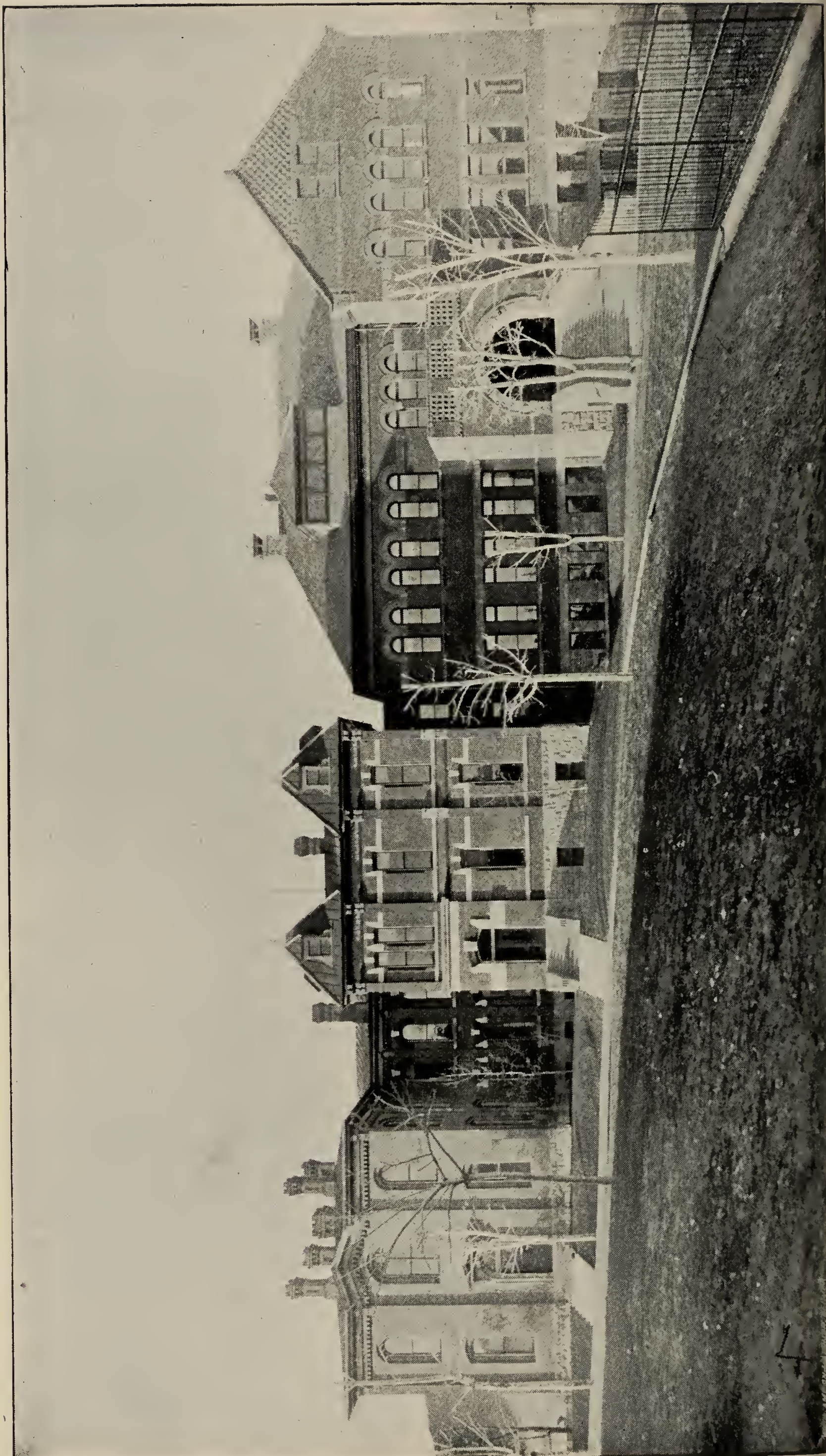
State School of Mines

GOLDEN
COLORADO

Catalogue
1897-98

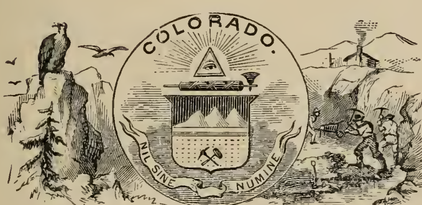


CATALOGUE

OF THE

STATE SCHOOL OF MINES

GOLDEN, COLORADO.



1897-98.

CALENDAR.

1897-98.

First Term Begins Sept. 13, 1897, Ends Feb. 2, 1898.
(Christmas Holidays, Dec. 23–Jan. 2, inclusive.)
Second Term Begins Feb. 7, 1898, Ends June 8, 1898.
Commencement, June 9, 1898.

1898-99.

EXAMINATIONS FOR ADMISSION.

June 13, 14, 1898. Sept. 8, 9, 10, 1898.

First Term Begins Sept. 12, 1898, Ends Feb. 1, 1899.
(Christmas Holidays, Dec. 22–Jan. 2, inclusive.)
Second Term Begins Feb. 6, 1899, Ends June 7, 1899.
Commencement, June 8, 1899.

BOARD OF TRUSTEES.

OFFICERS OF THE BOARD.

FACULTY.

REGIS CHAUVENET, A. M., B. S., President,
Professor of Chemistry.

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

LOUIS CLARENCE HILL, C. E., E. E.,
Professor of Physics and Electrical Engineering.

HOWARD VAN F. FURMAN, E. M.,
Professor of Metallurgy and Assaying.

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

CHARLES WORTHINGTON COMSTOCK, E. M.,
Professor of Mining Engineering.

ARTHUR RANSLEY CURTIS, B. S.,
Professor of Descriptive Geometry and Draughting.

ROBERT SUMMERS STOCKTON, E. M.,
Assistant Professor, Mathematics and Surveying.

Corrin Barnes, E. M.,

Assistant Professor of Chemistry.

William Jonathan Hazard, E. E.,

Instructor in Physics and Draughting.

William Bull Stoddard, B. S., Ph. D.,

Instructor in Chemical Laboratory.

John S. Mosby, Jr.,

Lecturer on Mining Law.

Elbridge Graves Moody,

Registrar and Librarian.

COMMITTEE ON STANDING AND CONDITIONS.

Professors Hill, Comstock and Stockton.

COMMITTEE ON ATHLETICS.

Professors Chauvenet, Patton and Stockton.

Wm. H. Bennett, Janitor.

Arthur B. Tripp, Engineer.

STUDENTS, 1897-98.

POST GRADUATES.

Logue, Nelson W., E. M. (Colorado State School of Mines.)	Aspen,	Colorado.
Stoddard, Wm. Bull, B.S., Ph.D. (Johns Hopkins.)	Denver,	Colorado.
Townsend, Arthur Rodman, B.S. (Sheffield Scientific School, Yale.)	New York,	New York.
Utley, Howard Harris, B. S. (Brown University.)	Providence,	Rhode Island.
Young, Frank B., E. M. (Colorado State School of Mines.)	Oakland,	California.

SENIORS.

Barbour, Percy P.	(E. M.)	Edgewater,	Colorado.
Bertschy, Perry H.	(E. M.)	Appleton,	Wisconsin.
Blumenthal, Emil E.	(E. M.)	Denver,	Colorado.
Caldwell, Florence H.	(C. E.)	Cleveland,	Ohio.
Church, Myron J.	(E. M.)	Milwaukee,	Wisconsin.
Clark, Winfred N.	(E. E.)	Paxton,	Illinois.
Corry, Arthur V.	(E. M.)	Butte,	Montana.
Davey, Wm. R., Jr.	(E. M.)	Lake City,	Colorado.
Dollison, James E.	(E. M.)	Golden,	Colorado.
Hamilton, Frank R.	(E. M.)	Denver,	Colorado.
Harrington, Orville	(E. M.)	Denver,	Colorado.
Ingols, J. August	(E. E.)	Denver,	Colorado.
Johnston, Fred.	(E. M.)	Denver,	Colorado.
Jones, Frank H.	(E. M.)	Dallas,	Texas.
*Jones, Junius H.	(E. M.)	Norfolk,	Virginia.
Kraemer, Edw. L.	(E. M.)	Denver,	Colorado.
Lampe, Oscar A.	(E. M.)	Denver,	Colorado.
Lucy, Richard W.	(C. E.)	Denver,	Colorado.
Magenau, William	(E. M.)	Milwaukee,	Wisconsin.
Norman, John Edw.	(E. M.)	Denver,	Colorado.
Rodriguez, J. Crisostomo	(E. M.)	Saltillo,	Mexico.
Smith, Harry C.	(E. M.)	Denver,	Colorado.
Stephens, Charles N.	(E. M.)	Denver,	Colorado.
Valentine, Malvern R.	(E. M.)	Denver,	Colorado.
Whitaker, Orvil R.	(E. M.)	Durango,	Colorado.

*Died in Denver, December 25th, 1897.

JUNIORS.

Adami, Charles J.	Helena,	Montana.
Benwell, Geo. A., Jr.	Linden,	New Jersey.
Brown, Geo. W.	Denver,	Colorado.
Bruce, Stuart S.	Cripple Creek,	Colorado.
Cramer, Curtis P.	Sedalia,	Colorado.
Dailey, Ross J.	Denver,	Colorado.
Davis, Gilbert L.	Denver,	Colorado.
Gleason, Geo. B.	Denver,	Colorado.
Glenn, Fred.	Golden,	Colorado.
Grant, Lester S.	Manitou,	Colorado.
Hodgson, Arthur	Aspen,	Colorado.
Jeffries, Edgar H.	Denver,	Colorado.
Johnson, Gilbert, Jr.	Denver,	Colorado.
Kelley, Fred. G.	Grand Island,	Nebraska.
Kerr, Victor E.	Golden,	Colorado.
Lee, Murray	Denver,	Colorado.
Muir, David	Rock Springs,	Wyoming.
Platt, Edwin H.	Toledo,	Ohio.
Reid, George D.	Norwich,	Connecticut.
Rising, Arthur F.	Williamsburg,	Mass.
Royer, Frank W.	Berkeley,	Colorado.
Rudd, Arthur H.	Chicago,	Illinois.
Slater, Amos	Denver,	Colorado.
Smith, Thomas G.	Denver,	Colorado.
Steinhauer, Frederick C.	Denver,	Colorado.
Thompson, James S.	Denver,	Colorado.
Tyler, Sydney B.	Denver,	Colorado.
Waltman, Will D.	ColoradoSprings,	Colorado.
Weiss, Andrew	Wels,	Austria.
Williams, Wakeley A.	Socorro,	New Mexico.

SOPHOMORES.

Adams, William E.	Telluride,	Colorado.
Ball, Louis R.	Dayton,	Ohio.
Berrey, Max L.	Colorado Springs,	Colorado.
Bowie, Alexander R.	Gallup,	New Mexico.
Bowman, Frank C.	Saint Charles,	Illinois.
Bruce, Harry F.	Kansas City,	Kansas.
Bruce, James L.	Cripple Creek,	Colorado.
Campbell, Brayton	Denver,	Colorado.
Climo, James	Pinos Altos,	New Mexico.
Drescher, Frank M.	Denver,	Colorado.
Evans, Harry R.	Jamestown,	Colorado.
Ewing, Charles R.	Del Norte,	Colorado.
Giddings, Donald S.	Denver,	Colorado.
Gwynn, Guy	Alma,	Colorado.
Hahn, Alexander T.	Pueblo,	Colorado.
Harrington, Daniel	Brighton,	Colorado.
Hayes, Annis C.	Denver,	Colorado.
Hill, William H.	Trinidad,	Colorado.
Jones, Fred.	Cripple Creek,	Colorado.
Lemke, Carl	Del Norte,	Colorado.
Lucy, Frank Allen	Denver,	Colorado.
Malmstrom, Clarence	Denver,	Colorado.
Millard, Frank	Apex,	Colorado.
Miller, Frank C.	Denver,	Colorado.
Moynahan, A. Edwin	Alma,	Colorado.
Nicolson, George W.	Black Hawk,	Colorado.
Pendery, John M.	Leadville,	Colorado.
Picotte, Harry T.	Hailey,	Idaho.
Price, Littleton, Jr.	Hailey,	Idaho.
Prout, John	Golden,	Colorado.
Robey, Lloyd	Villa Park,	Colorado.
Smith, Claude H.	Chicago,	Illinois.
Steele, James H.	Denver,	Colorado.
Woodhall, George	Denver,	Colorado.

FRESHMEN.

Airis, George E.	Salt Lake City,	Utah.
Ames, Hugh S.	Denver,	Colorado.
Ashley, Ralph E.	Denver,	Colorado.
Atwater, Maxwell W.	Syracuse,	New York.
Bailey, Fergus M.	Glendale,	Ohio.
Baker, Donald T.	Lewisburg,	Pennsylvania.
Barry, Paul A.	Fort Riley,	Kansas.
Becker, Frank A.	Leadville,	Colorado.
Bishop, Raymond	Denver,	Colorado.
Botts, Walter J.	Los Angeles,	California.
Bradley, Joseph M.	Canon City,	Colorado.
Brinker, Arthur C.	Denver,	Colorado.
Brown, Henry G.	Denver,	Colorado.
Buckingham, Avery	Springfield,	Ohio.
Buehler, Walter	Indianapolis,	Indiana.
Bumsted, Edward J.	San Francisco,	California.
Burke, Anthony J.	Denver,	Colorado.
Burlingame, Walter E.	Denver,	Colorado.
Cartwright, Robert V.	Van Alstyne,	Texas.
Chandler, John W.	Chicago,	Illinois.
Clark, George B.	Denver,	Colorado.
Clarke, Fred. H.	Pendleton,	Oregon.
Clarke, Overton E.	Denver,	Colorado.
Colburn, Frank O.	Salt Lake City,	Utah.
Collbran, Arthur H.	Denver,	Colorado.
Collins, Shrive B.	Del Norte,	Colorado.
Cornell, William A.	Denver,	Colorado.
Crow, Wade L.	Pueblo,	Colorado.
D'Arcy, Arthur	Denver,	Colorado.

