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SCHOOL OF ENGINEERING

CIRCULAR OF INFORMATION

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THE UNIVERSITY OF MISSOURI

The University of Missouri was located at Columbia, Missouri, in 1839, and courses of instruction in Academic work began in 1841. A Department of Education was established in 1867. The College of Agriculture and Mechanic Arts and the School of Mines and Metallurgy were made Departments of the University in 1870—the School of Mines being located at Rolla. The Law Department was opened in 1872; the Medical Department in 1873; the School of Engineering in 1877. The Experiment Station was established, under act of Congress, in 1888. The Missouri State Military School was created a Department in 1890. In 1896 the Graduate Department was established.

The University has thirty buildings—twenty-three at Columbia and seven at the School of Mines at Rolla.

The School of Engineering described in this pamphlet is at Columbia.

RESOURCES.

The buildings, grounds, and equipment for all departments of the University are worth nearly \$2,000,000. Moreover, the endowment (interest at five or six per cent) is \$1,240,000, and the income from the United States Government (Hatch, Morrill, and Adams Acts) is nearly \$45,000 a year. The income of the whole University from all sources for the year 1905 was about \$510,000. These things are of vital importance, for no Engineering School that depends for its support upon tuition fees is able to meet the costly requirements of modern education.

THE SCHOOL OF ENGINEERING.

It is the aim of the School of Engineering to provide a substantial foundation for the general and technical knowledge needed by the successful Engineer by giving its students thorough training in the fundamental principles which underlie all Engineering practice, with such applications to problems met in the several fields of practice as may be feasible in a technical school. To this end five courses of instruction are offered, corresponding to various lines of practice, and leading respectively to the degrees of Bachelor of Science (B. S.) in Civil Engineering, Electrical Engineering, Mechanical Engineering, Sanitary Engineering, and Chemical Engineering.

In each of these courses the first two years are mainly devoted to preliminary training in English, Mathematics, Physics, Chemis-

try, Drawing, Surveying, and Shopwork as a preparation for the more technical work of the last two years.

The course in *Civil Engineering* covers a very wide field, embracing topographical, railway, hydraulic, structural, municipal, and sanitary Engineering, and it is the aim to give a broad, general training which may later serve as a foundation for the development of any of the special lines of practice included under the general term, Civil Engineering.

The course in *Electrical Engineering* is intended to prepare students for electrical designing, manufacturing, contracting, and for the installation and management of light and power stations; in short, it is a thorough, broad, training for Electrical Engineers. The technical work consists of the theory and principles of electricity and magnetism; electrical measurements; calibration of instruments; tests of all kinds; design and construction; study of special problems in the generation, transmission, distribution, and utilization of electrical energy. Special attention is paid to alternating current phenomena.

The course in *Mechanical Engineering* is intended to fit students to enter readily any of the principal divisions of Mechanical Engineering. Training is given in the underlying principles of the profession, all work being so arranged that the application of these principles to special problems, which may arise in practice, may clearly be seen. The design of Engineering structures and machines, and the development, application, and measurement of power in its various forms are covered in the different courses.

The course in *Sanitary Engineering* is arranged with the purpose of combining a study of the principles of Sanitary Science with the fundamental training of the course in Civil Engineering.

The course in *Chemical Engineering* is offered to furnish training in Engineering together with specialization in Chemistry. In view of the development of the applications of Chemistry on a large scale in manufacturing, it is proposed to extend the course, making it more general on the Engineering side, or to offer several parallel courses as the demands may require.

REQUIREMENTS FOR ADMISSION.

Fifteen (15) units are required for admission to the School of Engineering, but two (2) conditions, for the fall of 1906 alone, will be allowed. These cannot be, however, in English or Mathematics.

A unit represents the equivalent of a year's work of nine months in one subject, in a good high school, normal school, or college, with five periods a week in the class-room or laboratory, each period of about forty minutes.

Three of these units *must* be in English, one and one-half in

Algebra, one in Plane Geometry, two in foreign languages, and one in science. The additional units required may be selected from the following list.

English—one unit.

Solid Geometry or *Plane Trigonometry*—one-half unit.

