Return to
JOBaker
203 Engg B

State School of Mines

Catalogue
1899-1900

GOLDEN
COLORADO

W. H. ENG. CO.

CATALOGUE

OF THE

SCHOOL OF MINES

OF

COLORADO.

1899-1900.

CALENDAR.

1899–1900.

First Term Begins Sept. 11, 1899, Ends Feb. 7, 1900.
(Christmas Holidays, Dec. 23–Jan. 2, inclusive.)
Second Term Begins Feb. 12, 1900, Ends June 13, 1900.
Commencement, June 14, 1900.

1900–1901.

EXAMINATIONS FOR ADMISSION.

June 15, 16, 1900. Sept. 13, 14, 15, 1900.

First Term Begins Sept. 17, 1900. Ends Feb. 6, 1901.
(Christmas Holidays, Dec. 22–Jan. 2, inclusive.)
Second Term Begins Feb. 11, 1901, Ends June 12, 1901.
Commencement, June 13, 1901.

FACULTY.

REGIS CHAUVENET, A. M., (Washington University.)
B. S., (Harvard.)
President and Professor of Chemistry.

PAUL MEYER, Ph. D., (Giessen.)
Professor of Mathematics.

LOUIS CLARENCE HILL, C. E., E. E., (University of Michigan.)
Professor of Physics and Electrical Engineering.

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

ARTHUR RANSLEY CURTIS, B. S., (Case School of Applied Science.)
Professor of Descriptive Geometry and Draughting.

CHARLES WORTHINGTON COMSTOCK,
E. M., C. E., (Colorado School of Mines.)
M. C. E., Ph. D., (Cornell.)
Professor of Mining Engineering.

JAMES COLE ROBERTS, Ph. B., (University of North Carolina.)
Professor of Metallurgy and Assaying.
Director of Chemical Laboratories.

ROBERT SUMMERS STOCKTON, E. M., (Colorado School of Mines.)
Professor of Surveying.

William Jonathan Hazard, E. E., (Colorado School of Mines.)
Instructor in Physics and Draughting.

Robert Nelson Hartman, A. M., (Penna. College.)
Ph. D., (Johns Hopkins.)
Instructor in Chemistry and Mineralogy.

Andrew Weiss, E. M., (Colorado School of Mines.)
Instructor in Mathematics and Surveying.

Charles Darwin Test, B. M. E., A. C., (Purdue University.)
Laboratory Assistant.

John S. Mosby, Jr.,
Lecturer on Mining Law.

Elbridge Graves Moody,
Registrar and Librarian.

William George Duval,
Curator of Apparatus.

COMMITTEE ON STANDING AND CONDITIONS.

Professors Hill, Comstock, Stockton.

COMMITTEE ON ATHLETICS.

Professors Chauvenet, Patton, Stockton.

COMMITTEE ON BUILDINGS AND EQUIPMENT.

Professors Curtis, Hill, Comstock.

William H. Bennett, Janitor.

Arthur B. Tripp, Engineer.

STUDENTS, 1899-1900.

SENIORS.

Adams, Wilber Edward	Denver, Colorado.
Ball, Louis Rice	Dayton, Ohio.
Benwell, George A., Jr.	Denver, Colorado.
Bruce, Harry F.	Kansas City, Kansas.
Crowe, Thomas B	Cascade, Colorado.
Drescher, Frank M.	Denver, Colorado.
Evans, Henry R.	Jamestown, Colorado.
Ewing, Charles R.	Del Norte, Colorado.
Giddings, Donald Shirley	Denver, Colorado.
Harrington, Daniel	Brighton, Colorado.
Jones, Edward B.	Cedar Rapids, Iowa.
Jones, Fred.	Cripple Creek, Colorado.
Kerr, Victor E.	Golden, Colorado.
Lemke, Carl	Del Norte, Colorado.
Malmstrom, C. Clarence	Denver, Colorado.
Moynahan, Ambrose E.	Alma, Colorado.
Nicolson, George W.	Idaho Springs, Colorado.
Noé, Adolf C. von	Graz, Austria.
Pendery, John M.	Leadville, Colorado.
Platt, Edwin Harvey	Denver, Colorado.
Price, Lyttleton, Jr.	Spokane, Washington.
Prout, John	Golden, Colorado.
Robey, Lloyd	Villa Park, Colorado.
Rudd, Arthur Horace	Golden, Colorado.
Slater, Amos	Denver, Colorado.
Smith, Claude H.	Chicago, Illinois.
Steele, James Henry	Salt Lake City, Utah.
Taylor, Harry Picotte	Hailey, Idaho.
Utley, Howard Harris (Ph. B., Brown University.)	Providence, Rhode Island.

JUNIORS.

Atwater, Maxwell W.	Syracuse, New York.
Bishop, Raymond	Denver, Colorado.
Bowman Frank C.	Saint Charles, Illinois.
Bradley, Joseph M.	Canon City, Colorado.
Breed, Charles Francis (B. S., University of Chicago.)	Freeport, Illinois.
Brinker, Arthur C.	Denver, Colorado.
Bruce, James L.	Cripple Creek, Colorado.
Bumsted, Edward J.	San Francisco, California.
Burlingame, Walter E.	Denver, Colorado.
Chandler, John Winthrop, Jr.	San Francisco, California.
Clark, George B.	Denver, Colorado.
Collbran, Arthur Harry	Denver, Colorado.
Collins, Shrive B.	Del Norte, Colorado.
Crow, Wade L.	Pueblo, Colorado.
DeCou. Ralph Ernest	Canon City, Colorado.
Downer, Roger H.	Ouray, Colorado.
Ehle, Mark, Jr.	Marshalltown, Iowa.
Frank, Harry L.	Antonito, Colorado.
Harris, Willard F. (B. S., Amherst College.)	Racine, Wisconsin.
Jackson, Walter H.	Vienna, Illinois.
Jeffries Edgar H.	Augusta, Kansas.

JUNIORS—Continued.

Johnson, Junius W.	Denver, Colorado.
Lewis, Frank E.	Denver, Colorado.
Lovering, Ira G.	Denver, Colorado.
Lucy, Frank Allen	Denver, Colorado.
McDaniel, Alexander K.	Denver, Colorado.
Marrs, George Oliver	Denver, Colorado.
May, John G.	Fremont, Nebraska.
Millard, Frank W.	Golden, Colorado.
Mulder, Jacob Cornelius. (B. S., Colorado Agricultural College.)	Fort Collins, Colorado.
Parrish, Carl Calvin	Leon, Iowa.
Pray, Winfred A.	Mosca, Colorado.
Richards, John V.	Spokane, Washington.
Sale, Andrew Jackson	Denver, Colorado.
Scheble, Max Carl	Hutchinson, Kansas.
Simpson, William P.	Kansas City, Kansas.
Small, Harvey B.	Dulzura, California.
Starbird, Edwin P.	Denver, Colorado.
Street, Gerald B. (S. B., Mass. Institution of Technology.)	Chicago, Illinois.
Test, Charles Darwin (B. M. E., A. C., Purdue University.)	Lafayette, Indiana.
Watson, Hugh C.	Denver, Colorado.
Williams, Fred. Tuttle	Cleveland, Ohio.
Woodhall, George, Jr.	Denver, Colorado.

SOPHOMORES.

Anderson, Neil A.	Rexburg, Idaho.
Badger, Herbert E.	Timnath, Colorado.
Bale, Bruce B.	Colorado Springs, Colorado.
Barclay, Isla James	London, England.
Barron, Chauncey T.	Seattle, Washington.
Berger, Walter F. B. (A. B., Yale.)	Denver, Colorado.
Bergh, John E.	Denver, Colorado.
Bucher, John W.	Berkeley, Colorado.
Buehler, Walter	Indianapolis, Indiana.
Butler, G. Montague	Lake Geneva, Wisconsin.
Charles, Lavern	Morrison, Colorado.
Coghill, Will H.	Monmouth, Illinois.
Coleman, R. Prewitt	Denver, Colorado.
Cox, W. Ray	Brookfield, Missouri.
D'Arcy, Arthur I.	Denver, Colorado.
Ellis, William W.	Denver, Colorado.
Emeis, Walter A.	Davenport, Iowa.
Ervay, Henry S. (C. E., Virginia Military Institute.)	Colorado Springs, Colorado.
Estes, Frank M., Jr.	Saint Louis, Missouri.
Fair, Fred. A.	Denver, Colorado.
Fitch, Frank	Denver, Colorado.
Gilmore, Quincy A.	Washington, D. C.

SOPHOMORES—Continued.

Greenfield, Edward W.	Durango, Colorado.
Ickis, Harry M.	Creston, Iowa.
Izett, Glen	Denver, Colorado.
Jay, Clyde H.	Florence, Colorado.
Lehmer, Frank W.	Omaha, Nebraska.
McAtee, Bernard M.	Denver, Colorado.
McClintock, Lloyd B.	Chagrin Falls, Ohio.
McElvenny, Robert F.	Denver, Colorado.
Mallinckrodt, Philip H.	Denver, Colorado.
Montrose, James F.	Denver, Colorado.
Moss, Cleveland O.	Ottumwa, Iowa.
Olney, Harry W.	Denver, Colorado.
Paul, Russell B.	Denver, Colorado.
Reno, Horace T.	Arvada, Colorado.
Steel, J. Marshall	Portland, Oregon.
Taggart, George K.	Dallas, Texas.
Thomson, Francis A.	Victoria, British Columbia.
Vail, Guy M.	Denver, Colorado.
Wallace, David B.	Denver, Colorado.
Ward, William F.	Denver, Colorado.
Wattles, William C.	Denver, Colorado.
Watts, Alfred C.	Newark, New Jersey.

FRESHMEN.

