Ref. Co.
Smith, Charles D.....*Atacama, Peru, S. A.*
Metallurgist.

1892.

Aller, Frank B.....*Peru, S. A.*
Metallurgist with M. Guggenheim.

Brown, Norton H.....*Denver, Colo.*
Surveyor General's Office.

Budrow, William B.....*Pueblo, Colo.*
Assistant Superintendent, Philadelphia Smelter.

Cole, Burt .....*St. Louis, Mo.*
Chief Engineer Illinois Fuel Co.

Hindry, Willis E.....*El Oro, Estado de Mexico, Mexico*
General Manager Esperanza Mining Co.

Kimball, George K., Jr.....*Idaho Springs, Colo.*
Superintendent, Old Town Consolidated Mining Co.

Kimball, Joseph S.....*Denver, Colo.*
Surveyor General's Office.

Lewis, William B.....*Denver, Colo.*
President, Pine River Lumber Co.

McMahon, Charles H.....*Santa Barbara, Chihuahua, Mexico*
General Superintendent, Montezuma Lead Co.

1893.

Collins, Philip M.....*Salida, Colo.*
Mining Engineer, S. and R. Reduction Works.

Hawley, R. Howard.....*Monterey, Mexico*
Chemist, National Mexican Smelting Co.

Jewell, Gilbert E.....*Chartres Towers, Queensland, Australia*
Metallurgist.

Milliken, William B.....*Denver, Colo.*
Mining Engineer.

Osborne, Arthur H.....*Georgetown, Colo.*
U. S. Deputy Mine Surveyor.

Stephens, Wallace A.....*1361 Logan Ave., Denver, Colo.*
Mining Engineer.

1894.

Atkins, Horace H.....*Pueblo, Colo.*
Chemist and Assayer, Philadelphia Plant.

Bowie, James W.....*Gallup, New Mex.*
Mine Superintendent, Caledonia Coal Co.

Post, George M.....*2928 Hale St., Denver, Colo.*
Assistant City Engineer.

Saint Dizier, Julius L.....*San Luis Potosi, Mexico*
Assistant Superintendent Cia Metalurgica, Mex., N. A. Smelter; Consular Agent of France; Professor of Analytical Chemistry and Metallurgy at the Scientific Institute.

Schneider, George W.....*135 Logan Ave., Denver, Colo.*
State Mine Inspector.

Wheeler, Charles E.....*Lampazos, Mexico*
Mining Engineer.

1895.

Arthur, Ed. P.....*Cripple Creek, Colo.*
Mining Engineer and U. S. Deputy Mine 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, Charles T.....*Gilt Edge, Fergus County, Mont.*
Manager Central Montana Mines Co.
Eaton, Albert L.....*Chihuahua, Mexico*
Mining Engineer, Chihuahua and El Potosi Mining Co.
Eye, Clyde M.....*Rossland, B. C.*
Superintendent, Rossland Power Co.
Field, Fred M.....*Pony, Mont.*
Metallurgist.
Gray, Latimer D.....*Rock Springs, Wyo.*
Electrical Engineer, Union Pacific Coal Co.
Hartzell, Lester J.....*Butte, Mont.*
Instructor in Laboratories, Montana School of Mines.
Kennedy, George A.....*2709 Boulevard F., Denver, Colo.*
Mining Engineer.
Limbach, Edmund C.....*Gilt Edge, Mont.*
Superintendent, Chicago-Montana Gold Mining Co.
Maxwell, Fred A. G.....*Randfontein, Transvaal, South Africa*
Metallurgist, Randfontein Estates.
Merryman, Herbert E.....*Cripple Creek, Colo.*
Surveyor.
Parker, James H.....*New York, N. Y.*
Student, Columbia University.
Rowe, Edmund E.....*325 Irvington Place, Denver, Colo.*
Manufacturer, E. E. Rowe & Co., Pressed Brick.
*Shetler, Waverly .....
Skinner, Lewis B.....*Denver, Colo.*
Western Chemical Manufacturing Co.
Stannard, Burt C.....*Everett, Wash.*
Chemist, Puget Sound Reduction Co.
Stockton, Robert S.....*Billings, Mont.*
Engineer, Crow Reservation Project, U. S. Geological Survey.
Suhr, Otto B.....*Niagara Falls, Ontario*
Resident Engineer, The Niagara Construction Co.
Titsworth, Frederick S.....*202 Boston Bldg., Denver, Colo.*
Lawyer.
Wallace, Lewis R.....*Morenci, Ariz.*
Superintendent, Detroit Copper Co.
Young, Frank B.....*Box 81, Exeter, Tulare County, Cal.*

1896.