FRESHMEN—Continued.

Davis, Charles A.	Denver,	Colorado.
De Cou, Ralph E.	Madison,	South Dakota.
Downer, Roger H.	Ouray,	Colorado.
Ehle, Mark, Jr.	Marshalltown,	Iowa.
Ellis, Charles W.	Aspen,	Colorado.
Farish, William A., Jr.	Denver,	Colorado.
Frank, Harry Louis	Antonito,	Colorado.
Funke, George R.	Denver,	Colorado.
Gibbs, Wesley	Denver,	Colorado.
Greenough, Ogden	Denver,	Colorado.
Haines, William Barre	Fillmore,	California.
Hallack, Charles, Jr.	Denver,	Colorado.
Hauser, Samuel T., Jr.	Helena,	Montana.
Hayden, Philip	Holton,	Kansas.
Henderson, Louis L.	Van Alstyne,	Texas.
Holderer, Fred.	Denver,	Colorado.
Izett, Glen	Denver,	Colorado.
Johnson, Junius W.	Denver,	Colorado.
Johnston, Harry V.	Denver,	Colorado.
Kerns, S. Milton	Denver,	Colorado.
Kruse, John Jacob	Denver,	Colorado.
Lemmon, Evan D.	Denver,	Colorado.
Lewis, Frank E.	Denver,	Colorado.
Lovering, Ira G.	Denver,	Colorado.
McAtee, Bernard	Denver,	Colorado.
McCanne, W. Gerald	Denver,	Colorado.
McDaniel, Alexander K.	Canon City,	Colorado.
McDonald, Walter	Rockvale,	Colorado.
Mallinckrodt, Philip H.	Boulder,	Colorado.

FRESHMEN—Continued.

May, John	Fremont,	Nebraska.
Nicholas, Harold G.	Washington,	D. C.
Nowland, Ralph C.	Leadville,	Colorado.
Offutt, James H.	Greensburg,	Pennsylvania.
Parrish, Karl C.	Leon,	Iowa.
Powell, John R.	Denver,	Colorado.
Powers, Oliver	Ainger,	Ohio.
Pray, Wilfred A.	Mosca,	Colorado.
Richards, John V.	Spokane,	Washington.
Sale, Andrew J.	Denver,	Colorado.
Serano, George W.	Newburgh,	New York.
Scheble, Max C.	Hutchison,	Kansas.
Shackelford, Earskin D.	Denver,	Colorado.
Shaffer, Earlscourt G.	Idaho Springs,	Colorado.
Sharps, Frank B.	Golden,	Colorado.
Simonton, Will G.	Philadelphia,	Penn.
Simpson, William P.	Kansas City,	Kansas.
Singer, Charles E.	Durhamville,	New York.
Small, Harvey B.	Dulzura,	California.
Starbird, Edward P.	Denver,	Colorado.
Storm, Lynn W.	Denver,	Colorado.
Taggart, George K.	Denver,	Colorado.
Vail, Guy M.	Denver,	Colorado.
Wakeman, Jesse H.	Minneapolis,	Minnesota.
Watson, Hugh C.	Denver,	Colorado.
Weddle, Ralph B.	Leadville,	Colorado.
Werden, Arthur C.	Denver,	Colorado.
White, Alward H.	El Paso,	Texas.

SUMMARY.

Post Graduates	5
Seniors	25
Juniors	30
Sophomores	34
Freshmen	86
Total	180

SUMMARY BY STATES AND COUNTRIES.

Colorado	117	Connecticut	1
Ohio	6	District of Columbia	1
California	5	Indiana	1
Illinois	5	Massachusetts	1
Kansas	5	Minnesota	1
New York	4	New Jersey	1
Texas	4	Oregon	1
Montana	3	Rhode Island	1
New Mexico	3	South Dakota	1
Pennsylvania	3	Virginia	1
Wisconsin	3	Washington	1
Idaho	2	Wyoming	1
Iowa	2	Austria	1
Nebraska	2	Mexico	1
Utah	2		

(Colorado, sixty-five per cent.; all others, thirty-five per cent.)

HISTORY AND ORGANIZATION.

The School of Mines of the State of Colorado was established by Act of the Territorial Legislative Assembly, approved February 9th, 1874.

Its first location was about one mile south of the City of Golden, where its support was so slight that it was soon seen that removal to a better site, and the erection of a building for its exclusive use were conditions without which it could not hope to survive.

An appropriation was granted by the General Assembly, and lots were given by citizens of Golden. No land has ever been granted by the State, so that subsequent additions have been made from the current income.

The building thus provided for was erected in 1880. It was, however, too small for any organized work to be carried forward in it, a fact evidently apparent to the next legislature, as an additional grant was made in 1881, and the building enlarged so as to include space for laboratories, and a hall for museum and other purposes. This building still forms a part of the group now occupied.

The school now began to grow in numbers, but from 1886 to 1889 its growth was merely nominal, so far as the roll of students was concerned. In fact, the space at its disposal during this period did not permit any expansion. Fifty was the average number of students, and more would have unduly crowded it. It was finally decided to erect an important addition from the current income.

This addition was first occupied in the fall of 1890. It is described under "Buildings." With its erection the elimination of the "special" courses, hitherto the bar to progress in either practical or theoretical lines, was begun.

The prediction was very freely made at the time, that this abolition of partial and "optional" courses would materially reduce the number of students, but, in two years the number increased 100 per cent., and a number of former partial students returned to take advantage of the full course now offered.

Although the course adopted in thus drawing from the current funds to erect permanent improvements, was the only possible policy, the strain upon resources was very great, and the reduction of income from a fifth to a sixth of a mill still further obstructed all plans for proper equipment. The rapid increase in numbers, and the no less marked advance in the demands made upon the management for the most modern methods, necessitated a still further addition to the "plant," and the Assembly of 1893 granted $20,000 for that purpose. The building was first occupied in the fall of 1894, and may be fairly considered the best, though by no means the largest of the buildings.

The removal of three departments to the new building allowed a re-arrangement not only radical in its great advance in convenience, but providing for future expansion in numbers, a consideration of no small importance.

The organization of the School of Mines of Colorado is set forth in the pages following. It resembles that of the best technical schools of the United States. With far greater confidence than ever before, the authorities of the institution now present its claims as a technical school of the first rank. With its many graduates occupying positions demanding responsibility and skill, it has long passed its experimental stage, but they are very far from asserting that nothing remains to be done, and so far as future means will permit it is their intention that every department shall continue to meet the ever growing demands of the industries of the State.

LOCATION.

The institution is located at the city of Golden, sixteen miles from Denver, on the Colorado Central Railroad, or a trifle over thirteen by the Denver, Lakewood & Golden Railroad.

The trains of the latter road are made to conform, in time schedule, to the requirements of the School of Mines, so that any student who prefers to reside in Denver, may do so without having to sacrifice any obligatory school hours.

The altitude of Golden is 5,700 feet above sea level, and the first foot-hills proper of the Rocky Mountains lie close to the town. No place in Colorado has a better health record. The climate is invigorating and pleasant, with open winters, and a large proportion of pleasant days.

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

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

Cheap commutation rates are given to students who desire to reside in Denver, while pursuing their course in the school. It is recommended, however, to all students above the Freshman class in grade, to reside in Golden, the time taken in daily transit being a strain upon the demands of the course.

EXPENSES.

Tuition is free. Students are charged with all material consumed or broken.

The following are the various fees and charges:

Freshmen, Qualitative, chemicals, etc., fee	$20.00
Freshmen, Qualitative, deposit, apparatus	10.00
Sophomores, Quantitative Analysis, fee	20.00
Sophomores, same, deposit for apparatus	20.00
Juniors, Surveying fee	10.00
Athletic Association, annual dues	5.00
Damage fee	2.00

In Assaying, the students are charged with all material in detail, instead of a term charge.

In the case of the "deposits" the amounts are credited and the student is then charged with all the apparatus he takes out for use, and again credited with all that he returns in good condition at the close of the year or term. Balance to his credit, if any, is then returned to him in cash. An additional deposit may be required at any time, if the apparatus called for is unusual or excessive.

Students leaving before the end of a term are not entitled to any reduction of their term fees. The only exception is made for those leaving on account of sickness.

All fees and deposits are payable in advance to the Registrar, whose receipt must be shown before any desk can be occupied.

Board and suitable accommodation can be obtained in Golden for from four to six dollars a week.

It is estimated that the total expense of the school year, fees included, need not in any case exceed three hundred and fifty dollars ($350.00). But the majority of the students come far under this figure, by clubbing, and other arrangements.

REQUIREMENTS FOR ADMISSION.

Candidates must be at least seventeen years of age. They must sustain examinations in English, Geography, Arithmetic, elements of Algebra, Geometry, and Zoology or Biology.

In Arithmetic they must be ready in the use of decimals and of Ratio and Proportion.

In Algebra, the first twelve chapters of Wentworth's "Higher" Algebra, or an equivalent.

The whole of Plane Geometry.

English of High-School standard is required, but no examination in Literature, nor in formal Grammar.

In General and Physical Geography, (one paper), such questions only are put as should form part of the general knowledge of any intelligent lad.

The Zoology or Biology is such as may be found in any of the elementary texts used in our Public Schools.

Candidates for advanced standing will be examined in all the studies of the course below the class applied for.

Candidates are recommended to attend at the June date. Deficiences may be made good at the Fall examinations.

Graduation diplomas from approved High Schools are received in lieu of examinations. These must bear date not earlier than the year preceding application. *The Faculty reserves the right, however, to examine for admission to any higher standing than the first term of the Freshman year, irrespective of the certificate brought from another institution.*

Examinations may be taken at the homes of the applicants, papers being forwarded to some responsible examiner.

COURSES AND DEGREES.

There are two full courses of study, viz.: Mining and Metallurgical Engineering, and Electrical Engineering. Each covers a period of four years. The studies, however, are identical during the first year of all courses, beginning to diverge at the opening of the second year.

The degrees given are:

Engineer of Mines and Metallurgy (E. M.)
Electrical Engineer (E. E.)

Students cannot make any variation or division in the regular course during the Freshman year. In the upper classes they may, subject in each case to approval by the Faculty, divide a year, *i. e.*, take two years' time for the work of a single year. This privilege, however, is subject to the invariable condition that the Mathematical studies shall be taken in the first of the two years, and the Chemical or other work in the second. The Faculty also reserves the right to require the repetition in the second year, of any or all of the work gone over in the first year.

No special or partial students are admitted, except as Post Graduates.

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

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

EXAMINATIONS AND CONDITIONS.

Regular examinations, which all students are required to attend, are held at the end of each term, on the various subjects pursued during the term. Upon the completion of any branch of study, the student will be subjected to a rigid examination upon the whole subject.

Absence from examinations, whether from illness or from any other cause, can be excused only upon presentation of satisfactory reasons to the President of the Faculty.

No student can present himself for examination in any subject who has not attended at least eighty per cent. of the lectures or other exercises on that subject.

Students failing to attend examinations for the removal of conditions cannot be re-examined, but must repeat the year.

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

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

The passing mark on all re-examinations shall be five units higher than that upon the first examination.

Any student having at the end of a term more than two conditions shall be relegated to the next lower class.

A complete failure in any subject may relegate a student to the next lower class.

(a) A failure to pass a second re-examination shall constitute a complete failure.

(b) An average mark of forty or less on the whole work in any subject shall constitute a complete failure.

(c) The absence of any student from twenty per cent. or more of the prescribed work in any subject shall constitute a complete failure.

No student may enter the Sophomore or Junior class with more than one condition.

No student may enter the Senior class with any condition.

Any member of the Senior class not in full standing in every subject at the time of the regular meeting of the Faculty in April shall be debarred from graduation.

When any prescribed trip is undertaken, having a practical bearing on the work of any course, the students in that course, and working for a degree to which that course is essential, shall be required to attend such trip, unless excused by a vote of the Faculty.

The attempt of any student to present as his own the work of another, or to pass any examination by improper means, will render him liable to expulsion.

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

THESES AND GRADUATION.

A thesis upon some practical subject is an important pre-requisite to graduation.

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

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

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

Each Senior shall submit, not later than November 1st, to the Professor in charge of the department in which he wishes to take his degree, the subject of his thesis, which subject must be approved by the Professor. Each thesis must be type-written or printed, on $10\frac{1}{4}$ x 8-inch paper, and bound in book form.

The completed theses must be handed in not later than June 1st.

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

No student shall be allowed to graduate while indebted to the School.

SCHEDULE OF STUDIES.

FRESHMAN YEAR.

FOR ALL COURSES.

FIRST TERM.

Algebra	5 hours a week.
Geometry	2 hours a week.
General Chemistry	4 hours a week.
Descriptive Geometry	2 hours a week.
Drawing	15 hours a week.

SECOND TERM.

Plane Trigonometry	3 hours a week.
Geometry	2 hours a week.
Algebra	3 hours a week.
General Chemistry	4 hours a week.
Descriptive Geometry	2 hours a week.
Drawing	6 hours a week.
Qualitative Analysis	12 hours a week.

COURSE IN MINING AND METALLURGY.

SOPHOMORE YEAR.

FIRST TERM.

Algebra	3 hours a week.
Analytical Geometry	2 hours a week.
Mineralogy	5 hours a week.
Physics	4 hours a week.
Physical Laboratory	2 hours a week.
Mechanism	1 hour a week.
Quantitative Analysis	12 hours a week.
Mechanical Drawing	4 hours a week.
Chemical Analysis (Lectures)	1 hour a week.

SECOND TERM.