Abernethy, Elmer Robt.	Spokane, Washington,
Adams, Charles	Denver, Colorado.
Aicher, Charles P.	Denver, Colorado.
Anderson, Glenn	White Sulphur Springs, Mont.
Anderson, Julius A.	Denver, Colorado.
Bailey, Mark	Chanute, Kansas.
Becker, Frank A.	Leadville, Colorado.
Becker, Lee	Manitou, Colorado.
Becker, Peter J.	Denver, Colorado.
Bender, Louis V.	Spokane, Washington.
Bicknell, John Henry	Golden, Colorado.
Boley, William, A.	Deadwood, South Dakota.
Bray, Eustace V.	Riverside, California.
Bryant, Lloyd L.	Greeley, Colorado.
Bucher, George J.	Berkeley, Colorado.
Carney, Hugh James	Ouray, Colorado.
Catron, John W.	Santa Fe, New Mexico.
Christensen, Arthur G.	Fremont, Nebraska.
Coffin, Roy G.	Longmont, Colorado.
Collins, Francis Winfield	Denver, Colorado.
Connor, Thomas V.	Pueblo, Colorado.
Cox, Augustus D.	Brookfield, Missouri.
Dawson, Eugene H.	Denver, Colorado.
Deniston, Roscoe I.	Pueblo, Colorado.
Devinny, George Valentine	Villa Park, Colorado.

FRESHMEN—Continued.

Douglass, Thomas J., Jr.	Los Angeles, California.
Duling, John F.	Stonewall, Colorado.
Dunkle, Fred. W.	Indianapolis, Indiana.
Edwards, William E.	Denver, Colorado.
Ellett, Thomas Stockton	Chicago, Illinois.
Emrich, Horace H.	Pueblo, Colorado.
French, Albert Carver	Pueblo, Colorado.
Fry, Louis D.	Ironton, Colorado.
Gelder, Joseph E.	Denver, Colorado.
Goodale, Stephen L. (Ph. B., Colorado College.)	Colorado Springs, Colorado.
Hallack, Charles, Jr.	Denver, Colorado.
Hamilton, George A.	Denver, Colorado.
Hatfield, Charles T.	Pomona, California.
Hauser, Sam'l Thomas, Jr.	Helena, Montana.
Hiltz, Fred. T.	Golden, Colorado.
Hoffman, G. Beaufort	Yankton, South Dakota.
Hurlbut, Wm. Whitehead	Denver, Colorado.
Hyder, Frederick B.	Denver, Colorado.
Jackson, Alvin Ross	Salt Lake City, Utah.
Jacobs, Edwin H.	Brighton, Colorado.
Jones, Ewing Llewellyn	Los Angeles, California.
Julihn, Carl Edward	Washington, D. C.
Kilbourn, William D.	Pueblo, Colorado.
Kimball, Harlow M.	Evanston, Illinois.
King, Henry E.	Colorado Springs, Colorado.
Klein, Will J.	Cleveland, Ohio.

FRESHMEN—Continued.

Kohn, Edgar Wessel	Pueblo, Colorado.
Krigbaum, Jos. Stephen	Denver, Colorado.
Liddell, Charles A.	Golden, Colorado.
Liddell, T. Parker	Golden, Colorado.
McCarthy, Wm. Francis	Denver, Colorado.
McDermut, Grace C. U.	Denver, Colorado.
McFadden, John Andrew	Santa Ana, California.
McGregor, Albert Edw.	Pueblo, Colorado.
Mantor, Herbert Owen	Salt Lake City, Utah.
Marr, Zac M.	Fremont, Nebraska.
Matthews, Arthur A.	Colorado Springs, Colorado.
Merwin, Eugene W.	Los Angeles, California.
Milliken, Frederick A.	Cripple Creek, Colorado.
Misner, Walter	Buffalo, New York.
Moore, E. Byron	Melbourne, Australia.
Morris, Howard G.	Denver, Colorado.
Mullen, James Seely	Denver, Colorado.
Nagel, Frank J.	Denver, Colorado.
Nagel, Henry P.	Denver, Colorado.
Nare, George Henry	Golden, Colorado.
Palsgrove, Harry G.	Grand Junction, Colorado.
Parker, Fred. L.	Salt Lake City, Utah.
Parsons, Horace Fleet	Wamego, Kansas.
Peck, William John	Saint Louis, Missouri.
Perrier, Alphonse S.	Saint Louis, Missouri.
Pinney, Elnor Stephens	Greeley, Colorado.
Prout, John W., Jr.	Golden, Colorado.

FRESHMEN—Continued.

Rabb, Edward Morris	Denver, Colorado.
Reese, William K.	Denver, Colorado.
Rhodes, William Barron	Denver, Colorado.
Robinson, George P.	Denver, Colorado.
Rogers, Blake	Florence, Colorado.
Rohland, William F.	Drifton, Pennsylvania.
Russell, Harry A.	Colorado Springs, Colorado.
Sauter, Charles	Golden, Colorado.
Schmalz, Charles H.	Chicago, Illinois.
Scott, Vincent Edward	New York City, New York.
Sharpe, Howard Brooks	Helena, Montana.
Sharps, Frank B.	Golden, Colorado.
Sklower, Joseph	White Sulphur Springs, Mont.
Sloan, William Arthur	Denver, Colorado.
Smith, E. Harding	Denver, Colorado.
Sneddon, Howard	Salida, Colorado.
Stevens, Earl C.	La Grande, Oregon.
Stuart, Joseph T.	Youngstown, Ohio.
Vivian, William	Idaho Springs, Colorado.
Washburn, Howard G.	Denver, Colorado.
Wells, Frank B.	Los Angeles, California.
Wickes, L. Webster	Helena, Montana.
Wilder, Michael A.	Trinidad, Colorado.
Witkowski, Adolph V.	Denver, Colorado.
Wolf, Harry J.	Colorado Springs, Colorado.
Wright, William Henry	Denver, Colorado.

SUMMARY.

Seniors	29
Juniors	43
Sophomores	44
Freshmen	104
Total	220

SUMMARY BY STATES AND COUNTRIES.

Colorado	136	New Jersey	2
California	10	Oregon	2
Illinois	9	South Dakota	2
Iowa	6	Wisconsin	2
Kansas	6	District of Columbia	1
Montana	5	New Mexico	1
Missouri	5	Pennsylvania	1
Ohio	5	Rhode Island	1
Washington	5	Texas	1
Nebraska	4	Australia	1
Utah	4	Austria	1
Indiana	3	British Columbia	1
New York	3	England	1
Idado	2		

(Colorado, sixty per cent.; all others forty 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 a mile south of the City of Golden, where it occupied rented property. It was seen that a better site and a building were conditions without which it could not survive.

The original appropriation of ten thousand dollars was the only one which the institution received in the first nineteen years of its existence. The building thus provided for was erected upon lots given by citizens of Golden, in 1880.

It was soon perceived that the school would receive support in the way of students far in excess of the capacity of the building erected from such an appropriation. From this time until 1894, all additions were made from current income, which for the greater part of the time was upon the basis of one-fifth of one mill of the tax valuation of the state.

No land having been granted by the state, and no special appropriation having ever been made toward equipment of any kind, the struggle for existence has always been severe. Of the two hundred thousand dollars now represented in the buildings and equipment, one hundred and sixty-five thousand has been saved out of income, and but thirty-five thousand has been given by appropriation.

In 1882 the original building was enlarged, and in 1890 a much larger building was added. The growth of the school imposed upon its trustees the alternative of fatally hampering its efficiency on the one hand, or of meeting the demands from current income on the other.

ENGINEERING HALL, WEST FRONT. 1894.
(POWER HOUSE AT THE LEFT. TABLE MOUNTAIN IN BACKGROUND.)

STATE SCHOOL OF MINES. EAST FRONT OF MAIN BUILDINGS.

1880. 1882. 1890.

Engineering Hall was erected in 1894, an appropriation of twenty thousand dollars having been made for it in the spring of 1893. Prior to this, the old system of special and partial courses had been abolished, and the solid progress since made may be fairly ascribed to this change.

In 1897 it became evident that the space available had again become insufficient, and a radical alteration of the largest building (1890) was carried out, a story being added, giving space for one of the finest draughting rooms in the West.

These visible additions to the material "plant" have been accompanied by successive advances in standard and method, probably greater in a relative sense than the increase in numbers or in appliances.

At the present time, applications for admission are somewhat in excess of the accommodations, and the number of the entering or Freshman class has been fixed at one hundred. As shown in the general statement on page 17, a large proportion of the students are from outside of Colorado.

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

LOCATION.

The institution is located at the City of Golden, sixteen miles from Denver, on the line of the Colorado and Southern Railroad, or a trifle over thirteen miles by the Denver, Lakewood and Golden Railroad. Trains of the former road leave Denver from the Union Station. The Denver, Lakewood and Golden leaves (by electric car) station on Arapahoe Street, Denver, between Fourteenth and Fifteenth Streets.

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

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

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

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

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

EXPENSES.

Tuition is free to *bona fide* residents of Colorado. Students from other states pay twenty-five dollars a term. All are charged with material consumed or broken.

The following are the various fees and charges :

Freshmen, Qualitative, chemicals, etc.	$20.00
Freshmen, Qualitative, deposit, apparatus	10.00
Sophomores, Quantitative Analysis, chemicals	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 "deposits" the amounts are credited, the student is charged with what he takes out, and credited with all that he returns in good condition. Balance to his credit is returned to him. An additional deposit may be required if the apparatus called for is excessive.

Students leaving before the end of a term are not entitled to any reduction of their term fees. Exception is made on account of sickness. All fees and deposits are payable in advance to the Registrar. Board and suitable accommodation can be obtained in Golden at from four to six dollars a week.

The total expense of the school year, fees included, need not exceed three hundred and fifty dollars ($350). But many students come under this figure, by clubbing, and other arrangements. The expense of the various trips is not included in this estimate. This expense is guaranteed not to exceed one hundred dollars for the entire series.

REQUIREMENTS FOR ADMISSION.

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

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.

(Applicants, whether coming by certificate or by examination, are warned that they should be past the initial stage of algebraic operations, *i. e.*, should not be liable to the ordinary blunders of beginners. Much experience in past years shows us that there are many failures in the Freshman class from poor preparation in this line.)

The whole of Plane Geometry. Applicants are expected to show clear notions of the nature of geometrical reasoning. Some original work is given in each paper.

English of high school standard is required. Some original composition is assigned, theme suggested in the paper, with the alternative of a theme selected by the applicant. Exercises in spelling, pronunciation, (diacritical marks), phrases for correction and punctuation. No formal examination is given, however, in Literature or in Grammar.