Atkinson, Walter J.....*Chicago, Ill.*
Civil Engineer.
Barensheer, William J.....*Taylor and Bert Sts., Denver, Colo.*
Assayer.
Barnes, Corrin.....*1843 Lawrence St., Denver, Colo.*
Assayer and Chemist.
Beeler, Henry C.....*Cheyenne, Wyo.*
Wyoming State Geologist.
Dwelle, Jesse E.....*Piute, Hern County, Cal.*
Bright Star Mine.
Griswold, George G.....*1260 Race St., Denver, Colo.*
Chemist, Globe Smelter.
Hoyt, George F.....*Mapimi, Durango, Mexico*
Assistant Superintendent, Smelter Minera de Peñoles.
Maynard, Rea E.....*Honolulu, Hawaiian Islands*
Milliken, John T.....*Deadwood, S. Dak.*
Imperial G. M. & M. Co.

Mitchell, George B.....*67 Dubord St., Montreal, Canada*
Assistant Engineer, Canadian Pacific Railway.

Nance, William H.....*Breckenridge, Colo.*
Superintendent Milling Department Quandary Mountain Mining and Milling Co.

Newnam, William E.....*Omaha, Neb.*
Chemist, A. S. & R. Co., Omaha Plant.

Paul, William H.....*2136 Marion St., Denver, Colo.*
Mining Engineer.

Strout, Fred McL.....*Deadwood, S. Dak.*
General Superintendent, Golden Crest Mining Co.

1897.

Buck, Arthur H.....*Miniaca, Chihuahua, Mexico*
Engineer, Sunset Mining Co.

Bussey, Edwin E.....*136 Florissant St., Cripple Creek, Colo.*
Gold Coin Mine, Victor.

Canning, Herbert A.....*Aspen, Colo.*
Mining Engineer.

Cohen, Louis.....*Sombrerete, Zacatecas, Mexico*
Assayer, Sombrerete Mining Co.

Draper, Marshall D.....*210-220 McPhee Bldg., Denver, Colo.*
Mining Engineer, American Exploitation Co.

Febles, John C.....*Box 153, Butte, Mont.*
Chemist, Anaconda Copper Mining Co.

Gross, John .....*Maitland, S. Dak.*
Mill Superintendent, Maitland Properties.

Hazard, W. J.....*Golden, Colo.*
Assistant Professor of Electrical Engineering, Colo. School of Mines.

Jarvis, R. P.....*Pullman, Wash.*
Professor of Mining and Metallurgy, Washington Agricult'al College.

Kelley, W. A.....*Denver, Colo.*
Chemist, McArthur-Forest Co.

Lerchen, F. H.....*630 Bryson Block, Los Angeles, Cal.*
Stephenson-Bennett Const. M. Co., Organ, N. M.

Logue, N. W.....*El Tigre, Sonora, Mexico (via Douglas)*
Mining Engineer.

MacGregor, George H.....*Central City, Colo.*
Old Town Mine.

McLeod, J. Norman.....*Salida, Colo.*
Assayer and Chemist.

Nelson, H. E.....*711 Fifth Ave., Spokane, Wash.*
Engineer for Bradley Eng. & Mach. Co.

Nye, Robert.....*1821 Sixth Ave., Moline, Ill.*
Manager of the Moline Mining Co.

Powell, George F.....*Venus Camp, Cal. (via Yuma, Ariz.)*
Superintendent, California King Gold Mines Co.

Roller, Arthur H.....*Idaho Springs, Colo.*
Superintendent, Shafter Mining Co. and Hudson Reduction Co.

Schumann, Enrique A.....

Starbird, H. B.....*Victorville, Cal.*
Lessee and Manager, Rose Mine.

Warnecke, Carl M.....*Sherman, Cal.*
Chief Electrician, Los Angeles-Pac. Railway Co.

Weed, Floyd .....*Kimberly, Utah*
Care Annie Laurie Mine.