Calculus	3 hours a week.
Analytical Geometry	2 hours a week.
Mineralogy	10 hours a week.
Physics	4 hours a week.
Physical Laboratory	2 hours a week.
Volumetric Analysis and Fire Assaying	8 hours a week.
Drawing	3 hours a week.
Mechanism	1 hour a week.

COURSE IN MINING AND METALLURGY.

JUNIOR YEAR.

FIRST TERM.

Calculus	5 hours a week.
Geology	3 hours a week.
Mechanics	2 hours a week.
Surveying	3 hours a week.
Surveying (Field Work)	9 hours a week.
Metallurgy	3 hours a week.
Machine Design	1 hour a week.
Machine Design Drawing	6 hours a week.

SECOND TERM.

Geology	3 hours a week.
Mechanics	4 hours a week.
Metallurgy	3 hours a week.
Surveying	2 hours a week.
Surveying (Field Work)	9 hours a week.
Graphics	2 hours a week.
Graphics (Drawing)	3 hours a week.
Machine Design	1 hour a week.
Machine Design (Drawing)	3 hours a week.
Testing Laboratory	1 hour a week.

COURSE IN MINING AND METALLURGY.

SENIOR YEAR.

FIRST TERM.

Metallurgy	4 hours a week.
Mining	2 hours a week.
Hydraulics	4 hours a week.
Theory of Construction	3 hours a week.
Theory of Construction (Drawing)	2 hours a week.
Hydraulic Laboratory	1 hour a week.
Technical Chemistry	2 hours a week.

SECOND TERM.

Metallurgy	4 hours a week.
Mining	2 hours a week.
Power Transmission	4 hours a week.
Technical Chemistry	2 hours a week.
Steam Engine Laboratory	2 hours a week.

COURSE IN ELECTRICAL ENGINEERING.

SOPHOMORE YEAR.

FIRST TERM.

Algebra	3 hours a week.
Analytical Geometry	2 hours a week.
Physics	4 hours a week.
Physical Laboratory	4 hours a week.
Mechanism	2 hours a week.
Chemical Analysis	1 hour a week.
Quantitative Analysis	12 hours a week.
Drawing	6 hours a week.

SECOND TERM.

Calculus	3 hours a week.
Analytical Geometry	2 hours a week.
Physics	4 hours a week.
Physical Laboratory	4 hours a week.
Mechanism	2 hours a week.
Drawing	9 hours a week.
Shop Work	6 hours a week.

COURSE IN ELECTRICAL ENGINEERING.

JUNIOR YEAR.

FIRST TERM.

Dynamo Machinery	4 hours a week.
Dynamo Laboratory	8 hours a week.
Calculus	5 hours a week.
Mechanics	2 hours a week.
Machine Design	2 hours a week.
Machine Design (Drawing)	8 hours a week.
Electrical Measurements	4 hours a week.

SECOND TERM.

Dynamo Machinery	4 hours a week.
Dynamo Laboratory	8 hours a week.
Mechanics	4 hours a week.
Batteries	2 hours a week.
Precision of Measurements	2 hours a week.
Differential Equations	2 hours a week.
Electrical Design	4 hours a week.
Electrical Measurements	10 hours a week.
Testing Laboratory	1 hour a week.

COURSE IN ELECTRICAL ENGINEERING.

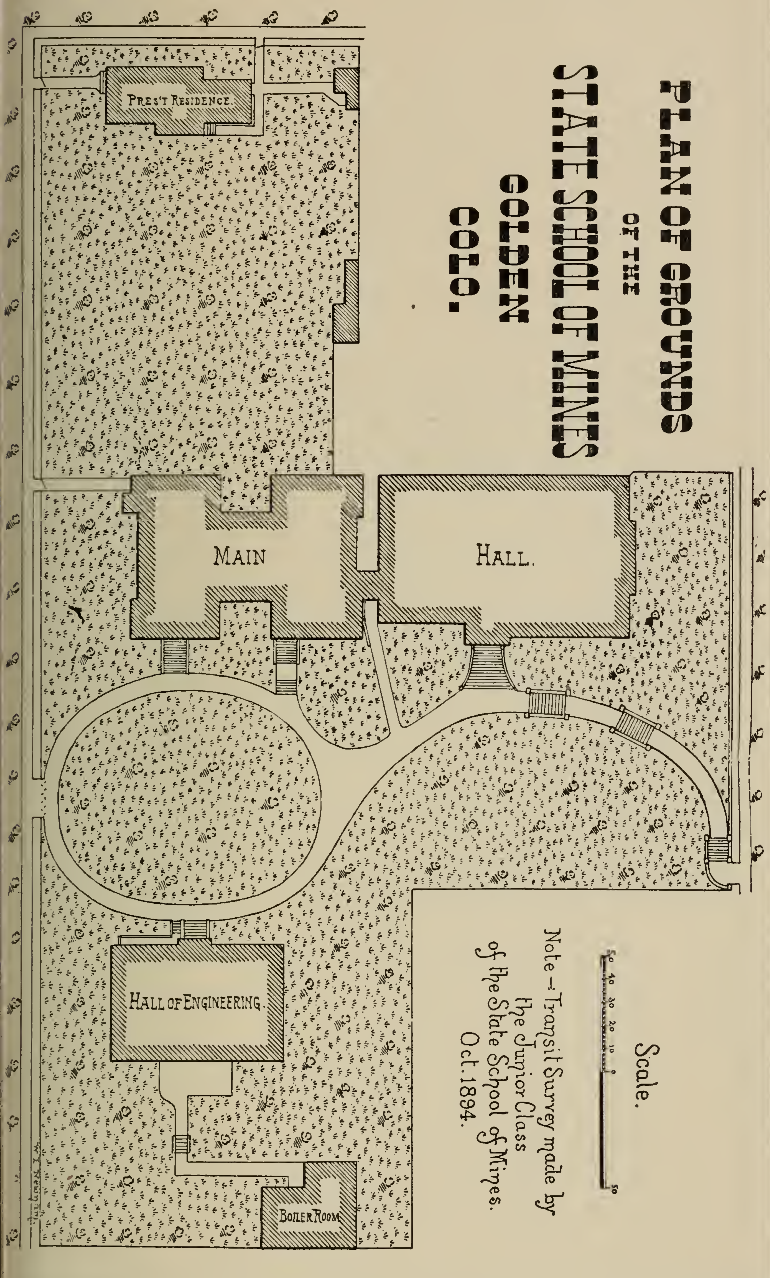
SENIOR YEAR.

FIRST TERM.

Hydraulics	4 hours a week.
Transformers and Alternating Currents	5 hours a week.
Dynamo Laboratory	8 hours a week.
Electrical Design	6 hours a week.
Photometry and Electric Lighting	2 hours a week.
Laboratory Work in Photometry	3 hours a week.
Hydraulic Laboratory	1 hour a week.

SECOND TERM.

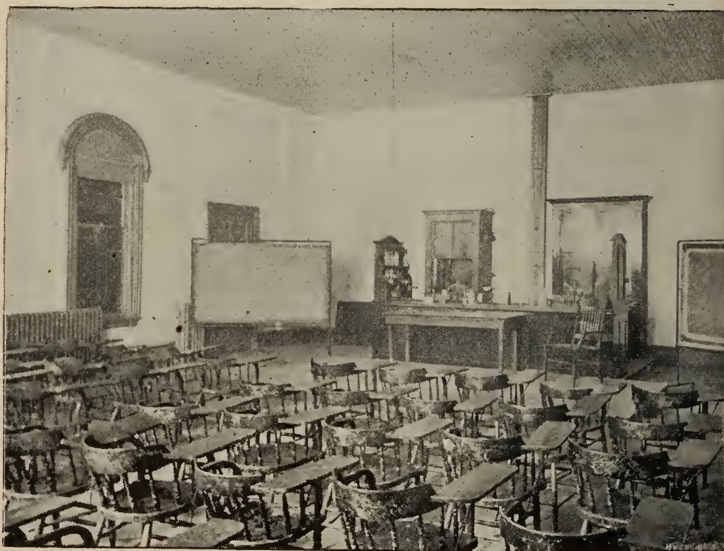
Power Transmission	4 hours a week.
Electrical Transmission	3 hours a week.
Steam Engine Laboratory	3 hours a week.
Electrical Design	6 hours a week.
Thesis Work	15 hours a week.


PLAN OF GROUNDS
OF THE
STATE SCHOOL OF MINES
GOLDEN
COLO.
PRES'T RESIDENCE.
MAIN
HALL.
HALL OF ENGINEERING.
BOILER ROOM
Scale.
50 40 30 20 10 0 50
Note - Transit Survey made by
the Junior Class
of the State School of Mines.
Oct. 1894.

DEPARTMENTS OF INSTRUCTION.

CHEMISTRY.

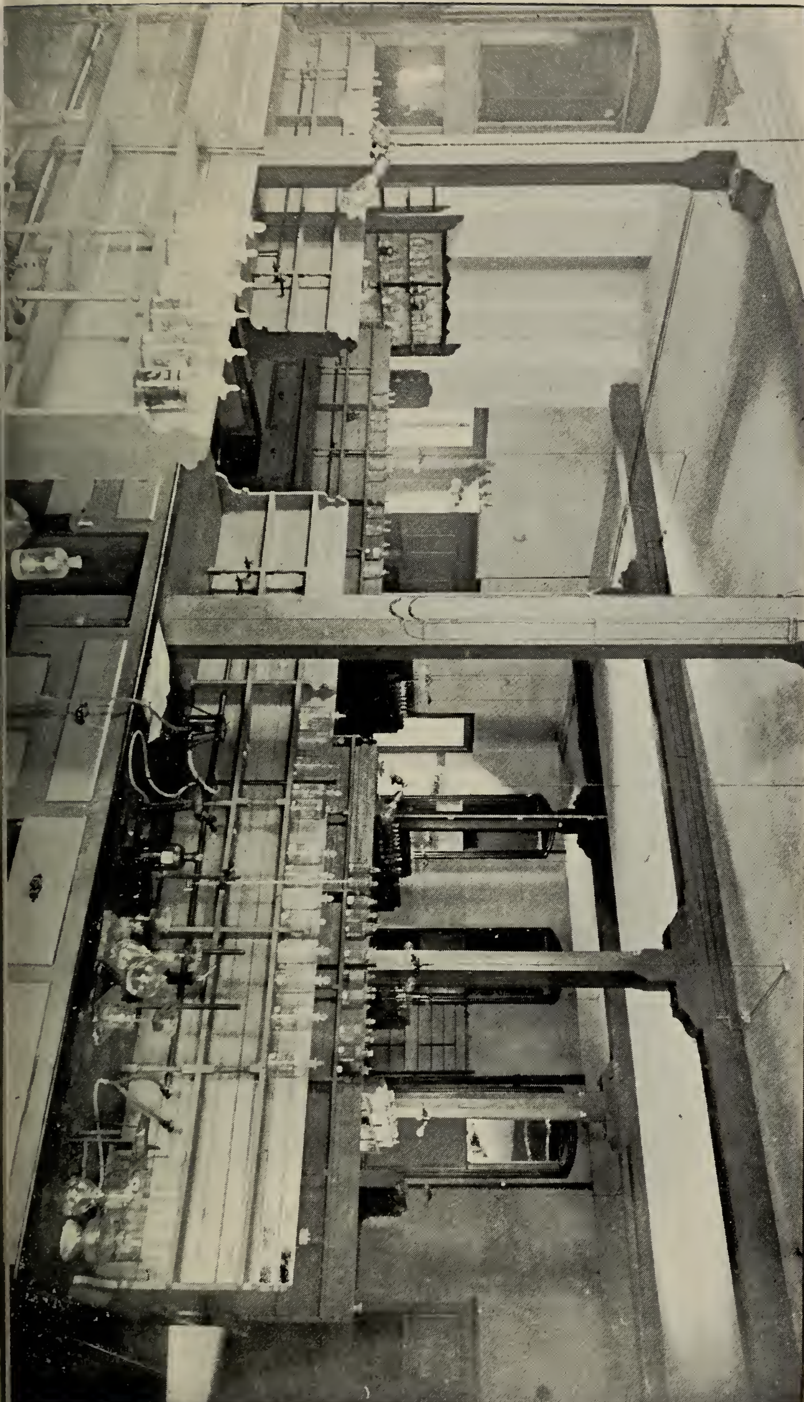
A large amount of time is devoted to Chemistry, general, analytical and applied.



CHEMICAL LECTURE ROOM.

Theoretical and Experimental Chemistry are taught during the first year. The course includes what is known as "general" Chemistry, its principles and nomenclature, and the use of symbols and equations to express them.

Lectures in Theoretical and Applied Chemistry begin in the Junior year, and continue during the Senior year. The lectures upon chemical theory are of a more advanced character than those in the course in "general" Chemistry.



Instruction in Analytical Chemistry begins with the second term of the first year. In this, and in the first term of the second year, qualitative analysis is pursued, the course including the reactions of the bases and acids, separation and identification of all the ordinary elements, and analysis of simple and complex compounds, ores, industrial products, slags and mattes.

The work is supplemented by lectures, in which the student is taught the theory of chemical equations, and details of manipulation. The laboratory is open every afternoon in the week except Saturday, but no class works in the chemical department on every afternoon of the week, laboratory work being alternated with drafting and other practical lines.

Instruction in Quantitative Analysis is given during the second year. The course includes the analysis of a number of salts of definite composition; the gravimetric determinations of iron, copper, zinc, lead and other metals from their ores; the complete analysis of limestones, clays, slags, and of various types of ores.

Assaying (wet and fire methods), commences with the rapid volumetric methods used in the west, for the valuation of ores and furnace products, and includes the analysis of slag, coal and cokes, and general commercial work, followed by the course in fire assaying.

The principles underlying the fluxing of ores are first taught, followed by the application of these principles to typical ores, siliceous, calcareous, barytic and pyritic, etc. This is succeeded by a large amount of practice on checked samples, obtained from the various mills and smelters.