Lewis's "First Book in Writing English" is recommended for preparation.

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

In Zoology, Steele's "Complete" is recommended for preparation. Applicants not prepared in this topic, are nevertheless admitted, provision being made for their instruction during the first term, though not in the school, nor by members of the Faculty. The fee for this course depends upon the number conditioned, and is usually about three dollars.

Prospective applicants are warned of the great risk attending attempts at self-preparation. This applies with most force in Geometry and Algebra.

Graduation diplomas from accredited high schools are accepted in lieu of examination for admission to entering class. They must, however, bear date not earlier than the year preceding application.

Candidates for advanced standing will be examined in all the studies of the course below the class applied for, unless they can present credits sufficient, in the opinion of the Faculty, for admission without examination. *The Faculty reserves the right, however, to examine for admission to any higher standing than the first term of the Freshman year, irrespective of the credits brought from another institution.* Those whose credits only partially admit them to a given class, can not be admitted to such class, unless they can also present credits for a portion of its work, thus providing time in which to make up the deficit in the work of the lower grade. Generally "mixed" standing is to be avoided.

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

Examinations may be taken at the homes of the applicants, papers being forwarded to some responsible examiner. This applies to Freshman admissions only.

All candidates for admission are advised to attend in June if possible, obtaining credits for whatever they pass in, and gaining knowledge of their deficiencies, to be made good at the Fall examinations.

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 can not 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 can not 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 $10\frac{1}{4}$x8-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	3 hours a week.
General Chemistry	4 hours a week.
Descriptive Geometry	2 hours a week.
Drawing	15 hours a week.

SECOND TERM.

Trigonometry	3 hours a week.
Algebra	5 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.

Calculus	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.

COURSE IN MINING AND METALLURGY.

SENIOR YEAR.

FIRST TERM.

Metallurgy	4 hours a week.
Mining	5 hours a week.
Hydraulics	4 hours a week.
Theory of Construction	2 hours a week.
Mining and Metallurgical Design	6 hours a week.
Hydraulic Laboratory	1 hour a week.
Theoretical Chemistry	1 hour a week.
Testing Laboratory	3 hours a week.

SECOND TERM.

Metallurgy	4 hours a week.
Mining	5 hours a week.
Power Transmission	4 hours a week.
Technical Chemistry	1 hour a week.
Steam Engine Laboratory	2 hours a week.

COURSE IN ELECTRICAL ENGINEERING.

SOPHOMORE YEAR.

FIRST 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.
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	3 hours a week.
Machine Design	2 hours a week.
Machine Design (Drawing)	8 hours a week.
Electrical Measurements	4 hours a week.
Differential Equations	2 hours a week.

SECOND TERM.

Dynamo Machinery	4 hours a week.
Dynamo Laboratory	8 hours a week.
Mechanics	3 hours a week.
Batteries	2 hours a week.
Precision of Measurements	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.

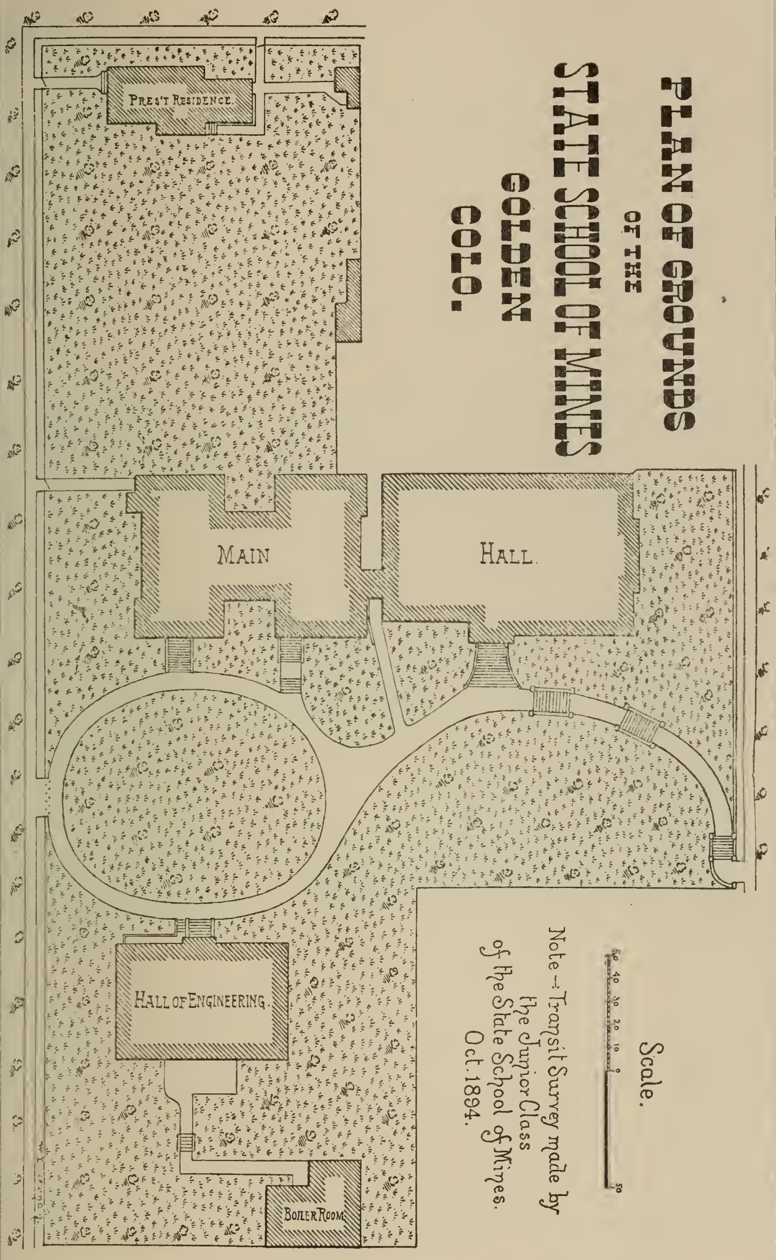
SENIOR YEAR.

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.

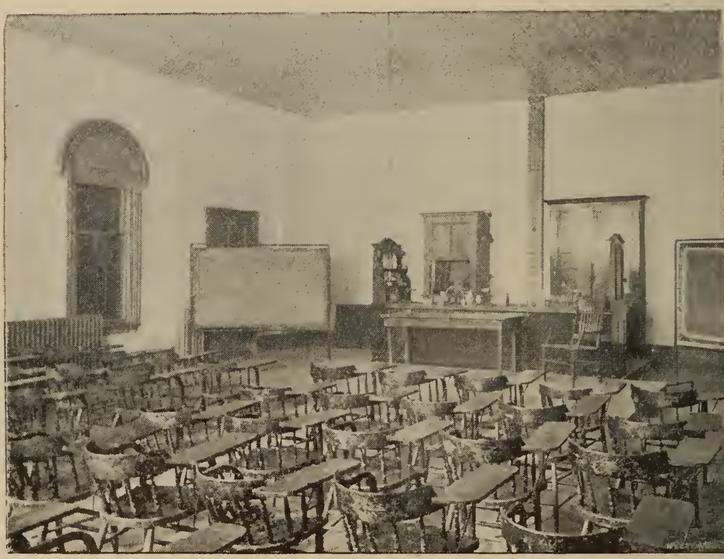
Power Transmission	4 hours a week.
Electrical Transmission	3 hours a week.
Steam Engine Laboratory	3 hours a week.
Electrical Design	6 hours a week.
Thesis Work	15 hours a week.


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.

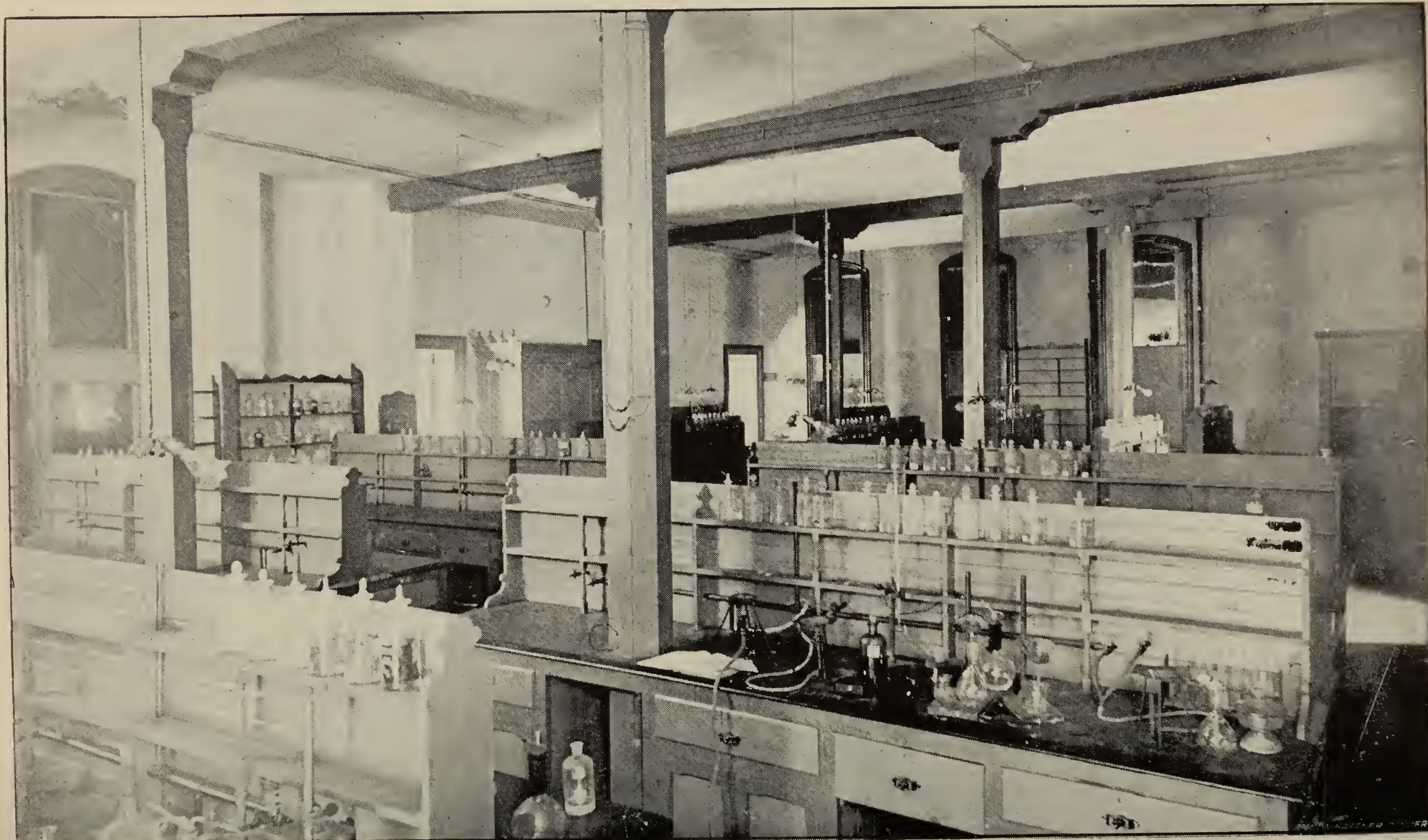
A large amount of time is devoted to Chemistry, general, analytical and applied.