Woods, Thomas H.....*Ouray, Colo.*
Superintendent, Camp Bird (Limited) Mills.

1898.

Barbour, Percy P.....*Idaho Springs, Colo.*
Surveyor, Stephens & Barbour.

Bertschy, Perry H.....*Gilt Edge, Mont.*
Chemist, Great Northern M. & D. Co.

Blumenthal, Emil E.....*Philipsburg, Mont.*
Chemist, Granite Bi-Metallic Mining Co. Con.

Caldwell, Florence H. (Mrs. Frank H. Jones).....*Trail, B. C., Canada*

Church, Myron J.....*Victor, Colo.*

Clark, Winfred N.....*Victor, Colo.*
Superintendent, Mountain Division Pueblo and Suburban Traction and Lighting Co.

Corry, Arthur V.....*Butte, Mont.*
Manager, Mont d' Or Mine.

Davey, William R.....*Lake City, Colo.*
Assayer.

Dollison, James E.....*Alma, Colo.*
Surveyor and Proprietor Alma Assay Office.

Hamilton, Frank R.....*Ouray, Colo.*
Assayer, Camp Bird Mine.

Harrington, Orville.....*Rock Springs, Wyo.*
Mining Engineer.

Ingols, J. August.....*Idaho Springs, Colo.*
Mining Engineer and U. S. Deputy Mineral Surveyor.

Johnston, Fred.....*Torreon, Coahuila, Mexico*
Assistant Superintendent, Campania Metallurgica.

Jones, Frank H.....*Trail, B. C., Canada*
Chemist, Rossland Power Co.

Kraemer, Edw. L.....*Morenci, Ariz.*
Detroit Copper Co.

Lampe, Oscar A.....*Parral, Mexico*
Assayer.

Lucy, Richard W.....*Idaho Springs, Colo.*
Surveyor.

Magenau, William.....*Trail, B. C.*
Mining Engineer.

Norman, Jno. Edw.....*302 Mining Exchange Bldg., Denver, Colo.*
Mining Engineer.

Rodriguez, J. Crisostomo.....*Saltillo, Mexico*
Mining Superintendent.

Smith, Harry C.....*1132 Washington Ave., Denver, Colo.*
Mining Engineer.

Stephens, Charles N.....*2605 Douglas Place, Denver, Colo.*
Draftsman, Colorado Telephone Co.

Valentine, Malvern R.....*Box 108, Victor, Colo.*
Manager, Taylor & Brunton Sampler.

Whitaker, Orvil R.....*San Juancito, Honduras, C. A.*
Superintendent, New York, Honduras and Rosario Mining Co.

1899.

Adami, Charles J.....*Box 612, Butte, Mont.*
Superintendent, Gagnor Mine.

Bruce, Stuart S.....*502 Boston Bldg., Denver, Colo.*
Mining Engineer.

Cramer, Curtis P.....*Tierro, New Mexico*
Assayer, Gilchrist & Dawson Co.

Davis, Gilbert L.....*816 Majestic Bldg., Denver, Colo.*
Assistant Engineer, Denver City Tramway Co., Denver, Colo.

Grant, Lester S.....*214 W. Eaton Ave., Cripple Creek, Colo.*
Superintendent, Isabella Gold Mining Co.

Hodgson, Arthur .....*Denver, Colo.*
Assayer, Denver Mint.

Johnson, Gilbert.....*Kennett, Shasta County, Cal.*
Engineer, Trinity Copper Co.

Kelley, Fred G.....*Milford, Utah*
Superintendent and Metallurgist, Majestic C. M. & S. Co.

Muir, David.....*Kennett, Shasta County, Cal.*
Engineer, Trinity Copper Co.

Rising, Arthur F.....*Modoc Prov., Ontario, Canada*

Royer, Frank W.....*4003 W. Thirty-fifth Ave., Denver, Colo.*
Mining Engineer.

Smith, Thomas G.....*1415 Thirty-fifth St., Denver, Colo.*
Assistant Supt., Grant Plant American Sm. & Ref. Co.

Steinhauer, Fred C.....*1065 Clarkson St., Denver, Colo.*

Thompson, James S.....*Sopris, Colo.*
Superintendent, Rocky Mountain Coal & Iron Co.

