Catalogue of the State School of Mines, Golden, Colorado. 1895-6

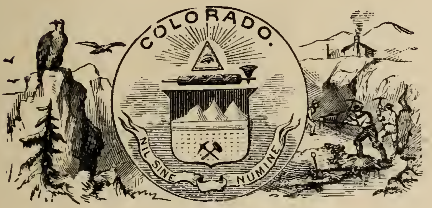
STATE SCHOOL OF MINES. EAST FRONT OF MAIN BUILDINGS.

CATALOGUE

OF THE

STATE SCHOOL OF MINES

GOLDEN, COLORADO.



1895-96.

DENVER, COLO.

NEWS PRINTING COMPANY.

1896.

CONTENTS.

CALENDAR.

1895-96.

Fall Term Begins	Sept. 16, 1895,	Ends Dec. 20, 1895.
Winter Term Begins	Jan. 2, 1896,	Ends Mch. 26, 1896.
Spring Term Begins	Mch. 29, 1896,	Ends June 11, 1896.

1896-97.

EXAMINATIONS FOR ADMISSION.

June 15, 16, 1896. Sept. 10, 11, 12, 1896.

Fall Term Begins	Sept. 14, 1896,	Ends Dec. 18, 1896.
Winter Term Begins	Jan. 4, 1897,	Ends Mch. 26, 1897.
Spring Term Begins	Mch. 29, 1897,	Ends June 9, 1897.

BOARD OF TRUSTEES.

OFFICERS OF THE BOARD.

FACULTY.

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

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

GEORGE CYRUS TILDEN, C. E.,
Professor of Analytical Chemistry.

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HOWARD VAN F. FURMAN, E. M.,
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Professor of Geology and Mineralogy.

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Assistant Professor in Mathematics and Surveying.

LATIMER D. GRAY, E. E.,
Assistant in Physical Laboratory.

ELBRIDGE GRAVES MOODY,
Registrar and Librarian.

STUDENTS, 1895-96.

POST GRADUATES.

Bancroft, Geo. J. (B. A. in M. E., Leland Stanford, Jr., 1895.)	Denver,	Colorado.
Forsythe, Robert J. (A. B., A. M., Harvard University.)	Cambridge,	Massachusetts.
Maynard, Rea E. (B. A. in M. E., Leland Stanford, Jr., 1895.)	Los Angeles,	California.

SENIORS.

Atkinson, Walter J.	(C. E.)	White,	South Dakota.
Barensheer, Wm. J.	(E. M.)	Denver,	Colorado.
Barnes, Corrin	(E. M.)	Jefferson County,	Colorado.
Beeler, Henry C.	(E. M.)	Denver,	Colorado.
Dwelle, Jesse E.	(E. M.)	Denver,	Colorado.
Griswold, Geo. G.	(B. S.)	Denver,	Colorado.
Hoyt, Geo. F.	(B. S.)	El Modena,	California.
Medell, Wm. S.	(B. S.)	Golden,	Colorado.
Mitchell, Geo. B.	(C. E.)	Denver,	Colorado.
Milliken, John T.	(E. M.)	Coal Creek,	Colorado.
Nance, Wm. H.	(E. M.)	Denver,	Colorado.
Newnam, Wm. E.	(B. S.)	Denver,	Colorado.
Paul, Wm. H.	(E. M.)	Denver,	Colorado.
Strout, Fred. McL.	(E. M.)	Ouray,	Colorado.

JUNIORS.

Arkins, Chas. T.	(E. M.) - Denver,	Colorado.
Brown, Fred L.	(E. M.) - Golden,	Colorado.
Brown, Walter	(E. M.) - Erie,	Colorado.
Buck, Arthur H.	(E. M.) - Denver,	Colorado.
Bussy, Edwin E.	(B. S.) - Denver,	Colorado.
Canning, Herbert A.	(E. M.) - Aspen,	Colorado.
Chappell, Abraham G.	(E. E.) - Lincoln,	Nebraska.
Cohen, Louis	(E. M.) - Denver,	Colorado.
Draper, Marshall D.	(E. M.) - Denver,	Colorado.
Dunham, Hermon E.	(E. M.) - Denver,	Colorado.
Febles, John C.	(B. S.) - Denver,	Colorado.
Gross, John	(E. M.) - Elyria,	Colorado.
Hazard, Wm. J.	(E. E.) - Pittsburgh,	Pennsylvania.
Ingols, J. Augustus	(E. E.) - Denver,	Colorado.
Jarvis, Royal P.	(E. M.) - Crested Butte,	Colorado.
Kelley, Wm. A.	(E. M.) - Denver,	Colorado.
Lerchen, Frank H.	(E. M.) - Denver,	Colorado.
Logue, Nelson W.	(E. M.) - Aspen,	Colorado.
McLeod, J. Norman	(E. M.) - Fairbury,	Nebraska.
MacGregor, Geo. H.	(E. M.) - Estes Park,	Colorado.
Magenau, William	(E. M.) - Denver,	Colorado.
Nelson, Harry E.	(E. M.) - Denver,	Colorado.
Nye, Robert	(E. M.) - Moline,	Illinois.
Ober, Geo. F.	(E. M.) - Victor,	Colorado.
Powell, Geo. F.	(B. S.) - Leadville,	Colorado.
Roller, Arthur H.	(B. S.) - Salida,	Colorado.
Starbird, Harold B.	(E. M.) - Denver,	Colorado.
Weed, Floyd	(E. M.) - Denver,	Colorado.
Woods, Thos. H.	(B. S.) - Denver,	Colorado.

SOPHOMORES.

Barbour, Percy P.	Edgewater,	Colorado.
Bertschy, Perry H.	Appleton,	Wisconsin.
Blumenthal, Emil E.	Denver,	Colorado.
Brown, George W.	Petersburg,	Colorado.
Burdsal, Chas. S.	Evanston,	Illinois.
Caldwell, Florence H.	Cleveland,	Ohio.
Corry, Arthur B.	Butte,	Montana.
Church, Myron J.	Milwaukee,	Wisconsin.
Davey, Wm. R.	Lake City,	Colorado.
Davidson, J. Lofton	Golden,	Colorado.
Davis, Ralph T.	Colorado Springs,	Colorado.
Deems, Mark	Dawkins,	Colorado.
Dollison, James E.	Golden,	Colorado.
Gleason, Geo. B., Jr.	Highlands,	Colorado.
Hamilton, Frank R.	Denver,	Colorado.
Harrington, Orville	Denver,	Colorado.
Hartman, Fred. C.	Sonora,	Mexico.
Hollis, Chauncey D.	Woodville,	New York.
Jeffries, Edw. H.	Denver,	Colorado.
Johnston, Fred.	Denver,	Colorado.
Jones, Frank H.	Dallas,	Texas.
Jones, Junius H.	Norfolk,	Virginia.
Kraemer, Edw. L.	Denver,	Colorado.
Laird, Eugene P.	Parkersburg,	West Virginia.
Lampe, Oscar A.	Denver,	Colorado.
Lawton, Frank C.	Colorado Springs,	Colorado.
Lee, Murray	Denver,	Colorado.
Lucy, Richard W.	Denver,	Colorado.
Mills, Eben B.	Denver,	Colorado.
Norman, J. Edward	Denver,	Colorado.
Orahood, Harper H.	Denver,	Colorado.
Pease, Jas. L.	Denver,	Colorado.
Reid, Geo. D.	Norwich,	Connecticut.

SOPHOMORES—Continued.

Rodriguez, Crisostomo	Saltillo,	Mexico.
Smith, Harry C.	Denver,	Colorado.
Stephens, Chas. N.	Denver,	Colorado.
Tippett, J. Mellon	McCoy,	Colorado.
Valentine, Malvern R.	Highlands,	Colorado.
Warnecke, Carl M.	Denver,	Colorado.
Whitaker, Orvil R.	Durango,	Colorado.

FRESHMEN.

Adami, Chas. J.	Helena,	Montana.
Argall, Harry	Denver,	Colorado.
Baily, Frank S.	Denver,	Colorado.
Bauer, John F.	Mancos,	Colorado.
Benwell, Geo. A., Jr.	Linden,	New Jersey.
Bowman, Frank C.	Denver,	Colorado.
Brown, Archie D.	Ouray,	Colorado.
Brown, Jas. W.	Giddings,	Texas.
Bruce, Stuart S.	Highlands,	Colorado.
Burdick, Edward	Chicago,	Illinois.
Cramer, Curtis P.	Sedalia,	Colorado.
Corry, Clarence A.	Butte,	Montana.
Cottrell, William T.	La Salle,	Colorado.
Crowe, Thomas B.	Cascade,	Colorado.
Daily, Ross John	Denver,	Colorado.
Davis, Gilbert L.	Denver,	Colorado.
Duvall, W. George	Golden,	Colorado.
Frizzell, Jas. A.	Manitou,	Colorado.
Glenn, Fred.	Golden,	Colorado.
Grant, Lester S.	Manitou,	Colorado.
Harker, Fritz P.	Denver,	Colorado.

FRESHMEN—Continued.

Hodgson, Arthur	Aspen,	Colorado.
Hoyt, Willis J.	Denver,	Colorado.
Hughes, Wm. T. S.	Coal Creek,	Colorado.
Johnson, Gilbert, Jr.	Denver,	Colorado.
Kerr, Victor E.	Golden,	Colorado.
Kobayashi, Gisaku	Tokio,	Japan.
Malmstrom, Clarence C.	Denver,	Colorado.
Miller, Frank C.	Denver,	Colorado.
Muir, David, Jr.	Rock Springs,	Wyoming.
Olshausen, John	El Paso,	Texas.
Platt, Edwin H.	Denver,	Colorado.
Pearce, Herbert B.	Denver,	Colorado.
Rising, Arthur F.	Williamsburg,	Mass.
Robey, Lloyd	Villa Park,	Colorado.
Rouse, Lucius H.	Colorado Springs,	Colorado.
Royer, John L.	Berkeley,	Colorado.
Rudd, Arthur H.	Chicago,	Illinois.
Slater, Amos	Denver,	Colorado.
Songer, Fred. E.	Berkeley,	Colorado.
Steinhauer, Fred. C.	Denver,	Colorado.
Stewart, Edward G.	Denver,	Colorado.
Thompson, Jas. S.	Denver,	Colorado.
Tyler, Sidney B.	Denver,	Colorado.
Van Fleet, Mont. V.	Pulaski,	Pennsylvania.
Waltman, Will D.	Colorado Springs,	Colorado.
Weiss, Andrew	Wels,	Austria.
Werden, Arthur C.	Denver,	Colorado.
Williams, Wakeley A.	Socorro,	New Mexico.

SUMMARY.

Post Graduates	3
Seniors	14
Juniors	29
Sophomores	40
Freshmen	49
Total	135

SUMMARY BY STATES AND COUNTRIES.

Colorado	102	Connecticut	1
Illinois	4	Japan	1
Montana	3	New Jersey	1
Texas	3	New Mexico	1
California	2	New York	1
Massachusetts	2	Ohio	1
Mexico	2	South Dakota	1
Nebraska	2	Virginia	1
Pennsylvania	2	West Virginia	1
Wisconsin	2	Wyoming	1
Austria	1		

The summary shows that seventy-six per cent. of the students are from Colorado, and twenty-four per cent. from other states or countries.

GRADUATES, JUNE, 1895.

Arthur, Edward P., Jr.	(E. M.)	Cripple Creek,	Colorado.
Davis, Carl Raymond	(E. M.)	Butte,	Montana.
Dockery, Love Atkins	(E. M.)	Love,	Mississippi.
Durell, Charles Terry	(E. M.)	Denver,	Colorado.
Eaton, Albert L.	(E. M.)	Denver,	Colorado.
Eye, Clyde M.	(E. M.)	Leadville,	Colorado.
Field, Fred. M.	(E. M.)	Billings,	Montana.
Gray, Latimer D.	(E. E.)	Golden,	Colorado.
Hartzell, Lester J.	(B. S.)	Golden,	Colorado.
Kennedy, Geo. Adams	(E. M.)	Highlands,	Colorado.
Limbach, Edmund C.	(E. M.)	Monument,	Colorado.
Maxwell, Fred. A.	(E. M.)	Golden,	Colorado.
Merryman, Herbert E.	(E. M.)	Denver,	Colorado.
Parker, James H.	(E. M.)	White Oaks,	New Mexico.
Rowe, Edward E.	(B. S.)	Golden,	Colorado.
Shettler, Waverly	(E. M.)	Marshalltown,	Iowa.
Skinner, Lewis B.	(B. S.)	Denver,	Colorado.
Stannard, Burt C.	(B. S.)	Troy,	New York.
Stockton, Robert S.	(E. M.)	Golden,	Colorado.
Suhr, Otto B.	(E. M.)	New York,	New York.
Titsworth, Frederick S.	(E. M.)	Denver,	Colorado.
Wallace, Louis R.	(E. M.)	Corning,	Iowa.
Young, Frank B.	(E. M.)	Oakland,	California.