Physics, Chemistry, Biology, Zoology, or Botany—one to two units.

Drawing, Manual Training, or Physiography—one unit.

History or *Latin*—one to four units.

German, French, Spanish, or Greek—one to three units. It is strongly recommended that students present two units in French or German to meet the requirements in foreign language.

In 1907-8 one-half unit in Solid Geometry will be a fixed requirement in Engineering. The courses in Engineering require that the students be strong in Mathematics and Science. Those who are not strong in these subjects are advised not to undertake work in Engineering.

Students from Accredited Schools will not be admitted subject to a condition unless they are graduates of such schools.

ENTRANCE EXAMINATIONS AND CERTIFICATES.

Examinations for admission will be held at the University 10, 11, 12, September, 1906. All persons desiring to enter during the first semester of the session of 1906-7, except those holding certificates of graduation from Accredited Schools and those who have already fulfilled the entrance requirements, must take these examinations.

The University will admit without examination such graduates of an Accredited School as bring proper credentials of the fact that they have completed the subjects required for entrance.

The diploma will not be accepted as a credential. The student must present the proper form of certificate signed by the Principal or Superintendent of the Accredited School. Blank certificates will be furnished by the Dean upon application. These certificates should be filled out and sent to the "Committee on Entrance, Columbia, Missouri."

Students who do not hold certificates of graduation from an Accredited School may present their grades in any subject. In such cases they should have the grades certified by the proper official of the school in which the grades were made.

As the necessity for correction appears in many instances, the student may avoid delay and inconvenience by sending certificates in advance of the opening of the session.

SPECIAL STUDENTS.

Persons who desire to follow special lines of work, and who have not had the preliminary preparation required for admission as regular students, may be admitted as Special Students for the purpose of pursuing courses for which their preparation fits them. Such students must satisfy the Dean that they can, with profit to themselves, pursue the work selected, and they are required to maintain the same standard of excellence which is required of regular students. No Special Student may be a candidate for a degree unless he makes good his entrance requirements and enters in regular standing before the beginning of the senior year.

ADVANCED STANDING.

Applicants for advanced standing are required to present credentials showing completion of courses equivalent to those for which they seek credit. Claims for advanced standing must be made by the student within one semester after entrance. Those who wish it may have their claims passed upon by the Dean before matriculation.

FEEES AND EXPENSES.

Tuition is free in all departments of the University. Students in the School of Engineering, excepting State Cadets, pay an annual entrance, library, and incidental fee of five dollars. A deposit of five dollars is required upon entrance into each laboratory course taken by the student. From this amount is deducted the fixed laboratory charge and any charges for materials or for damage to property of the University, and the remainder, if there be any, is refunded to the student at the end of the session.

The estimated cost of board and room rent in the University Dormitories for men varies from about \$2.50 to about \$3.50 a week. Board and lodging in private families may be had for from \$3.50 to \$5.00 a week. Private clubs also are formed in which the average cost is \$2.50 a week. The rent of rooms is from \$1.00 to \$2.00 a week.

LIBRARY.

The School of Engineering is equipped with an excellent working library of technical books, and with the best Engineering magazines.

The General Library of the University contains many books and pamphlets, and is open to all students of the University. Books may, under regulations, be drawn from the Library.

The Library and Reading Room of the Missouri State Historical Society located in Academic Hall are open to all students of the University.

Our students have access in all to about 120,000 books and pamphlets on the campus of the University.

ENGINEERING SOCIETY.

There is a flourishing Engineering Society, composed of members of the Junior and Senior classes, which affords opportunity for discussion of current Engineering topics, and brings the students and faculty together in a social way.

ATHLETICS.

A new \$70,000 gymnasium has just been completed. Work in physical training and athletics is thoroughly organized. The students have teams for football, basketball, track athletics, lawn tennis, and so on. There are excellent golf links, tracks, tennis courts, and several athletic fields.

NONRESIDENT LECTURERS.

During the session lectures are delivered on Engineering subjects by prominent Engineers. This brings the students in touch with actual practice. The regular instruction requires frequent reference to current periodicals, and this, also, familiarizes the students with actual Engineering work.