CHEMICAL LECTURE ROOM.

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

Lectures in Theoretical and Applied Chemistry begin in the Senior year, and continue throughout that year.



CHEMICAL LABORATORY. QUALITATIVE.

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 during part of 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 are taught the theory of chemical equations, and details of manipulation. The laboratory is open every afternoon except Saturday, but no class works in it 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 or salts of definite composition; the gravimetric determinaticns 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.

Fire assaying is taken up by sections, running throughout the year, usually one afternoon a week.

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.

The department wishes to acknowledge its indebtedness to the Omaha and Grant Works, (Denver), the "Bimetallic," (Leadville), to all the Pueblo works, and to Mr. E. E. Burlingame of Denver, for numerous checked samples, numbering in all several thousands.

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

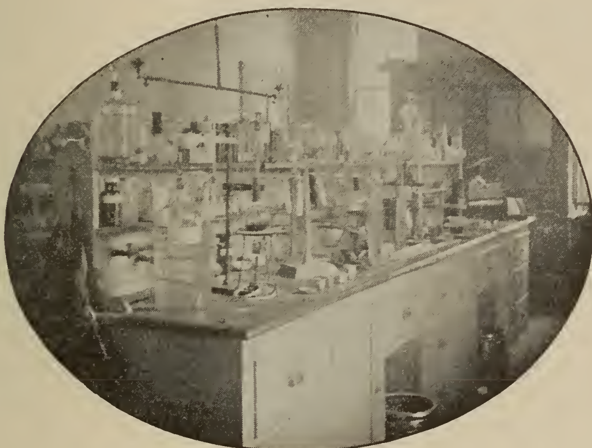
The school has secured very great numbers of well-checked samples, and may claim to be far more than usually well supplied with material for assays and analyses. Students are required to "check" with the results obtained by experienced workers, and that, too, with certainty and rapidity, before they 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.

General Principles of Metallurgy—Historical sketch. The relations of Chemistry to Metallurgy. Properties of the metals. Alloys, brasses and bronzes. Thermo treatment of metals.

Fuels (solid, liquid and gaseous), their occurrence, manufacture and uses.

Refractory materials, their occurrence, properties, manufacture and uses.

Furnaces, different types used for various metallurgical operations. Blowing apparatus. Hot-blast stoves.

Fluxes, including the study of slags and calculation of furnace charges. Typical metallurgical processes.

Sampling of Ores and Metallurgical Products. 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.

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

Metallurgy of Iron and Steel—The ores of iron and their impurities. The metals, iron and steel, their chemical and mechanical properties, as affected by process of manufacture or by impurities. The blast furnace. Manufacture of steel by the Bessemer process and its modifications.

Copper Smelting and Refining—Smelting in reverberatory and blast furnaces.

Pyritic smelting.

Refining of mattes by various processes.

Electrolitic refining.

Metallurgy of Lead—Smelting in reverberatory furnaces, in the American ore hearth, and in blast furnaces. The desilverization of base bullion. Cupellation.

SENIOR YEAR.

Metallurgy of Gold—Occurrence and properties. General discussion of various processes for extraction from ores.

Extraction by amalgamation. Arrangement of plant, and description of typical mills.

Chlorination process.

Cyanide process.

Melting and refining of gold, and parting of gold and doré bullion.

Metallurgy of Silver—Occurrence and properties. General discussion of various processes for extraction 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.

Metallurgy of Zinc, Tin, Aluminum, Mercury, Antimony and Platinum.

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

Graduating Theses—Students who choose a metallurgical subject for their graduation thesis are given a typical ore of gold, silver, lead or copper, 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.

This course is given by lectures abundantly illustrated by lantern slides and supplemented by visits to the iron, lead and copper smelting works of Pueblo; lead and copper smelters of Denver and Leadville; cyanide plants of the Cripple Creek district; zinc works at Canon City, and various concentration and sampling works throughout the State. The text-books and books of reference used in this course are:

"Introduction to Metallurgy" - Roberts-Austen.
"Ore Dressing in Europe" --- W. B. Kunhardt.
"Modern Copper Smelting" -- E. D. Peters, Jr.
"Metallurgy of Lead" ------ H. O. Hofman.
"Metallurgy of Gold" ------ T. K. Rose.
"Metallurgy of Silver" ------ Eissler.
"Metallurgy of Silver" ------ Eggleston.

In addition to these regular texts, numerous references are made to current technical literature.

MINING AND METALLURGICAL EXCURSIONS.

Visits to local mines and metallurgical plants are of weekly occurrence during the last two years of the course. In addition to these the Senior class makes two excursions to more distant plants. The first of these takes place in the fall just previous to the opening of the school year, and the second shortly before commencement. *These trips are required of all Senior candidates for the Mining and Metallurgical degree.*

The graduating class of 1898 devoted two weeks to the spring trip, visiting Manitou for the study of the local geology; Cripple Creek for the inspection of the mines, cyanide mills and power plants of the famous gold camp: the large chlorination plant at Colorado City; the coal mines, and the plants of the American Zinc-Lead Co., and the Colorado Electric Power Co., at Canon City; and the steel works and lead smelters at Pueblo.

During the last weeks of the vacation, the class of 1900 spent a week inspecting the principal mines and mills of Leadville and Aspen. On these trips the students are accompanied by two or more professors, and the visits are carefully scheduled. The inspection of the various works is accompanied by lectures on the ground, by the professors in charge.

Many students work during the summer months in mines or mills. Though this is no part of the course, students in the upper classes are urged to avail themselves of these opportunities.

The institution is greatly indebted for facilities furnished by Mr. Frank Trumbull, President of the Colorado & Southern Railroad, the transportation between Denver and Leadville having been a free gift to the school.

METALLURGICAL MODELS AND MATERIALS.

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.

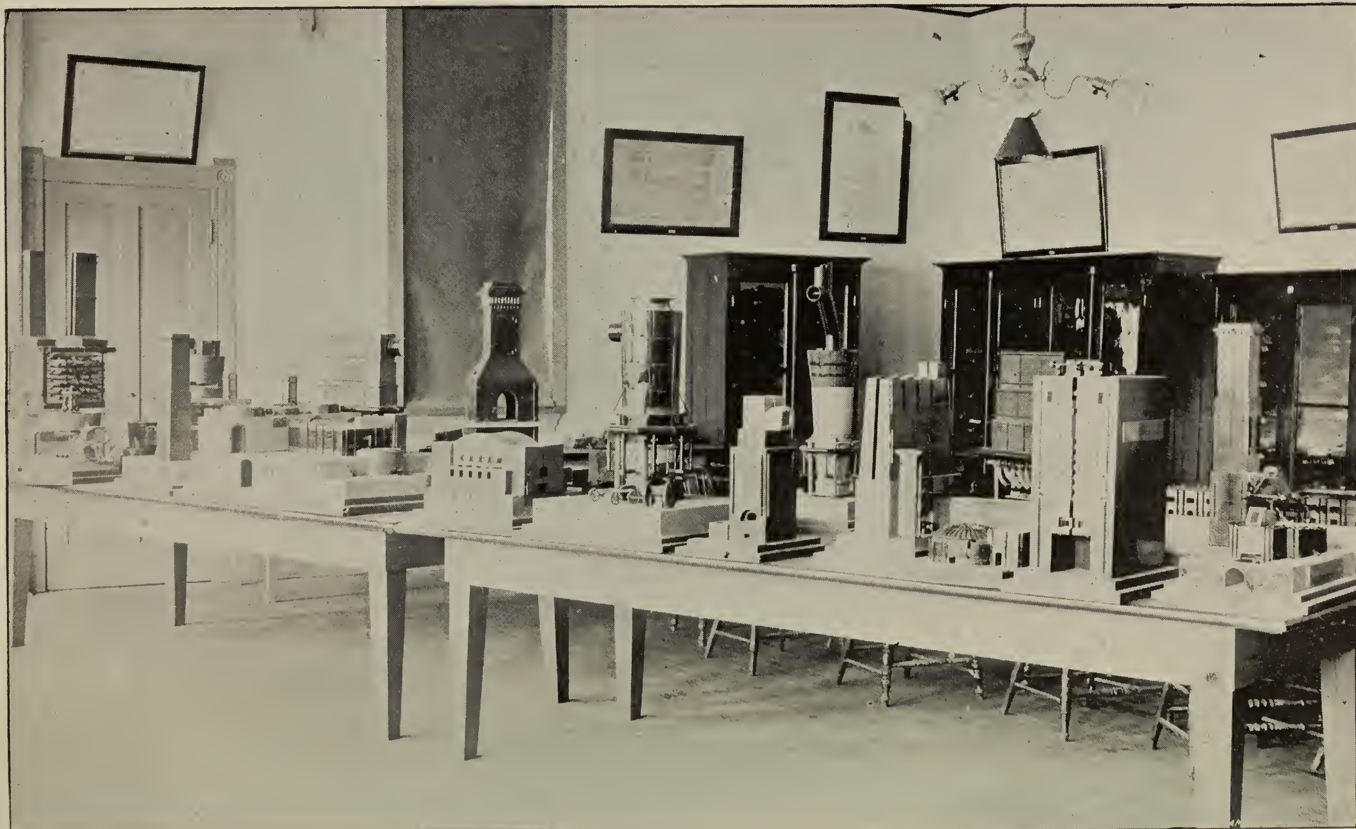
Refining cupel for making fine silver.