Townsend, Arthur R.....*117 E. Fifty-seventh St., New York City*
Mining Engineer, Liberty Bell G. M. Co.

Tyler, Sydney B.....*Ocampo, Durango, Mexico*
Superintendent, San Luis Mining Co.

Waltman, Will D.....*108 N. Wahsatch Ave., Colorado Springs, Colo.*
Assistant City Engineer.

Weiss, Andrew.....*Chamber of Commerce Bldg., Denver, Colo.*
U. S. Geological Survey.

Williams, Wakely A.....*Grand Forks, British Columbia*
Superintendent, Granby Cons. M. & Sml. Co.

1900.

Adams, Wilber E.....*36 Adams Block, Lewiston, Idaho*
Mining Engineer and U. S. Deputy Mineral Surveyor.

Benwell, George A.....*211 California Bldg., Denver, Colo.*
Mining Engineer.

Bruce, Harry F.....*Tonopah, Nevada*
Electro Geodetic Mg. Co.

Crowe, Thomas B.....*Cripple Creek, Colo.*
Assistant Manager, Gold Exploration Co.

Drescher, Frank M.....*Prescott, Ariz.*
Mining Engineer.

Evans, Henry R.....*Reno, Nevada*
U. S. Government Survey.

Ewing, Charles R.....*Del Norte, Colo.*

Giddings, Donald S.....*Navotari, Sonora, Mexico*
Chief Surveyor and Engineer, Pilares Mines.

Harrington, Daniel .....*Sunnyside, Utah*
Assistant Engineer Utah Fuel Co.

Jones, Edward B.....*Dooley Block, Salt Lake, Utah*
General Manager, St. Julien Gold M. & M. Co.

Jones, Fred.....*Box 818, Cripple Creek, Colo.*
Engineer, Stratton Consolidated Mines.

Lemke, Carl .....*Silverton, Colo.*
Grand Mogul Mine.

Malmstrom, Clarence C.....*Box 57, Idaho Springs, Colo.*
Assayer.

Moynahan, Ambrose E.....*Alma, Colo.*
Assayer and Mining Engineer.

Nicolson, George W.....*Box 34, Mojave, Cal.*
Superintendent, Queen Esther Mine.

Pendery, John M.....*Leavenworth, Kan.*
Platt, Edwin H.....*Denver, Colo.*
Assistant Manager, Denver Engineering Works.
Price, Lyttleton, Jr.....*Bellevue, Idaho*
Minnie Moore Mining Co.
Prout, Jno. .....*Golden, Colo.*
Robey, Lloyd .....*Gabriel, Durango, Mexico*
San Luis Mining Co.
Rudd, Arthur H.....*Golden, Colo.*
U. S. Deputy Mineral Surveyor.
Slater, Amos.....*408 Boston Bldg., Denver, Colo.*
Geological Department C. F. & I. Co.
*Smith, Claude H.....
Steele, James H.....*Denver, Colo.*
Instructor in Mathematics and Drafting, Manual Train. High School.
Taylor, Henry Picotte.....*Box 785, Salt Lake City, Utah*
Utley, Howard Harris.....*415 W. Jefferson St., Louisville, Ky.*
Engineer, North Jellico Coal Co., Taylor Coal Co. and Williams Coal Co.

1901.

Atwater, Maxwell W.....*Box 573, Telluride, Colo.*
Liberty Bell Gold Mining Co.
*Bishop, Raymond .....
Bowman, Frank C.....*Central City, Colo.*
Cyclops Assay Office.
Bradley, Joseph M.....*Box 778, Florence, Colo.*
Breed, Charles Francis.....*817 Boston Bldg., Denver, Colo.*
Colorado Fuel & Iron Co.
Brinker, Arthur C.....*517-18 Cooper Bldg., Denver, Colo.*
With J. B. Farish, Mining Engineer.
Bruce, James L.....*Flat River, Mo.*
Surveyor, Federal Lead Co.
Bumsted, Edward J.....*Howardsville, Colo.*
Mining Engineer, Highland Mary Mine, Gold Tunnel, Drainage & Transportation Co.
Burlingame, Walter E.....*1736 Lawrence St., Denver, Colo.*
Chemist and Assayer, E. E. Burlingame & Co.
Chandler, John Winthrop, Jr.....*Coulterville, Mariposa County, Cal.*
Superintendent, Champion Mine.
Clark, George B.....*Pueblo, Colo.*
Assayer, Eilers Plant, American Smelting & Refining Co.
Collins, Shrive B.....*Box 94, Amethyst P. O., Creede, Colo.*
Mining Engineer.
*Crow, Wade L.....
DeCou, Ralph E.....*Table Mountain, Mammoth P. O., Ariz.*
Table Mountain Copper Co.
Downer, Roger H.....*Ironton, Colo.*
Superintendent, Barstow Mill.
Ehle, Mark, Jr.....*Rapid City, S. Dak.*
Professor of Engineering in the South Dakota School of Mines.
Frank, Harry L.....*Dedrick, Trinity County, Cal.*
Engineer, Trinity Co. Gold Mining Co.
Harris, Willard F.....*Ouray, Colo.*
Chief Engineer, Camp Bird Mine.
Jackson, Walter H.....*St. Louis, Mo.*
Illinois Exhibit Department of Mines and Metallurgy, Louisiana Purchase Exposition.