After attaining sufficient expertness, the student is given various furnace products, copper mattes, base bullion, doré bars, and black copper, which usually, even to experienced assayers, are exceedingiy troublesome.

In the Fire Assay course, large numbers of samples are given for examination. It is believed, indeed, that no technic school in the country exacts such an amount of actual practice from its students as is here insisted upon before the student is pronounced fit for a practical assayer. The best proof of the success of the institution in this direction is the fact that no term passes without application being made to it for assayers or chemists.

From smelting works and other establishments in the State, the school has secured very great numbers of well-checked samples, and may claim to be far more than usually well supplied with material for assays and analyses. Students are required to "check" with the results obtained by experienced workers, and that, too, with certainty and rapidity, before they can pass out of this department.

Each student receives individual instruction in the laboratory. If his progress exceeds that of his classmates, he may be promoted to a higher class of work, provided same does not interfere with the regular schedule of laboratory terms.

There are four laboratories for general chemical work, and two for fire assaying. The whole of the first floor of the old building is now devoted to practical chemistry, and much of the basement and second floor. There are two balance rooms, two private laboratories and still room. The general laboratories are fitted with working desks, each student having the exclusive use of one, in which he keeps (under lock) the apparatus he has drawn from the school. The laboratory is furnished with gas (manufactured on the premises), and with sinks, hoods and all other necessary adjuncts. Apparatus is issued as called for, by the Registrar. (See "Expenses.")

No fee for chemicals less than that for a whole term can be accepted. Students are strictly prohibited from taking analyses or assays on their own account, whether for a fee or gratuitously. All work, of whatever description, performed by laboratory students must be at the suggestion and under the direction of the Professors of Chemistry.

Attendance in the laboratory on all days scheduled is as obligatory as that upon lectures or other exercises.

STOICHIOMETRY.

This subject is taught by lectures and recitations, with numerous exercises in calculation. It is not wholly confined to chemical calculation, but includes physical and metallurgical features.

The lectures begin with the second term of the first year, and end with the year. An advanced course, having reference mainly to slag calculations, and introductory to third year work in Metallurgy, is taken in the second term of the second year.

The entire course includes the metric system, specific gravity determinations, density and tension of gases, calculation of formulæ and analyses, slag calculations, and generally, all applications of elementary mathematics to chemical and metallurgical problems.

METALLURGY.

The study of Metallurgy begins with the Junior year, and continues throughout the remainder of the school course. The subject is taught by illustrated lectures, study of text-books, and visits to metallurgical works, where the students see and study the operations described in the class room.

JUNIOR YEAR.

The General Principles of Metallurgy—The relations of Chemistry to Metallurgy. Properties of the metals. Thermal treatment of metals. The metallurgy of alloys, brasses and bronzes. Thermal measurements. Fuels (solid, liquid and gaseous), their occurrence, manufacture, properties and uses. Fluxes, including a study of slags and calculation of furnace charges. Refractory materials; their occurrence, properties, manufacture and use. The classification of furnaces, and the study of the different types of furnaces used for various metallurgical operations. Blowing apparatus. Hot-blast stoves. Classification of metallurgical processes and a general study of typical processes.

Text-book, "An Introduction to the Study of Metallurgy." Roberts-Austen.

The Sampling of Ores and Metallurgical Products—Lectures illustrated by lantern slides, working drawings, and visits to works.

Ore Dressing and Concentration—General principles. Hand sorting. Crushing and pulverizing machinery. Sizing by means of screens. Hydraulic classification. Jigging. Machines for the treatment of fine material; as, buddles, vanners and percussion tables. The various systems of concentration in use in the United States and Europe. Description of typical plants. Dry concentration. Magnetic separation.

Text-books, "The Art of Ore-Dressing in Europe." W. B. Kunhardt. "Metallurgy of Gold." T. K. Rose.

The Metallurgy of Gold—The occurrence and properties of gold. General discussion of the various processes for the extraction of gold from ores. Placer and hydraulic mining. The extraction of gold by amalgamation. Arrangement of plant. Description of typical mills.

Text-book, "The Metallurgy of Gold." T. K. Rose.

SENIOR YEAR.

The Roasting of Gold, Silver, Copper, Lead, Zinc and Iron Ores.

Text-book, "Modern Copper Smelting." E. D. Peters, Jr.

Copper Smelting and Refining—Reverberatory furnace smelting. Blast furnace smelting. Pyritic smelting. The refining of blister copper. Electrolytic refining.

Text-book, "Modern Copper Smelting." E. D. Peters.

The Metallurgy of Lead—Reverberatory furnace smelting. Smelting in the American ore hearth. Blast furnace smelting. Desilverization of base bullion. Cupellation.

Text-book, "Metallurgy of Lead." H. O Hofman.

The Metallurgy of Zinc, Tin, Aluminum, Mercury, Antimony and Platinum—A series of illustrated lectures is given on the metallurgy of these metals.

The Metallurgy of Gold (Concluded)—The Chlorination process, Cynanide process. Melting and refining gold. The parting of gold and doré bullion.

Text-book, "Metallurgy of Gold." T. K. Rose.

Metallurgy of Silver—The occurrence and properties of silver. General discussion of the various processes for the extraction of silver from ores. The Patio process. The pan amalgamation process. The combination process. Chloridizing, roasting and pan amalgamation. The Boss process. Wet processes. Refining silver bullion. A series of illustrated lectures is delivered in this course.

Metallurgy of Iron and Steel—Direct methods. Blast furnace practice. Manufacture of wrought iron. Manufacture of steel by the Bessemer, open hearth and other processes.

A series of illustrated lectures, including a visit to the works of the Colorado Fuel and Iron Company, at Pueblo, is given in this course.

Purchasing and Testing Ores—A series of lectures is given, followed by practical work in the laboratory. (See Graduating Theses.)

Metallurgical Design—The students are required to visit one of the smelting works in the neighborhood of Denver and obtain notes and measurements of a reverberatory furnace and a blast furnace. From the data thus obtained they execute working drawings for the construction of furnaces.

Graduating Theses—Students who choose a metallurgical subject for their graduating thesis are given a typical ore of gold, silver, copper or lead, which they test and determine the most profitable method of treatment to be adopted under the given commercial conditions. The student, having selected a method of treatment, then prepares working drawings and specifications for a plant to treat the given ore. The drawings, specifications, and a summary of the tests, constitute the thesis necessary for graduation.

MINING AND METALLURGICAL EXCURSION.

In addition to the visits made to both mines and metallurgical works, located near Golden, the Senior class makes an annual excursion to more distant plants. This excursion is part of the regular course and is required of all Senior students who are candidates for the Mining and Metallurgical degrees. The graduating class of 1897 was taken to Manitou where a study of the local geology was made. At Colorado City the chlorination plant of the Philadelphia-Colorado Reduction Company was inspected. At Pueblo the iron and steel works of the Colorado Fuel and Iron Company, the silver-lead smelting works of the Colorado Smelting Company, the silver-lead smelting and refining works of the Pueblo Smelting and Refining Company, and the silver-lead and copper smelting plants of the Philadelphia Smelting and Refining Company were inspected. At Cyanide the large cyanide plant of the Metallic Extraction Company was visited. The oil wells and refining works of the United Oil Company at Florence were inspected after which a trip was made through the coal mines of the Colorado Fuel and Iron Company, located in the Canon City district. Several of the large mines in the Leadville district were visited. The party proceeded to Aspen, where a number of the large mines, including the Smuggler, Mollie Gibson, Free Silver, Bushwhacker, Johnson-Della S., and the properties of the Aspen Mining and Smelting Company were inspected. The concentrating works of the Smuggler Company and the electric generating and transmission plants were also visited.

In addition to these excursions, many students work during the summer vacations in mines and ore reduction plants. This work is not compulsory, but all students are earnestly requested to avail themselves of opportunities thus offered.

The school has the advantage of a remarkable collection of models from the workshop of Theodore Gersdorf, Freiberg, Saxony, illustrating the principal types of modern furnaces in this country and Europe. Each model is made to a scale from the working drawings, and is complete in every detail. The following furnaces are represented in this collection:

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

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

Round silver-lead furnace, as used in Germany.

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

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

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

Zinc pots as used in same.

Sweating furnace as used in same.

Lead pots as used in same.

Concentration cupel for making silver bullion.

Refining cupel for making fine silver.

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

Silesian zinc furnace, as used in parts of Europe.

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

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

Gerstenhofer roasting furnace, for fine copper and iron sulphides.

Tin blast furnace, as used in Saxony.

Bismuth smelting furnace, as used in Germany.

Large mercury furnace, as used in Almaden, Spain.

Fume furnace, for making lead and zinc paints.

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

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

2. Working model of ore rolls, same scale.

3. Working model of a Dodge Crusher.

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

A Vezin laboratory jig has also been added to collection through the courtesy of Mr. Henry A. Vezin of Denver.

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

In Colorado students have unusual opportunities for the practical study of metallurgical operations on a large scale. Denver is not only the mining center of the United States, but the business of treating silver and gold ores by lead smelting is carried on by large plants in Denver and Pueblo, on a scale unequaled in any other part of the world. In both cities large matte smelting plants, representing the most advanced methods in the art of metallurgy, are in operation for the treatment of gold and silver by this process.

In the State, within easy reach of students, metallurgical and mining work of every description is in active operation:

Coal mining, coke and charcoal manufacture.

Brick and tile works.

Iron blast furnaces, and Bessemer steel works.

Gold, silver and lead mining, gold placer mining, smelting processes of all kinds. Gold mining, concentration milling, silver chloridizing, lixiviation milling, wet processes for gold, ore sampling works, iron foundries and machine shops, with manufacturing establishments in great variety.

In the course of study, special attention is paid to those branches of Metallurgy now applied to Western ores, but the important fact is always kept in view that under the commercial conditions of the United States, a successful career is best assured to students by giving them a thorough training in all departments of Metallurgy. A student can never be certain in what line of metallurgical or mining work he will be occupied, since this usually depends upon the chances of his business career. It is therefore intended that the students shall leave their studies thoroughly qualified to undertake whatever kind of mining or metallurgical work they may find to do in after life.

The lectures throughout are richly illustrated by lantern exhibits of plans, views and designs of metallurgical works and appliances.

A fine collection of ores and economic products has been added to the department during the past two years, and is used in both the Metallurgical and Mining courses.

MINING.

This subject is taught by lectures illustrated by lantern slides, photographs and drawings. Five lectures per week are delivered during the Senior year. In addition to the class-room instruction, one afternoon per week is devoted to the detailed design of a plant for the development of a mine, the ruling conditions being specified.

The outline of the course is as follows:

Ore Deposits—Their classification, modes of formation and economic study. Descriptions of typical deposits.

Boring—Diamond drill work and the percussion methods.

Breaking Ground—Hand tools, rock drills, channellers, coal cutters, steam shovels and dredges. Explosives; black powder, nitro-glycerine, gun-cotton and their compounds; methods of testing and calculations of heat and pressure developed. The wave of explosion and the theory of blasting. Pointing and charging holes. Methods of firing.

Shaft-Sinking, Tunnelling and Supporting Excavations—Methods of sinking and driving in loose and running ground. Linings of wood, metal and masonry, their relative strength, cost and durability. Timbering of stopes and other working places and preservation of timber.

Exploitation—Systems of mining in beds and veins. Descriptions of the special methods adopted for working bodies of soft ore and large masses.

Transportation—Underground and surface. Vehicles and motive powers. Self-acting and engine planes and haulage by the tail rope and continuous rope systems. Electric haulage. Surface tramways and aerial ropeways.

Hoisting—Receptacles, ropes, gallows frames and motive powers. Safety appliances. Pneumatic hoisting.

Drainage—Sources of mine water. Dams and drainage levels. Hoisting water. Direct acting and Cornish pumps. Pumping by compressed air and electricity.

Ventilation and Lighting—Natural ventilation. Friction of air in mines. Furnaces and fans. Efficiency of ventilating apparatus. Candles, open lights, safety lamps and the electric light.

Ascent and Descent—Ladders. Buckets and cages. Man engines. Time required and consideration of the relative economy of the different methods.

Accidents—Surface and underground. Classification and mortality.

Administration—Business management and the principles of the employment of labor.

Mine Examination—Sampling of ore bodies, estimation of "ore in sight" and the valuation of mining properties.

Throughout the course the economic questions involved are kept constantly in view. Estimates of cost are given whenever obtainable from reliable sources. Care is taken to impress upon the student that mining is a *business*, and to be successful, must be conducted on business principles.

Mine surveying is referred to elsewhere.

MATHEMATICS.

Euclidian Geometry, Algebra, Plane Trigonometry and Descriptive Geometry are pursued during the first year.

In Geometry many problems not in the text are given, especially toward the close of the course. Much stress is laid upon clear comprehension of geometric reasoning, and upon ability to apply it to original solutions.

The student is made sufficiently familiar with determinants and special algebraic methods to make extensive use of them in Analytical Geometry and Calculus, which begin in the second year.

The problem of maxima and minima of analytical functions is treated in its widest sense, and, so far as the present theory of quantics allows, not only the necessary, but also the sufficient conditions are rigorously established in determinant form.

The course in the fourth year is subject to variation. It consists mainly of exercises and lectures in selected parts of Advanced Mathematics. In this way lectures on the following subjects have been delivered to students specially interested in pure mathematics:

Solution of the most general system of Algebraic Equations.

Introduction to Weirstrass' Theory of Analytic Functions.

Method of Least Squares.

Elliptic Functions.

Integration on Riemann's Surfaces.

Analytical Mechanics.

A full set of models is provided for instruction in Descriptive Geometry.

DEPARTMENT OF GEOLOGY AND MINERALOGY.

There is probably no technical school in the United States more favorably situated for the study of Geology and Mineralogy than is the Colorado State School of Mines.

