THE TEACHING OF SOILS AT WSU 1/

Robert L. Hausenbuiller 2/

At the time of its inception in 1892, Washington State University, known then as Washington State College, consisted of several departments, among them, the Department of Agriculture. This Department had the responsibility of teaching all agricultural courses as well as administering the newly formed Agricultural Experiment Station. In its first year, the Department consisted of two Faculty: John D. Scobey, Agriculturist, and Edward R. Lake, Horticulturist and Botanist. Both had masters degrees.

The first annual catalogue of Washington State College listed a four-year curriculum for students in the Department of Agriculture. Courses within the Department were taught under either Agriculture or Horticulture. The Agricultural courses, which were spread over five consecutive terms (quarters) in the Sophomore and Junior years, embraced (1) Rural Economy, (2) Livestock and Poultry, and (3) Farm Crops. Soils was included within the Farm Crops courses under such headings as soils and soil analysis, chemistry of plant life, crop rotations, and manures and fertilizers.

According to the second annual catalogue of Washington State College, E. A. Bryan became President of the College and Director of the Experiment Station in 1893. The teaching of soils was the responsibility of E. R. Lake, now Agriculturist and Horticulturist. Topics in Soils were broadened somewhat and included the relation of soils to plants, how plants feed and

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1/ Part of History of Agronomy and Soils, WSU. 1984.

2/ Professor of Soils and Soil Scientist Emeritus. Department of Agronomy and Soils, WSU. Pullman, WA 99164-6420.

grow, drainage, irrigation methods and effects, and the nature and use of fertilizers.

In 1894, William J. Spillman joined the faculty as Professor and appears to have been the sole member of the Department of Agriculture in 1896 (see Exhibit 1). As shown in this Exhibit, soils was still taught as a part of the more general courses, namely, Farm Crops and Agricultural Physics.

The Department gained a second member in 1898; E. E. Elliott, Assistant Professor. At this time a course titled Agronomy - Soils and Crops appeared in the catalogue. Irrigation and drainage were now taught under courses in Farm Engineering. The separate areas of Farm Engineering and Agronomy were recognized within the Department of Agriculture at this time.

In 1902, Spillman resigned, and his seat as Head of the Department was taken by Elliott, now a Professor. George Severance joined the Department the same year, and by 1905 was teaching the first course under the specific heading of Soils (see Exhibit 2). Severance also taught courses in Crop Production, Irrigation Farming, Climatology, and Advanced Soil Studies. The latter course dealt with Bureau of Soils (USDA) methods of soil analysis and soil survey and classification. In 1906, Inorganic Chemistry was listed for the first time as a prerequisite for the beginning course in soils.

In 1907, four-year schedules of studies for three subject matter areas, or groups, within the Department of Agriculture appeared in the catalogue. The groups were: Agronomy, Animal Husbandry and Dairying, and General Agriculture (see Exhibit 3). In the schedule for the Agronomy

paratus; 1 balance, and various other pieces of apparatus for use in physiological and histological work; bell jars, moist chambers, dissecting instruments, and an abundance of apparatus for the collection and preservation of plants and animals. For illustrated lectures, the department has an electric projecting microscope, by Colt & Co., Chicago.

About 200 standard works of reference and files of several technical magazines are accessible to students.

Each student is provided with a microscope and a set of reagents, together with all the necessary tools needed in either botanical or zoölogical dissections, and in the preparation and mounting of microscopical specimens.

IV.—DEPARTMENT OF AGRICULTURE.

WILLIAM J. SPILLMAN, PROFESSOR.

The purpose of this course is to fit students for intelligent, practical farming; for farm supervision; for investigating agricultural problems; for experiment station work; and for teaching Agriculture. Since this science rests mainly on chemistry, botany and zoölogy, students in this department are expected to take a large amount of work in these sciences. Instruction in Agriculture will extend throughout the four years, much of which will be by the laboratory method. This will be supplemented by lectures and collateral reading. For the latter purpose, all the standard works on agricultural subjects and the leading agricultural papers are placed in the library for the use of students.

1. **Comparative Anatomy.** *Full course.* The horse, cow, sheep and hog are studied with special reference to their normal structure, the adaptability of structure to use, and their nutritive processes. This course is identical with course 1, School of Veterinary Science. Daily, first semester.

2. Continuation of course 1. *Full course.* Daily, second semester. (See Department of Veterinary Science.)

3. **Farm Crops and Principles of Feeding.** *Full course.* The first eight weeks of this course will be devoted to lectures on agricultural plants, their uses, distribution and cultivation. The remainder of the course will consist of three lectures and four hours laboratory work per week in principles of feeding, including composition of feeding stuffs, nature and use of these components, compounding rations, systems of soiling crops and pastures. Daily, first semester.

4. **Breeds and Breeding.** *Full course.* A study of the history, characteristics and adaptabilities of the different breeds; the principles of breeding and judging live stock. Two hours each week throughout the semester will be devoted to judging stock, the score card being used until the student is capable of accurate judging. Lectures will also be given on registration of stock. Four lectures per week and two hours judging stock, second semester.