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.



GROUP OF METALLURGICAL MODELS.

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 Keys 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. It includes:

(a) Collection of ores of all the precious and commercial metals.

(b) Collection of slag and matte specimens, the gifts of various smelting works.

(c) Numerous exhibits of concentration products.

Many of these collections were originally parts of exhibits made at the Chicago and other expositions, afterwards donated to the school.

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, two afternoons per week are 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. Description 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, Tunneling 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.

Placer Mining—Pipe lines, nozzles and hydraulic elevators; their construction and use. Sluices—construction, length, grade and efficiency. Working dry placer ground with a steam shovel. River dredging. Cost and results.

Mine surveying is referred to elsewhere.

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.

This department is indebted to the generosity of Mr. D. R. C. Brown, of Aspen, for two very elaborate and accurate models showing the geological structure of the famous Aspen district and the method of developing and working the ore bodies.

One of these models is a representation on a scale of 1:400 of all the workings of the Della S. Consolidated Mining Company in Smuggler Mountain, and covers an area of about a quarter by a third of a mile. The other, on a somewhat smaller scale, consists of twenty accurate geological sections, drawn on glass, distributed over the same area. Mr. Brown has also presented to the School of Mines a series of large maps, constituting what is probably the most perfect geological representation of the Aspen region in existence.

Mr. Frank Bulkley, Manager of the Aspen Mining and Smelting Company, has presented the department of mining with a valuable series of maps, showing the extensive workings of the properties under his control.

Through the kindness of A. Leschen & Sons, and of Broderick & Bascom, of St. Louis; the Trenton Iron Company and John A. Roebling's Sons Company, of Trenton, New Jersey, and Washburn & Moen, of Worcester, Massachusetts, the school has come into possession of a complete series of sections of all the types of wire rope now in use.

The museum of this department is supplied with a set of models illustrating all the approved methods of mine timbering, and with a number of mine lamps showing the evolution of the modern methods of lighting. Electric blasting appliances are provided for experimental purposes and an apparatus for measuring the work developed by the decomposition of explosives has recently been constructed at the School for the use of students of the Senior class.

It is to be noted that many topics, both theoretical and practical, which are not included under the head of "Mining" in the school courses, have in fact their immediate application in practical mining. It would be an entirely misleading idea to suppose that only the Senior hours scheduled under "Mining" are devoted to that topic.

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 apprehension 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 third and fourth years 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.

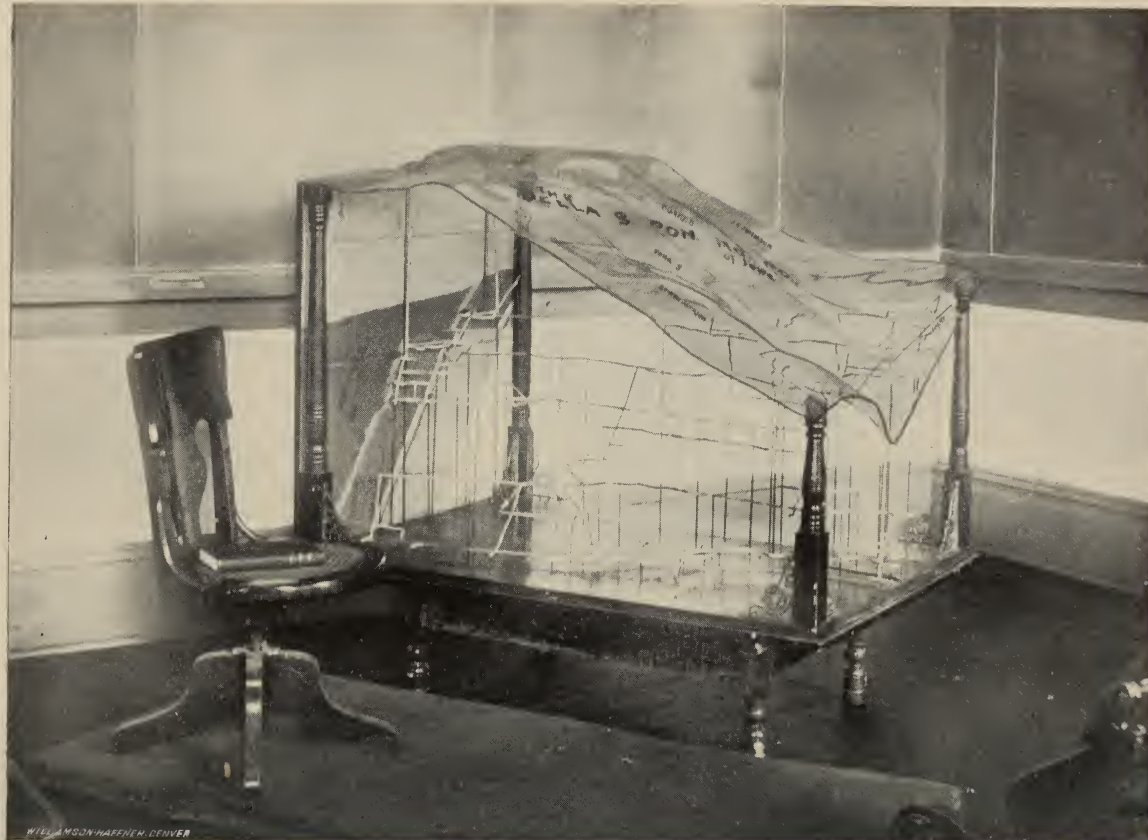
Method of Least Squares.

Elliptic Functions.

Integration on Riemann's Surfaces.

Analytical Mechanics.

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



MODEL OF THE DELLA S. CONSOLIDATED MINE, ASPEN, COLORADO.

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 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 in the 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 and classification 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. Many graduates and mining men, friends of the institution, have contributed by gifts to this collection.

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

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

Fifth—A Student's Working Collection of Minerals, consisting of about twenty thousand unlabled 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 unlabled rocks, to be used by students in connection with the study of Lithology.

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

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

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

Fourteenth—Professor Patton's private collection of rocks.

MUSEUM.

As is necessarily the case in a technical school, most of the collections are arranged for purposes of instruction. Such material is to be found in the numerous cases of drawers lining the sides of the rooms. The material of greatest interest to the visitor is to be found in the flat-top glass cases. This consists mainly of minerals, but in part also of Colorado fossils. The institution has at various times been presented with specimens of ores and minerals by graduates and friends. Many of these have been included in the "Type" Collection, but numbers are to be found in the museum, which has grown more rapidly during the past three years than at any previous time. The additions within the past two years include over seven hundred crystals, for the Crystal Collection, and a mass of material, estimated at over ten thousand specimens, now incorporated in the various collections, mainly in the "Working Collection."

Among the more interesting displays are quartz and microcline crystals from Florissant, Colorado; telluride gold and silver specimens from Boulder County, Colorado; beautiful golden calcites from Joplin, Missouri; the set of crystallized sulphur specimens; and many curious ores of various metals, chiefly gifts of mining friends. Above all, however, the cases of zeolites (thomsonite, analcite, natrolite, etc.) from North Table Mountain, Golden, deserve attention. Probably no thomsonites have ever been found so unique and so beautiful as are some of these 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 52 and 53, 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. Numerous sections of Colorado rocks have been prepared and mounted for microscopical examination.

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, 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 February 1st 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	3,605
Working Collection of Minerals	24,450
Display Collection of Minerals	1,305
Supplementary Collection of Minerals	950
Crystal Collection	1,600
Display Collection of Fossils	342
Miscellaneous Collection of Fossils	920
Type Collection of Rocks	1,800
Working Collection of Rocks	7,168
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	44,966

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.

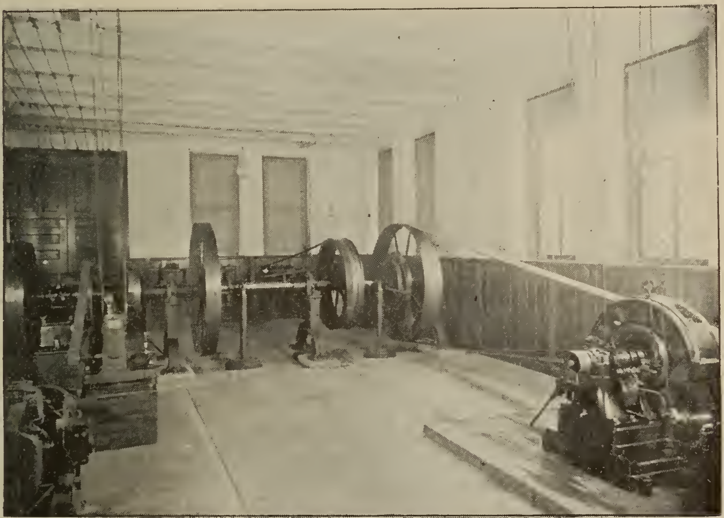
The second term is devoted chiefly to an elementary course in electricity and magnetism.

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. 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 is fairly complete. A fine Troemner and an excellent Sartorius balance belong to the laboratory, while a number of balances from the chemical department 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, which has received material additions during the school year just past.

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 occupy the student five times a week, during the fourth year. Two full afternoons per week, in addition, are 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 switch board 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 Gen. 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.

The course in Hydraulics, given during the first term of the Senior year, embraces the study of the laws governing the flow of water in pipes, conduits and open channels, as well as the measurement of water by weirs and orifices. The class room work is supplemented by practical experiments in the laboratory and in the field. The latter part of this term is devoted to the study of pumping machinery, special attention being given to mine pumps. This department has been presented with a good collection of pumps of various makes, which will be tested by the class

During the second term five lectures per week are given on Power Transmission and the Steam Engine. Teledynamic Transmission receives some attention, although electric and compressed air methods of transmitting power occupy most of the time.