GEOLOGICAL LECTURE ROOM.

Located immediately at the foot-hills west of Denver, there is ready access to an almost unsurpassed series of geological sections in which all the formations from the triassic up to the recent may be readily studied. In addition to this the crystalline schists of the archæan are to be found exposed in great variety within a mile or two of the school, and the more recent volcanic rocks may be studied in the basalt and andesitic tufas of North and South Table Mountains, which form conspicuous features in the immediate landscape.

In the coal mines, stone quarries and fire-clay beds of the vicinity, there are excellent opportunities for the study of Economic Geology, while the paleontologist has a good field for study in the famous fossil leaf deposits of the cretaceous and tertiary formations to be seen almost at the very doors of the school.

A large variety of minerals may also be collected in the crystalline rocks of the neighboring foot-hills and in the cavities in the basalt flow capping both North and South Table Mountains.

In addition to these great natural advantages have been added very extensive geological and mineralogical collections which in number, variety, classification and value, far exceed any other collection to be found within the State of Colorado.

To the collections originally obtained by purchase from Ward & Howell of Rochester, New York, from J. Alden Smith, (formerly State Geologist,) from J. S. Randall of Georgetown, Colorado, and by gifts from various mines and individuals, has from year to year been added a large amount of material collected by the professor in charge and by others.

This department occupies four rooms, in all of which may be found portions of the various mineral and geological collections. These collections have been 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 contains at present specimens representing two hundred and seventeen species and sixty-one additional varieties. These specimens come from many countries, but Colorado minerals are specially well represented.

Second—A Display Collection, mainly of large and fine specimens of minerals and rocks.

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 several 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 Rock Working 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—Duplicates of rocks, minerals and fossils, to be used for exchange with other institutions. (See pages 66–68.)

Thirteenth—The United States Geological Survey educational series of rocks.

Fourteenth—Professor Patton's private collection of Minerals, displayed in part in the Faculty room.

Fifteenth—Professor Patton's private collection of rocks.

MUSEUM.

As is necessarily the case in a technical school the great bulk of the collections are gathered and arranged to be used for the purpose of instruction. Such material is to be found in the numerous cases of drawers lining the sides of the different rooms.

The material of greatest interest to the visitor is to be found in the flat topped glass cases in three of the rooms. This consists mainly of minerals, but in part also of Colorado fossils. In most cases this material is so disposed as to make the most effective display with little regard to systematic classification.

The institution has at various times been presented with specimens of ores, rocks and minerals, by graduates and friends in the mining regions. Many of these have been included in the "Type Collection," but large numbers of them are to be found in the museum, which has grown more rapidly during the past two years than at any previous time.

Among the more interesting displays may be mentioned the quartz and microcline crystals from Florissant, Colorado; the telluride of gold and silver specimens from Boulder County, Colorado; the beautiful golden calcites from Joplin, Missouri, and the set of crystallized sulphur specimens.

COURSE IN GEOLOGY.

This course runs through the Junior year and is divided into four subjects, namely: Dynamical Geology, Structural Geology, Lithology, Historical Geology. The general principles of Geology are taught through text-book (Le Conte's Elements of Geology) and lectures, supplemented by numerous field excursions.

The Rock Type Collection, Rock Working Collection, and the other collections named on pages 47 and 48, come into constant use during this course, whose intent is to make of Geology a study of practical application in connection with mining and prospecting.

The surroundings are peculiarly adapted to further this intent. The vicinity of Golden is rich in rocks of various ages, including also many illustrations of Economic Geology. Building stone, clay, limestone and coal are mined or quarried within sight of the school, while the formations include the tertiary, cretaceous, jura-trias, archæan and eruptive rocks.

The excellent and constantly growing collections of rocks make it possible to familiarize the student with all the important rock types and to make the study of Lithology a thoroughly practical one.

COURSE IN MINERALOGY.

Under this head are included Crystallography, Blow-Piping and Determinative Mineralogy.

The immediate object of this course is to give the student in a comparatively short time a thorough familiarity with the more commonly occurring minerals, *i. e.*, with such as form the materials of rocks, or are likely to be met with in connection with mining operations.

It is quite possible so to train the powers of observation that, with the aid of a knife, a pocket lens and, perhaps, of one or two other simple accessories, which can easily be carried in the pocket, one can determine on the spot nine-tenths of the minerals he meets. In the study of minerals, therefore, attention is directed mainly to the physical properties, namely, to those that can be recognized by the aid of sight and touch.

The course in Mineralogy extends throughout the whole of the Sophomore year, five hours a week being devoted to this subject, the first term, and eleven hours the second term. The course opens with the study of Crystallography, which requires two-thirds of the first term. The remaining weeks of the term are devoted mainly to a short course in the use of the blow-pipe, in which only such reactions are studied as are likely to be made use of in determining minerals later in the year. Determinative Mineralogy is taken up about Christmas and extends throughout the rest of the school year.

Crystallography and Blow-Piping are taught by means of lectures and practical laboratory work. In Determinative Mineralogy, lectures are made to supplement the text-book used (Moses' and Parsons' Mineralogy, Crystallography and Blow-Pipe Analysis).

SUMMARY OF COLLECTIONS WITH NUMBER OF SPECIMENS IN EACH.

Type Collection of Minerals	3,125
Working Collection of Minerals	12,600
Display Collection of Minerals	1,155
Supplementary Collection of Minerals	950
Crystal Collection	870
Display Collection of Fossils	260
Miscellaneous Collection of Fossils	920
Type Collection of Rocks	1,800
Working Collection of Rocks	4,800
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	29,306

EXCHANGE MATERIAL.

The school has now on hand a considerable quantity of exchange material in the line of minerals, rocks and fossils, an itemized list of which follows. Any one wishing to arrange for a mutual exchange should communicate with Professor Horace B. Patton, Golden, Colorado, sending, if possible, a list of minerals, etc., offered in exchange.

MATERIAL OFFERED FOR EXCHANGES.

I. COLORADO MINERALS.

SAN JUAN MOUNTAINS.

Zunyite, Zuni mine, Silverton. In small, sharp tetrahedrons, etc. Can be furnished in large quantity.

Huebnerite, Gladstone. Divergent aggregates of bronze colored crystals, one to two inches long, imbedded in quartz.

Sphalerite, Ute and Ulay mine, Lake City. In yellow cleavable masses with galenite and chalcopyrite.

Barite and pyrite, George III. mine, Carson. Thin reticulated plates of barite spangled with minute crystals of pyrite.

Chalcedony, Ute Creek. Botryoidal and banded. Colors gray, white and green.

Milk opal, Ute Creek.

Rhodochrosite, Vallecita Basin. In deep pink, cleavable masses.

Enargite, National Belle mine, Red Mountain. In cleavable masses.

Bornite; Red Mountain. In pure masses.

LEADVILLE.

Pyrite, R. A. M. shaft. Irridescent crystals, small but brilliant in clusters, lining cavities in massive pyrite.

Galenite and pyrite, Mahala mine. In handsome cellular, intergrown, branching aggregates.

SUMMIT COUNTY.

Pyrite and sphalerite, Wulfley mine, Kokomo. Branching aggregates of pyrite penetrating sphalerite.

Orthoclase, Kokomo. Loose crystals, one to two inches, simple and twinned.

Orthoclase, Robinson. Sharp, white crystals averaging one inch, simple and in Carlsbad and Baveno twins.

OTHER COLORADO LOCALITIES.

Corundum, near Salida. Flat crystals one-eighth to one-quarter inch, (basal plane and rhombohedron), imbedded in quartz, etc., forming a corundum schist. Color deep blue, also gray and brown.

Sylvanite and other tellurides of gold and silver, Boulder County.

Graphic granite, Clear Creek. In masses up to two feet.

Zeolites, Table Mountain, Golden. Natrolite, chabezite, thomsonite, analcite.

II. TINTIC RANGE AND MERCUR, UTAH.

Olivenite, Centennial Eureka mine, Eureka. In aggregates of nearly parallel plates lining cavities in limonite.

Olivenite, Carissa mine, Mammoth. Small prismatic crystals, also in tufted, fibrous and velvety aggregates.

Conichalcite, Carissa mine, Mammoth. In handsome green coatings on limonite, etc.

Realgar, Mercur. Massive.

III. MISCELLANEOUS LOCALITIES.

Cyanite, Litchfield County, Connecticut. Green color.

Vivianite, Mullica Hill, N. J. A few rosettes and divergent aggregates.

Prehnite, near Duluth, Minnesota.

Copper, Lake Superior. In Calumet and Hecla conglomerate.

Garnets, Michigamme, Michigan. Partly altered to chlorite. Also the same in chlorite schist.

Calcite, Rockland, Maine. In flat crystals.

Willimite, Franklin Furnace, New Jersey. In rhombohedral crystals.

Rubellite and lepidolite, San Bernardino County, California. Handsome radiated and divergent prisms imbedded in lepidolite.

Hanksite, Borax Lake, San Bernardino County, California. In half-inch crystals.

Muscovite, Saratoga, Wyoming. Handsomely figured in red, brown, yellow and black colors by means of iron oxides.

ROCKS AND FOSSILS.

ROCKS FROM CRIPPLE CREEK, COLORADO.

Phonolite, three varieties, from Beacon Hill.

Phonolite, Lookout Mountain.

Phonolite, Mt. Pisgah.

Phonolite, Rhyolite Mountain.

Phonolite, Bull Cliffs.

Phonolite (peculiar spotted variety), Bull Cliff Summit.

Trachytic phonolite, Bull Hill.

Nepheline syenite, Vindicator mine, Bull Hill.

Nepheline syenite, Longfellow mine, Bull Hill.

Andesite, with large black apatite crystals, resembling quartz, Battle Mountain.

Granite, coarse red, fresh, Rhyolite mountain.

Granite, with strongly developed gneissose structure, Grouse Mountain.

Andesite breccia, Rhyolite Mountain.

Banded andesite ash rock, stained very handsomely in purple, red, yellow and white colors, Bull Cliff.

Fluorite-quartz rock, compactly crystalline, deep purple color, Anaconda.

VARIOUS LOCALITIES.

Spherulites, Silver Cliff and Rosita, Colorado. Remarkably fine roundish, mostly compound spherulites in all sizes from one inch to over a foot, found in rhyolite and obsidian. Also fragments of larger compound spherulites showing branching intergrowths of quartz and feldspar. (See paper by W. Cross on Spherulites in Acid Eruptive Rocks, Philosophical Society of Washington. Bulletin, Vol. XI, pp. 411-444.)

Obsidian, Silver Cliff, Colorado.

Hornblende andesite, Rico, Colorado.

Ryolite, Kokomo, Colorado. With and without phenocrysts of feldspar.

Tourmaline schists, Belcher Hill, Jefferson County, Colorado.

Andalusite schists, Vallecita Valley, San Juan Mountains, Colorado.

Crinkled mica schist, Van Bibber Creek, Jefferson County, Colorado.

Flint conglomerate, Green Mountain, Jefferson County, Colorado.

Basalt, Table Mountain, Golden, Colorado.

Potsdam sandstone, Portage Entry, Lake Superior. Showing well-defined ripple marks.

Gabbro, Duluth, Minnesota.

Melaphyre, Houghton, Michigan. Many varieties, showing amygdules of chlorite, calcite, epidote, etc.

Andesite, Crater Lake, Oregon. Mostly hypersthene A., but showing a great variety of structure and color from coarsely crystalline to obsidian.

Fossil leaves, Table Mountain, Golden. Tertiary leaves of many species.

Silicified wood, Green Mountain, Golden, Colorado.

Sharply defined veins of quartz and of quartz and muscovite in black tourmaline schist, Jefferson County, Colorado.

MATERIAL DESIRED IN EXCHANGE.

The School of Mines can make good use of almost any pure mineral, especially if well crystallized. Sulphides, arsenides, antemonides, etc., are specially desired, and in considerable quantity; also loose crystals suitable for use in studying crystal forms. Those desiring to make exchanges are requested to submit lists of minerals or rocks offered. (See page 52.)

PHYSICS.

The course in Physics is given by lectures and recitations, accompanied by practical work in the laboratory. The course embraces molecular physics, gravitation, mechanics of liquids and gases, elementary machines, acoustics, the theory of heat and of the steam engine, and the general principles of light.

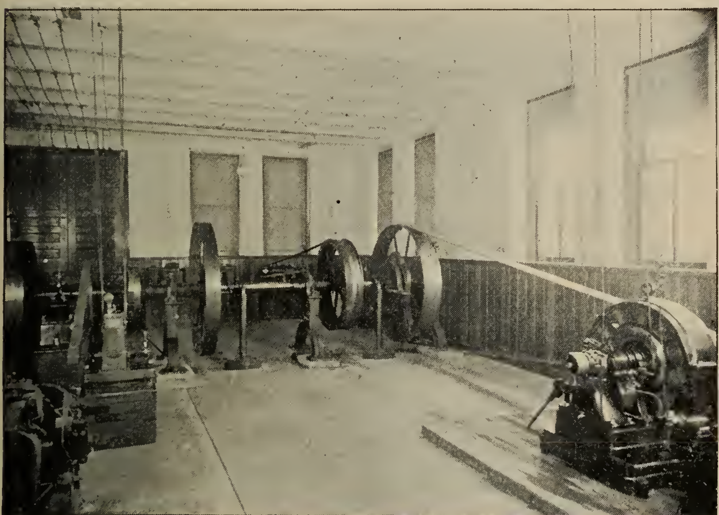
The second term is devoted chiefly to an elementary course in electricity and magnetism.

The object of the laboratory course is not original research, but the acquirement of a certain familiarity with the subjects which this work alone can give. During the first part of the course the student acquires facility in the use of instruments, and accuracy in measurement, which fit him for the other work in the laboratory. The experiments are quantitative, and are selected with the view of illustrating the fundamental principles of the subject rather than of devoting the student's whole time to the elaborate determination of a few constants.