5. **Agricultural Physics.** *Full course.* The principles of Physics, as applied in agricultural and dairy machinery, the construction and ventilation of farm buildings, construction and management of silos, and as affecting soil moisture. The latter subject will include drainage, irrigation, evaporation and methods of tillage. During the study of machinery, drainage, irrigation, evaporation and methods of tillage, four hours per week are devoted to laboratory work, accompanied by three lectures. Five lectures per week during the remainder of the first semester.

6. **Dairying.** *Full course.* The care of dairy products on small farms is fully considered; in addition, students are instructed and trained in practical arrangements and business methods of the creamery and cheese factory, the machinery used in the different processes, methods of testing milk, creaming, ripening cream, churning, handling butter, and cheese making. The principal part of the instruction will consist of actual work with these processes. The scientific principles involved in dairying will be treated in lectures two hours per week. Work in dairy and creamery, six hours per week, second semester.

7. **Farm Economy.** *Two-fifths course.* Lectures are given on methods of keeping farm accounts, structure of buildings and fences, and laws relating to the same; how to market crops and

Exhibit 1, from the 1896 WSU catalogue, showing two courses, Farm Crops and Principles of Feeding and Agricultural Physics, in which soils concepts were taught.

IV.—DEPARTMENT OF AGRICULTURE.

EDWIN E. ELLIOTT, PROFESSOR.
WALTER S. THORNBER, PROFESSOR OF HORTICULTURE.
GEORGE SEVERANCE, ASSISTANT PROFESSOR OF AGRICULTURE.
DENNIS C. MOORING, INSTRUCTOR IN HORTICULTURE.
WILLIAM A. LINKLATER, INSTRUCTOR IN ANIMAL HUSBANDRY.
IRA P. WHITNEY, INSTRUCTOR IN DAIRYING.
————————, INSTRUCTOR IN AGRONOMY.

The courses of study given in this department are designed to equip students (1), for intelligent, practical farming; (2), for farm management and supervision; (3), for investigating agricultural problems in connection with Experiment Station work; (4), for teaching agriculture and the applied sciences; and (5), for service in the U. S. Department of Agriculture. In addition to such special preparation, the course is intended to give students a practical training in the sciences which underlie the study of agriculture. Complete courses are required or offered in Chemistry, Physics, Botany, Veterinary Science, and Zoology, all of which are taught outside of the department. Such subjects as Political Economy, History, Modern Languages, and Literature are given a prominent place, and the complete course is intended to equip the student with a well-balanced education.

The work in agriculture proper extends throughout the entire College course. The laboratory method is used in all subjects that are adapted to it. Laboratory work is, in all cases, supplemented by lectures and collateral reading. For the latter purpose the general library, with its specially selected departmental alcoves, the files of the Experiment Station, and a large list of current periodicals, are all available.

The courses are so planned that the work naturally falls into the following four groups, or divisions: AGRONOMY, HORTICULTURE, ANIMAL HUSBANDRY, DAIRYING. The student is allowed to select and follow which of these groups he may prefer, and opportunity is given for a wide range of studies from which to choose. While it is presumed that those making choice of a group will usually follow out

the subjects so arranged and composing the group, there is nothing to prevent the election of other subjects in other groups if the student so prefers, and his freedom is only limited by the number of electives or alternatives permitted in the schedule. There are also a number of additional courses offered, not scheduled or required, which are open to election.

AGRONOMY.

1. Soils. *Full course.* This course is designed to acquaint the student with a knowledge of the origin, formation, and classification of soils, with special reference to those peculiar to the Northwest; texture in its relation to moisture, temperature, and air; capillarity, osmosis, and diffusion as affected by the various operations of tillage; fertility, and the conditions and circumstances that influence it. The handling of soils under irrigation and the treatment of alkali lands will be considered. Physical analysis of soils. Lectures and readings. Three recitations and two laboratory periods per week, first semester. Assistant Professor Severance.

2. Rural Engineering. *Three-fifths course.* This subject includes the principles of drainage, irrigation, road-making, construction of buildings, fences, etc., and the mechanical principles involved in farm machinery. Three times a week, second semester. Assistant Professor Severance.

3. Crop Production. *Full course.* A study of the requirements and adaptability of the cereals, grasses, legumes, and other crops and their culture; seeds, selection and vitality, and germination; preparation of seed bed; time and methods of seeding and subsequent care of crop; systems of rotation; influence of climate and soil conditions on the distribution and development of different crops; enemies to plant growth, weeds, injurious insects, fungus diseases, and methods for their prevention and eradication. Four recitations and two hours of laboratory work per week, second semester. Assistant Professor Severance.

4. Cereal Crops. *Full course.* A study of grains; grain judging; grading for market according to inspectors' and buyers' standards; harvesting, storing, and handling to secure quality and prevent loss; extent, distribution, and cost of production; markets, and uses of the crop. Three recitations or lectures and two laboratory periods per week, first semester.

Exhibit 2, from the 1905 WSU catalogue, showing the Divisions of the Department of Agriculture and the composition of the general courses in soils.

AGRICULTURE.

AGRONOMY GROUP.

SCHEDULE OF STUDIES.

FRESHMAN YEAR.

FIRST SEMESTER.—*The Study of Animal Form* (A. H. 1) or *Fruit Growing* (Hort. 2); *Trigonometry* (Ma. 3), 3-5; and *Climatology* (Ag. 7), 2-5; *Chemistry; German* 1 or *French* 1.