HISTORY AND ORGANIZATION.

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

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

An appropriation was granted by the General Assembly, and lots were given by citizens of Golden on which to erect the building. No land, however, was then or has ever been granted by the State, so that subsequent additions have been made from the current income of the institution.

The building thus provided for was erected in 1880. It was, however, even for that time quite too small for any organized work to be carried forward in it, a fact evidently apparent to the next legislature, as an additional grant was made in 1881, and the building was enlarged so as to include space for laboratories, a few small rooms for lectures, and a larger hall for museum and other purposes. This building still forms a part of the group now occupied by the school, though much of the work has been transferred to the later additions to be mentioned.

The school now began to grow in numbers, but from 1886 to 1889 its growth was merely nominal, so far as the roll of students was concerned, though the standard of instruction was being constantly raised.

In fact, the space at its disposal during this period did not permit any expansion. Fifty was the average number of students, and more would have unduly crowded it. It was finally decided by the Trustees to erect an important addition from the current income which at that time was one-fifth of one mill of the State tax.

This addition was first occupied in the fall of 1890. It is described under "Buildings" in the present catalogue. With its erection the elimination of the "special" courses, hitherto the bar to progress in the development of either practical or theoretical lines, was begun. It is significant of the rapid rise in the educational demand of the State, that the prediction was very freely made at the time, that this abolition of partial and "optional" courses would materially reduce the number of students. However, in two years the number increased 100 per cent., and a number of former partial students returned to take advantage of the full course now offered.

Although the course adopted in thus drawing from the current funds to erect permanent and expensive improvements, was the only possible policy, and while it resulted in raising the efficiency of the institution in a marked degree, the strain upon its resources was very great, and the reduction of income from a fifth to a sixth of a mill, before the debt on this addition was cleared, still further obstructed all plans for proper equipment. Nevertheless, the close of the year 1892 found the school fairly in sight of freedom from debt. Meantime the rapid increase in numbers, and the no less marked advance in the demands made upon the management for the most modern methods, especially for electrical instruction, necessitated a still further addition to the "plant," and the Assembly of 1893 granted $20,000 for that purpose. With every effort on the part of the Trustees to hold the plans within that figure, it was found it would require almost exactly the sum originally asked for ($25,000) to complete the new edifice, without fatal hampering of its proposed uses. The building was first occupied in the fall of 1894, and may be fairly considered the best, though by no means the largest of the buildings.

The removal of three departments to the new building allowed a re-arrangement not only radical in its great advance in convenience, but providing for future expansion in numbers, a consideration of no small importance. The space needed in a technical school is necessarily far greater than in any other, proportionately to the number of students, since each and every student must be provided in addition to space in the lecture room, with laboratory, draughting room, physical testing and mechanical working spaces, the practical work absorbing far more space than that needed for all the lectures and recitations.

The organization of the School of Mines of Colorado is set forth in the pages following. It resembles that of the best technical schools of the United States, and the institution is now in fact what it has long been in intent, a "School of Applied Science," with the weight of instruction thrown to every branch having a more or less direct bearing upon mining and metallurgy.

With far greater confidence than ever before, the authorities of the institution now present its claims as a technical school of the first rank. They feel that with its many graduates occupying positions demanding responsibility and skill, it has fully passed its experimental stage, but they are very far from asserting that nothing remains to be done, and so far as future means will permit it is their intention that every department shall continue to meet the ever growing demands of the industries of the State and of practical science.

LOCATION.

The institution is located at Golden, sixteen miles west of Denver, on the Colorado Central Railroad, or thirteen miles by the Denver, Lakewood & Golden Railroad. It is at an altitude of 5,700 feet above sea level, and very close to the first foot-hills of the Rocky Mountains.

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 illustrations of the geological formations of various ages, affording abundant opportunities for practical instruction as well as exercise.

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

EXPENSES.

Tuition is free. Students are charged with material consumed or broken. Students in Assaying and Analytical Chemistry pay fifteen dollars ($15.00) per term for fuel, gas and ordinary chemicals. Expensive chemicals are charged as used.

A deposit of ten dollars ($10.00) is required of each student in qualitative analysis, and twenty dollars ($20.00) of each student in quantitative analysis, at the opening of his course. These amounts being credited, the student is charged with apparatus taken out for use, and again credited with all that he returns in good condition at the close of the year or term. Balance to his credit, if any, is then returned to him in cash. An additional deposit may be required at any time, if the apparatus called for is unusual or excessive.

Ten dollars ($10.00) a year is added to the bill of students in Surveying and Electrical Engineering, for the use and wear of instruments.

Members of the students' "Athletic Association" pay a fee of one dollar a term, which is reserved for the renewal and repair of gymnasium apparatus. A small deposit is required on keys issued to students for lockers and drawers. This is refunded upon return of the keys.

Each student also deposits a "damage fee," the amount of which is fixed by the Faculty. It has not hitherto exceeded two dollars per annum. From this fund, repairs necessitated by willful damage are paid for.

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

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

It is estimated that the total expense of the school year, fees included, need not in any case exceed three hundred and fifty dollars ($350.00). Many students, however, have come very far within these figures by special arrangements and "clubbing," so that it is hardly practicable to name a minimum figure.

REQUIREMENTS FOR ADMISSION.

Candidates for admission must be at least seventeen years of age. They must sustain a satisfactory examination in English Composition, Geography, Arithmetic, and in the first elements of Algebra and Geometry.

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

In Algebra the fundamental operations, also factoring and fractions, as in Wentworth's "Complete" Algebra, or an equivalent.

In Geometry the first two books of any standard text, i. e., triangles, etc., and first book on the circle.

The very slight requirement in Geometry indicates that it is not what the candidate has "gone over," but his appreciation of geometric reasoning that is regarded.

Thoroughness in the elements is far better preparation than the imperfect knowledge of a whole text-book.

Candidates for advanced standing will be examined upon all the studies of the course below the class they propose to enter, as well as upon the subjects required for admission.

June examinations for admission having now been instituted (in addition to those in September), it is recommended to all prospective candidates to attend at the earlier date. Any deficiency then discovered can almost certainly be made good before the opening of the Fall term.

Certificates of proficiency from approved High Schools will be received in lieu of examination for admission to the Freshman class. The Faculty reserve the right, however, to examine for admission to any higher standing than the first or Fall term admission to the Freshman year, irrespective of the certificate brought from another institution.

COURSES AND DEGREES.

There are three full courses of study, viz: Civil Engineering, Mining and Metallurgical Engineering, and Electrical Engineering.

Each covers a period of four years. The studies, however, are identical during the first two years of all courses, beginning to diverge at the opening of the third year. Candidates for degree of Electrical Engineer may omit Mineralogy under certain conditions.

The degrees given are:

Civil Engineering (C. E.)
Engineer of Mines and Metallurgy (E. M.)
Electrical Engineer (E. E.)

Students will not be admitted to the fourth year as applicants for the degree of "C. E." unless they have shown very marked ability in Mathematics. They must also have been connected with some survey or other active field operation in engineering lines, during one of the vacations of their course.

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

EXAMINATIONS.

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.

A student failing in more than two subjects at the June examination must repeat the year. A complete failure in one or two branches may subject him to the same condition. If conditioned in one or two branches the condition must be made up prior to the opening of the ensuing Fall term, at any regular examination date, i. e., in June or September, as announced in the catalogue.

A student failing in term examination (December or April), or debarred from same by absences, may, at the discretion of the Faculty, be excluded from the course.

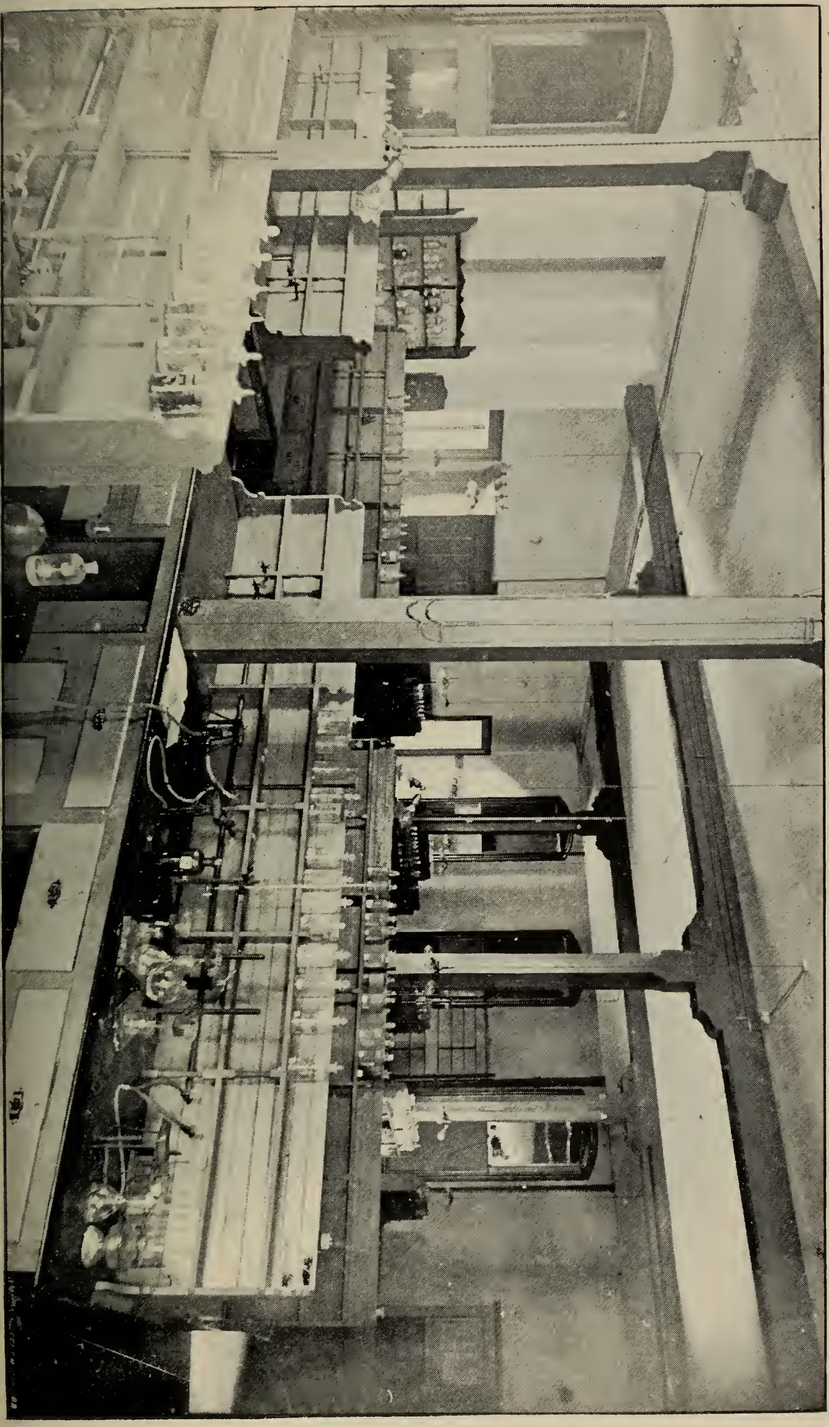
The attempt of any student to present as his own, the work of another, or to pass any examination by improper means, will render him liable to expulsion.

Absence from examinations, whether from illness or from any other cause, can only be excused 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. No re-examinations will be allowed except by special vote of the Faculty.

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

No student can enter the Senior class "conditioned."



MEMOIRS AND THESES.

Each student is required, during the summer vacation preceding his senior year, to execute a memoir on some subject assigned by the Faculty. The subject is chosen with direct reference to the practical end the student has in view in his course of study.

Careful inspection of mines, metallurgical works, etc., furnishes the student material from which to make his estimates and calculations. These memoirs and accompanying drawings must be completed and handed to the Faculty for acceptance on or before December 1st.

At the end of the third year the student is also assigned a subject for a graduating thesis. Such data are given as would be met with in practical experience. When completed, the thesis is presented to the Faculty for approval. It must be handed in on or before April 1st.

All memoirs, theses and drawings which constitute any 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.

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

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

SCHEDULE OF STUDIES.

FRESHMAN YEAR.

FOR ALL COURSES.

FIRST TERM.

Algebra, (Wentworth's "Higher")	3 hours a week.
Geometry, (Chauvenet's, Byerly edition)	2 hours a week.
General Chemistry, (Lectures)	5 hours a week.
Mechanical Drawing	12 hours a week.
Descriptive Geometry	2 hours a week.

SECOND TERM.