The equipment of the laboratory is fairly complete. A fine Troemner and an excellent Sartorius balance belong to the laboratory, while a number of balances from the chemical laboratory are available during a part of the time. Forty micrometers and vernier callipers are provided, as well as spherometers, protractors, etc. Jolly balances, hydrometers of various kinds, thermometers, a fine Kater's pendulum, lenses, mirrors, galvanometers, resistance boxes, Wheatstone bridges, apparatus for the determination of the law of the pendulum and for the determination of Young's modulus, form part of the equipment.

ELECTRICAL ENGINEERING.

The course in Electrical Engineering is intended to cover both the theoretical and practical parts of the subject. It is adapted to the needs of the State by the devotion of much time to the applications of electricity to mining and metallurgy.



DYNAMO ROOM.

In the third and fourth years, work in Mechanical Engineering forms a considerable part of the course. Tests of steam engines, boilers and water wheels are made from time to time. The engine is fitted up for testing, as is the eighty horse-power boiler furnishing steam to Engineering Hall. The course in Electrical Units and Measurements consists of lectures on the theory and value of the units of the science and the modern methods of measurement. Four hours per week are devoted to work in the laboratory.

The course in the Distribution of Electricity embraces distribution for lighting and the various systems for the transmission of power.

Lectures on the theory and design of Dynamo-Electric Machinery will occupy the student five times a week during the fourth year. Two full afternoons per week, in addition, will be devoted to work in the laboratory and in the designing room. Alternate currents and alternate current transformers occupy a large portion of the time during this year.

The laboratory work of the fourth year consists of insulation and capacity tests, measurement and location of faults, determination of magnetization curves of iron and steel, determination of characteristic curves of various machines, and of tests of dynamos and motors, as well as standardizing and calibrating various instruments.

Besides the space occupied by the general lecture room and the Physical Laboratory, a large room is fitted up on the second floor for work in Photometry. In addition to the Bunsen photometer, a complete "Reichsanstalt" standard photometer, with all accessories, has recently been added to the equipment of this room. The various experimental machines are belted to pulleys on a jack shaft, driven by the engine in the dynamo room. The instruments for use in testing are in a smaller room adjoining, where the marble switchboard and the large resistance coils are also placed. Separate wires run to each room from both the alternate and continuous current circuits and also from the sixty-cell accumulator recently purchased from the Electric Storage Battery Company. The rooms on the north side of the building, devoted to electrical measurements, have little iron used in their construction, while the room designed for magnetic measurements has none. These rooms are equipped with piers, non-inductive resistances, gas, water and direct connections to all circuits, besides the ordinary galvanometers, resistance boxes, balances and other instruments.

The department, in addition to these appliances, is well equipped with high-grade galvanometers and the ordinary apparatus for electrical measurements. Dynamometers, of various types, and wattmeters enable efficiency tests to be conveniently made. Kelvin balances, electrostatic voltmeters, ammeters and voltmeters of various makes, form part of the equipment.

Through the kindness of Mr. Irving Hale, the department has been presented with a twenty-five horse-power motor.

To Mr. Paul Webster, a former student of the institution, the department is indebted for a small steam engine.

Mr. John Pipe has recently presented the department with a dynamo of considerable historical interest.

PRIME MOVERS AND POWER TRANSMISSION.

During the fourth year, a portion of the time is devoted to the study of Steam Engines and Hydraulic Motors of various types. This subject is given by lectures accompanied by laboratory work. Complete tests are made of engines and boilers, and of some type of water wheel.

In Hydraulics, especial attention is given to the flow of water in pipes, conduits and open channels. Measurements are made of flow of water over weirs and through orifices, and of the flow in the ditches near Golden, by a number of methods.

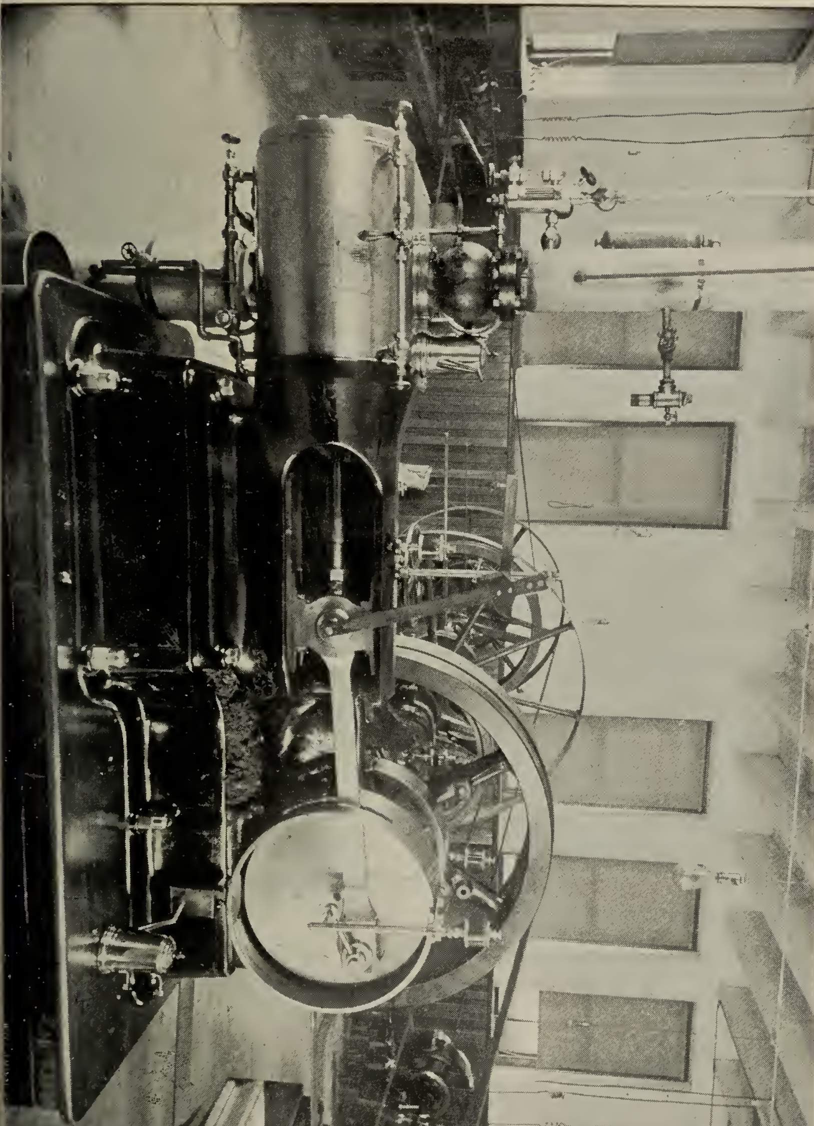
MECHANICS.

This course occupies three hours per week during the entire Junior year. It includes Statics, Dynamics and Mechanics of Materials. In the development of formulæ and methods, free use is made of mathematical ideas and symbols. A knowledge of the Differential and Integral Calculus is a necessary preliminary to the study of this subject as here pursued. The practical applications are, however, kept constantly in view, and approximate methods are introduced whenever they can be shown to be sufficiently exact and to materially simplify the results. The students are encouraged in every way to rely upon their own reasoning powers, and to guard against a mere copying of book or class-room processes. They are taught to reason from fundamental principles in all cases, and to avoid "rule of thumb" work.

Mechanics of Materials is treated simply as a branch of the general subject, and not as a separate study. The principal formulæ are developed from a consideration of the same principles which form the basis of Statics.

In the laboratory each student makes a prescribed series of tests on wrought iron, steel, cast iron, wood, building stone and brick. The tests on wood are conducted by the methods developed in the work of the United States Bureau of Forestry, and tests on all other materials by the most approved methods now in use. For this work the laboratory is supplied with a Riehlé testing machine of one hundred thousand pounds capacity, fitted for work in tension, compression and transverse testing.

The text-book used for the class-room work is Church's "Mechanics of Engineering."



GRAPHICS.

Two hours per week of lecture and text-book work, and two afternoons per week of drafting are given to this subject during the second term of the Junior year. The properties of reciprocal figures, the equilibrium polygon and the frame pencil are developed and illustrated in the class-room and applied to numerous problems by the student in the drafting room. Each student determines the stresses in a number of framed structures under the various loadings to which they are subject. Roof trusses, iron building frames, gallows frames, bridge trusses, trestle bents and cranes are among the structures assigned to members of the class for analysis.

Although great importance is attached to the graphical method, the analytic determination of stresses is not neglected and at least one frame is treated by both methods and the results compared.

The effect of the rigidity of certain classes of frames upon the stresses in their members is studied, and several methods for the calculation of deflections and the stresses in redundant members are developed.

The graphic determination of bending moments in pins subject to non-coplanar forces is taken up both in the lecture and drafting rooms.

It is intended that this course and the one in "Mechanics of Materials" shall cover all the ground preparatory to actual structural design which is taken up in the Senior year.

THEORY OF CONSTRUCTION.

In this course the principles and methods developed in the study of Mechanics and of Graphics are applied to the design of structures of various kinds. Among these are wooden and steel roofs and buildings, gallows frames, trestles, flumes, masonry arches, dams, retaining walls, chimneys and foundations. Standard specifications are discussed in detail and with great care, and those theories which are incomplete are supplemented by accounts of methods adopted in existing structures. Records of failures are studied and the causes pointed out whenever they can be ascertained. The limitations put upon many theoretical results by labor conditions and the means available for executing the work are considered. Economic considerations are kept constantly in view and students are taught that *least cost* is the first essential. However, it is not forgotten that first cost is not the only cost and the question of durability is carefully studied.

Each student makes several designs of structures, both framed and masonry, and executes complete working drawings, bills of material and detailed estimates of cost.

These lectures and two afternoons in the drafting room each week of the first term, Senior year, are given to this subject. Baker's "Masonry Construction" is used as a text during a portion of the term. For the remainder of the term no text-book is used, but Johnson's "Engineering Contracts and Specifications" and "Modern Framed Structures" are frequently referred to as supplements to the lecture work.

SURVEYING.

The instruction in this subject is both theoretical and practical, the aim being to convey to the mind of the student a broad understanding of the subject and its applications in the professional work of the Mining and Civil Engineer. As a means to this end, the institution is well supplied with the necessary instruments for field practice. Among these may be mentioned one complete mining transit with side telescope, two complete mining transits with combination top telescope and solar attachment, one triangulation transit, three complete engineer's transits with solar attachments, four engineer's levels, one needle compass, one three-hundred-foot steel tape, standardized, and all the necessary accompanying apparatus for field and office use, such as chains, tapes, stadia boards, levels, rods, etc.†

The class instruction begins with adjustment and use of the transit, and the principles of Land Surveying, the field work consisting of traverses, and various problems designed to familiarize the student with the actual handling of the transit and tapes, and to illustrate the care necessary to secure good results. The problems are all plotted and handed in, and accuracy insisted upon.

The use and adjustments of the level are treated in the same order as with the transit. Simple exercises in differential leveling being given until the student has sufficient experience to enable him to run profile lines, and

† The surveying instruments are all of the best makes, and additions are constantly being made. Among the makers may be mentioned Buff & Berger, Heller & Brightley, Gurley & Sons and Troughton & Simms.

determine from them, the best grade for street and sewer lines. The further use of the level being left until the subject of railroad surveying is reached. The various solar attachments are next considered, and the principles on which they depend thoroughly explained. At the same time the adjustment of some form of the attachment being made by each individual as indeed are all the instrumental adjustments. In this connection, the "Direct Solar Observation" is given and used in the field. This subject is regarded as of fundamental importance for nearly all surveying work and especially is this true of claim surveying for patent, to which great attention is paid. Each party undertakes the complete survey of a mining claim for patent, going through all the field work that a United States Deputy Mineral Surveyor would have to do, checking meridians, determining free end lines, computing areas and intersections, and finally making a preliminary plat and writing up field notes according to the requirements of the Surveyor-General's office. The lectures given on this subject enter into the detail in which it is involved and touch upon the mining law relating to surveyors and the patenting of mining property. The general theory and practice in underground survey is discussed, especial attention being paid to the instrumental difficulties and particular problems encountered. Toward the end of the year time is allowed for the complete survey of some mine in the vicinity and the making of the accompanying maps and computations.

In Topographical Surveying each class makes a survey and contour map of some favorable place, with a view to locating the best position for a dam or reservoir site, or with a view to city improvements.

In City Surveying, classes are instructed in the laying out of cities and towns, surveys of new subdivisions, street improvements, giving of grades, etc., together with such applications of each in the field as time will allow.

In Geodetic Surveying, classes are instructed in the outlines of that subject, the different kinds of triangulation, description of the United States Coast Survey base apparatus and the establishment of stations and signals. A base line is measured with a three-hundred-foot steel tape and all corrections made so as to eliminate errors of sag and pull. On this rests a system of triangulation of the neighboring peaks and all angles measured and adjusted, and distances computed.

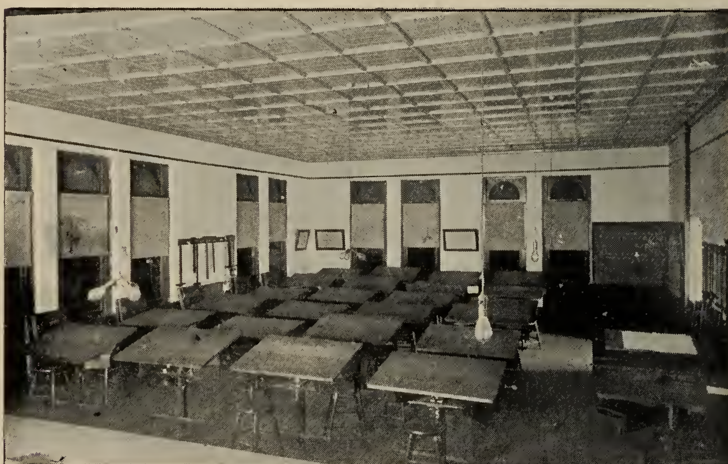
In Railroad Surveying, classes are instructed in the theory of curves of different kinds, running of levels and the measurement of earthwork. Considerable time is devoted in the field to a projected line with preliminary and location surveys, topography, cross-sectioning and preliminary and final estimates of earthwork.