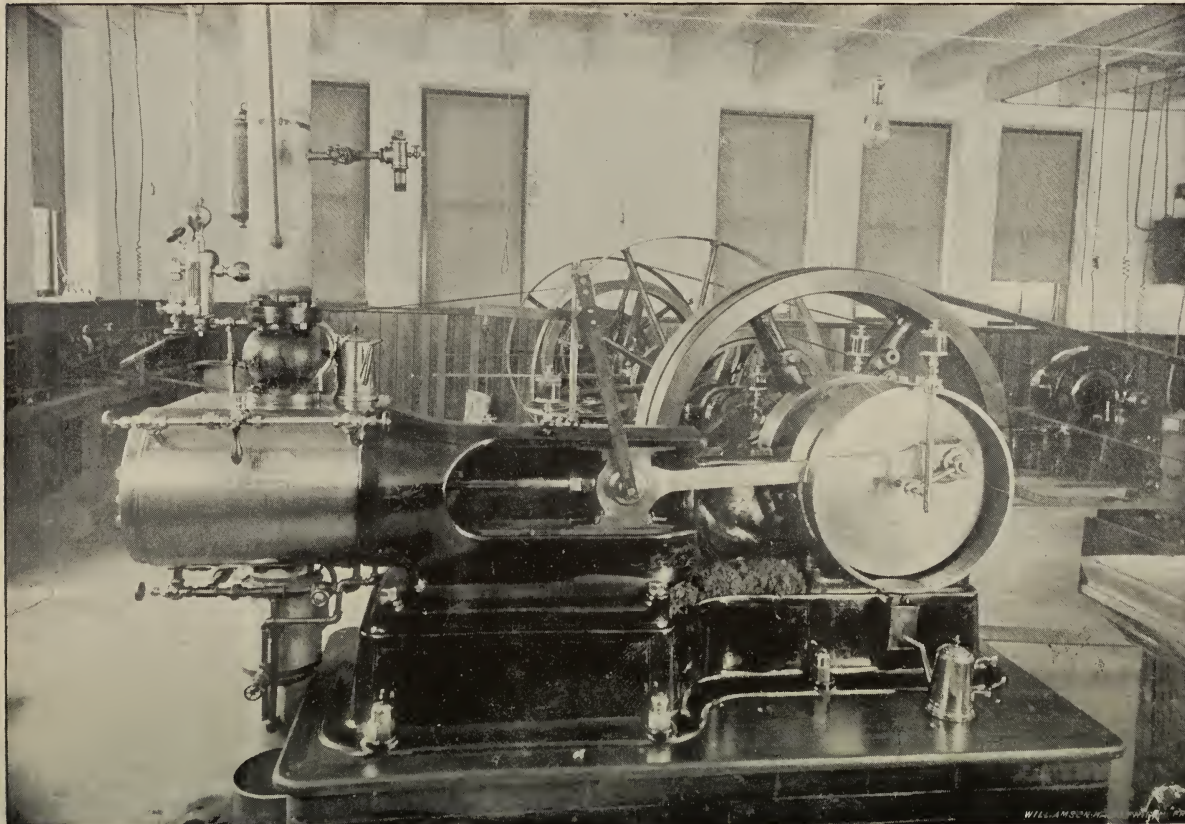
MECHANICS.

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 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."



ENGINE IN BASEMENT OF ENGINEERING HALL.

GRAPHICS.

Two hours per week of lecture and text-book work, and one afternoon 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 and shafts 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 various structures. 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 with great care. 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 theoretical results by labor conditions, and the means available for executing the work, are considered. Economic considerations are kept in view, and students are taught that *least cost* is the first essential. Nor is it forgotten that first cost is not the only cost, the question of durability being 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.

Two lectures each week of the first Senior term are given to this subject. Baker's "Masonry Construction" is used as a text during a portion of the term. During its remainder, no text is specified, but Johnson's "Engineering Contracts and Specifications," and "Modern Framed Structures," are used as supplements to the lecture work.

The Carnegie Steel Company, Limited, has presented to the Engineering Department a complete series of sections of structural steel.

MINING AND METALLURGICAL DESIGN.

Two afternoons each week during the Senior year are given to the design of a plant for the operation of a mine or for the treatment of ores. The student's preference is regarded to some extent as to the character of the plant. These designs are very complete, and involve careful study of structural, mechanical and metallurgical features. The buildings are designed in accordance with standard specifications, and rigid adherence to the best mechanical and metallurgical practice is required. A site is assigned for each plant, the student surveys it and does his work in all respects as though the structure were to be built. The problems are all different, and though the requirements correspond to existing conditions in some American mining region, they are so arranged that mere copying of a plant already built is impossible. All work is based on careful computations, and a good reason for everything is insisted upon. Each student hands in a complete set of *working* drawings of his buildings, furnaces, etc.; detailed specifications for their construction; a bill of material for the entire plant, and an estimate of the total cost.

Among the problems recently assigned are a plant for handling fifteen hundred tons daily from a depth of three thousand feet; a lead smelting plant of one thousand tons daily capacity; a three hundred ton cyanide mill; a plant for working one of the largest mines in Cripple Creek; a five hundred ton chlorination mill and several concentrating mills for treating assigned ores.

SURVEYING.

The instruction in this course covers both the theoretical and practical parts of surveying, the aim being to convey to the student a broad understanding of the subject and its special applications in the professional work of the Mining Engineer.

The institution is well supplied with the necessary instruments for practical work in the field. Among these may be mentioned: Five light mountain transits each provided with some standard form of solar attachment; two of these transits are provided with auxiliary telescopes, for taking highly inclined sights in underground work. Also, one mining transit with side telescope, one heavy triangulation transit, one ordinary heavy engineer's transit with Saegmuller attachment, four wye levels and one needle compass, together with all the necessary accompanying apparatus, such as tapes, level rods, stadia boards, 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, accuracy being insisted upon.

The use and adjustments of the level are treated in the same order as with the transit. After adjusting, the students are given simple exercises in differential leveling until they have become familiar with the instruments. Then some problem involving profile leveling is undertaken, such as the determination of street grades or sewer lines from the profiles. The further use of the level is left until the subject of Railroad Surveying is reached.

In Topographical Surveying, each class makes a survey of some favorable place by the transit and stadia method. From the notes taken a contour map is drawn 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 methods of laying out of cities and towns, resurveys to locate lots described in deeds or on plots, street improvements, giving of grades, etc., together with such applications of each in the field as time will allow.

The determination of the true meridian by means of the various Solar Attachments is made clear by the discussion of the astronomical principles involved, and the adjustment and use of these attachments in the field. In this connection the method of direct solar observation for meridian is given. During the course each student is required to determine the true meridian by making an observation on the pole star; he is also required to find the latitude by an observation of the sun, using transit, solar attachment or sextant.

Mining Surveying includes the methods used in locating and patenting mining claims, and in underground surveying. Each party undertakes the complete survey of a mining claim for patent, going through all the work a U. S. Deputy Mineral Surveyor would have to do, field work, calculations and the preparation of the preliminary plot and 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 theory and practice of underground surveying is fully discussed, especial attention being paid to the instrumental difficulties and unique problems encountered. The field work includes the survey of some mine in the vicinity, and the making of the accompanying computation and maps.

In Geodetic Surveying, classes are instructed in the outlines of that subject, the different kinds of triangulation, descriptive 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, pull, temperature and grade. On this rests a system of triangulation of the neighboring peaks, all angles being 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. The time in the field is devoted to a projected line with preliminary and location surveys, topography, cross-sectioning and preliminary and final estimates of earth work.

The liberal time scheduled, coupled with the fact that our winters are usually 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.

In field practice the class is divided into groups, so as to allow the maximum amount of practice to each individual. The members of the groups also alternate as to duties, so that each one in turn has ample opportunity for mastering every detail.

The instruments above noted are of the best makes. Among them may be mentioned, Buff & Berger, Heller & Brightley, Gurley & Sons, Keufel & Esser and Young.

Addititions are constantly being made, keeping pace with the growth of the school.

Many students, in the vacation between their Junior and Senior years, have secured employment at underground or surface surveying in various mining "camps."

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 DRAFTING 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 no student is allowed to proceed who can not neatly execute at least two alphabets in free-hand.

Then follows the more difficult work in connection with the subject of Descriptive Geometry, including a large number of elementary problems, leading gradually into the advanced work of that subject, and ending with problems in shades and shadows and isometric projections. This completes the purely elementary work.

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

The advanced drawing is all of a practical nature. The elements which have been mastered in the previous years are here combined, and only 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 complete in every way, and students are taught to make prints either from tracings or direct from the bond papers now so much used.

Applicants for advanced standing must bring with them the work they have executed in Mechanical Drawing, or in Descriptive Geometry.

The work by years is as follows:

FRESHMAN YEAR

The work of the first term includes the use of drawing instruments, mounting sheets, etc. 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. In the second term 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, and isometric projections, occupy the whole time.

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.

The whole of the first term is occupied with problems 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.

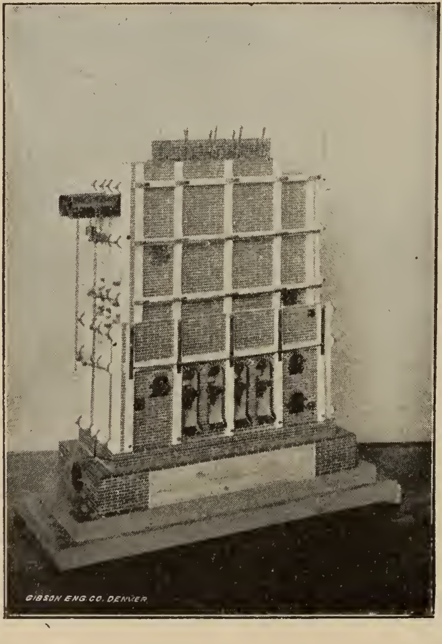
JUNIOR YEAR.

The study of Machine Design is taken up in the class-room at the beginning of this year and continues through the year. The drawing 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; 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.