Algebra	3 hours a week.
Geometry	2 hours a week.
General Chemistry	5 hours a week.
Mechanical Drawing	12 hours a week.
Descriptive Geometry	2 hours a week.

THIRD TERM.

Plane Trigonometry, (Chauvenet's)	3 hours a week.
Geometry	2 hours a week.
General Chemistry	5 hours a week.
Qualitative Analysis, (three afternoons)	9 hours a week.
Mechanical Drawing, (two afternoons)	6 hours a week.
Descriptive Geometry	2 hours a week.

SOPHOMORE YEAR.

FOR ALL COURSES.

FIRST TERM.

Analytical Geometry	2 hours a week.
Algebra	3 hours a week.
Physics, (Lectures)	3 hours a week.
Physics, (Laboratory)	4 hours a week.
Chemistry, (Lectures)	1 hour a week.
Analytical Chemistry, (Laboratory)	6 hours a week.
Mineralogy*	5 hours a week.
Mechanical Drawing	4 hours a week.

SECOND TERM.

Analytical Geometry	2 hours a week.
Advanced Algebra	3 hours a week.
Mineralogy*	5 hours a week.
Physics, (Lectures)	3 hours a week.
Physics, (Laboratory)	4 hours a week.
Chemistry, (Lectures)†	1 hour a week.
Chemistry, (Laboratory)†	4 hours a week.
Mechanical Drawing	6 hours a week.

THIRD TERM.

Differential Calculus	3 hours a week.
Mineralogy*	5 hours a week.
Physics, (Lectures)	3 hours a week.
Physics, (Laboratory)	4 hours a week.
Mechanical Drawing	9 hours a week.

*Mineralogy may be omitted by "E. E." students.

†Chemistry is dropped in this term by "C. E." students, extra Draughting being substituted.

COURSE IN MINING AND METALLURGY.

JUNIOR YEAR.

FIRST TERM.

Analytical Geometry	2 hours a week.
Differential Calculus	3 hours a week.
Kinematics and Statics	3 hours a week.
Surveying, (Recitations)	2 hours a week.
Surveying, (Field Work)	12 hours a week.
Metallurgy	3 hours a week.
Mining	2 hours a week.
Analytical Chemistry	9 hours a week.
Mechanical Drawing	4 hours a week.

SECOND TERM.

Analytical Geometry	2 hours a week.
Calculus	3 hours a week.
Metallurgy	3 hours a week.
Mining	2 hours a week.
Dynamics	3 hours a week.
Surveying and Tunnelling	2 hours a week.
Surveying, (Field Work)	Saturdays.
Chemistry	6 hours a week.
Machine Design	4 hours a week.

THIRD TERM.

Applied Calculus	3 hours a week.
Mechanism and Machinery	3 hours a week.
Graphical Analysis	2 hours a week.
Surveying, (Recitations)	2 hours a week.
Surveying, (Field Work)	6 hours a week.
Electrical Measurements	1 hour a week.
Electrical Measurements (Laboratory Work)	3 hours a week.
Machine Design	6 hours a week.

COURSE IN MINING AND METALLURGY.

SENIOR YEAR.

FIRST TERM.

Metallurgy	3 hours a week.
Mining	2 hours a week.
Geology	3 hours a week.
Strength of Materials	3 hours a week.
Strength of Materials, (Testing Machine)	3 hours a week.
Thermo-Dynamics	2 hours a week.
Theory of Construction	2 hours a week.
Hydraulics	2 hours a week.
Electric Power Transmission	3 hours a week.
Advanced Chemistry	2 hours a week.

SECOND TERM.

Metallurgy	3 hours a week.
Mining	2 hours a week.
Strength of Materials	3 hours a week.
Strength of Materials, (Laboratory)	3 hours a week.
Geology	3 hours a week.
Prime Movers and Steam Engines	2 hours a week.
Theory of Construction	2 hours a week.
Chemical Technology	2 hours a week.
Electric Transmission of Power	2 hours a week.

THIRD TERM.

Metallurgy	3 hours a week.
Mining	2 hours a week.
Geology	3 hours a week.
Chemical Technology	2 hours a week.

Thesis Work.

COURSE IN CIVIL ENGINEERING.

JUNIOR YEAR.

FIRST TERM.

Analytical Geometry	2 hours a week.
Differential Calculus	3 hours a week.
Kinematics and Statics	3 hours a week.
Surveying, (Recitations)	2 hours a week.
Surveying, (Field Work)	12 hours a week.
Masonry Structures	2 hours a week.
Drawing	6 hours a week.

SECOND TERM.

Analytical Geometry	2 hours a week.
Calculus	3 hours a week.
Statics and Dynamics	3 hours a week.
Framed Structures, treated analytically and graphically	3 hours a week.
Surveying, (Recitations)	3 hours a week.
Surveying, (Field Work and Computations)	9 hours a week.
Graphic Analysis of Arches and Designing Masonry Structures	3 hours a week.

THIRD TERM.

Calculus	3 hours a week.
Machine Dynamics and Designing	3 hours a week.
Framed Structures	2 hours a week.
Surveying, (Recitations)	3 hours a week.
Surveying, (Field Work, etc.)	9 hours a week.
Electrical Measurements	1 hour a week.
Electrical Measurements (Laboratory Work)	3 hours a week.

COURSE IN CIVIL ENGINEERING.

SENIOR YEAR.

FIRST TERM.

Strength of Materials ------------------3 hours a week.
Economics of Railway Location ----------3 hours a week.
Hydraulics and Hydraulic Motors--------5 hours a week.
Framed Structures, (Complete Designs of
Bridges and Roofs)----------------2 hours a week.
Electric Power Transmission-----------3 hours a week.
Testing, (Laboratory) ------------------3 hours a week.
Hydraulic, (Laboratory) ----------------3 hours a week.
Designing ----------------------------3 hours a week.

SECOND TERM.

Strength of Materials ------------------3 hours a week.
Water Supply and Irrigation------------4 hours a week.
Prime Movers and Steam Engines ------2 hours a week.
Framed Structures, (Completed) --------2 hours a week.
River and Harbor Improvements -------2 hours a week.
Testing, (Laboratory) -----------------3 hours a week.
Designing ----------------------------9 hours a week.

THIRD TERM.

City and Sanitary Engineering ---------3 hours a week.
Abstracts and Reports of Engineering
Work and Literature --------------3 hours a week.
Designing ----------------------------3 hours a week.
Thesis Work.

COURSE IN ELECTRICAL ENGINEERING.

JUNIOR YEAR.

FIRST TERM.

Analytical Geometry	2 hours a week.
Differential Calculus	3 hours a week.
Mining	2 hours a week.
Metallurgy	3 hours a week.
Primary and Secondary Batteries, (Recitations)	1 hour a week.
Primary and Secondary Batteries, (Laboratory Work)	6 hours a week.
Pattern Work	3 hours a week.
Electrical Measurements	4 hours a week.
Drawing and Machine Design	4 hours a week.

SECOND TERM.

Analytical Geometry	2 hours a week.
Calculus	3 hours a week.
Graphic Analysis	2 hours a week.
Dynamo Electric Machinery	3 hours a week.
Dynamo Electric Machinery, (Laboratory)	3 hours a week.
Pattern Work	4 hours a week.
Drawing and Machine Design	6 hours a week.

THIRD TERM.

Applied Calculus	3 hours a week.
Dynamo Electrical Machinery, (Recitations)	3 hours a week.
Dynamo Electrical Machinery, (Laboratory)	3 hours a week.
Machine Dynamics and Designing	3 hours a week.
Shop Work	6 hours a week.
Electrical Magnetism, (Lectures)	2 hours a week.
Electrical Magnetism, (Laboratory)	6 hours a week.

COURSE IN ELECTRICAL ENGINEERING.

SENIOR YEAR.

FIRST TERM.

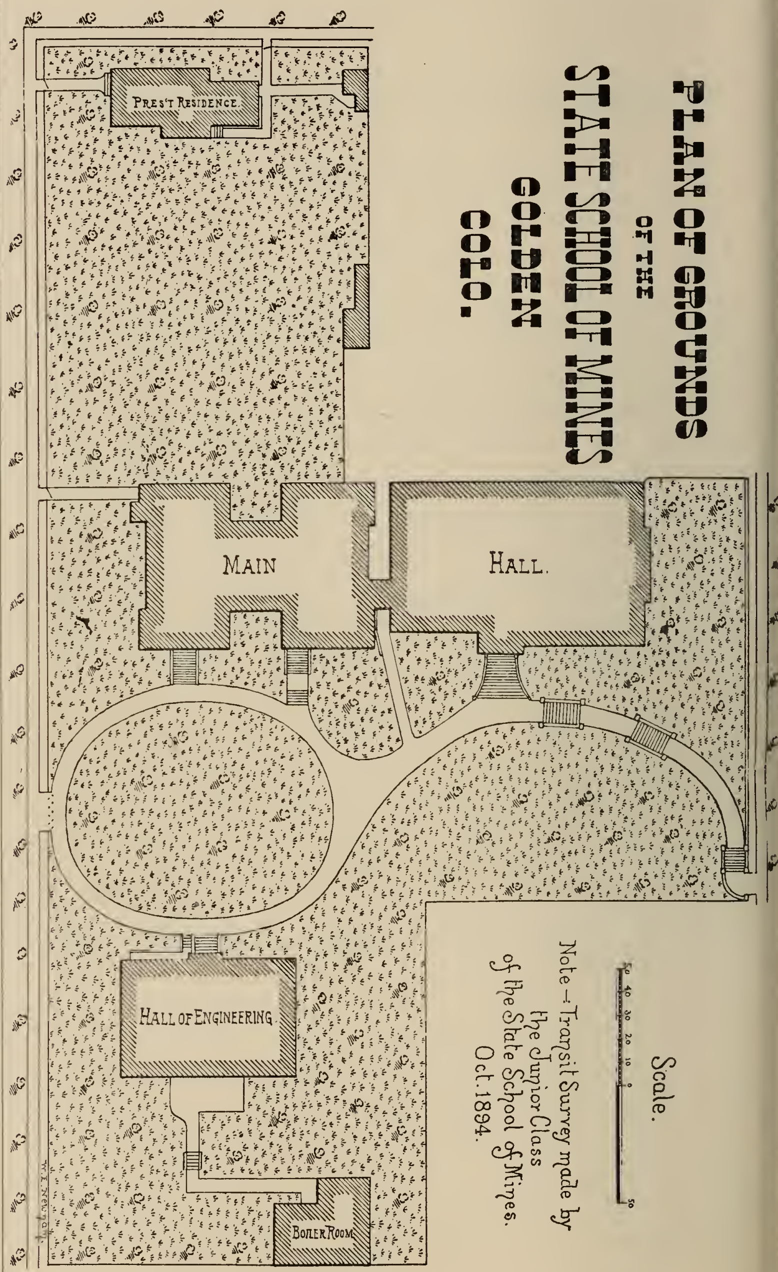
Dynamo Electric Machinery, (Lectures) --- 3 hours a week.
Dynamo Electric Machinery, (Laboratory) - 3 hours a week.
Thermo-Dynamics ---------------------- 2 hours a week.
Electric Power Transmission ----------- 2 hours a week.
Hydraulics --------------------------- 2 hours a week.
Photometry, (Lectures) ---------------- 1 hour a week.
Photometry, (Laboratory) -------------- 3 hours a week.
Shop Work --------------------------- 6 hours a week.
Testing of Engines and Dynamos, (Lectures) 1 hour a week.
Testing of Engines and Dynamos, (Laboratory) ----------------------------- 6 hours a week.

SECOND TERM.

Hydraulics --------------------------- 2 hours a week.
Dynamo Electric Machinery, (Lectures) --- 3 hours a week.
Dynamo Electric Machinery, (Laboratory) - 6 hours a week.
Prime Movers and Steam Engines -------- 2 hours a week.
Shop Work --------------------------- 6 hours a week.
Distribution of Electricity for Lighting --- 2 hours a week.
Electro Metallurgy -------------------- 2 hours a week.
Strength of Materials ----------------- 3 hours a week.

THIRD TERM.