SECOND SEMESTER.—*Feeds and Feeding* (A. H. 3), 3-5, and *Plane Surveying* (C. E. 7a), 2-5; *Rhetoric and Composition* (Engl. 2); *Chemistry* 3a; *German* 1 or *French* 1.

SOPHOMORE YEAR.

FIRST SEMESTER.—*Soils* (Ag. 1); General Botany (Bot. 1); *Agricultural Chemistry* (Chem. 19); *German* 2 or *French* 2.

SECOND SEMESTER.—*Crop Production* (Ag. 3); *The French Revolution and Napoleonic Era* (Hist. 1); *Agricultural Chemistry* (Chem. 20), 3-5, and *Types of Carbon Compounds* (Chem. 14), 2-5; *German* 3 or *French* 3.

JUNIOR YEAR.

FIRST SEMESTER.—*Cereal Crops* (Ag. 4); Economic Fungi (Bot. 9); Economic Entomology (Zool. 8); Elective; *Military Science* (for men), 1-5.

SECOND SEMESTER.—*Plant Breeding* (Ag. 5); Bacteriology (Zool. 11); Plant Physiology (Bot. 5); Oratory and Debate (Engl. 6); *Military Science* (for men), 1-5.

SENIOR YEAR.

FIRST SEMESTER.—*Thesis;* Dynamical and Structural Geology (Geol. 1), 3-5, and Historical Geology (Geol. 2), 2-5; Irrigation Farming (Ag. 6); Agricultural Economics (Ec. Sci. 13).

SECOND SEMESTER.—*Thesis; Rural Economy* (Ag. 9), 2-5, and *Rural Engineering* (Ag. 2), 3-5; Elective; Elective.

Courses printed above in *italics* are required for graduation; others are recommended as suitable electives. For description of the courses offered by the department of Agriculture, see pages 61-69. For the general requirements for grdauation, see page 161

Exhibit 3, from the 1907 WSU catalogue, showing the four-year Schedule of Studies for the Agronomy Group.

Group, three soils, or soils-related, courses were required: Beginning Soils, Agricultural Chemistry, and Irrigation Farming. Other soils courses were available and could be taken as electives.

In 1909, Howard B. Berry was hired as Instructor and took over most of the soils instruction. He was replaced by Clark C. Thom in 1910. In the same year, George Severance, who had continued to teach some soils courses, transferred to Puyallup as Head of the Branch Experiment Station that had been established there. His replacement in Pullman was Leonard Hegnauer, a Crop Scientist, which left full responsibility for teaching the soils courses to Mr. Thom. Thom carried a heavy load for a number of years and taught soils at both beginning and advanced levels.

By 1911, four courses in soils were offered: the beginning course, termed Soils Physics, Soils and Fertilizers, Irrigation and Dry Farming, and Advanced Soil Studies. A fifth course taught in the Chemistry Department, Agricultural Chemistry, had a strong bias toward soils. In 1912, there was the first indication that students could take higher level soils courses applicable toward an advanced degree, a Master of Science in Agriculture. For this, two laboratory courses, directed by Mr. Thom, were listed in the catalogue.

In 1914, George Severance returned to Pullman as Head of the Department of Agriculture. He apparently did no teaching, thus leaving this responsibility in soils totally to Mr. Thom. Even so, two new soils courses were added at this time: Applied Soil Bacteriology, and Principles of Soil Productivity. However, Arthur F. Heck joined the Agricultural Faculty in 1915 and took over a part of the teaching load in soils. During Heck's second year, in 1916, separate schedules of study were listed for

Soils and for Farm Crops in the catalogue (see Exhibit 4b), but only for Junior and Senior years. All majors in Agriculture followed the same schedule for the first two years. As shown in Exhibit 4a, Professor Thom and Mr. Heck were now teaching six separate courses in soils, with the introductory course being taught each semester. Thom resigned in the fall of 1916, which left Heck with the entire teaching load.

Fred J. Sievers, Soil Physicist, joined the Faculty in 1917. In the following year, a split in Farm Crops and Soils occurred, and separate departments were established for each. Sievers was made Head of Soils; Edward Schafer, became Head of Farm Crops. This change accompanied the transformation of the Department of Agriculture into a College, with Edward C. Johnson as Dean and George Severance as Vice Dean. Henry F. Holtz joined the Department of Soils as Soil Physicist in 1918, but his work was limited primarily to research. As shown by Exhibits 5a, all teaching of soils was in the hands of Sievers and Heck. They shared this responsibility through 1923, a period during which the types of courses and the curriculum in soils remained stable.

In 1924, two courses, Soil Management and Plant Nutrition, were added, and in the following year students could take a course titled Special Problems for credit. Also in 1925, a new course-numbering system was adopted by the University: numbers 0-99 were for undergraduate credit; 100-199 for either undergraduate or graduate credit; and 200-level numbers for graduate credit only. Most of the courses taught in soils qualified for graduate credit (see Exhibit 6).

In 1928, Soils and Farm Crops were combined into a single department, the Department of Agronomy, with E. G. Schafer as Head. Soils was

DEPARTMENT OF AGRICULTURE.