LABORATORIES.

During the last four years the School has been equipped with laboratories for the principal experimental work required of Engineers. The equipment is modern and adequate for all present needs.

INSTRUCTION.

CIVIL ENGINEERING.

F. P. SPALDING, Professor; W. S. WILLIAMS, A. LINCOLN HYDE, Assistant Professors; E. L. DRIGGS, Assistant.

This department is well equipped with instruments for teaching and surveying. There are 14 transits, 9 levels, 2 plane tables, 4 compasses, sextants, tapes, and small instruments for land topographical and railway surveys; and an 8-inch Fauth theodolite, Brandis triangulation transit, Saegmuller precise level, base apparatus, etc., for geodetic surveys.

In the laboratory for testing materials there are: a Standard abrasion cylinder for paying brick, three testing machines arranged

for tension, compression and tranverse tests, and Olsen torsion machine, extensometers, deflective gauges, compression micrometers, and small tools and instruments needed for tests of iron, steel, wood, brick, etc. The cement laboratory is fitted for all standard tests. There are Olsen and Fairbanks testing machines, mortar mixer, briquette press, apparatus for heat tests, Vicat and Gilmore needles for rate setting, appliances for fineness and specific gravity tests, glass mixing tables, and a good outfit of moulds and other small instruments.

For office work there are rolling and polar planimeters, a pantagraph, topographical protractors, stadia charts and slide rule, Thatcher calculating instrument, beam compass, etc. About 500 drawings of recent bridges, presented by Mr. T. G. Wilkerson (class of 1890) of Pittsburg, and a set of 130 drawings, carefully arranged, indexed, and presented by Dr. J. A. L. Waddell, illustrating recent practice in bridge design, are available for instruction.

COURSE IN CIVIL ENGINEERING.

| | <i>Hours.</i> | | <i>No. of Course.</i> |
|---|-----------------|-----------------|-----------------------|
| | <i>1st Sem.</i> | <i>2nd Sem.</i> | |
| <i>Freshman Year.</i> | | | |
| Algebra, Trig., and Anal. Geom. | 5 | 5 | Math. 1aA, 2aE & 1bI |
| Composition and Rhetoric. | 3 | 3 | Chemistry 2 |
| General Inorganic Chemistry | 3 | 3 | English 1 |
| Mechanical Drawing. | 3 | 0 | Drawing 1a |
| Woodwork and Forging | 2 | 0 | Shopwork 1a |
| Descriptive Geometry. | 0 | 3 | Drawing 2b |
| Topographical Drawing. | 1 | 0 | Drawing 5a |
| Elementary Surveying. | 0 | 3 | C. E. 1b |
| <i>Sophomore Year.</i> | | | |
| Calculus. | 5 | 5 | Math. 4E |
| Higher Sur. & Ry. Location. | 3 | 3 | C. E. 2a & 4b |
| General Physics. | 6 | 6 | Physics 3 |
| Machine Dr. & Stereotomy | 2 | 2 | Drawing 6a & 4b |
| Elementary Construction. | 2 | 2 | C. E. 6 |
| <i>Junior Year.</i> | | | |
| Mechanics of Engineering. | 5 | 5 | Mechanics 3 |
| Railway Engineering. | 3 | 0 | C. E. 5a |
| Spher. and Prac. Astronomy. | 5 | 2 | Astronomy 5 |
| Steam Engineering. | 3 | 0 | M. E. 1a |
| Frame Structures. | 3 | 3 | C. E. 10 |
| Sanitary Engineering. | 0 | 2 | C. E. 8b |
| Materials of Construction. | 0 | 2 | C. E. 19b |
| Construction. | 0 | 2 | C. E. 20b |

| <i>Senior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|-----------------------------------|-----------------|-----------------|-----------------------|
| Hydraulic Motors..... | 2 | 0 | M. E. 7a |
| Mechanical Lab..... | 0 | 1 | M. E. 11b |
| Geodetic Surveying..... | 0 | 3 | C. E. 3b |
| Hydraulics..... | 2 | 0 | C. E. 9a |
| Bridge Design..... | 5 | 0 | C. E. 11a |
| Theory of Structures..... | 0 | 3 | C. E. 12b |
| Masonry Structure..... | 2 | 2 | C. E. 13 |
| Testing Laboratory..... | 1 | 0 | C. E. 14a |
| Specifications and Contracts..... | 0 | 1 | C. E. 16b |
| Thesis..... | 0 | 2 | C. E. 30b |
| Elective..... | 3-6 | 3-6 | |

ELECTRICAL ENGINEERING.