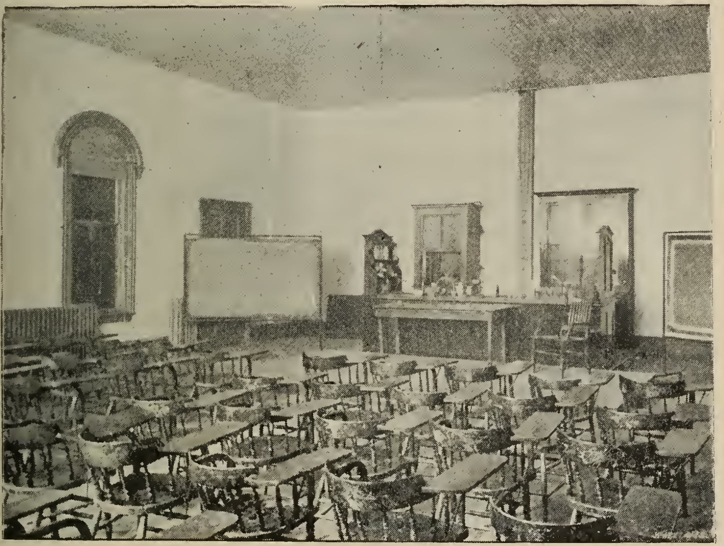
Transformers, (Lectures and Laboratory Work) ------------------------- 4 hours a week.
Electric Machinery -------------------- 3 hours a week.
Designing ---------------------------- 3 hours a week.
Thesis Work ------------------------- 15 hours a week.


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

DEPARTMENTS OF INSTRUCTION.

CHEMISTRY.

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



CHEMICAL LECTURE ROOM.

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

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

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

The work is supplemented by lectures, in which the student is taught the theory of chemical equations, and details of manipulation. The laboratory is open every afternoon in the week except Saturday.

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

Fire Assaying is a part of this course, coming usually in its last term. Those students who have made more than the usual progress in the schedule work, are put upon special cases, such as the examination of drinking water for sanitary investigations, analysis of pig iron and steel, and other work demanding delicate manipulation.

Accurate methods are taught in Quantitative Analysis, but a due time is given to instruction in the rapid volumetric methods, which find so much favor in Western metallurgical works, for ore and matte valuation.

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. Not less than fifty assays for copper, and several hundred for silver and gold, with very numerous cases for other metals, are required of every student. The best proof of the success of the institution in this direction is the fact that no term passes without application being made to it for assayers or chemists.

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

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

There are three 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, private laboratory 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 third 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 through the remainder of the school course, the work being arranged as follows:

JUNIOR YEAR.

The general principles of Metallurgy, including the properties and thermal treatment of metals, the metallurgy of alloys, bronzes, brasses, etc., fuels, fluxes and the calculation of furnace charges, the general study and classification of furnaces and metallurgical processes.

Text-book, "Introduction to Metallurgy." W. C. R. Austen.

Solid, Liquid and Gaseous Fuels—Their manufacture and use, principles and methods of combustion. The principles of furnace design and construction, draft, (natural and artificial), chimneys, blast machinery, hot-blast stoves, etc. Refractory materials, acid neutral and basic, fire-clays, crucibles.

Electro Metallurgy—The separation and refining of metals by electricity.

Ore Dressing and Concentration—The principles of concentration machinery and appliances. The selection and arrangement of machinery and the designing of concentrating mills.

Text-book, "The Art of Ore Dressing in Europe." W. B. Kunhardt.

The Metallurgy of Iron and Steel—Direct methods, blast-furnace practice, the manufacture of wrought iron, manufacture of steel by Bessemer, open hearth and other processes.

The Metallurgy of Antimony, Bismuth, Mercury, Nickel, Arsenic and Platinum.

Metallurgy of Tin, Zinc and Aluminum.

Copper Smelting and Refining, with the treatment of gold and silver ores by matte smelting.

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

SENIOR YEAR.

Lead Smelting and Refining as applied to the treatment of gold and silver ores.

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

Metallurgy of Silver — Free milling, chloridizing, roasting and amalgamation, the treatment of silver ore by wet processes.

Text-book, "Metallurgy of Silver." M. Eissler.

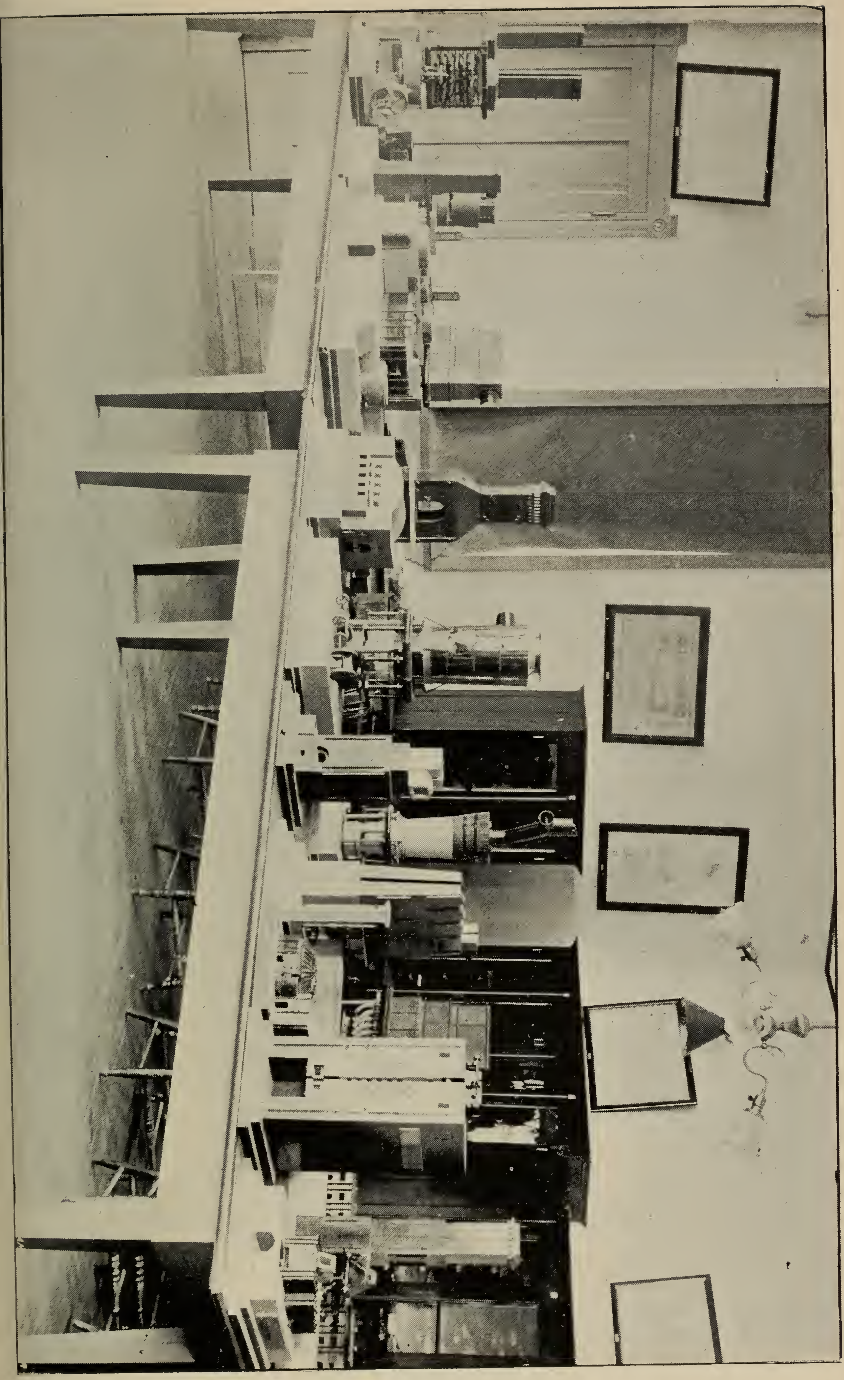
Metallurgy of Gold—Free milling, combination processes, the treatment of gold ores by wet processes, chlorination, and the cyanide process.

Text-book, Rose's "Metallurgy of Gold."

Ore Sampling and Ore Buying—The selection of metallurgical processes, designing of metallurgical plants, practical problems.

Graduating Theses—The student is required to select the best method of treating the ore from some mine or district, and to make working drawings and specifications for the construction of a plant.

The course of Metallurgy as outlined above is taught by class-room lectures, aided by the study of the best works on the principal subjects, these works being used as text-books by the student. 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 and in Utah.

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

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

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

Zinc pots as used in same.

Sweating furnace as used in same.

Lead pots as used in same.

Concentration cupel for making silver bullion.

Refining cupel for making fine silver.

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

Silesian zinc furnace, as used in parts of Europe.

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

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

Gerstenhofer roasting furnace for fine copper and iron sulphides.

Tin blast furnace, as used in Saxony.

Bismuth smelting furnace, as used in Germany.

Large mercury furnace, as used in Almaden, Spain.

Fume furnace for making lead and zinc paints.

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

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

2. Working model of ore rolls, same scale.

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

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

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

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

Coal mining, coke and charcoal manufacture.

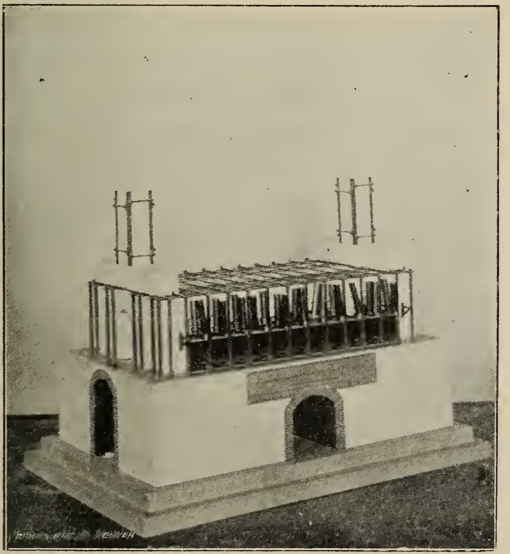
Brick and tile works.

Iron blast furnaces, and Bessemer steel works.

Gold, silver and lead mining, gold placer mining, smelting processes of all kinds. Gold milling, 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, after leaving school, 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, and when actively engaged in this special work they will use the scientific methods of study, and acquire the practical experience to make them specialists in such work.

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



MINING.

The students are taught the best methods of Mining as they have been developed in various parts of the world. Lectures on this subject are given during the entire Junior year, and include the following subjects:

Explosives and blasting. Hand and machine drilling.

Drills, Channellers, Quarry machinery, Coal cutters.

Air Compression, and the use of compressed air. Diamond Drill work. Deep boring by American drop-drill.

Methods of shaft sinking. Methods of driving tunnels, drifts, etc.

Hoisting machinery and hoisting methods. Surface works. Underground haulage and machinery. Surface transportation of ore and materials. Elevated and surface tramways, etc. Mine drainage and pumping machinery.

Ventilation and lighting of mines.

Mine timbering. General methods of extracting and developing ore bodies.

Special Departments of mining work. Open air quarrying, Coal mining, Metal mining, Hydraulic gold mining. Details of special and typical mines.

The Costs of Mining.

Mining Laws of the United States.

Prospecting, Sampling mines. Expert examination of mines.

Text-book, "Coal Mining." H. W. Hughes.

MATHEMATICS.

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

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

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

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

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

Solution of the most general system of Algebraic Equations.

Introduction to Weirstrass' Theory of Analytic Functions.

Method of Least Squares.

Elliptic Functions.

Integration on Riemann's Surfaces.

Analytical Mechanics.

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

DEPARTMENT OF GEOLOGY AND MINERALOGY.

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

GEOLOGICAL LECTURE ROOM.

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

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

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

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

To the collections originally obtained by purchase from Ward & Howell of Rochester, New York, from J. Alden Smith, (formerly State Geologist,) and 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. The largest single addition, however, has been made during the past summer, amounting to a total of from three to four thousand specimens, obtained by purchase, collection and exchange.

The collections in this department have been removed from the original location on the second floor, to the first floor, and now occupy the space formerly given over to the Department of Physics. The department occupies at present three rooms.

First, museum; second, the lecture and working room; third, a room devoted to display of Colorado fossils.

In connection with this change of location, the collections have undergone a very thorough reorganization and rearrangement, necessitated by the large additions constantly being made. The various collections have been classified as follows:

First—A 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 one hundred and ninety species and sixty-one additional varieties. These specimens come from many countries, but Colorado minerals are specially well represented. The mineral species and varieties contained in this collection are given in a tabulated list to be found on pages 55–62.

Second—A Display Collection, mainly of large and fine specimens, to be found in the glass cases in the museum.

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, consisting of several thousand unlabeled specimens, similar to those in the Type Collection, to be used by the student for study and determination.

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

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

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

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

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

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

Twelfth—Duplicates of rocks, minerals and fossils, to be used for exchange with other institutions. See pages 63 and 64.

Thirteenth—A Collection of Rocks (the private property of Professor Patton), used in connection with the course in Lithology.

MUSEUM.

In this room is to be found the display collection arranged mainly in flat-top glass cases, of which there are twenty-one. As this room offers the greatest attraction for most visitors, a brief enumeration of their contents is here given. As the minerals in these cases are arranged purely for purposes of display, no thorough classification has been attempted. In some cases they have been arranged by localities and in others by mineral associations. In the list given below the cases are numbered consecutively, running around the walls from left to right, the cases in the center being given last.