GEORGE SEVERANCE, *Professor, and Head of the Department.*
CLARK C. THOM, *Professor of Soils.*
AMER B. NYSTROM, *Professor of Dairying.*
EDWIN G. SCHAFER, *Professor of Farm Crops.*
WILLIAM HISLOP, *Professor of Animal Husbandry.*
IRVING D. CHARLTON, *Professor of Agricultural Engineering.*
HELEN D. WHITAKER, *Assistant Professor of Poultry Husbandry.*
EDWARD F. GAINES, *Instructor in Agronomy.*
THOMAS H. WRIGHT, JR., *Instructor in Dairy Manufactures.*
ARTHUR F. HECK, *Instructor in Soils.*
CARROLL E. HOWELL, *Instructor in Animal Husbandry.*
LEONARD J. FLETCHER, *Instructor in Agricultural Engineering.*
EMORY D. ALVORD, *Instructor in Farm Crops.*
ROY M. PHILLIPS, *Instructor in Dairy Production.*
WILLIAM K. WHITAKER, *Instructor in Poultry Husbandry.*
EARL B. KRANTZ, *Instructor in Animal Husbandry.*

The courses of study offered in this department are intended to give a thorough training in the field of agriculture as a science. The art, or practice, of agriculture, as a vocation, is not lost sight of; but the fundamental purpose of the work leading to the degree of Bachelor of Science is a mastery of the science itself. For this reason, the work in agriculture proper is given chiefly in the last two years of the course, and is preceded by as thorough training as possible in the sciences which underlie the principles of agriculture; namely, Botany, Chemistry, Veterinary Science, and Zoology. Such subjects as Political Science, History, Modern Languages, and Literature are given a prominent place, and the complete course is intended to equip the student with a well-balanced education.

The completion of such a course prepares the student for intelligent practical farming; for farm management and supervision; for investigating agricultural problems in connection with

Experiment Station work; for teaching agriculture and the allied sciences; or for service in the United States Department of Agriculture. The demand for men trained to fill such positions far exceeds the supply.

The laboratory method of study is used in all subjects that are adapted to it. Laboratory work is, in all cases, supplemented by lectures and collateral reading. For this purpose the general library, with its specially selected departmental alcoves, the files of the Experiment Station, and a large list of current periodicals are all available.

Courses are offered in six groups: General Agriculture, Farm Crops, Soils, Animal Husbandry, Dairy Husbandry, and Poultry Husbandry. The student is allowed to select the group he prefers, and opportunity is given to choose from a wide range of studies. While it is presumed that those making choice of a group will usually follow out the subjects so arranged and composing the group, there is nothing to prevent the election of other subjects in other groups if the student so prefers, and his freedom is only limited by the number of electives or alternatives permitted in the schedule. There are also a number of additional courses offered, which are open to election.

For the courses required for graduation from this department, see the Schedule of Studies on pages 312-316.

AGRONOMY.

SOILS.

1. SOIL PHYSICS. *Four hours.** A study of the nature and origin of soils, their formation, and classification. The use of soil; soil texture; the physical relation of soil to moisture, temperature, and air. Physical analysis of soils. Prerequisite: Chemistry 1. Two recitations and four hours of laboratory work per week, each semester. *Mr. Heck.*

8. ADVANCED SOIL STUDIES. *Three hours.* This course embraces largely a study of the methods used by the Bureau of Soils of the United States Department of Agriculture in conducting both laboratory and field investigations in the physical and biological properties of soils; the use of the centrifugal machine

* For the meaning of the term "hour," see page 87.

Exhibit 4a, from the 1916 WSU catalogue, showing course offerings in soils.

for mechanical analysis and the apparatus for determining the temperature, moisture, and soluble salts. Classification and mapping, accompanied by a study of Experiment Station literature and Government publications. Prerequisite: Ag. 1. Two recitations and two hours of laboratory work per week, first semester. *Professor Thom.*

11. Dry Farming Practices. *Three hours.* Dry farming defined; general climatic features of dry farming areas of the United States; total and seasonal precipitation; water capacity of soils; storage and conservation of natural precipitation in the soil; summer tillage in relation to dry farming; methods of tillage; the water requirements of crops and their adaptability to dry farming conditions. Prerequisite: Ag. 1. Three lectures or recitations per week, with library work, second semester. *Professor Thom.*

18. Applied Soil Bacteriology. *Three hours.* The practical application of Soil Bacteriology. The effect of methods of cultivation, rotation, moisture, and soil texture upon the growth and activity of soil organisms and the relation of these organisms to soil fertility. The laboratory periods to consist largely of work in the field, supplemented by work in the greenhouse and tests in the laboratory. Prerequisites: Ag. 1, Chem. 19, and Bot. 72. One lecture and four hours of laboratory work per week, first semester. *Professor Thom.*

21. Irrigation and Drainage Practices. *Three hours.* A general study of the use of irrigation water in growing crops. The relation of soil moisture to crop production. The preparation of the soil to receive water, methods of distributing water on the land; the storage and conservation of water in the soil. The moisture requirements of crops and their adaptability to irrigation conditions. The economical use of water. The bad effects of over-irrigation, seepage water, and alkali. Open drains and tile systems for the draining out of surplus water. Prerequisite: Ag. 1. Three lectures per week, first semester. *Professor Thom* and *Mr. Heck.*