H. B. SHAW, Professor; A. E. FLOWERS, Assistant Professor;
two Instructors to be appointed by 1 September.

The aim of the course is to furnish thorough training for Electrical Engineers. For this purpose the individual studies have been very carefully selected and arranged, the technical subjects being varied slightly from year to year to meet the demands of a rapidly developing profession. The first two years are devoted to preliminary training in English, Mathematics, the Sciences, and in Drawing and Shopwork. Studies 1 to 7b on the following page are given in the junior and senior years.

Instruction is given by means of recitations, lectures, and laboratory work, thoroughly correlated, the idea being to present the subject to the student as a whole, and from all points of view. A feature of considerable interest in the work is the student meetings of the American Institute of Electrical Engineers held in connection with the Seminar. The department of Physics has charge of the special course—lectures and laboratory work—in Electrical Measurement for students in Electrical Engineering.

Attention is called to the studies, Steam Engineering, Kinematics, Hydraulic Motors, and Mechanical Laboratory under the direct charge of the department of Mechanical Engineering.

For the laboratory work in Electrical Engineering distinctively there are the following laboratories: Dynamo Laboratory for Direct and Alternating Currents. Standardizing Laboratory for the calibration of instruments, Laboratory for the testing of materials used in Electrical Construction. These Laboratories are already fairly well equipped with different types, makes and sizes of motors and generators, together with ammeters, volt-meters, and other instruments and accessories. Apparatus is being continually added as necessary. Facilities for research work are continually being improved, each student being required to present a thesis evidencing original research. As the result of such research work may be mentioned a 40,000 volt testing transformer and an oscillograph constructed by students.

COURSE IN ELECTRICAL ENGINEERING.

Hours.

| <i>Freshman Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|---------------------------------|-----------------|-----------------|-----------------------|
| Trig., Algebra and Anal. Geom.. | 5 | 5 | Math. 1aE, 2aE & 1b |
| Composition and Rhetoric..... | 3 | 3 | English 1 |
| Genl. Inorganic Chemistry..... | 3 | 3 | Chemistry 2 |
| Mech. Drawing and Des. Geom... | 3 | 3 | Drawing 1a and 2b |
| Woodwork and Forging..... | 3 | 3 | Shopwork 1 |

| <i>Sophomore Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|--------------------------------|-----------------|-----------------|-----------------------|
| Calculus | 5 | 5 | Math. 4E |
| General Physics | 6 | 6 | Physics 3 |
| Machine Work..... | 2 | 2 | Shopwork 2 |
| Elementary Surveying..... | 2 | 0 | C. E. 1a |
| Elements of Machine Drawing... | 0 | 2 | Drawing 3b |
| Steam Eng. and Kinematics..... | 3 | 3 | M. E. 1a & 2b |

| <i>Junior Year.</i> | <i>1st Sem.</i> | <i>2nd sem.</i> | <i>No. of Course.</i> |
|-------------------------------|-----------------|-----------------|-----------------------|
| Mechanics of Engineering..... | 5 | 5 | Mechanics 3 |
| Electrical Measurements..... | 2 | 2 | Physics 4 |
| Electrical Machinery | 4 | 4 | E. E. 1 |
| Alternating Currents..... | 3 | 3 | E. E. 2 |
| Seminary..... | 1 | 1 | E. E. 6 |

| <i>Senior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|-----------------------------|-----------------|-----------------|-----------------------|
| Hydraulic Motors..... | 2 | 0 | M. E. 7a |
| Mechanical Lab..... | 2 | 2 | M. E. 13 |
| Advanced Alt. Currents..... | 3 | 3 | E. E. 3 |
| Electrical Design..... | 3 | 3 | E. E. 4 |
| Electrical Engineering..... | 3 | 3 | E. E. 5 |
| Seminary..... | 2 | 2 | E. E. 6 |
| Thesis.. | 0 | 2 | E. E. 7b |

MECHANICAL ENGINEERING.