Case 1—Light colored microcline, Florissant, Colorado.

Case 2—Green microcline or amazon stone, Florissant, Colorado.

Case 3—Smoky quartz, Florissant, Colorado.

Case 4—Varieties of crystallized quartz and chalcedony from various localities.

Case 5—Crystallized calcite and aragonite.

Case 6—Cerussite, rhodochrosite, smithsonite and wood opal.

Case 7—Miscellaneous silicates, especially garnets from Salida, Colorado, and from Alaska; beryl from Bear Creek, Colorado; also calamine, tourmaline, etc.

Case 8—Choice specimens of crystallized galenite, sphalerite from Colorado localities, also other sulphides.

Case 9—A very beautiful display of sulphur and celestite from Sicily; also of pink tourmaline in lepidolite from San Diego County, California.

Case 10—Fossil leaves from Florissant, Colorado.

Case 11—A fine display of opal and chalcedony from Ute Creek, Hinsdale County, Colorado.

Case 12—Azurite and malachite from Arizona (one very large and fine specimen of azurite); also selenite from Utah, Sicily and France; also conichalcite and brochantite.

Case 13—Miscellaneous minerals belonging to the private collection of Professor Patton.

Case 14—Apophyllite, chabazite and analcite from Table Mountain, Golden, Colorado.

Case 15—Thomsonite, mesolite, calcite, bole, etc., from Table Mountain, Golden, Colorado.

Case 16—A fine display of delicate, fibrous natrolite, from South Table Mountain, Golden, Colorado.

Case 17—Miscellaneous minerals, especially crystallized copper, fluorite, pyrite, etc.

Case 18—Casts of celebrated gold and platinum nuggets, dendrites, landscape marble, pyrophyllite, wavelite, pyroxine and chrysotile.

CASES IN CENTER OF ROOM.

Case 19—An open display of geodes, graphic granite, calcareous tufa, quartz, opal, chalcedony, contorted schists and veins, ripple marks, etc.

Case 18—Large glass case. First, cut gems; second, rough gems; third, native gold; fourth, native silver;

fifth, rare minerals, especially rich silver-bearing minerals e. g. proustite, stromeyerite, polybasite, freiberite, coselite, beegerite, chalcotrichite.

Case 21—Large glass case. First, crystallized sphalerite; second, a unique display of pyrite crystals from Gilpin County, Colorado; third, chalcopyrite, galenite, marcasite, boleite, azurite, goethite, johannite, chalcostibite, variscite; fourth, crystallized fluorite, amethyst, etc.; fifth, agate, Iceland spar, aragonite, also orthoclase crystals from Colorado.

Case 22—Large glass case. First, black and white mica; second, epidote, huebnerite, adamite, serpierite, barite, wulfenite, chalcanthite, fibroferrite, halotrichite, sulfoborite, kylindrite, caledonite; third, sixty-six specimens forming a rare display of tellurides of gold, silver, lead, etc., and of native tellurium, embracing tellurium, lionite, selen-tellurium, tetradymite, joseite, chilinite, auriferous hessite, petzite, hessite, altaite, coloradoite, sylvanite, calaverite, nagyagite, schirmerite, tellurite, roscoelite, auriferous selenide, tellur-pyrites, etc.; fourth, alaskaite, clay concretions, priceite, strontianite, brucite, hydrodolomite, ruby silver, etc.

On the tops of the cases of drawers in the lecture room are numerous large specimens of minerals, rocks and fossils among which are specially to be emphasized some large fossil palm stumps and palm leaves collected in the vicinity of Golden.

COURSE IN GEOLOGY.

This course extends throughout the Senior year, embracing three hours each week in addition to numerous excursions into the surrounding country. In this course special attention is paid to Lithological, Dynamical and Structural Geology, a large part of one term being devoted specially to the study and classification of rocks. The Lithological Geology is taught entirely by the aid of lectures and practical determinative work on the part of students.

The Rock Type Collection, Rock Working Collection, and the other collections named on pages 48 and 49, 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 remaining branches are taught by aid of a textbook (Le Conte's Elements of Geology) supplemented by lectures and excursions.

COURSE IN MINERALOGY.

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

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

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

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

Crystallography and Blow-Piping are taught by means of lectures and practical laboratory work. In Determinative Mineralogy, lectures are made to supplement the text-book used (Dana's Manual of Mineralogy and Lithology).

EXCHANGE MATERIAL.

The school has now on hand a considerable quantity of exchange material in the line of minerals, rocks and fossils, an itemized list of which will be found on pages 63 and 64. Any one wishing to arrange for a mutual exchange should communicate with Professor Horace B. Patton, Golden, Colorado, sending, if possible, a list of minerals, etc., offered in exchange.

SUMMARY OF COLLECTIONS WITH NUMBER OF SPECIMENS IN EACH.

Type Collection of Minerals	2,700
Working Collection of Minerals	11,400
Display Collection of Minerals	1,080
Supplementary Collection of Minerals	870
Crystal Collection	860
Display Collection of Fossils	260
Miscellaneous Collection of Fossils	920
Type Collection of Rocks	1,590
Working Collection of Rocks	2,400
Total Number of Specimens	22,080
Professor Patton's Collection of Rocks	1,500

In addition to the above enumerated collections, the school has a very large number of still unclassified ore specimens packed away in boxes, for which at present there is no room in the space allotted to the department.

MINERALS IN THE TYPE COLLECTION.

NOTE.—The minerals in this collection are arranged in accordance with the system adopted in the latest edition of Dana's System of Mineralogy. Each specimen has a double number; the first (the one given before the name of the mineral in this list) is Dana's species number, the second is the individual number of the specimen. Of the two numbers following the mineral name, and enclosed in brackets in this list, the first refers to the page in Dana's Manual of Mineralogy and Lithology, the second to the drawer of the Type Collection in which the species is to be found.

I. NATIVE ELEMENTS.

1. Diamond ------------------(115. Dr. 73.)
2. Graphite ------------------(119. Dr. 73-74.)
3. Sulphur ------------------(106. Dr. 74-75.)
7. Tellurium ----------------(108. Dr. 75.)
8. Arsenic -------------------(110. Dr. 75.)
9. Allemontite ---------------(113. Dr. 75.)
10. Antimony ----------------(112. Dr. 75.)
11. Bismuth ------------------(113. Dr. 75.)
13. Gold ----------------------(122. Dr. 76.)
14. Silver ---------------------(129. Dr. 76-77.)
15. Copper -------------------(145. Dr. 77-78.)
16. Mercury ------------------(142. Dr. 79.)
20. Platinum -----------------(139. Dr. 79.)

II. SULPHIDES, SELENIDES, TELLURIDES, ARSENIDES, ANTIMONIDES.

26. Realgar -------------------(111. Dr. 79.)
27. Orpiment -----------------(111.. Dr. 79.)
28. Stibnite ------------------(112. Dr. 79.)
34. Molybdenite --------------(108. Dr. 80.)

GALENITE GROUP. ISOMETRIC, HOLOHEDRAL.

42. Argentite ---------- (131. Dr. 80.)
45. Galenite ---------- (160. Dr. 80-82.)
46. Altaite ---------- (164. Dr. 82.)

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54. Chalcocite ---------- (146. Dr. 82.)
58. Sphalerite ---------- (170. Dr. 83-85.)
63. Alabandite ---------- (Dr. 85.)

CINNABAR-MILLERITE GROUP. HEXAGONAL AND RHOMBOHED.

66. Cinnabar ---------- (143. Dr. 85.)
70. Millerite ---------- (181. Dr. 86.)
71. Niccolite ---------- (182. Dr. 86.)
74. Pyrrhotite ---------- (192. Dr. 86.)

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78. Bornite ---------- (148. Dr. 86.)
83. Chalcopyrite ---------- (147. Dr. 87.)
84. Stannite ---------- (176. Dr. 88.)

PYRITE GROUP. ISOMETRIC, PARALLEL HEM.

85. Pyrite ---------- (189. Dr. 88-89.)
87. Smaltite ---------- (181. Dr. 89.)
89. Cobaltite ---------- (182. Dr. 89.)

MARCASITE GROUP. ORTHORHOMBIC.

96. Marcasite ---------- (191. Dr. 90.)
97. Lollingite ---------- (193. Dr. 91.)
98. Arsenopyrite ---------- (192. Dr. 91.)

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104. Sylvanite ---------- (132. Dr. 91.)

III. SULPHO-SALTS.

130. Jamesonite ---------- (164. Dr. 91.)
136. Bournonite ---------- (149. Dr. 92.)
144. Pyrargyrite ---------- (132. Dr. 92.)
145. Proustite ---------- (133. Dr. 92.)
148. Tetrahedrite ---------- (150. Dr. 92-93.)
149. Tennantite ---------- (149. Dr. 93.)
153. Stephanite ---------- (133. Dr. 93.)
158. Enargite ---------- (149. Dr. 93.)

IV. HALOIDS.

166. Halite ------------------(243. Dr. 97.)
169. Cerargyrite ---------------(134. Dr. 97.)
170. Embolite ----------------(134. Dr. 98.)
175. Flourite -----------------(227. Dr. 98-100.)
183. Cryolite -----------------(216. Dr. 100.)
193. Atacamite ---------------(150. Dr. 100.)
201. Carnallite ----------------(224. Dr. 100.)

V. OXIDES.

210. Quartz ------------------(253. Dr. 101-109.)

A. Phenocrystalline or Vitreous Varieties—Rock Crystal, Amethyst, Rose, Smoky Blue, Opalescent, Milky, Ferruginous, with enclosures.

B. Cryptocrystalline Varieties—Chalcedony, Carnelian, Chrysoprase, Heliotrope, Prase, Agate, Geyserite, Flint, Hornstone, Jasper.

C. Special Varieties—Tabular Quartz, Pseudomorphous, Silicified Wood, Agatized Wood, Quartzite, Itacolumite.

212. Opal --------------------(259. Dr. 109-112.)

Varieties—Precious, Common, Jasp-Opal, Wood-Opal, Hyalite, Tripoli, Diatomaceous Earth, Infusorial Earth.

224. Cuprite ------------------(151. Dr. 113.)
228. Zincite ------------------(171. Dr. 113.)
231. Corundum ----------------(211. Dr. 113-114.)
232. Hematite -----------------(193. Dr. 114-117.)
Also Var. Martite.
233. Ilmenite -----------------(195. Dr. 117.)

SPINEL GROUP. ISOMETRIC, MAINLY OCTAHEDRAL.

234. Spinel -------------------(213. Dr. 117-118.)
236. Gahnite ------------------(214. Dr. 118.)
237. Magnetite ----------------(196. Dr. 118-119.)
239. Franklinite ---------------(197. Dr. 120.)
241. Chromite -----------------(197. Dr. 121.)
243. Hausmannite --------------(207. Dr. 121.)

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248. Cassiterite ---------------(176. Dr. 121-122.)
250. Rutile -------------------(179. Dr. 122.)
254. Pyrolusite ----------------(206. Dr. 122.)

Hydrous Oxides.

257.	Goethite	(199.	Dr. 123.)
258.	Manganite	(207.	Dr. 123.)
259.	Limonite	(198.	Dr. 123-125.)
261.	Bauxite	(213.	Dr. 125.)
262.	Brucite	(223.	Dr. 125.)
269.	Psilomelane	(207.	Dr. 126.)
	Variety Wad	(208.	Dr. 126.)

CARBONATES.

CALCITE GROUP. RHOMBOHEDRAL.

270.	Calcite	(234.	Dr. 129-136.)

Varieties—Marble, Dr. 51, Chalk, Dr. 51, Stalactitic and Stalagmitic, Dr. 52-54, Tufaceous, Dr. 54.

271.	Dolomite	(238.	Dr. 137.)
271A.	Ankerite	(239.	Dr. 137.)
272.	Magnesite	(226.	Dr. 137.)
273.	Siderite	(203.	Dr. 138.)
274.	Rhodochrosite	(201.	Dr. 138-139.)
275.	Smithsonite	(172.	Dr. 139.)

ARAGONITE GROUP. ORTHORHOMBIC.

277.	Aragonite	(237.	Dr. 140-141.)
279.	Witherite	(241.	Dr. 141.)
280.	Strontianite	(242.	Dr. 141.)
281.	Cerussite	(168.	Dr. 142-143.)

288.	Malachite	(154.	Dr. 143.)
289.	Azurite	(156.	Dr. 144.)
296.	Natron	(249.	Dr. 144.)
303.	Zaratite	(185.	Dr. 144.)

SILICATES.

A. Anhydrous Silicates.

FELDSPAR GROUP.

313.	Orthoclase	(300.	Dr. 147.)

Varieties—Adularia and Common Orthoclase.