23. The Principles of Soil Productivity. *Five hours.* The laws of crop nutrition. The different needs of different crops as affected by the habit and character of the plant; the amount of soilage and seed produced; the extent of root system; the age

Exhibit 4a continued.

of the plant, its length of life, etc. The soil solution, diffusion, and osmosis. Strong solutions, weak solutions. The solubility of plant foods as affected by methods of tillage. Spring tillage, summer tillage, fall tillage, intertillage, and summer fallow. Humus in its relation to fertility, its effect upon soil moisture, soil texture, and the solubility of plant foods in the soil. Effect of sodding. Rotations; why rotations increase productivity. Long and short rotations compared. Suitable rotations for the different systems of farming. The laboratory work will consist almost entirely of pot experiments in the greenhouse and of tests made in the field. Prerequisites: Ag. 1 and Bot. 18. Two lectures and six hours of laboratory work per week, second semester. *Professor Thom.*

AGRONOMY.

FARM CROPS.

3. Forage Crops. *Five hours.* A study of the requirements and adaptability of the grasses, legumes, and other crops and their culture; seeds, selection and vitality, and germination; preparation of seed bed; time and methods of seeding and subsequent care of the crops; systems of rotation; influence of climate and soil conditions on the distribution and development of different crops. Prerequisites: Bot. 1, 2, 91, and 92. Four recitations and two hours of laboratory work per week, second semester. *Professor Schafer* and *Mr. Alvord.*

4. Cereal Crops. *Five hours.* A study of the cereals; methods of production, harvesting, and marketing of grains; soil and climate adaptations; markets and uses of the crop. Prerequisites: Bot. 1, 2, 91, and 92. Three recitations and four hours of laboratory work per week, first semester. *Professor Schafer* and *Mr. Alvord.*

5. Plant Breeding. *Two hours.* A study of the methods of improving cereal and forage crops. The laws of heredity, variation, and selection as applied to these crops; hybridization and pure-line selection; methods of keeping records; breeding for special purposes. Prerequisites: Bot. 1, 2, 91, 92, and 45; Ag. 3 and 4. Two recitations per week, with library and field work, second semester. *Mr. Gaines.*

7. Climatology. *Two hours.* A consideration of climate, with special reference to its relation to agriculture. Special attention is given to local climate. Practice work in keeping meteor-

AGRICULTURE*—GENERAL COURSE.

Freshman Year.

First Semester—	Hrs.	Second Semester—	Hrs.
Animal Form (A. H. 1) or *Field Crops* (Ag. 22)	5	*Field Crops* (Ag. 22) or *Animal Form* (A. H. 1)	5
English 28 and 30	5	*English* 29 and 31	5
Chemistry 1	5	*Chemistry* 33	5
Physics 13	3	*Physics* 14	3
Zoology 38	2	*Geology* 17	2

Sophomore Year.

Section A.

Soil Physics (Ag. 1)	4	*Farm Machinery* (Ag. 26)	3
Soils and Fertilizers (Chem. 19)	3	*Farm Motors* (Ag. 27)	2
Farm Dairying (D. 1)	3	*Chemistry* 14	5
Botany 1 and 91	5	*Bacteriology* (Bot. 18)	3
A Modern Language†	5	*A Modern Language*†	5

Section B.

Farm Motors (Ag. 27)	2	*Soil Physics* (Ag. 1)	4
Soils and Fertilizers (Chem. 19)	3	*Dairy Farming* (D. 1)	3
Botany 1 and 91	5	*Farm Machinery* (Ag. 26)	3
Bacteriology (Bot. 18)	5	*Chemistry* 14	5
A Modern Language†	5	*A Modern Language*†	5

Junior Year.

Principles of Feeding (A. H. 3)	3	*Economic Science, Education, or English*	5
Principles of Breeding (A. H. 4)	2	*Economics* 31	5
Zoology 22	5	*A Modern Language*	5
A Modern Language	5	Elective	5
Elective	5		

Senior Year.

Principles of Fruit Growing (Hort. 11)	5	*Farm Management* (Ag. 13)	3
Major Elective‡	5	*General Poultry Husbandry* (P. H. 5)	3
Elective	10	*Major Elective*‡	5
		Elective	9

For description of the courses offered by the department of Agriculture, see pages 144-156. For definition of the term "hour" and the general requirements for graduation, see pages 87, 89.

Freshmen and Sophomores should add to their schedule Military Drill or Physical Culture, and all students should add to their schedule the course in "How to Use the Library." See page 291.

* The work in the Freshman year is the same for all Agricultural groups. Beginning with the Junior year the work is differentiated into six groups: General, Soils, Crops, Dairy Husbandry, Animal Husbandry, and Poultry Husbandry. The student may select one group and must complete the work required in some one group before graduation. Ample opportunity is given to elect subjects from other groups during the Junior and Senior years.

† High school credits in foreign language may be applied toward the two years of foreign language requirement.

‡ Any subject taught in any Division of Agriculture shall be considered a major in the course in General Agriculture.

AGRICULTURE—FARM CROPS GROUP.

(Freshman and Sophomore years the same as in General Agriculture.)

Junior Year.