LIBRARY.

The Library contains nearly five thousand volumes, (exclusive of pamphlets,) 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.

The authorities of the Institution desire to acknowledge the generosity of Capt. Edw. L. Berthoud, formerly a trustee of the school, and of Mr. Edw. G. Stoiber, of Silverton, Colorado, 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 of 1899 on the value of apparatus and machinery is $45,000, which figure is *exclusive* of all furniture, fittings, desks, cases or ordinary school appliances.

BUILDINGS AND GROUNDS.

(1). BUILDING OF 1880-'82.

The combined building of 1880-'82, has the main dimensions of 100 x 70 feet, two stories, and basement extending under most of the space.

The Riehlé testing machine (see "Mechanics"), stands in the south basement. 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 main lecture room for mathematics. The lecture room for general chemistry is next in order, with annex room for apparatus.

Special laboratories (50 x 25) 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.

The length of this building 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, and the department of geology and mineralogy. The latter is divided into three rooms, one for the museum, two for working departments and lecture room.

The second floor is divided into: (1.) Lecture room for metallurgy, containing also the collections and models for this department. (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 occupied by the Freshman Draughting room. The space is four thousand square feet. This fine room is lighted partly by windows, but largely by skylights, 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).

Engineering Hall is a three-story brick and stone structure, fifty by seventy-five feet. The lower floors are devoted to Physics and Electricity, the upper floor contains two large draughting rooms, a blue-print room, and Professor's office.

The second floor is devoted to Physics and to elementary work in Electricity and Magnetism. The lecture room, furnished with raised seats, will accommodate 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. 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 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.

(4). GROUNDS.

The tenth General Assembly gave $5,000 for improvement of the grounds, the City of Golden permitting the absorption 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.

A recent purchase of land in the immediate vicinity of the present grounds affords space for future expansion, a necessity already indicated by the rapid rise in numbers.

GOLDEN HIGH SCHOOL.

WILLIAM TRIPLET, PRINCIPAL.

REGULATIONS.

Pupils admitted to the High School may pursue such studies as they are prepared to take, but fifteen (15) units of study, including History and English four (4), Algebra one and one-half ($1\frac{1}{2}$), and Geometry one and one-half ($1\frac{1}{2}$), will be required for graduation.

By "Unit of Study" is meant a year's work on any branch, five (5) recitations per week, for thirty-six (36) weeks. Seventy (70) per cent is required as a passing grade.

The twenty (20) units of study are as follows:

I. Mathematics, 4.
- (a) Algebra, $1\frac{1}{2}$.
- (b) Geometry (Plane and Solid), $1\frac{1}{2}$.
- (c) Trigonometry, $\frac{1}{2}$.
- (d) Arithmetic, $\frac{1}{2}$.

II. Science, 4.
- (a) Physiography, 1.
- (b) Physics, 1.
- (c) Chemistry, 1.
- (d) Biology, 1.

III. History and English, 4.

IV. Latin, 4.

V. German, 4.

This school offers ample opportunities to those wishing to prepare for the 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 value 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 1899-1900 are as follows:

President ....Daniel Harrington (1900).
Vice President............Claude H. Smith (1900).
Secretary ....Clarence C. Malmstrom (1900).
Treasurer ....Ambrose E. Moynahan (1900).
Corresponding Secretary...Professor James C. Roberts.

ALUMNI ASSOCIATION.

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

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

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

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

The officers of the Association for the year ending June 15th, 1900, are as follows:

President	Chas. W. Comstock (1890).
1st Vice President	John Gross (1897).
2nd Vice President	O. R. Whitaker (1898).
Secretary and Treasurer	Robert S. Stockton (1895).
Executive Committee	O. B. Suhr (1895). Chas. T. Durell (1895). Wm. H. Paul (1896).

DIRECTORY OF GRADUATES.

NAME AND ADDRESS. **1883.** OCCUPATION.

Middleton, Wm. B. .... Mining Engineer.
Denver, Colorado.

Wiley, Walter H. .... Mining Engineer.
Denver, Colorado.

1886.

van Diest, Edmund C. .... Superintendent, Maxwell Land Grant.
San Luis, Costilla County, Colorado.

Gehrmann, Charles A. .... Superintendent, Consolidated Stanley Mining Company.
Idaho Springs, Colorado.

1888.

Ambrosius, Carl E. .... Mining Engineer.
Guanacevi, Durango, Mexico.

*Floyd, John A. ....

Kingman, Jerry .... Chemist.
Los Angeles, California.

*Lorah, Bela I. ....

1889.

Bellam, Henry L. .... Chemist, Anaconda Mining Company.
Anaconda, Montana.

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

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

1890.

Comstock, Chas. W. .... Professor of Mining Engineering, Colo. School of Mines.
Denver, Colorado.

*Deceased.

NAME AND ADDRESS.	OCCUPATION.
1891.	
Johnson, Edward W. Pueblo, Colorado.	Chemist, Colorado Smelting Company.
Smith, Charles D. Pueblo, Colorado.	Metallurgist, Philadelphia Smelter.
1892.	
Aller, Frank B. Perth Amboy, New Jersey.	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. El Oro, Mexico.	Superintendent, Esperanza Mine.
Kimball, George K., Jr. Idaho Springs, Colorado.	Chemist, Kilton Ore Purchasing Co.
Kimball, Jos. S. Creede, Colorado.	Assayer, Commodore Mine.
Lewis, Wm. B. Denver, Colorado.	Manager, Denver Sulphite Fibre Co.
McMahon, Charles H. Sombrerette, Zacatecas, Mexico.	General Superintendent, Sombrerette Mining Co.
1893.	
Collins, Philip M. Georgetown, Colorado.	Assayer.
Hawley, R. Howard Pueblo, Colorado.	Chemist, Philadelphia Smelter.
Jewell, Gilbert E. Chartres Towers, Queensland, Australia.	Metallurgist.
Milliken, Wm. B. Elkton, Colorado.	Manager, Arequa Mill, Colorado Ore Reduction Co.

NAME AND ADDRESS.	OCCUPATION.
1893.	
Osborne, Arthur H. Victor, Colorado.	Surveyor.
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.	Lawyer.
Saint Dizier, Julius L. San Luis Potosi, Mexico.	Engineer, Compania Metalurgica Mexicana.
Schneider, George W. Central City, Colorado.	Mine Surveyor.
Wheeler, Charles E. Golden, Colorado.	
1895.	
Arthur, Edward P. Cripple Creek, Colorado.	Surveyor, U. S. Dept.
Davis, Carl R. Butte, Montana.	Mining Superintendent, Boston and Montana Copper Co.
Dockery, Love Atkins St. Eulalia, Chihuahua, Mexico.	Mining.
Durell, Charles T. Randsbury, California.	Mine Surveyor, Yellow Aster M. & M. Co.
Eaton, Albert L. Leadville, Colorado.	Assayer.
Eye, Clyde M. Maiden, Montana.	Ass't Superintendent, New Year Mine.
Field, Fred. M. Pony, Montana.	Metallurgist, (Cyanide).
Gray, Latimer D. Rock Springs, Wyoming.	Manager, Electric Dept. U. P. Coal Co.

1895.

NAME AND ADDRESS.	OCCUPATION.
Hartzell, Lester J. Phillipsburg, Montana.	Chemist, Granite and Bimetallic Min. Cos.
Kennedy, George A. Silverton, Colorado.	Surveyor and Assayer.
Limbach, Edmund C. Victor, Colorado.	Surveyor.
Maxwell, Fred. A. G. Randfontein, 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, Golden Pressed and Fire Brick Co.
Shetler, Waverly Montanas, Estacion Alamo, N. Leon, Mexico.	Supt. of Montanas Mines of La Gran Fuerdicion.
Skinner, Lewis B. Denver, Colorado.	Chemist, Western Chemical Co.
Stannard, Burt C. Everett, Washington.	Chemist, Puget Sound Reduction Co.
Stockton, Robert S. Golden, Colorado.	Professor of Surveying, Colo. School of Mines.
Suhr, Otto B. Norris, Montana.	Engineer, Telluride Power Transmission Company.
Titsworth, Frederick S. Denver, Colorado.	
Wallace, Lewis R. Morenci, Arizona.	Detroit Copper Company.
Young, Frank B. Oakland, California.	Mining.

1896.

NAME AND ADDRESS.	OCCUPATION.
Atkinson, Walter J. Chicago, Illinois.	Civil Engineer.
Barensheer, Wm. J. Argentine, Kansas.	Assayer, Consolidated Kansas City Smelting & R. Co.
Barnes, Corrin Cripple Creek, Colorado.	Assayer and Surveyor.
Beeler, Henry C. Cambria, Wyoming.	Cambria Mining Company.
Dwelle, Jesse E. Scranton, Pennsylvania.	Colliery Eng. Co.
Griswold, George G. Pueblo, Colorado.	Chemist, Philadelphia Smelter.
Hoyt, George F. Atlanta, Georgia.	Metallurgist.
Maynard, Rea E. Honolulu, Hawaiian Islands.	
Mitchell, George B. Greytown, Nicaragua.	Surveyor, Isthmuthian Canal Commission.
Milliken, John T. Elkton, Colorado.	Metallurgist, Arequa Mill.
Nance, Wm. H. St. Louis, Missouri.	St. Louis Smelting and Refining Company.
Newnam, Wm. E. Omaha, Nebraska.	Chemist, O. & Grant Works.
Paul, Wm. H. Central City, Colorado.	Assayer, Standard Assay Office.
Strout, Fred. McL. Telluride, Colorado.	Assayer and Chemist, Cimarron Mine.

1897.

NAME AND ADDRESS.	OCCUPATION.
Buck, Arthur H. Bacerac, Sonora, Mexico.	Dos Cabezas Mine.
Bussey, Edwin E. Denver, Colorado.	Assayer.