During the course each student is required to make a determination of the true meridian by an observation on the pole star; he is also required to find the latitude using transit solar attachment or sextant.

The liberal time scheduled, coupled with the fact that our winters are generally mild and open allows very thorough instruction in the field and admits class instruction and the field work devoted to the same subject to occur practically at the same time.

DRAUGHTING.

It is the object in this department to first give a thorough grounding in all the more elementary parts of Mechanical Drawing, and to follow this with their application in the most practical way possible in a technical school.



SOPHOMORE DRAUGHTING ROOM.

The student is first taught the proper way of using his instruments, preparing his sheets, etc., and then given the simplest of geometrical figures, to cultivate some skill in their use. At this time individual instruction is given each student.

The work then leads into the more difficult elements of drawing, including line shading and tinting, together with lettering, and nó student is allowed to proceed who cannot neatly execute at least two alphabets in free-hand.

Then follows all the more difficult work, in projections and intersections, interspersed with representative practical problems, to show the direct application to actual work. The elements of all the methods of representing objects upon one plane including true perspective, completes the purely elementary work.

In all this work, as in the more advanced, no grades are given. Each drawing must be up to a certain standard, such as would hold in any well regulated drawing office, before being accepted, it being considered that under these conditions all drawings are of the same rank, except as to artistic effect, which is not considered a requisite of pure Mechanical Drawing.

The advanced drawing is all of a practical nature. The elements which have been thoroughly mastered in the previous years are here combined, and none but the methods used in the best American drawing offices are followed.

To this end, the drawing rooms have been equipped with the most efficient appliances. The Freshmen have large, rigid drawing tables, with ample room for each individual, and the advanced classes have improved individual tables, adjustable in every way, the light being reflected from the perfectly white walls, giving a mild diffused light, much preferred to strong direct light.

The blue-print room is modern and complete in every way, and students are taught to make prints either from tracings or direct from the bond papers now so much used in many offices.

The work by years is as follows:

FRESHMAN YEAR.

Use of drawing instruments, mounting sheets, etc. This includes the proper selection of instruments, testing and care of pen points, and like details, all of great importance to the beginner. Plain geometrical problems, simple projections and intersections; plans, elevations and sections, exercises in lettering, both free-hand and with the instruments; line shading, tinting and shading with tints; with applications of each as in working drawings. The working of problems, as given in Church's Descriptive Geometry, including a large number of exercises relating to the first seventeen problems as there given; problems in intersections, including the intersections of planes with cylinders, planes and cones, planes and surfaces of revolution; surfaces of revolution with surfaces of revolution, etc.; exercises in shades and shadows.

SOPHOMORE YEAR.

At the beginning of this year the study of Elementary Mechanism is taken up in the class-room and continues throughout the year. A part of the first term is used on the study of Isometric projection and true perspective.

Several sheets of drawing follow, involving the continual use of the principles of Descriptive Geometry in the representation of actual machine parts.

The rest of the year is given over to problems in Mechanism. This includes the laying out of lobed wheels, spur wheels, beveled wheels, sprocket wheels, cams, special motions with link work, etc.

Blue printing is explained at the beginning of the year, and the student becomes practiced in the process by making prints of his own work from time to time.

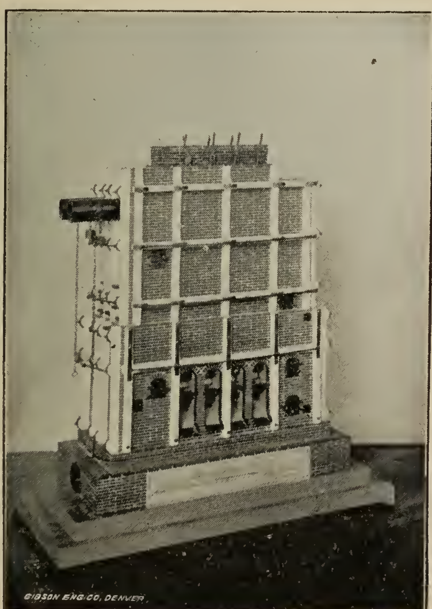
Special pains are taken all through this year to get the student in the way of making good working drawings according to the best American practices.

JUNIOR YEAR.

The study of Machine Design is taken up in the class-room at the beginning of this year and continues through the first term. The drawing for this term is all in connection with this study, and includes the designing of such parts of machines as follows: bolts and nuts; keys and cotters; pipes and pipe joints; shafting and shaft couplings; journals and journal bearings; arms, hubs and rims of gear wheels, belt wheels, sheave wheels, etc. Rivets and riveted joints; horse power of belts and gearing, brackets and pillow blocks, with other devices, are all explained and drawn.

SENIOR YEAR.

The Draughting of this year is distributed among the several departments of Metallurgy, Engineering and Electrics. Designs assigned according to the special work of the student, are executed of metallurgical plants, masonry work and bridges, and of electrical machinery. The draughting of this year, in short, is not intended as instruction in draughting, but as applied work.



FIELD TRIPS.

An important part of the work of the institution consists in visiting mines, smelters, power plants and other works, where the process lectured upon may be seen in actual operation.

Trips of this description have been made in past years to Aspen, Leadville, Central and Idaho Springs, in Colorado, and to the Michigan copper and iron mines (Summer of 1893).

In the line of Coal Mining and Economic Geology, excursions have been made to El Moro and Trinidad, Canon City and the local mines (near Golden).

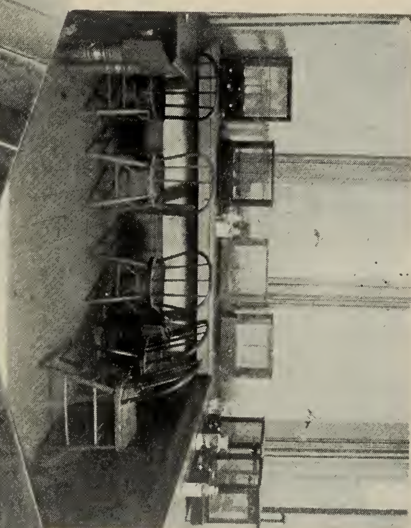
Metallurgical trips to the smelters at Denver and vicinity are quite frequent, while Pueblo and Leadville have also been included in longer trips.

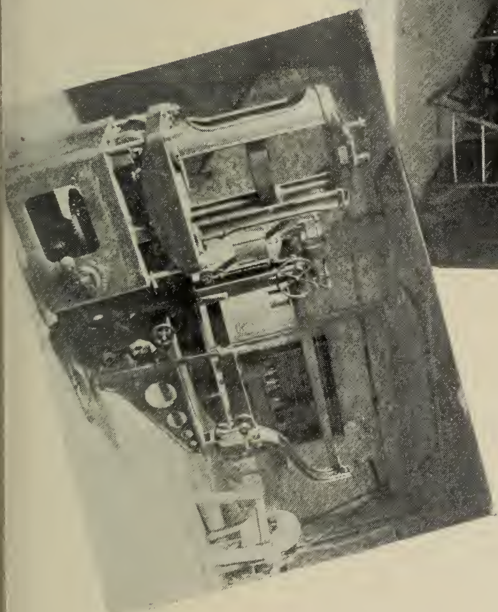
The trip of 1896, lasting a fortnight, included Manitou (geology); Pueblo (steel works, smelters); Florence (oil); Canon City (coal mining) and Leadville (mines and reduction works).

The trip of 1897 is described on page 39.

Geological excursions have been frequent, and although chiefly confined to a radius of ten miles from Golden, have been extended to Boulder County, to the Pike's Peak region, and to the southern portion of the State.

On these trips, low traveling rates are secured for the students, and, as presenting practical advantages too great to need any arguments in their favor, they have recently been made part of the obligatory work of the course.





LIBRARY.

The Library contains nearly five thousand volumes, mostly standard scientific and technical works, though history and travels are not neglected. Its cost per volume, as must be the case with scientific works, has been large.

Complete sets of the transactions of the institute of mining engineers, civil engineers, association of engineering societies, journals of chemistry, electricity and metallurgy, and technical cyclopedias in various lines, are among the recent additions.

The shelf and catalogue arrangements are upon the Dewey decimal system. Pamphlets are separately placed in special drawers, also under classification.

Students have free access to the library at all hours, whether for use as a reading room, or to select books for borrowing.

The authorities of the institution desire to acknowledge the generosity of Capt. Edw. L. Berthoud, formerly a trustee of the school, in presenting a number of valuable works.

APPARATUS AND MACHINERY.

The scientific apparatus in the various departments can hardly be named in detail in the catalogue. Reference should be made to the headings, "Departments of Instruction," under which some description will be found. The estimate for the year 1897 on value of apparatus and machinery is $36,000, which figure is *exclusive* of all furniture, fittings, desks, cases or ordinary school appliances.

BUILDINGS.

(1). BUILDING OF 1880-'82.

The combined building, 1880-'82, has the main dimensions of 100x70 feet, two stories, and basement extending under most of the space.

The Riehlé testing machine (see "Mechanics"), stands in the south basement, and is run by electric motor.

One of the two rooms for furnace assaying is also in this basement, which contains besides, rooms for testing of material and for the storage of laboratory supplies.

The main floor is wholly occupied by chemical laboratories, assay rooms, balance rooms, and rooms for the storage and issue of apparatus. (See "Chemistry.")

The second floor contains the lecture room for mathematics (excepting Freshman year). This room is at the north end of the building, dimensions 21x44 feet. The lecture room for general chemistry (35x35) is next in order, having an annexed room for apparatus.

Special laboratories (50x25) are also upon this floor, the remainder of whose space is occupied by several small rooms for balances and apparatus of various kinds.

(2). BUILDING OF 1890.

This building is connected with that of 1882 by passages on every floor. Its length is one hundred feet; its width from fifty-seven to sixty-eight feet. Its basement contains the gymnasium (q. v.) lavatories, shower bath, work-shop, steam-heating, boiler and gas apparatus.

The first floor contains the offices of the Registrar, library and reading room on one side of the main hall. The space on the other side (65x40), is occupied by the department of geology and mineralogy. It is divided into two rooms, one for the museum, the other is the working department and lecture room, containing all the collections used for instruction in geology, mineralogy, lithology and blow-piping.

The second floor is divided into: (1.) Lecture room for metallurgy and mining, containing also the collections and models for this department, and the arc lantern for exhibition of the numerous slides which have been prepared of working draughts for these courses. (2.) Lecture room for mathematics, chiefly devoted to Freshman work. (3.) Lecture room for engineering classes. (4.) Lecture room, used by various classes. (5.) Office rooms for Professors.

The fourth floor is entirely occupied by the Freshman Draughting room, and Professor's office. The space is four thousand square feet. This fine room is lighted partly by windows, but largely by sky-lights, and is fitted up with conveniences for stretching and washing drawings, and other appliances. It will accommodate over one hundred and twenty students.

This building stands upon ground overlooking the town, and presents a handsome appearance. It was first occupied at the opening of the fall term of 1890.

(3). BUILDING OF 1894 (HALL OF ENGINEERING).

The completion of Engineering Hall has placed the department of Physics and Electrical Engineering on a new footing. The space in the old quarters was entirely inadequate for a department of so much importance to a state in which electric power is so widely used in mining operations.

Engineering Hall is a three-story brick and stone structure, fifty by seventy-five feet. The lower floors are devoted to Physics and Electricity, while the upper floor contains two large draughting rooms, a blue-print room and a room containing the school's collection of drawings, tracings and blue prints, which is also used as a study by the instructor in drawing.

The second floor is devoted to Physics and to elementary work in Electricity and Magnetism. The lecture room, furnished with raised seats, will accommodate about seventy students. For experiments in light, the room can be quickly darkened. The photometer room is fitted for experiments in light and the measurement of arc and incandescent lamps. The room devoted to laboratory work in Physics and Elementary Electrical Measurements is well lighted and fitted with slate shelves and heavy tables. The balances, placed on separate slate shelves supported from the walls of the building, are in another room, connected with the main laboratory. Gas, air, water and electricity are supplied at various points in the laboratory.

The south half of the lower floor is divided into two rooms, the larger containing the fifty horse-power, high-speed engine, the dynamos and motors for testing purposes. All wires run from this room to the smaller, which contains the slate switch board, the measuring instruments for testing work, and the large resistance coil. A small workshop connects with the dynamo room. The battery room, floored with tiles, contains the sixty-cell accumulator and various primary batteries. Three light rooms furnished with piers, on the north side of the building, are devoted to advanced work in Electrical Measurements. Very little iron is used in the construction of the lower portion of the building, so that all the rooms are well adapted for electrical measurements.

The building is heated by the Sturtevant system. The boiler house contains the Sturtevant engine and fan, eighty-horse power boiler, feed pumps, heater, etc.

R. S. Roeschlaub, of Denver, was the architect of the buildings of 1890 and of 1894.

The total floor space in the three buildings is over forty-five thousand square feet.

GROUNDS.

The tenth General Assembly gave $5,000 for improvement of the grounds, the City of Golden permitting the absorbtion of the street formerly dividing Engineering Hall from the other buildings. Stone walks, terraces and grass plats now give to the entire premises a finish long lacking.

A final readjustment of the space in the buildings of 1880, 1882, and 1890, effected in the fall of 1897, allows the utilization of all the space hitherto unavailable.

The site, well above the main part of the town, is admirable both for scenic and sanitary environment.