Johnson, Junius W.....*1038 Pennsylvania Ave., Denver, Colo.*
Surveyor, Denver & Northwestern Railway.
Lewis, Frank E.....*1224 Stout St., Denver, Colo.*
Surveyor, Colorado Telephone Co.
Lovering, Ira G.....*Somerset, Colo.*
Utah Fuel Co.
Lucy, Frank Allen.....*Idaho Springs, Colo.*
Surveyor.
McDaniel, Alexander K.....*731 W. Granite St., Butte, Mont.*
Surveyor and Mining Engineer, Boston & Montana Cons. C. & S. Mining Co.
Marrs, George Oliver.....*Central City, Colo.*
Surveyor, Saratoga Mine.
May, John G.....*Velardina, Durango, Mexico*
Velardina Mining & Smelting Co.
Millard, Frank W.....*Ely, Nevada*
Parrish, Carl C.....*Tuolumne, Cal.*
Superintendent, New Era Mining Co.
Pray, Winfred A.....*Golden, Colo.*
Surveyor and Mining Engineer.
Sale, Andrew J.....*Ely, Nevada*
Scheble, Max C.....*South McAlester, Indian Territory*
Surveyor, Great Western Coal & Coke Co.
Simpson, William P.....*Monterey, Mexico*
Head Assayer, Monterey Plant, American Sm. & Ref. Co.
Small, Harvey B.....*Ojuela, Durango, Mexico*
Engineer, Compania Minera de Peñoles.
Starbird, Edwin P.....*Victor, California*
Lessee, Rose Mine and Mill.
Street, Gerald B.....*56 W. Fourth South St., Salt Lake, Utah*
The Samuel Newhouse Co.
Watson, Hugh C.....*San Juancito, Honduras, C. A.*
Mill Superintendent, New York & Honduras Rosario Mining Co.
Williams, Fred Tuttle.....*Victor, Colo.*
Mining Engineer, Portland Gold Mining Co.

1902.

Anderson, Neil A.....*Frisco, Utah*
Surveyor, Cactus Co.
Badger, Herbert E.....*Greeley, Colo.*
Mining Engineer, Badger and Badger.
Barron, Chauncey T.....*El Paso, Texas*
Bergh, John Evans.....*Bingham Canon, Utah*
Mining Engineer, Bingham Con. M. & S. Co.
Bucher, John William.....*Arispe, Sonora, Mexico*
General Manager, Robiscanora Gold Mining Co.
Butler, G. Montague.....*Golden, Colo.*
Instructor in Geology and Mineralogy, Colorado School of Mines.
Charles, Lavern J.....*Spokane, Wash.*
U. S. Geological Survey.
Christensen, Walter.....*Mercur, Utah*
Metallurgist, Mercur Gold Mining Co.
Collbran, Arthur Harry.....*Kuala Lijus, Pahang, Korea*
Ketchan Syndicate.
Cox, W. Ray.....*Wallace, Idaho*
Scott, Anderson & Co.
Ehrich, Walter L.....*320 Sansome St., San Francisco, Cal.*
Mining Engineer.