313A.	Perthite	(—.	Dr. 148.)
315.	Microcline	(300.	Dr. 48-149.)
316.	Albite	(296-299. For all four species of plagioclase.)	Dr. 149-151.)
317.	Oligoclase		
319.	Labradorite		
320.	Anorthite		
321.	Leucite	(295.	Dr. 151.)

PYROXENE GROUP.

323. Enstatite .... (264. Dr. 151.)
324. Hypersthene .... (264. Dr. 151.)
325. Pyroxene .... (265. Dr. 152-153.)
    VARIETIES—Diopside, Hedenbergit, Augite.
326. Acmite .... (268. Dr. 154.)
327. Spodumene .... (269. Dr. 154.)
329. Wollastonite .... (265. Dr. 154.)
330. Pectolite .... (315. Dr. 155.)
335. Rhodonite .... (268. Dr. 155.)

AMPHIBOLE GROUP.

338. Amphibole .... (270. Dr. 156-159.)
    VARIETIES—Tremolite, Actinolite, Nephrite, Asbestos, Mountain Cork, etc., Edenite, Pargasite, Hornblende.
341. Crocidolite .... (273. Dr. 159.)

VARIOUS GROUPS.

344. Beryl .... (274. Dr. 160.)
353. Iolite .... (287. Dr. 160.)
357. Nephelite .... (293. Dr. 160.)
362. Sodalite .... (294. Dr. 161.)
370. Garnet .... (278. Dr. 161-163.)
    VARIETIES—A. Grossularite; B. Pyrope; C. Almandite; E. Andradite; F. Uvarovite.
376. Chrysolite or Olivine .... (277. Dr. 164.)
381. Willemite .... (173. Dr. 164.)
383. Dioptase .... (156. Dr. 164.)
386. Meionite .... (293. Dr. 164.)
387. Wernerite .... (292. Dr. 165.)
391. Melilite .... (283. Dr. 165.)
393. Vesuvianite .... (282. Dr. 165.)
394. Zircon .... (281. Dr. 166.)
397. Topaz .... (309. Dr. 166.)
398. Andalusite .... (306. Dr. 167.)
399. Sillimanite .... (307. Dr. 167.)
400. Cyanite .... (308. Dr. 167-168.)
401. Datolite .... (311. Dr. 168.)
406. Zoisite .... (285. Dr. 169.)
407. Epidote .... (283. Dr. 169-170.)
408. Piedmontite .... (284. Dr. 170.)
409. Allanite .... (284. Dr. 170.)
410. Axinite .... (286. Dr. 170.)
411. Prehnite .... (317. Dr. 170.)

415. Chondrodite .... (303. Dr. 171.)
423. Calamine .... (174. Dr. 171-172.)
426. Tourmaline .... (304. Dr. 172-174.)
428. Staurolite .... (313. Dr. 174.)

B. Hydrous Silicates.

ZEOLITE DIVISION.

435. Apophyllite .... (316. Dr. 177.)
438. Heulandite .... (325. Dr. 177-178.)
441. Phillipsite .... (324. Dr. 178.)
442. Harmotome .... (323. Dr. 178.)
443. Stilbite .... (324. Dr. 178-179.)
447. Chabazite .... (322. Dr. 179-180.)
450. Analcite .... (322. Dr. 180.)
453. Natrolite .... (321. Dr. 180-181.)
455. Mesolite .... (321. Dr. 181.)
456. Thomsonite .... (320. Dr. 181.)

MICA GROUP.

458. Muscovite .... (288. Dr. 181-184.)
460. Lepidolite .... (289. Dr. 184.)
462. Biotite .... (291. Dr. 184-185.)
462A. Phlogopite .... (290. Dr. 186.)

CLINTONITE (BRITTLE MICA) GROUP.

464. Margarite .... (341. Dr. 186.)
466. Chloritoid .... (341. Dr. 186.)
467. Phyllite .... (341. Dr. 186.)
467. Ottrelite .... (341. Dr. 187.)

CHLORITE GROUP.

468. Clinochlore .... (339. Dr. 187.)
Variety—Ripidolite.
468. Ripidolite .... (340. Dr. 187.)
468A. Penninite .... (339. Dr. 187.)
469. Prochlorite .... (340. Dr. 187.)
480. Jefferisite .... (339. Dr. 188.)

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481. Serpentine .... (329. Dr. 188-189.)
Varieties—Common, Williamsite, Chrysolite, Picrolite.
483. Genthite .... (185. Dr. 189.)
483A. Garnierite .... (185. Dr. 189.)
484. Talc .... (326. Dr. 190.)
485. Sepiolite .... (328. Dr. 190.)

DIVISIONS IV. AND V.

492. Kaolinite ----------------(332. Dr. 190.)
497. Pyrophyllite --------------(328. Dr. 191.)
504. Chrysocolla ---------------(157. Dr. 191.)

TITANO-SILICATES, TITANATES.

510. Titanite -----------------(312. Dr. 191-192.)
514. Astrophyllite -------------(292. Dr. 192.)
519. Dysanalite ----------------(234. Dr. 192.)

NIOBATES, TANTALATES.

525. Columbite ----------------(201. Dr. 195.)
529. Samarskite ---------------(221. Dr. 195.)
537. Monazite -----------------(222. Dr. 195.)

PHOSPHATES, ARSENATES, VAVADATES, ANTIMONATES.

APATITE GROUP.

549. Apatite ------------------(233. Dr. 196.)
550. Pyromorphite --------------(167. Dr. 197.)
551. Mimetite -----------------(167. Dr. 197.)
552. Vanadinite ----------------(168. Dr. 197.)

BELONGING TO VARIOUS GROUPS.

573. Dufrenite -----------------(203. Dr. 197.)
574. Lazulite ------------------(218. Dr. 197.)
597. Vivianite -----------------(202. Dr. 198.)
601. Erythrite -----------------(184. Dr. 198.)
639. Wavellite -----------------(220. Dr. 198-199.)
642. Turquois ------------------(219. Dr. 199.)

BORATES.

698. Boracite -----------------(225. Dr. 199.)
704. Colemanite ---------------(231. Dr. 199.)
707. Borax --------------------(246. Dr. 199.)
708. Ulexite ------------------(231. Dr. 200.)

SULPHATES, CHROMATES, ETC.

716. Thenardite ----------------(246. Dr. 200.)

BARITE GROUP.

719. Barite ____________________(240. Dr. 200-201.)
720. Celestite __________________(242. Dr. 202.)
721. Anglesite _________________(165. Dr. 202-203.)
722. Anhydrite ________________(230. Dr. 203.)

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725. Crocoite __________________(166. Dr. 203.)
733. Hanksite _________________(249. Dr. 203.)

HYDROUS SULPHATES.

746. Gypsum __________________(229. Dr. 204-205.)
800. Alunite ___________________(217. Dr. 206.)

TUNGSTATES, MOLYBDATES.

812. Wolframite _______________(200. Dr. 206.)
818. Wulfenite ________________(166. Dr. 206.)

VIII. HYDROCARBON COMPOUNDS.

P. 998. Ozocerite ______________(347. Dr. 207.)
P. 1002. Succinite ______________(348. Dr. 207.)
P. 1007. Copalite _______________(349. Dr. 207.)
P. 1015. Petroleum _____________(344. Dr. 207.)
P. 1017. Asphaltum ____________(349. Dr. 207.)
P. 1018. Elaterite ______________(347. Dr. 207.)
P. 1020. Albertite ______________(349. Dr. 207.)
P. 1020. Gilsonite ______________(——. Dr. 208.)
P. 1021. Anthracite _____________(350. Dr. 208.)
P. 1021. Bituminous Coal _______(351. Dr. 208-209.)
P. 1022. Cannel Coal ___________(——. Dr. 208.)
P. 1022. Lignite ________________(351. Dr. 208.)
P. 1022. Jet ___________________(352. Dr. 209.)

MINERALS OFFERED FOR EXCHANGE.

Willimite crystals, Franklin Furnace, New Jersey.

Copper in calcite, Keweenaw Point, Lake Superior.

Copper in Calumet and Hecla conglomerate, same place.

Copper crystallized, same place.

Garnets partly altered to chlorite, Michigamme, Michigan.

Garnets like the above enclosed in chlorite schist, same place.

Rubellite in lepidolite, San Bernardino County, California.

Rhodochrosite with good color, Vallecita Basin, San Juan Mountains, Colorado.

Enargite, massive and crystallized, National Belle Mine, Red Mountain, San Juan Mountains, Colorado.

Graphic granite in large pieces and in quantity, Clear Creek, Colorado.

Natrolite, Golden, Colorado.

Chabazite, Golden, Colorado.

Thomsonite, Golden, Colorado.

Calcite, crystallized, Rockland, Maine.

Hanksite crystals, Borax Lake, San Bernardino County, California.

Orthoclase crystals, Kokomo, Colorado.

Botryoidal chalcedony, Ute Creek, Hinsdale County, Colorado.

Green chalcedony, Ute Creek, Hinsdale County, Colorado.

Milk opal, Ute Creek, Hinsdale County, Colorado.

Pyrolusite, Virginia, Minnesota.

Malachite and azurite, Bisbee, Arizona.

Sylvanite and other tellurides, Boulder County, Colorado.

Prehnite, near Duluth, Minnesota.

Chert, Balfour, Colorado.

Microcline crystals, Florissant, Colorado.

Laumontite, near Duluth, Minnesota.

Smoky quartz, Florissant, Colorado.

Silicified wood, Golden, Colorado.

Crystals of native tellurium (about one-fourth inch), Boulder County, Colorado.

Muscovite, figured with enclosed iron oxides, very fine, Saratoga, Wyoming.

ROCKS AND FOSSILS.

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

Flint conglomerate, Green Mountain, Jefferson County, Colorado.

Potsdam sandstone showing ripple marks, Portage Entry, Houghton County, Michigan.

Gabbro, Duluth, Minnesota.

Melaphyre, Houghton, Michigan.

Basalt, Table Mountain, Golden, Colorado.

Fossil leaves from the tertiary and jurassic, Golden, Colorado.

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

Three hours per week for three terms are given to work in the laboratory. During the first part of the course the student acquires facility in the use of the instruments and accuracy in measurement, which fit him for the other work in the laboratory.

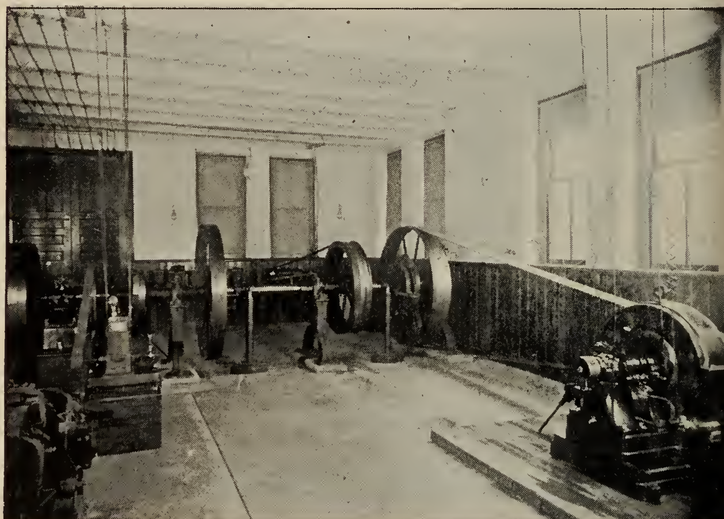
The object of the laboratory work is not original research, but the acquirement of a certain familiarity with the subject which this work alone can give. The experiments are quantitative and are selected with the view of illustrating the fundamental principles of the subject rather than of devoting the student's whole time to elaborate determinations of a few constants. No advanced course in physics is required, a good foundation knowledge of the subject being all that is aimed at.

The text-books used in the laboratory are Glazebrook and Shaw's Practical Physics, Stewart and Gee's Practical Physics, Pickering's Physical Manipulations, Ayrton's Practical Electricity, besides a list of references to more extensive works.

The laboratory is supplied with numerous duplicates of the various pieces of apparatus required.

ELECTRICAL ENGINEERING.

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



DYNAMO ROOM.

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

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

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

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

Besides the space occupied by the general lecture room and the Physical Laboratory, a large room is fitted up on the second floor for work in Photometry. The various experimental machines are belted to pulleys on a jack shaft, driven by the engine in the dynamo room. The instruments for use in testing are in a smaller room adjoining, where the marble switchboard and the large resistance coils are also placed. Separate wires run to each room from both the alternate and continuous current circuits and also from the sixty-cell accumulator presented by the Carpenter Electric Storage 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 the currents, 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. Cradle and absorbtion dynamometers and Watt meters enable efficiency tests to be conveniently made. Kelvin balances, electrostatic volt meters, ammeters and volt meters of various makes, form part of the equipment.