First Semester—	Hrs.	Second Semester—	Hrs.
Botany 2 and 92	5	*Principles of Feeding* (A. H. 3)	3
Cereal Crops (Ag. 4)	5	*Forage Crops* (Ag. 3)	5
A Modern Language	5	*Plant Breeding* (Ag. 5)	2
Elective	5	*A Modern Language*	5
		Botany 45	5

Senior Year.

Plant Pathology (Bot. 51)	5	*Soil Productivity* (Ag. 23)	5
Economics 31	5	*Farm Management* (Ag. 13)	3
Economic Science, Education, or English	5	*Weeds* (Ag. 25)	2
Climatology	2	Elective	10
Elective	3		

AGRICULTURE—SOILS GROUP.

(Freshman and Sophomore years the same as in General Agriculture.)

Junior Year.

First Semester—	Hrs.	Second Semester—	Hrs.
English, Education, or Economics	5	*Principles of Soil Productivity* (Ag. 23)	5
Agricultural Quantitative Analysis (Chem. 22)	5	*General Plant Physiology* (Bot. 45)	5
Applied Soil Bacteriology (Ag. 18)	3	*Economics* 31	5
Climatology	2	*A Modern Language*	5
A Modern Language	5		

Senior Year.

Cereal Crops (Ag. 4)	5	*Farm Management*	3
Principles of Feeding	3	*Research*	5
Research	5	Elective	12
Elective	7		

For description of the courses offered by the department of Agriculture, see pages 144-156. For definition of the term "hour" and the general requirements for graduation, see pages 87, 89.

Freshmen and Sophomores should add to their schedule Military Drill or Physical Culture, and all students should add to their schedule the course in "How to Use the Library." See page 291.

Exhibit 4b, from the 1916 WSU catalogue, whowing Schedules of Studies for Juniors and Seniors in Soils and Crops.

DEPARTMENT OF SOILS

FRED J. SIEVERS,
Head of the Department.

A. FLOYD HECK,
Assistant Professor of Soils.

HENRY F. HOLTZ,
Assistant Soil Physicist.

1. (Ag. 1) Soil Physics

Four hours. A study of the origin of soil materials; methods of formation; mechanical composition and classification; texture and structure as affecting capillarity, diffusion, temperature, aeration, and as affected by tillage, cropping, and organic matter; absolute and apparent specific gravity; porosity and capillary capacity; tillage and cropping as affecting moisture. Two lectures and four hours of laboratory work per week, each semester. Professor SIEVERS and Assistant Professor HECK.

2. (Ag. 23) Soil Fertility

Five hours. The influence of the fertility of the soil upon crop yields; effects of different crops, rotations and methods of cultivation on the immediate crop producing power of the soil and the ultimate effect of different systems of farming upon soil fertility; the fertility of soils of different types or classes from the various sections of the State of Washington; depletion and maintenance of the fertility of the soil; principles and methods of maintaining a permanent system of agriculture. Two lectures and six hours of laboratory work per week, second semester. Prerequisite: Soils 1. Assistant Professor HECK.

3. (Ag. 18) Soil Biology

Three hours. Bio-chemical activities of soil micro-organisms as related to soil fertility; factors affecting the protozoa, algae, fungi, and bacteria; decomposition of crop residues, green and farm manures and the effect on the availability of plant food materials; ammonification, nitration, nitrogen fixation, and possible losses. One lecture and four hours of laboratory work per week, first semester. Prerequisite: Bact. 1. Assistant Professor HECK.

4. (Ag. 8) Advanced Soil Studies

Three hours. This course is designed largely to cover the more advanced fields of soil Physics and soil Fertility. Students who have completed the first courses in these subjects are given an opportunity to further pursue the same subjects along more advanced and special lines; the work mainly to consist of laboratory work with consultations and assigned library work; time to be arranged with the instructor. First semester. Prerequisites: Soils 1 and 2. Consulting Instructor Assistant Professor HECK.

5. (Ag. 11) Dry Farming

Three hours. Dry farming defined; general climatic features of dry farming areas of the United States; total and seasonal precipitation; water capacity of soils; storage and conservation of natural precipitation in the soil; summer tillage in relation to dry farming; methods of tillage; the water requirements of crops and their adaptability to dry farming conditions. Three lectures per week with library work, second semester. Prerequisite: Soils 1. Professor SIEVERS.

6. (Ag. 34) Irrigation Farming

Two hours. A general study of the use of irrigation water; relation of soil moisture to crop production; preparation of the soil to receive water and methods of distribution on the land; storage and conservation of water in the soil; moisture requirements of crops and their adaptability to irrigated conditions; economical use of water; the bad effects and correction of over-irrigation, seepage water, and alkali. Two lectures per week with assigned outside reading, first semester. Prerequisite: Soils 1. Professor SIEVERS.

Exhibit 5a, from the 1918 WSU catalogue, showing course offerings in soils.

AGRICULTURE—SOILS GROUP

Junior Year

First Semester—	Hrs.	Second Semester—	Hrs.
Principles of Economics (Ec. 31)	5	**Soil Fertility** (Soils 2)	5
Principles of Feeding (A H 3)	3	**Economics, Education, or English**	5
Cereal Crops (F. C. 3)	3	**Agricultural Elective**	5
Climatology (F. C. 7)	2	**Science Elective**	5
Agricultural Elective	3		
Elective	4		

Senior Year

Soil Biology (Soils 3)	3	**Farm Management** (Ag. 13)	3
Thesis, Research, or Major Elective	5	**Thesis, Research, or Major Elective**	5
Agricultural Elective	7	**Agricultural Elective**	7
Elective	5	Elective	5

Courses printed above in bold-faced type are required for graduation.