ARTHUR M. GREENE, JR., Professor; A. L. WESTCOTT, Assistant Professor; E. A. FESSENDEN, Instructor; J. R. WHARTON, Assistant.

The aim of this course is to train the student in the underlying principles of the profession so as to enable him to take up readily any special branch of Mechanical Engineering. For this purpose the design of Engineering structures and mechanics and the application, measurement, and production of power are studied. Instruction is given principally by the aid of text books and laboratory work, lectures being used in a few of the courses to supplement the text books. In the class rooms advanced problems taken principally from practice are given for solution, the aim being to prepare the student for the practical work which is to come after graduation.

The department is equipped with an excellent working library which is always accessible to the student. The reading room, open at all times, is supplied with the best Engineering magazines. The laboratory is equipped with steam, gas, and oil engines, steam turbine, water wheels, injectors, pumps, air compressors, fans, blowers, hoisting appliances, and apparatus for testing standardizing instruments. A large number of indicators, planimeters, thermometers, and water meters are used on tests, and the properties of oils, coals, transmission material, and gases are determined by apparatus for these purposes.

The work in the laboratory is to familiarize the student with the use and the care of these machines as well as with the principles underlying the design, construction, and use. In equipping the laboratory it has been the aim to select apparatus which would bring the student in contact with most of the important forms or types of machines for developing and measuring power. It is also the intention to have him make most of the tests which a Mechanical Engineer is called upon to execute, and at the same time an attempt is made to have the student make original investigations on simple problems.

COURSE IN MECHANICAL ENGINEERING.

The Freshman and Sophomore years are identical with those of the course in Electrical Engineering.

Hours.

| <i>Junior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|----------------------------|-----------------|-----------------|-----------------------|
| Steam Boilers..... | 3 | 1 | M. E. 3 |
| Thermodynamics..... | 0 | 3 | M. E. 4b |
| Mechanical Laboratory..... | 1 | 1 | M. E. 11 |
| Graphics of Machines..... | 2 | 0 | M. E. 14a |
| Electrical Machinery..... | 4 | 3 | E. E. 1 |
| Mill Structures | 0 | 2 | C. E. 18b |
| Mechanics of Engineering.. | 5 | 5 | Mechanics 8 |

| <i>Senior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|------------------------------------|-----------------|-----------------|-----------------------|
| Heat Engines..... | 3 | 0 | M. E. 5a |
| Steam Engine Design..... | 3 | 2 | M. E. 6 |
| Hyd. Motors and Pumping Mach.. | 2 | 2 | M. E. 7a and 8b |
| Machine Design..... | 2 | 2 | M. E. 9 |
| Mechanical Lab..... | 2 | 1 | M. E. 12 |
| Thesis | 0 | 2 | M. E. 19b |
| Alternating Currents..... | 3 | 3 | E. E. 2 |
| Contracts and Specifications... .. | 0 | 1 | C. E. 16b |
| Electives | 0 to 3 | 2 to 5 | |

COURSE IN SANITARY ENGINEERING.

The Freshman and Sophomore years are identical with those of the course in Civil Engineering.

Hours.

| <i>Junior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|-------------------------------|-----------------|-----------------|-----------------------|
| Mechanics of Engineering..... | 5 | 5 | Mech. 3 |
| Tech. Chemistry..... | 3 | 3 | Chem. |
| General Geology..... | 3 | 3 | Geo. 1 |
| Framed Structures | 3 | 3 | C. E. 10 |
| Steam Engineering..... | 3 | 0 | M.E.1a |
| Mechanics of Construction.... | 0 | 3 | C. E. 19b |