Ellis, William Witty.....*839 Equitable Bldg., Denver, Colo.*
Mining Engineer.
Estes, Frank M., Jr.....*Steamboat Springs, Colo.*
Mining Engineer.
Ickis, Harry M.....*Manila, P. I.*
Surveyor, Mining Bureau.
Lehmer, Frank Welton.....*Gebo, Mont.*
Engineer, Gebo Coal Co.
Montrose, James Fay.....*Lead, S. Dak.*
Assayer, Hidden Fortune Mine.
Moss, Cleveland Osgood.....*Red Rock, Ariz.*
Engineer, Imperial Copper Co.
Paul, Russell B.....*San Juancito, Honduras, C. A.*
Mining Engineer, New York, Honduras & Rosario Mining Co.
Powers, Oliver.....*Telluride, Colo.*
Telluride Power Transmission Co.
Reno, Horace Thornton.....*Fraser, Colo.*
Surveyor, Denver & Northwestern Railroad Co.
Richards, John V.....*Kendall, Mont.*
Kendall Mine.
Rowe, Charles Elmer.....*420 McPhee Bldg., Denver, Colo.*
Mining and Civil Engineer.
Storm, Lynn W.....*Clear Creek, Utah*
Pleasant Valley Coal Co.
Watts, Alfred C.....*817 Boston Bldg., Denver, Colo.*
Engineer, Rocky Mountain Coal & Iron Co.

1903.

Coghill, W. H.....*Calumet, Mich.*
Assistant Engineer, Tamarack Mining Co.
Coleman, R. Prewitt.....
Cox, Augustus D.....*Mullan, Idaho*
Devinney, George V.....*Creede, Colo.*
Chemist, East Willow Mining Co.
Dunkle, Fred W.....*Victor, Colo.*
Elkton Consolidated M. & M. Co.
Emrich, Horace H.....*142 Water St., Perth Amboy, N. J.*
American Smelting & Refining Co.
Fleming, William L.....*Box 75, Victor, Colo.*
Timberman.
Foster, George C.....*1734 Arapahoe St., Denver, Colo.*
Henry E. Wood & Co.
Fry, Louis D.....*San Jose de Cruces, via Parral, Chihuahua, Mexico*
Assayer and Surveyor.
Funk, Walter A.....*Central City, Colo.*
Mining Engineer and U. S. Deputy Mineral Surveyor.
Hyder, Frederick B.....*Mountain City, Elko County, Nevada*
U. S. Deputy Mineral Surveyor, Nevada and Colorado.
Izett, Glenn.....*Littleton, Colo.*
Denver Union Water Company.
King, Henry E.....*419 East Kiowa St., Colorado Springs, Colo.*
Transitman, City Engineer's Office.
Liddell, Charles A.....*Box 353, Denver, Colo.*
Mining Engineer.
Liddell, T. Parker.....*Box 353, Denver, Colo.*
Mining Engineer.
McDermutt, Grace C. U.....*760 Newton St., Denver, Colo.*
McElvenny, Robert F.....*514 North G St., Tacoma, Wash.*
Metallurgist, Tacoma Smelter.

Merwin, Eugene W.....

Nagel, Frank J.....*San Juancito, Honduras, C. A.*
Assayer, New York & Honduras Rosario Mining Co.

Palsgrove, Harry G.....*San Juancito, Honduras, C. A.*
Asst. Supt. and Engineer, N. Y. & Honduras Rosario Mining Co.

Parsons, H. F.....

Rhodes, William B.....*Ouray, Colo.*
Mining Engineer.

Sloan, W. Arthur.....*Silver City, New Mexico*
Superintendent, Chatham Copper Co.

Taggart, George K.....*Coapa, Michoacan, Mexico*
Mining Engineer and Supt. National Capital Copper Mining Co.

Ward, William F.....*Ruby, Mont.*
Assistant Engineer, Conrey Placer Mining Co.

Wattles, William C.....*Macleod, Alberta, Canada*
Assistant Engineer and Surveyor for Dominion of Canada.

Wells, Frank B.....*Telluride, Colo.*
Liberty Bell Mine.

Wolf, Harry J.....*Box D, Telluride, Colo.*
Mining Engineer, Ella Gold Mining Co.

1904.

Adams, Charles.....*1507 Washington Ave., Colorado Springs, Colo.*
General Metals Co.

Anderson, Axel E.....*Tallopoosa, Georgia*
Georgia Gold Mines Co.