Exhibit 5b, from the 1918 WSU catalogue, showing the Schedule of Studies for Junior and Senior years in soils.

DEPARTMENT OF SOILS

FRED J. SIEVERS, Professor of Soils, and Head of the Department.
H. F. HOLTZ, Associate Professor of Soils.
EVERETT W. BLAISDELL, Fellow.
ROSCOE E. BELL, Fellow.

1. SOILS. *First semester. Three hours. Two class periods and four hours laboratory work per week.* MR. SIEVERS and ASSISTANT. The origin of soil materials; methods of formation; mechanical composition and classification; texture and structure as affecting capillarity, temperature, aeration, and as affected by tillage, cropping and organic matter; porosity and capillary capacity; tillage and cropping as affecting moisture and plant food.

102. (2) SOIL FERTILITY. *Second semester. Three hours. One class period and four hours laboratory work per week. Prerequisites: Chem. 22, Soils 1.* MR. HOLTZ and ASSISTANT. What constitutes soil fertility and an application of the factors that may have a temporary or permanent influence on it.

103. (3) SOIL BIOLOGY. *First semester. Three hours. One class period and four hours laboratory work per week. Prerequisites: Bact. 1, Chem. 22.* MR. HOLTZ and ASSISTANT. The factors affecting the biochemical activities of soil organisms as related to the elaboration of plant food and to productivity in general.

104. (4) ADVANCED SOIL STUDIES. *Each semester. Two to five hours. Class periods and laboratory by arrangement. Prerequisite: Soils 102.* MR. HOLTZ. The more advanced fields of soil physics and soil fertility.

105. (5) SOIL MANAGEMENT. *Second semester. Two hours. Two class periods per week. Prerequisite: Soils 1.* MR. SIEVERS. The application of the principles involved in promoting and maintaining the productiveness of various soil types under arid, humid and irrigated conditions.

106. (6) IRRIGATION FARMING. *First semester. Two hours. Two class periods per week. Prerequisite: Soils 1.* MR. SIEVERS. The methods of using irrigation water from the standpoint of their influence on those fundamental factors having a direct bearing on economic crop production.

107. (7) PLANT NUTRITION. *Second semester. Three hours. Two class periods and three hours laboratory work per week. Prerequisites: Soils 1, Bot. 1, and Chem. 22.* MR. SIEVERS. Those external factors and relationships influencing plant growth that are controllable by agricultural practices.

108. (8) CLIMATOLOGY. *First semester. Two hours. Two class periods per week. Prerequisite: Four hours of physical or biological science.* MR. SIEVERS. Climate, with special reference to its relation to agriculture. Special attention is given to local climate. Practice work in keeping meteorological records and in interpreting their meaning.

109. (9) SPECIAL PROBLEMS. *Each semester. Two to five hours. Class periods and laboratory by arrangement. Prerequisites: Soils 102 and 103.* MR. SIEVERS and MR. HOLTZ. Special assignment of problems selected to stimulate the initiative and imagination essential to successful research work.

110. (10) SPECIAL PROBLEMS. *Each semester. Two to five hours. Class periods and laboratory by arrangement. Prerequisite: Soils 109.* MR. SIEVERS and MR. HOLTZ. Continuation of Soils 109.

112. (12) SEMINAR. *Each semester. One hour. Prerequisite: senior standing.* MR. SIEVERS. A review of Experiment Station literature and other research reports pertaining to soils and soil management. Seniors majoring in soils are given an opportunity to make an extended field trip as a supplement to this course.

113. (13) SEMINAR. *Each semester. One hour. Prerequisite: Senior Standing.* MR. SIEVERS. Continuation of Soils 112.

214. (14) RESEARCH. *Each semester. Two to five hours. Prerequisites: Soils 102 and 103.* MR. SIEVERS and MR. HOLTZ. Original investigations of selected problems pertaining to soils or soil management.

215. (15) RESEARCH. *Each semester. Two to five hours. Prerequisite: Soils 214.* MR. SIEVERS and MR. HOLTZ. Continuation of Soils 214.

COURSES FOR GRADUATE CREDIT. Major or minor, 104, 105, 106, 107, 109, 110, 112, 113, 214, 215. Minor, 102, 103, 108.

AGRICULTURE—SOILS

Freshman and sophomore years the same as in General Agriculture.