| <i>Senior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|----------------------------------|-----------------|-----------------|-----------------------|
| Mechanical Laboratory..... | 0 | 1 | M. E. 11b |
| Gen. Bacteriology and Hygiene... | 3 | 3 | Bact. 1a and 7b |
| Bridge Design..... | 5 | 0 | C. E. 11a |
| Hydraulics..... | 2 | 0 | C. E. 9a |
| Specification and Contracts..... | 0 | 1 | C. E. 16b |
| Masonry Structures..... | 2 | 2 | C. E. 13 |
| Municipal Engineering..... | 2 | 2 | C. E. 7 |
| Engineering Laboratory..... | 1 | 0 | C. E. 14a |
| Hyd. Motors and Pumping Mach.. | 2 | 2 | M. E. 7a and 8b |
| Construction..... | 0 | 2 | C. E. 20b |
| Thesis..... | 0 | 2 | C. E. 21b |

COURSE IN CHEMICAL ENGINEERING.

Hours.

| <i>Freshman Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|--------------------------------|-----------------|-----------------|-----------------------|
| Trig. and Anal. Geom..... | 3 | 5 | Math. 1aE and 1bE |
| Composition and Rhetoric..... | 3 | 3 | English 1 |
| General Inorganic Chem..... | 3 | 3 | Chemistry 2 |
| Qualitative Analysis | 0 | 3 | Chemistry 5b |
| Mechan. Drawing and Des. Geom. | 3 | 3 | Drawing 1a and 2b |
| Steam Eng. and Kinematics..... | 3 | 0 | M. E. 1a |

| <i>Sophomore Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|-----------------------------|-----------------|-----------------|-----------------------|
| General Physics..... | 6 | 6 | Physics 3 |
| Calculus..... | 5 | 5 | Math. 4E |
| Organic Chemistry | 3 | 3 | Chemistry 4 |
| Quantitative Analysis | 3 | 0 | Chemistry 6a |
| Kinematics..... | 0 | 3 | M. E. 2b |

| <i>Junior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|---------------------------------|-----------------|-----------------|-----------------------|
| Mechanics of Engineering..... | 5 | 5 | Mechanics 3 |
| Physical Chemistry..... | 3 | 3 | Chemistry 10 |
| Thermodynamics..... | 0 | 3 | M. E. 4b |
| Electrical Machinery..... | 4 | 4 | E. E. 1 |
| Elements of Machine Drawing.... | 2 | 0 | Drawing 3b |

| <i>Senior Year.</i> | <i>1st Sem.</i> | <i>2nd Sem.</i> | <i>No. of Course.</i> |
|---------------------------------|-----------------|-----------------|-----------------------|
| Technical Chemistry..... | 3 | 3 | Chemistry 10 |
| Electrical Measurements..... | 2 | 2 | Physics 4 |
| Heat Engines..... | 3 | 0 | M. E. 5a |
| Machine Design..... | 2 | 2 | M. E. 9 |
| Elective (to be chosen from | 5 | 6 | |
| Chemistry, E. E. and M. E.).... | 0 | 2 | |
| Thesis..... | | | |

ADVANCED DEGREES.

The degree of Civil Engineer (C. E.), Electrical Engineer (E. E.), Mechanical Engineer (M. E.), and Chemical Engineer (Ch. E.), will be conferred on candidates who, after receiving the first degree from this University, or from one of equivalent standing, have spent in the same course one year (at least ten hours a week) in graduate work in the University, or two years in professional practice and graduate work *in absentia*. The candidate must pass an examination on his graduate work and present a satisfactory thesis. The thesis subject shall be presented to the Dean on or before November 1, and the thesis shall be presented on or before May 1st of the given year. Those who with professional practice pursue graduate work in *absentia* must be regularly enrolled as graduate students, paying the usual fees.

For a general catalogue of the University, address Merrill Otis, University Publisher, Columbia, Missouri. For further information concerning the School of Engineering, address Arthur M. Greene, Jr., Junior Dean, Columbia, Missouri.

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Derivatives - Access copy

| | |
|------------------|--|
| Compression | LZW |
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| Color | Grayscale, 8 bit |
| File types | Tiffs converted to pdf |
| Notes | Greyscale pages cropped and canvassed. Noise removed from background and text darkened. |