Carney, Hugh J.....*Ouray, Colo.*
Mining Engineer.

DeSollar, Tenny C.....*Cooney, N. M.*
Mogallon G. & C. Co.

Emeis, Walter A.....*Victor, Colo.*
Ajax Gold Mining Co.

Fillins, Lee L.....*Georgetown, Colo.*

Franck, Albert C.....*Ouray, Colo.*
Assayer, Barstow M. & M. Co.

Franck, Robert P.....*623 Main St., Butte, Mont.*
Gagnon Mine.

Goodale, Stephen L.....*Colorado Springs, Colo.*
Camp Bird (Limited), Ouray, Colorado.

Hill, Frank C.....*Ouray, Colo.*
Ouray Smelting Co.

Johnson, L. G.....*2218 Lafayette St., Denver, Colo.*

Kilbourn, W. D.....*199 South Main St., Middletown, Conn.*
Manufacturer.

Kimball, Harlow M.....*Great Falls, Mont.*
Boston & Montana Cons. Copper & Silver Mining Co.

Larsh, Walter S.....*2109 Sixteenth Ave., Denver, Colo.*

Lee, Wallace.....*601 Mumford Ct., Kansas City, Mo.*

Nagel, Henry P.....*Independence, Colo.*
Vindicator Gold Mining Co.

Prier, Truman D.....*Ruby, Mont.*
Courey Placer Co.

Robinson, George P.....*Howardsville, Colo.*
Highland Mary Mine,, Gold Tunnel, Drainige & Transportation Co.

Sherman, Scott H.....*Holmes, Wyo.*
Duchess M. M. & S. Co.

Spencer, W. Irving.....*Park City, Utah*
Daly West Mill.

Tescher, Samuel.....*Canon City, Colo.*
Assistant to Division Engineer of C. F. & I. Co.

Thomas, John S.....*St. Louis, Mo.*
C. S. M. Exhibit, Louisiana Purchase Exposition.

Thomson, Francis A.....*Forks Creek, Colo.*
Superintendent, Bates Mill.

Trumbull, L. W.....*Laramie, Wyo.*
Professor of Mining Engineering, University of Wyoming.

*Vaughn, Robert M.....

Wackenhut, George J.....*531 E. Pike's Peak Ave., Colo. Springs, Colo.*

Wallace, Howard J.....*Durango, Colo.*
Surveyor.

Washburn, H. G.....*Victor, Colo.*
Portland Gold Mining Co.

Weil, Jacob.....*453 Ellis St., Chicago, Ill.*

Wells, B. T.....*Grand Forks, B. C.*
Chemist, Cranby Cons. Mining, Smelting & Power Co., Ltd.

GEOGRAPHICAL LOCATION OF ALUMNI

United States.

Colorado	125	Illinois	2
Montana	17	New York	2
California	16	Nebraska	1
Utah	12	Kansas	1
Arizona	6	Kentucky	1
Washington	5	Texas	1
South Dakota	5	Indian Territory	1
Wyoming	5	Michigan	1
Nevada	5	New Jersey	1
Missouri	4	Georgia	1
Idaho	4	Connecticut	1
New Mexico	3		

Foreign Countries.

Mexico	24	Hawaiian Islands	1
Canada	6	Philippine Islands	1
British Columbia	6	South Africa	1
Honduras	5	Australia	1
South America	2	Korea	1

ALUMNI ASSOCIATION.

The Association of the Alumni of the Colorado School of Mines holds its annual meeting and banquet on the day following the commencement exercises, unless otherwise provided by the Executive Committee.

All graduates holding degrees are eligible to membership, and are invited to the annual meeting and banquet.

The aim of the 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 their Alma Mater.

All graduates are earnestly requested to join the organized body and to keep the Secretary advised as to their addresses.

The officers of the Association for the year ending June, 1904, are as follows:

ROBERT S. STOCKTON, '95, President.
HERBERT A. CANNING, '97, Vice President.
AMOS SLATER, '00, Secretary.
GILBERT L. DAVIS, '99, Treasurer.

Executive Committee.

EDWARD E. ROWE, '95.
EDWARD P. ARTHUR, '95.
MARSHALL D. DRAPER, '97.

Address all communications for the Alumni Association, P. O. Box No. 236, Denver, Colorado.

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