NAME AND ADDRESS. 1897.	OCCUPATION.
Canning, Herbert A. Victor, Colorado.	Superintendent, Granite Mine.
Cohen, Louis Black Hawk, Colorado.	Assayer, State Ore Sampling Works.
Draper, Marshall D. Denver, Colorado.	Draper & McLeod, Chemists.
Febles, John C. Pueblo, Colorado.	Chemist, Colorado Smelter.
Gross, John Sombrerette, Zacatecas, Mexico.	Superintendent, Mills of Sombrerette M. Co.
Hazard, W. J. Golden, Colorado.	Instructor, Colorado School of Mines.
Jarvis, R. P. Leadville, Colorado.	Bimetallic Smelter.
Kelley, W. A. Denver, Colorado.	Chemist, McArthur-Forest Company.
Lerchen, F. H. Scranton, Pennsylvania.	Chemist, Colliery Eng. Company.
Logue, N. W. Leadville, Colorado.	Assayer, Ibex Mining Company.
McLeod, J. Norman Denver, Colorado.	Draper & McLeod, Assayers and Chemists.
MacGregor, George H. Estes Park, Colorado.	
Nelson, H. E. Cyanide, Colorado.	Engineer, Metallic Extraction Company.
Nye, Robert Boise, Idaho.	Mining.
Powell, Geo. F. Denver, Colorado.	
Roller, Arthur H. Nogales, New Mexico.	Surveyor, El Paso & Northeastern Ry. Co.
Schumann, Enrique A. New York, N. Y.	

1897.

NAME AND ADDRESS.	OCCUPATION.
Starbird, H. B. Victor, California.	Rose M. & M. Co.
Warnecke, Carl M. Sherman, California.	Electrician, Los Angeles & Pacific Ry. Co.
Weed, Floyd Cyanide, Colorado.	Chemist, Metallic Extraction Company.
Woods, Thomas H. Ouray, Colorado.	Camp Bird Mine.

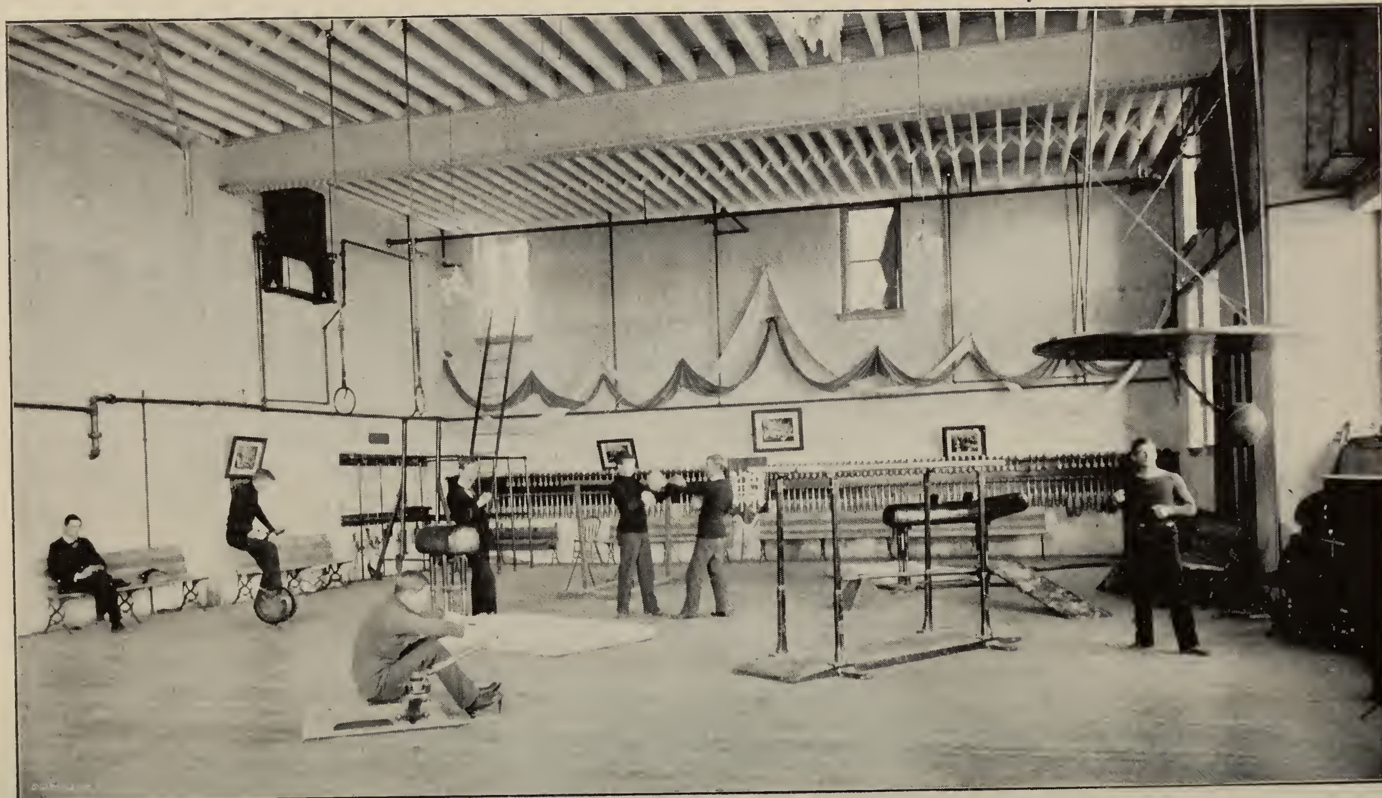
1898.

NAME AND ADDRESS.	OCCUPATION.
Barbour, Percy P. Francis, Boulder County, Colorado.	Assayer, Big Five Mining Co.
Bertschy, Perry H. Elkton, Colorado.	Assayer, Arequa Mill.
Blumenthal, Emil E. Phillipsburg, Montana.	Chemist, Granite & Bimetallic Mining Co.
Caldwell, Florence H. Cleveland, Ohio.	
Church, Myron J. Ahuacatlan, Topic, Mexico.	Manager, Two Republics Gold Min. Co.
Clark, Winfred N. Denver, Colorado.	Electrician.
Corry, Arthur V. Kingman, Arizona.	Manager, New England & Arizona Mining Co.
Davey, Wm. R. Lake City, Colorado.	Assayer.
Dollison, James E. Alma, Colorado.	Assayer.
Hamilton, Frank R. Ouray, Colorado.	Assayer, Camp Bird Mine.
Harrington, Orville Denver, Colorado.	
Ingols, J. August Morenci, Arizona.	Detroit Copper Co.

NAME AND ADDRESS.	OCCUPATION.
1898.	
Johnston, Fred. Bisbee, Arizona.	Engineer.
Jones, Frank H. Georgetown, Colorado.	Assayer and Surveyor.
Kraemer, Edw. L. Leadville, Colorado.	Assayer, Bimetallic Smelting Co.
Lampe, Oscar A. Parral, Mexico.	Assayer.
Lucy, Richard W. Leadville, Colorado.	Surveyor, Colorado & Southern Ry.
Magenau, William Kingman, Arizona.	Assayer, New England & Arizona Mining Co.
Norman, John Edw. Denver, Colorado.	
Rodriguez, J. Crisostomo Saltillo, Mexico.	Mine Superintendent.
Smith, Harry C. Denver, Colorado.	
Stephens, Charles N. Denver, Colorado.	Draughtsman.
Valentine, Malvern R. Victor, Colorado.	Assayer, Taylor & Brunton Sampler.
Whitaker, Orvil R. Cerralvo, Nuevo Leon, Mexico.	Mine Superintendent.
1899.	
Adami, Charles J. Butte, Montana.	Surveyor, B. & M. and B. & B. Co.
Bruce, Stuart S. Denver, Colorado.	Draughtsman, Boston Building.
Cramer, Curtis P. Leadville, Colorado.	Assayer, Bimetallic Smelter.
Davis, Gilbert L. Denver, Colorado.	Surveyor, Denver Tramway Co.
Grant, Lester S. Manitou, Colorado.	Surveyor.

NAME AND ADDRESS. 1899.	OCCUPATION.
Hodgson, Arthur Denver, Colorado.	Assayer, Denver Mint.
Johnson, Gilbert J. Ouray, Colorado.	Assayer and Surveyor, American Nettie Mine.
Kelley, Fred. G. Black Hawk, Colorado.	Surveyor, Cook Mining Co.
Muir, David Ydalpom, Shasta County, California.	Assayer, Bully Hill Mine.
Rising, Arthur F. Perth Amboy, New Jersey.	Ass't Chemist, Raritan Refining Co.
Royer, Frank W. Arastra, Colorado.	Assayer, Silver Lake Mine.
Smith, Thos. G. Denver, Colorado.	Chemist, Omaha & Grant Smelter.
Steinhauer, Frederick C. El Oro, Estada Mexico, Mexico.	Surveyor, Compania Minera La Esperamza y Anexas.
Thompson, James S. Denver, Colorado.	
Townsend, Arthur R. Leadville, Colorado.	Assayer, Union Smelting Co.
Tyler, Sydney B. Denver, Colorado.	Surveyor.
Waltman, Will. D. Cripple Creek, Colorado.	Surveyor.
Weiss, Andrew Golden, Colorado.	Instructor in Mathematics and Surveying, Colorado School of Mines.
Williams, Wakely A. Grand Forks, British Columbia.	Ass't. Supt. Granby Cons. M. & Sm. Co.

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



GYMNASIUM, LOOKING WEST. BASEMENT OF BUILDING OF 1890.

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 Qualitative Analysis.
Cairns' Quantitative Analysis.
Furman's Manual of Assaying.
Wentworth's Higher Algebra.
Chauvenet's Geometry, Byerly's Edition.
Chauvenet's Trigonometry.
Tanner and Allen's Analytical Geometry.
Osborne's Calculus.
Stahl and Wood's 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.
Hutton's Mechanical Engineering of Power Plants.
Johnson's Engineering Contracts and Specifications.
Johnson's Surveying.
Nagle's Field Manual.
Merriman's Hydraulics.
Church's Mechanics of Engineering.
Greene's Roof and Bridge Trusses.
Baker's Masonry Construction.
Johnson's Theory and Practice of Framed Structures.
Foster's Ore and Stone Mining.
Peters' Copper Smelting.
Eissler's Metallurgy of Silver.
Eggleston'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 Blow-Pipe Analysis.
Patton's Lecture Notes on Crystallography.

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