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

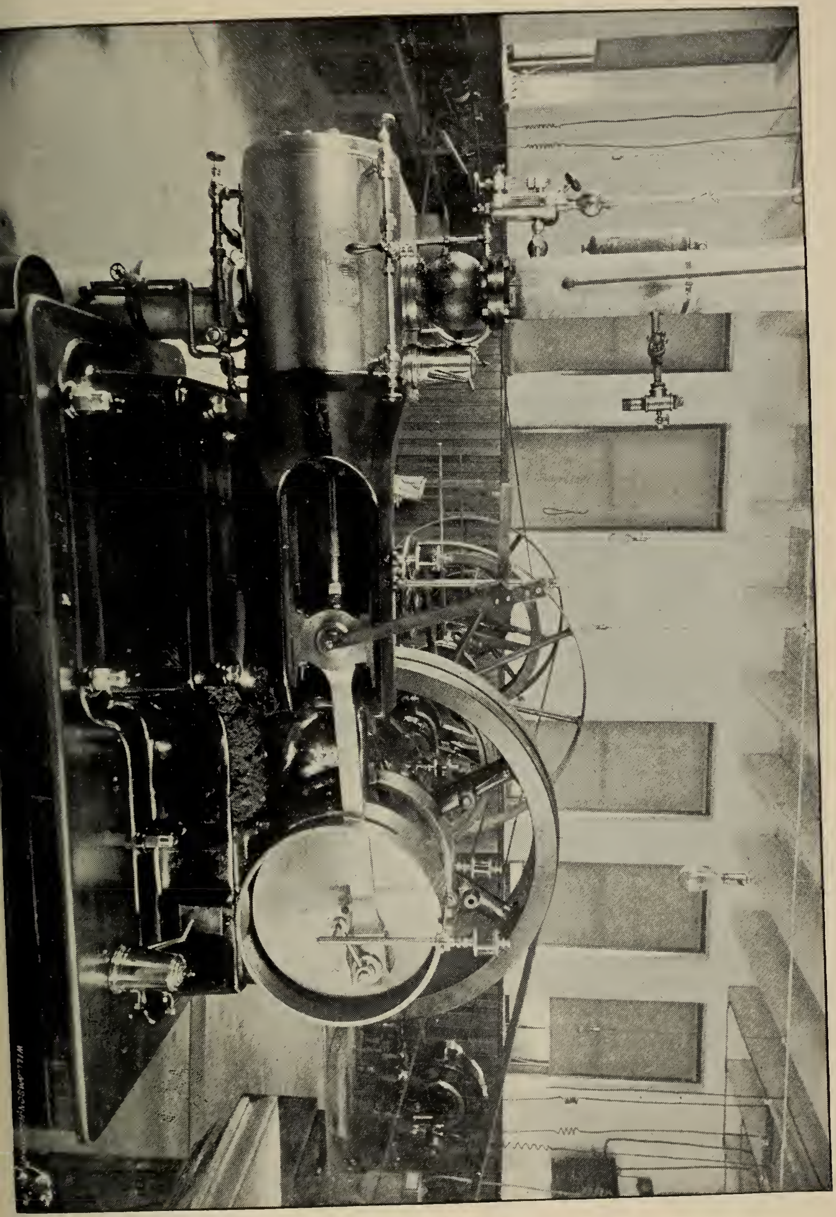
To Mr. Paul Webster, a former student of the institution, the department is indebted for a small steam engine.

Additions are being constantly made and during the past school year have been the largest in the history of the school.

APPLIED MECHANICS.

Beginning with the third year the study of Applied Mechanics is pursued in its various branches of Statics, Kinematics and Dynamics, with the purpose of giving the student a broad comprehension of the relation of forces acting upon matter at rest or in motion. Investigations concerning these are carried on by analytical and graphic methods, and the laws governing balanced forces, forces in motion, frictional forces and kindred subjects are investigated.

In the latter part of the third year the study of Mechanism and Machine Dynamics is introduced. A careful analysis of the various motions with a graphic study of resistance in machines, prepares the student for the critical examination of practical working machines.



A study of the strength of materials is pursued during the entire fourth year, comprising a careful study of the effects of stresses and strains and the proper limits of safety in their use. In connection with this each student is required to make a series of definite tests of wrought iron, steel, cast iron and wood in tension, compression and bending.

A Riehlé testing machine of one hundred thousand pounds capacity, cross breaking machine, cement testing appliances with various lathes and bench tools for preparing specimens, afford opportunities for independent research, as well as for class drill and illustration.

During a part of the fourth year the study of Prime Movers, particularly steam engines and boilers, occupies the students' attention. In this connection the combustion of fuel, with designing of stacks and furnaces, is treated. A course of Thermodynamics is also pursued in the fourth year.

Designing of machinery for special purposes will be pursued under direction of the instructor, particular attention being given to the study of gearing, transmission of power by belt and wire cable, boxes, shafting, fly-wheels and governors.

To more fully acquaint the student with the most approved forms of mining, reducing and smelting machinery in use, visits will be made to large manufactories of machinery at shops or warehouses, neighboring mines and smelting plants.

CIVIL ENGINEERING.

The course of study in Civil Engineering has been planned to meet the professional needs of the mining engineer as well as those of the civil engineer. Thus, while the students in both courses take all the work in surveying, applied mechanics, graphics and structural designing, students who are candidates for the degree of Civil Engineer have special lines of work laid out for them from the beginning of the winter term of the Sophomore year. They drop their chemical work at that time. The facilities for instruction, illustration, experimental work and research are thought to equal those of any institution west of the Mississippi. The full course of study begins in the Junior year with the study of applied mechanics, surveying, theory and practice of framed structures, and designing masonry structures. Two afternoons per week during the first term are devoted to making the complete detail measurements and drawings of some railway or highway bridge in order to familiarize the student with structural forms and details. Other afternoons are taken up in the drafting room with such subjects as tinting and shading, pen topography, colored topography, etc.

In connection with designing of masonry structures, the subjects of foundations of all kinds, cements, building stones, etc., are investigated and each student makes designs of stone arches, chimneys and retaining walls.

A large part of the fourth year is devoted to designing and investigation of framed structures, such as roofs, railway and highway bridges and long arch bridges of steel. A complete study is also made of the various systems of sewage disposal, water supply and sanitary improvements of cities and towns. The candidate for the degree of Civil Engineer is expected to show special aptitude in mathematics, and pursues a course of study in higher engineering problems.

Theory and practice are combined wherever possible, and the student placed on his own responsibility, so that our graduates, aided by such technical and practical training as they have obtained, will develop into useful investigators and constructors.

SURVEYING.

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

The subject of Land Surveying is then taken up and various problems solved, in the office and field, relative to areas, subdivisions of land and retracing of section and township lines of the government land surveys.

In Topographical Surveying, each class makes a complete survey and contour map of a portion of the City of

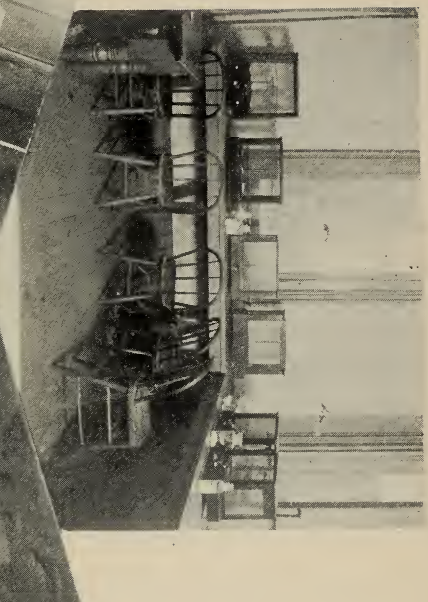
Golden, using the transit and stadia method; in addition to this, contour maps are made of several promising reservoir sites, and from these, preliminary estimates of capacity made and compared. In City Surveying, classes are instructed in the laying out of cities and towns, surveys of new subdivisions, street improvements, giving of grades, etc., together with such applications of each in the field as time will allow.

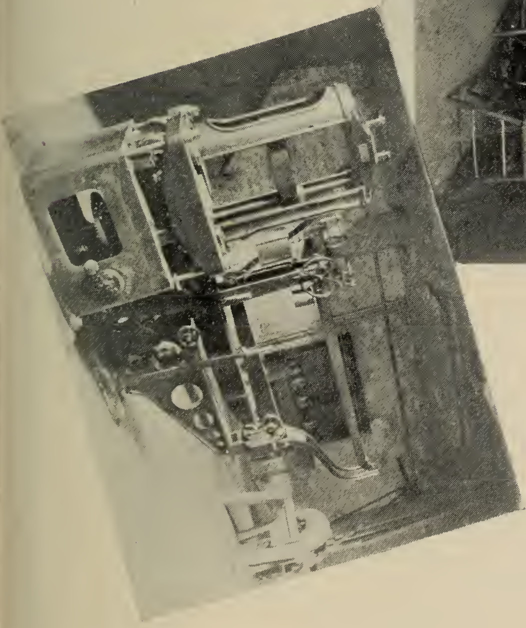
In Geodetic Surveying, classes are instructed in the outlines of that subject, the different kinds of triangulation, description of the U. S. Coast Survey base apparatus and the establishment of stations and signals. A base line is measured with a three-hundred-foot steel tape and all corrections made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

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

In Mine Surveying, various problems relative to underground surveying are solved, especial attention being paid to those which present peculiar difficulties and require careful instrumental work and computations. A complete survey is made of some mine in the neighborhood and each student required to make all the computations and plat the field notes. Each student is also required to make a survey of several intersecting mining claims, together with such computations as would be necessary for a patent survey.

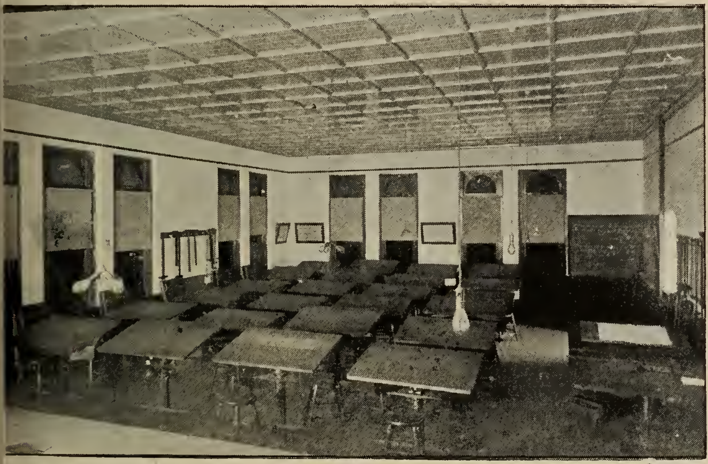
Each student, during the course, is required to make a determination of the true meridian by an observation on the pole star, and check the same by the methods of direct observation on the sun and solar attachment to the transit.





DRAUGHTING.

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



SOPHOMORE DRAUGHTING ROOM.

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

The work then leads into the more difficult elements f drawing, including line shading and tinting, together ith lettering, and no student is allowed to proceed who annot neatly execute at least two alphabets in free-hand.

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

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

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

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

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

The work by years is as follows:

FRESHMAN YEAR.

Use of drawing instruments, mounting sheets, etc. This includes the proper selection of instruments, testing and care of pen points, and like details, all of great importance to the beginner. Plain geometrical problems, simple projections and intersections; plans, elevations and sections, exercises in lettering, both free-hand and with the instruments; line shading, tinting and shading with tints; with applications of each as in working drawings. The drawing of problems, including Spherical Projections, and Shades and Shadows.

SOPHOMORE YEAR.

Mechanical, Cavalier and Isometric Projections; true perspective; the construction of detail drawings, of simple parts of machines, etc., particular attention being given to the making of complete and perfectly plain drawings according to the best American practices. This includes work on bond paper and tracing linen, and complete instructions are given in the details of blue printing.

JUNIOR YEAR.

The work resembles that of the latter part of the previous year, with the exception that more responsibility is thrown upon the student. Drawings of complete machines or structures, together with details, are made, in which more or less originality is required.

ORIGINAL WORK.

Instruction in Draughting, so far as concerns manual skill and the principles of projections and perspective, ends with the first term of the Junior year.

From this time until graduation the draughting work of any course consists of special work undertaken according to the suggestions of the Professors having in charge the technical lines of the Senior and Junior classes.

Mining projects, metallurgical plants, steam or electrical machinery, and in short, any practical designs to be worked out or illustrated, are assigned to members of the two upper classes, as applications of knowledge or manual skill already acquired.

MINING AND METALLURGICAL EXCURSIONS.

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

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

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

Metallurgical trips to the smelters at Denver and vicinity are quite frequent, while Pueblo and Leadville have also been included in longer trips, the iron and steel works at Pueblo being among those inspected.