GOLDEN HIGH SCHOOL.

The courses in the Golden High School (Prof. Wm. Triplett, Principal), are those recommended by the Colorado State Teachers' Association. They have been adopted in all the higher institutions of learning in the State, having preparatory departments.

Pupils in the High School may pursue such studies as they are prepared to take, but fifteen units of study including History and English (4), Algebra ($1\frac{1}{2}$) and Geometry ($1\frac{1}{2}$) are required for graduation.

By "Unit of Study" is meant a year's work on any branch, five recitations per week for thirty-six weeks.

In addition to the topics named above, Physiography, Biology, Trigonometry, Latin and German form parts of the course.

The entire upper floor of an eight-room building is used by the High School. This school offers ample opportunity for preparation to those wishing to enter the State School of Mines.

THE SCIENTIFIC SOCIETY.

In connection with the school is the organization known as the "Technical and Scientific Society of the Colorado School of Mines," composed of active members from the Senior and Junior classes, the Faculty and the Alumni of the School. Sophomores and Freshmen are associate members.

The object of the society is the presentation and discussion of papers on technical and engineering subjects, so that the special knowledge of one member may be shared by all. A secondary object is the benefit to be derived from addressing a public assembly, giving the members a confidence in themselves which may be of valne to them in their careers.

A salient feature of the society is the delivery of lectures, from time to time, by professional men and members of the Alumni, who have had practical experience in their several branches of engineering.

Officers are elected each year from the Senior class.

The programmes are prepared by an appointed committee selected from the Senior and Junior classes. The meetings are held monthly in the school building.

Officers for the year 1897-'98 are as follows:

President	Malvern R. Valentine,	(1898).
Vice President	Oscar A. Lampe,	(1898).
Secretary	Frank H. Jones,	(1898).
Treasurer	Fred. Johnston,	(1898).
Corresponding Secretary	Prof. H. van F. Furman.	

ALUMNI ASSOCIATION.

The Association of the Alumni of the Colorado State 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 in aiding each other, and to make an organized effort to elevate and uphold the reputation and standard of the Alma Mater.

The officers of the Association for the year ending June 11th, 1898, are as follows:

President	Edward E. Rowe,	(1895).
1st Vice President	George M. Post,	(1894).
2d Vice President	W. H. Paul,	(1896).
Secretary and Treasurer	Robert S. Stockton,	(1895).
Members of the Executive Committee	Geo. W. Schneider,	(1894).
	John Gross,	(1897).

DIRECTORY OF GRADUATES.

NAME AND ADDRESS.	OCCUPATION.
1882.	
Middleton, Wm. B. Denver, Colorado.	Mining Engineer.
1883.	
Wiley, Wm. H. Idaho Springs, Colorado.	Mining Engineer.
1886.	
van Diest, Edmond C. San Luis, Costilla County, Colorado.	Superintendent, Maxwell Land Grant.
Gehrmann, Charles A. Idaho Springs, Colorado.	Superintendent, Stanley Consolidated Mining Company.
1888.	
Ambrosius, Carl E. Guanacevi, Durango, Mexico.	Mining Engineer.
*Floyd, John A.	
Kingman, Jerry Los Angeles, California.	Chemist.
*Lorah, Bela I.	
1889.	
Bellam, Henry L. Anaconda, Montana.	Chemist, Anaconda Mining Company.
Craigue, Wm. H. Colorado Springs, Colorado.	Mining Engineer.
*Wertheim-Salomonson, F. M. G. A.	

* Deceased.

NAME AND ADDRESS.	OCCUPATION.
1890.	
Comstock, Chas. W. Ithaca, New York.	Professor of Mining Engineering, Colo. School of Mines.
1891.	
Johnson, Edw. W. Pueblo, Colorado.	Chemist, Colorado Smelting Company.
Smith, Charles D. Pueblo, Colorado.	Metallurgist, Philadelphia Smelter.
1892.	
Aller, Frank B. Perth Amboy, N. J.	Chemist, Perth Amboy Reduction Co.
Brown, Norton H. Golden, Colorado.	Surveyor.
Budrow, Wm. B. Aguas Calientes, Mexico.	Chemist, La Gran Fundicion.
Cole, Burt Los Angeles, California.	Engineer.
Hindry, Willis E. Delamar, Nevada.	
Kimball, George K., Jr. Idaho Springs, Colorado.	Mine Superintendent, Calumet G. M. and M. Company.
Kimball, Jos. S. Russell Gulch, Colorado.	
Lewis, Wm. B. Denver, Colorado.	Manager, Denver Sulphite Fibre Co.
McMahon, Charles H. Sierra Mojada, Coahuila, Mexico.	Mine Superintendent.

NAME AND ADDRESS.	OCCUPATION.
1893.	
Collins, Phillip M. Georgetown, Colorado.	Dewey Bros., Sampling Works.
Hawley, R. Howard Pueblo, Colorado.	Chemist, Philadelphia Smelter.
Jewell, Gilbert E. Chartres Towers, Queensland, Australia.	Metallurgist.
Milliken, Wm. B. Cripple Creek, Colorado.	Manager, Turner Mill.
Osborne, Arthur H. Irvington-on-Hudson, New York.	Chemist.
Stephens, Wallace A. Denver, Colorado.	Metallurgist.
1894.	
Atkins, Horace H. Denver. Colorado.	Omaha and Grant Smelting Co.
Bowie, James W. Gallup, New Mexico.	Mine Superintendent, Caledonia Coal Co.
Post, George M. Denver, Colorado.	Student Law Department, Denver Univ.
Saint Dizier, Julius L. Monterey, Mexico.	
Schneider, George W. Pine Creek, Colorado.	Mine Surveyor.
Wheeler, Charles E.	
1895.	
Arthur, Edward P. Cripple Creek, Colorado.	Surveyor, U. S. Dept.
Davis, Carl R. Butte, Montana.	Mining Superintendent, Boston and Montana Copper Co.

NAME AND ADDRESS. 1895.	OCCUPATION.
Dockery, Love Atkins St. Eulalia, Chihuahua, Mexico.	Mining.
Durell, Charles T. Krugersdorp, S. A. R., Africa.	Mine Surveyor, Porges Randfontein Mining and Milling Co.
Eaton, Albert L. Leadville, Colorado.	Assayer.
Eye, Clyde M. Arastra, San Juan County, Colorado.	Assayer, Silver Lake Mining Co.
Field, Fred. M. Virginia City, Montana.	Metallurgist, (Cyanide).
Gray, Latimer D. Golden, Colorado.	Electrician, Golden Illuminating Company.
Hartzell, Lester J. Butte, Montana.	
Kennedy, George A. Silverton, Colorado.	Surveyor and Assayer.
Limbach, Edmund C. Victor, Colorado.	Surveyor.
Maxwell, Fred. A. G. Krugersdorp, S. A. R , Africa.	Metallurgist, Porges Randfontein Mining and Milling Co.
Merryman, Herbert E. Denver, Colorado.	Assayer.
Parker, James H. White Oaks, New Mexico.	Mine Superintendent.
Rowe, Edward E. Golden, Colorado.	Superintendent, J. B. and Wm. Church Brick Company.
Shetler, Waverly Sierra Mojada, Coahuila, Mexico.	Mine Surveyor.

NAME AND ADDRESS.	OCCUPATION.
1895.	
Skinner, Lewis B. Anaconda, Montana.	Chemist, Anaconda Company.
Stannard, Burt C. Everett, Washington.	Chemist, Puget Sound Reduction Co.
Stockton, Robert S. Golden, Colorado.	Assistant Professor of Mathematics, Colo. School of Mines.
Suhr, Otto B. Provo City, Utah.	Engineer, Telluride Power Transmission Company.
Titsworth, Frederick S. Anaconda, Montana.	Metallurgist, Anaconda Copper Company.
Wallace, Louis R. Morenci, Arizona.	Copper Reduction Company.
Young, Frank B. 15 Masonic Temple, Denver, Colorado.	Assistant Superintendent, Mining.
1896.	
Atkinson, Walter J. Chicago, Illinois.	Civil Engineer.
Barensheer, Wm. J. Denver, Colorado.	
Barnes, Corrin Golden, Colorado.	Ass't Professor Chemistry, Colorado State School of Mines.
Beeler, Henry C. Cambria, Wyoming.	Cambria Mining Company.
Dwelle, Jesse E. Scranton, Pennsylvania.	Chemist, Colliery Engineer Company.
Griswold, George G. Pueblo, Colorado.	Chemist, Philadelphia Smelter.
Hoyt, George F. El Modena, California.	

NAME AND ADDRESS. 1896. OCCUPATION.

Maynard, Rea E. ---------------- Mining Superintendent.
Bumblebee, Arizona.

Mitchell, George B. ---------------- Civil Engineer.
Cramp's Ship Building Yards, Philadelphia.

Milliken, John T. ---------------- Chemist, Turner Cyanide Mill.
Cripple Creek, Colorado.

Nance, Wm. H. ----------------------------------
Denver, Colorado.

Newman, Wm. E. ---------------- Chemist, La Gran Fundicion.
Aguas Calientes, Mexico.

Paul, Wm. H. ---------------- Assayer, Standard Assay Office.
Central City, Colorado.

Strout, Fred. McL. ---------------- Assayer.
Ouray, Colorado.

1897.

Buck, Arthur H. ----------------------------------
White Oaks, New Mexico.

Bussey, Edwin E. ---------------- Assayer.
Eldora, Colorado.

Canning, Herbert A. ---------------- Mining.
Aspen, Colorado.

Cohen, Louis ---------------- Bimetallic Smelter.
Leadville, Colorado.

Draper, Marshall D. ----------------------------------
Denver, Colorado.

Febles, John C. ---------------- Chemist, Colorado Smelter.
Pueblo, Colorado.

Gross, John ---------------- Engineer, Kilton Ore Purchasing Co.
Florence, Colorado.

Hazard, W. J. ---------------- Instructor in Physics and Drawing.
Golden, Colorado.

NAME AND ADDRESS. 1897.	OCCUPATION.
Jarvis, R. P. Leadville, Colorado.	Bimetallic Smelter.
Kelley, W. A. Denver, Colorado.	
Lerchen, F. H. Denver, Colorado.	
Logue, N. W. Golden, Colorado.	Student, State School of Mines.
McLeod, J. Norman Wilson, Colorado.	Assayer, Silver Pick Mine, Mt. Wilson G. and S. M. Co.
MacGregor, George H. Estes Park, Colorado.	
Nelson, H. E. Denver, Colorado.	Draughtsman, F. M. Davis Mfg. Co.
Nye, Robert Telluride, Colorado.	
Powell, Geo. F. Summitville, Colorado.	Assayer.
Roller, Arthur H. Monte Cristo, Washington.	Assayer.
Starbird, H. B. Central City, Colorado.	Mining.
Warnecke, Carl M. Denver, Colorado.	Electrician.
Weed, Floyd Cyanide, Colorado.	Chemist, Metallic Extraction Company.
Woods, Thomas H. Denver, Colorado.	
Schumann, Enrique A. Germany.	

Alumni will confer a favor by notifying Prof. Stockton of errors or omissions in the above directory, which is known to be incomplete.

GYMNASIUM.

The Gymnasium is the most spacious and the best equipped of any college or school gymnasium in the State, and is a valuable adjunct to the school equipment. It is in the basement of the building of 1890, its floor (65x40) admitting drill exercise with ample space for apparatus, while its height of twenty feet allows the use of swinging appliances and perfect ventilation. Around the walls are pulling weights of every description, while among the other instruments are swinging ring, 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 others.

The Gymnasium is open every school afternoon, also for systematic class-work and "free exercise" three evenings of each week. Instruction is given in gymnastic exercises on those evenings. Shower baths (hot or cold) adjoin the gymnasium. Each student pays a fee of one dollar a term for the use of gymnasium and deposits one dollar for his locker key, the latter being returnable. The gymnasium fee is used exclusively for repairs and renewals of gymnastic apparatus.

The Gymnasium is managed by the "School of Mines Athletic Association," composed of officers and students of the institution. The Directors of this Association are responsible to the school for the maintenance of order and care of apparatus.

TEXT BOOKS.

Richter's Inorganic Chemistry.
Prescott and Johnson's Qualitatlve Analysis.
Cairns' Quantitative Analysis.
Furman's Manual of Assaying.
Wentworth's Higher Algebra.
Chauvenet's Geometry, Byerly's Edition.
Chauvenet's Trigonometry.
De Volson Wood's Analytical Geometry.
Osborne's Calculus.
Stahl and Woods' Elementary Mechanism.
Low and Bevis' Machine Drawing and Design.
Grant's Gear Wheels.
Church's Descriptive Geometry.
Morris' Geometrical Drawing.
Carhart's University Physics.
Stewart and Gee's Practical Physics.
Balfour Stewart's Principles of Heat.
Thompson's Dynamo Electric Machinery.
Thompson's Electricity and Magnetism.
Bedell and Crehore's Alternating Currents.
Fleming's Alternate Current Transformer.
Thompson's Polyphase Electric Currents.
Holmes' Steam Engine.
Johnson's Engineering Contracts and Specifications.
Nichol's Water Supply.
Wilson's Manuel of Irrigation Engineering.
Johnson's Surveying.
Godwin's Field Book.
Merriman's Hydraulics.
Church's Mechanics of Engineering.
Green's Roof and Bridge Trusses.
Baker's Masonry Construction.
Johnson's Theory and Practice of Framed Structures.
Hughes' Coal Mining.
Austen's Introduction to Metallurgy.
Peters' Copper Smelting.
Eissler's Metallurgy of Silver.
Rose's Metallurgy of Gold.
Hofman's Metallurgy of Lead.
Le Conte's Geology.
Kemp's Handbook of Rocks.
Moses' and Parsons' Mineralogy, Crystallography and Blowpipe Analysis.
Patton's Lecture Notes on Crystallography.

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