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

On these trips, low traveling rates are secured for the students, and though they cannot be made obligatory, they are strongly recommended to all, as presenting practical advantages too great to need any arguments in their favor.

LIBRARY.

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

Complete sets of the transactions of the institutes of mining engineers and of civil engineers, association of engineering societies, journals of chemistry, electricity and metallurgy, and many technical cyclopedias in various lines have recently been added.

Students have free access to the Library, which can be used as a reading room at all hours.

FIELD WORK AND PUBLICATIONS.

Since 1885 the school has undertaken the work of a Geological Survey and Mining Bureau. Reports were published in 1885, 1886, 1887 and 1889. The minerals and ores collected are retained in the collection of the institution. The contributions hitherto published, in the reports above mentioned, have been as follows:

AUTHOR.	DATE.	SUBJECT.
A. A. Blow, C. E.	1887.	Ore Chutes and Recent Developments on Iron Hill, Leadville.
P. H. Van Diest, E. M.	1886.	Mineral Resources of Boulder County.
Prof. Regis Chauvenet.	1885.	Preliminary Notes on the Iron Resources of Colorado.

AUTHOR.	DATE.	SUBJECT.
Prof. Regis Chauvenet.	1886.	Notes on Iron Deposits of Northern Colorado.
" " "	1887.	Iron Resources of Gunnison County.
Prof. Arthur Lakes.	1885.	Reports on Trinidad and Crested Butte Coal.
" " "	1886.	Geology of the Aspen Mining District.
" " "	1887.	Geology of Colorado Ore Deposits.
" " "	1889.	Geology of Colorado Coal Deposits.
Prof. Magnus C. Ihlseng.	1885.	The San Juan Region.
" " "	1885.	Oil Fields of Fremont County.
" " "	1886.	The Present Mining Law Chaos.
" " "	1887.	Notes on Leadville.
Prof. George C. Tilden.	1886.	Mining Notes from Eagle County.
" " "	1887.	Western Assay Methods.
Prof. Benjamin Sadtler.	1889.	Colorado Cokes.
Prof. Louis C. Hill.	1892.	Present Applications of Electricity to Mining in Colorado.
Prof. Edmund B. Kirby.	1894.	Metallurgical Treatment of Low-Grade Ores.

During the year 1891, Prof. Tilden undertook and executed a large number of water analyses from the wells and water supply of Denver. The wells alone included in this investigation numbered over three hundred.

These publications are issued as the means of the institution will permit, no special appropriation for either field-work or printing having ever been made by the State.

BUILDINGS.

(1). BUILDING OF 1880-'82.

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

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

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

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

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

A special laboratory (35x25) is also upon this floor, the remainder of whose space is occupied by several small rooms for storage and apparatus of various kinds.

(2). BUILDING OF 1890.

This building is connected with that of 1882 by passages on every floor. Its length is one hundred feet, its width varies 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 President and Registrar, library and reading room, on one side of the main hall. The space on the other side (65 x 40), hitherto devoted to physics, is now occupied by the department of geology and mineralogy. It is divided into two rooms, one (22 x 40) for the museum, the other (40 x 43) is the working department and lecture room, containing all the collections and appliances used for instruction in geology, mineralogy, lithology and blow-piping.

The second floor is divided into: (1.) Lecture room (35 x 20) for metallurgy and mining, containing also the collections and models for this department, and the arc lantern for exhibition of the numerous slides which have been prepared of working draughts for these courses. (2.) Lecture room (40 x 40) for mathematics, chiefly devoted to Freshman work. (3.) Lecture room (22 x 35) for engineering classes. (4.) Draughting room (26 x 40) for upper classes. (5.) Office rooms for Professors.

This building stands upon ground overlooking the town, and presents a handsome appearance. The basement is in solid red sandstone, the upper stories in brick, laid in red mortar, and trimmed with the same red stone. It was first occupied at the opening of the fall term of 1890.

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

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

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

The second floor is devoted to Physics and to elementary work in Electricity and Magnetism. The lecture room, furnished with raised seats, will accommodate about seventy students. Besides the ordinary gas and water connections, the lecture table is connected to the high and low potential alternating and direct currents. 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. Special wires connect with both the alternating and direct current circuits and with the storage battery. The room devoted to laboratory work in Physics and Elementary Electrical Measurements is well lighted and fitted with slate shelves and heavy tables. The apparatus for students' use is kept in a small room opening off the laboratory. The balances, placed on separate slate shelves supported from the walls of the building, are in another room, connected with the main laboratory. Gas, air, water and electricity are supplied at various points in the laboratory.

The south half of the lower floor is divided into two rooms, the larger containing the fifty horse-power high-speed engine, the dynamos and motors for testing purposes. All wires run from this room to the smaller, which contains the marble switch board, the measuring instruments for testing work, and the large resistance coil. These have a combined capacity of absorbing one hundred K. W. A non-inductive resistance, capable of absorbing thirty K. W., is also placed here. 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. One room contains no iron whatever, and is used for magnetic observations. Very little iron is used in the construction of the lower portion of the building, so that all the rooms are well adapted for electrical measurements.

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

The compact arrangement of this building makes it the most efficient, in proportion to cost, of any of the additions to the School of Mines.

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 thousand square feet.

GROUNDS.

The tenth General Assembly gave $5,000 for improvement of the grounds, the City of Golden permitting the absorbtion of the street formerly dividing Engineering Hall from the older 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 1895, accompanied these improvements, and allows the utilization of all the space hitherto unavailable.

APPARATUS.

The scientific apparatus in the various departments can hardly be described in detail, or even named, in a school catalogue. It may be said, however, that in Chemistry the apparatus in stock is ample for the supply of every student in the laboratory, and includes fine balances, volumetric instruments, and every approved appliance for analytical and experimental chemistry. The laboratory fittings have been mentioned under "Chemistry."

The surveying instruments are of the best makes, and several of each kind are provided, so that several parties can be in the field at the same time. Among the makers are Gurley & Sons, Young & Sons, Negretti & Zambra, and Troughton & Simms. Six transits, five levels, and all necessary accessory instruments are included.

Two very beautiful mining transits, by Buff & Berger, with complete set of attachments, form the latest addition to this collection, which of course is in constant use in field work.

The electric equipment is very complete, the instruments being of the very best construction—motors, volt meters, galvanometers, numerous resistance sets, sixty-cell storage battery, electro-dynamometers, cradle dynamometer, Kelvin balances and a variety of other instruments, the whole comprising one of the best collections west of the Mississippi.

Reference should be made to the various articles under "Departments of Instruction," for details concerning the scientific equipment. The estimate for the year 1894 on value of strictly scientific apparatus on hand is $24,000, though additions are being rapidly made, and these figures will soon be out of date. They are *exclusive* of all furniture, fittings, cases and ordinary school appliances.

SCIENTIFIC SOCIETY.

In the Spring of 1892 the "Scientific Society of the State School of Mines" was organized with a membership representing every class, and the Faculty, as well as a few outside of the school, whose names are identified with the earliest of Colorado's scientific enterprises. The object of the society is to afford occasions for the presentation and discussion of papers written by the members upon scientific subjects. The organization is liberal in every particular, and is governed by a constitution the provisions of which are sufficient to maintain integrity, the imposition of harassing detail having been studiously avoided. The programmes are prepared by an executive committee, the meetings being held in the school building.

GOLDEN HIGH SCHOOL.

The courses of study in the Golden High School are those recommended by the Colorado State Teachers' Association. They have been adopted as the preparatory course in all the higher institutions of learning in the State, having preparatory departments. These courses embrace Algebra, Plane and Solid Geometry, Physics, Chemistry and Biology. Four years of English, including Rhetoric, and four years of Latin. General History is also included in the course.

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

TEXT BOOKS.

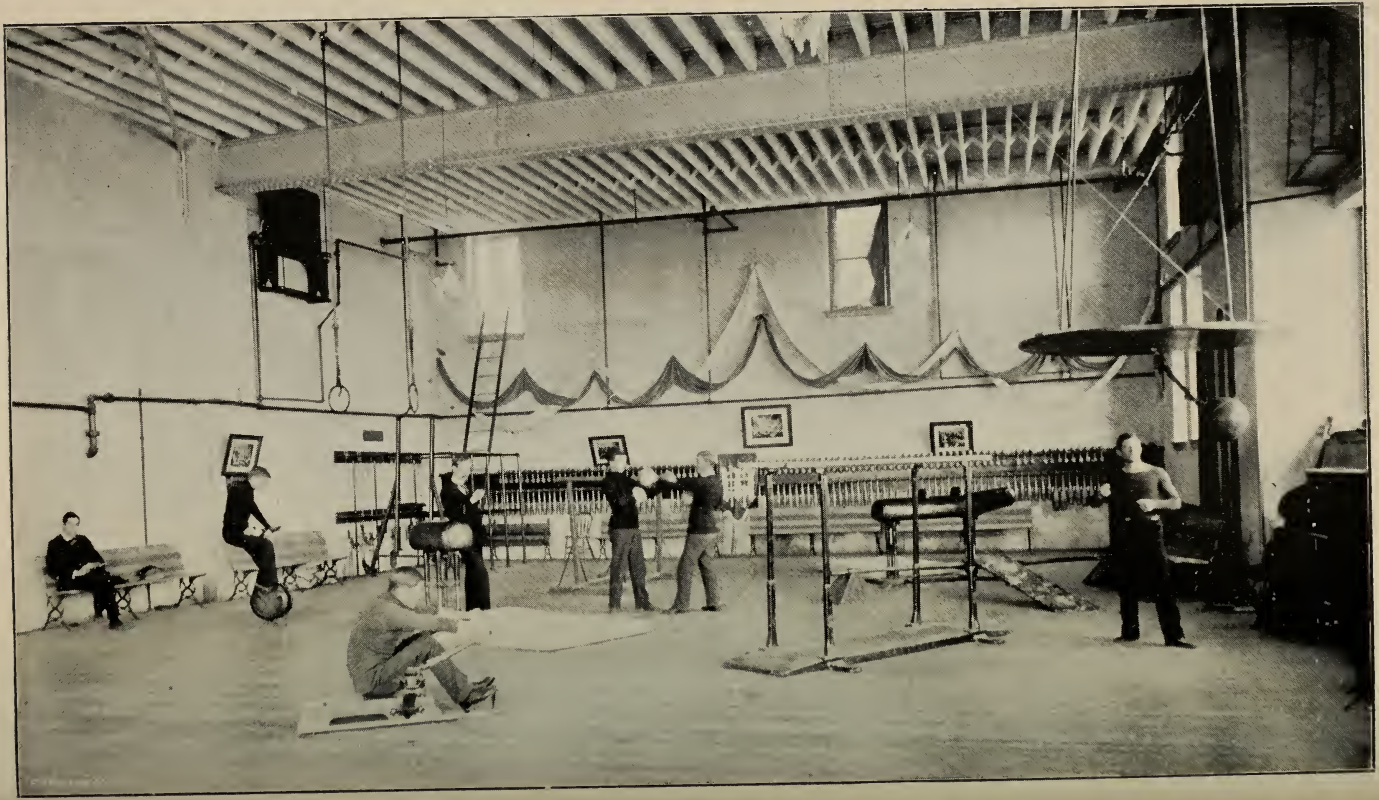
Roscoe's Elementary Chemistry.
Prescott and Johnson's Qualitative Analysis.
Cairns' Quantitative Analysis.
Wentworth's Higher Algebra.
Chauvenet's Geometry, Byerly's Edition.
Chauvenet's Trigonometry.
Nichols' Analytical Geometry.
Osborne's Calculus.
Church's Descriptive Geometry.
Morris' Geometrical 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 Polyphate Electric Currents.
Holmes' Steam Engine.
Johnson's Engineering Contracts and Specifications.
Nichol's Water Supply.
Wilson's Manual of Irrigation Engineering.
Johnson's Surveying.
Godwin's Field Book.
Merriman's Hydraulics.
Church's Mechanics of Engineering.
Green's Roof and Bridge Trusses.
Baker's Masonry Construction.
Johnson's Theory and Practice of Framed Structures.
Hughes' Coal Mining.
Austen's Introduction to Metallurgy.
Peters' Copper Smelting.
Eissler's Metallurgy of Silver.
Rose's Metallurgy of Gold.
Hofman's Metallurgy of Lead.
Le Conte's Geology.
Dana's Manual of Mineralogy and Lithology.
Patton's Crystallography.

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 (65 x 40) 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 rings, parallel bars, horse buck, quarter circle, "cage" with apparatus for development of every set of muscles, ladders, spring-board, complete sets of clubs and dumb-bells and many 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.



GYMNASIUM, LOOKING WEST. BASEMENT OF BUILDING OF 1890.