Junior Year

First Semester—	Hrs.	Second Semester—	Hrs.
Principles of Feeding (A. H. 2)	3	Soil Fertility (S. 102)	3
Forage Crops (F. C. 2)	2	Adv. Cereal Crops (F. C. 102)	3
Rural Landscape Art (Hort. 60)	2	English	3
Climatology (S. 108)	2	Physical Education (P. E. 6)	½
Physical Education (P. E. 5)	½	Elective	8
Elective	7		

Senior Year

Soil Biology (S. 103)	3	Farm Management (F. M. 11)	3
General Plant Physiology (Bot. 125) or Science Elective	4	Farm Drainage (A. E. 3)	2
Soils Elective	4	Soils Elective	4
Elective	5	Electives	7

Exhibit 6, from the 1927 WSU catalogue, showing course offerings and the Schedule of Studies for the Junior and Senior years in soils.

maintained as a separate subsection within the Department. Sievers had resigned, and Dr. S. C. Vandecaveye, who had been a Soil Microbiologist with the Experiment Station since 1924, was brought in as Head of the Soils Section. Mr. Heck took leave that year and was replaced by Roscoe Bell as Instructor. A schedule of studies for soils disappeared from the catalogue, although one remained for agronomy. Even so, students could specialize in soils through a choice of electives, and like all other students in agriculture, were granted a Bachelor of Science in Agriculture on graduation.

Prior to 1929, degrees higher than Master of Science had not been granted at Washington State University. This changed in 1929 when two Ph.D. degrees were awarded. One of these was to Frederick J. Stevenson, who had studied Plant Breeding in the Department of Agronomy; the other was to LaVern A. Barnes, in Bacteriology. The first Ph.D. in Soils was granted to Carl A. Larson in 1931, and a second to Lloyd D. Doneen, in 1933. Both Larson and Doneen worked on soil fertility problems under S. C. Vandecaveye.

By 1930, the two undergraduate courses, Plant Nutrition and Soil Management, were combined into a single course. A new course, Soil Physics and Surveying, and two graduate courses, Advanced Soil Fertility and Advance Soil Microbiology were introduced. In 1931, Roscoe Bell resigned and was replaced by G. O. Baker as Instructor. Dr. L. C. Wheeting also joined the Soils Faculty, primarily to do work on the Washington State Soil Survey.

G. O. Baker resigned in 1936 and was replaced by L. T. Kardos, a graduate of Rutgers University. During this period courses continued to be

revamped and expanded to include new knowledge. The number of course offerings also grew. This was in part due to a dramatic increase in demand for trained soil scientists by the USDA as its National Soil Survey Program moved into high gear. By 1939, 16 courses in soils in addition to Research were taught by Vandecaveye and Kardos (see Exhibit 7). Soils was now a distinct area of specialization for undergraduates within the Department of Agronomy, and advice in course selection was offered in the catalogue for those planning to do graduate work in soils. By this time a course in Soil Conservation Engineering was being offered by the Department of Agricultural Engineering.

In 1942, L. C. Wheeting, an Army Reservist, was called to active duty and was replaced temporarily, from 1944 to 1946, by Jay Haddock, from Utah. In 1943, Louie Kardos resigned and was replaced by Henry W. Smith, a Soil Morphologist from Nebraska. Dr. Smith, meticulous in approach and a strong advocate of excellence in teaching, played a major role in decisions regarding the teaching of soils throughout his long career. In the early years of his tenure, he, like Kardos, shared the teaching of most soils courses with Dr. Vandecaveye.

Substantial growth in the Soils Teaching Faculty followed World War II. In 1946, C. D. Moodie, who was completing work on a doctorate at WSU, was hired as Instructor, and Wheeting returned from military duty the same year. Three others were added to the Faculty in 1948: Dr. H. E. Dregne, to do work on Soil Testing; Dr. J. R. McHenry, a Soil Physicist, and R. A. McCreery, as Instructor and part-time graduate student. Also in 1948, a separate schedule of studies for soils was reintroduced into the catalogue (see Exhibits 8a and b). In 1949, Research and Thesis were separated from other graduate courses by assigning to them 300-level numbers in the catalogue.

DEPARTMENT OF AGRONOMY

Professor and Head of the Department, E. G. Schafer; Professors, E. F. Gaines, S. C. Vandecaveye, L. C. Wheeting; Instructors, W. Hermann, L. T. Kardos.

FARM CROPS

1. Field Crops. *Each semester. Three hours. Two class periods and two hours laboratory work per week.* Mr. Schafer and Mr. Hermann. The adaptability, distribution, and uses of cereal crops. Seed selection, preparation of seed bed, and other important factors in the development of field crops.

2. Forage Crops. *First semester. Two or three hours. One or two class periods and two hours laboratory work per week. Prerequisites: Bot. 2 and F. C. 1.* Mr. Hermann. The production, preservation, and utilization of annual and perennial grasses, legumes, and other forage crops. Adaptability and distribution of forage crops, and factors affecting their value for hay, pasture, silage, etc.

5. Weeds. *Second semester. Two hours. One class period and two hours laboratory work per week. (Given in alternate years; given in 1939-40.) Prerequisite: Bot. 2.* Mr. Schafer. The distribution of weeds, their effect on crop yields, and their control by cropping systems, chemicals, and cultivation.

8. General Agronomy. *First semester. Two hours. Two class periods per week. Designed for students not majoring in the College of Agriculture.* Mr. Schafer. The fundamental principles of crop production and soil management.

9. Crop Judging. *Second semester. Two hours. Four laboratory hours per week.* Mr. Schafer and Mr. Hermann. Judging crops and identification of crops and weeds.

104. Crop Breeding. *Second semester. Three hours. Three class periods per week. Prerequisites: Zool. 162, F. C. 1, and junior standing.* Mr. Gaines. The major crops with reference to the inheritance of their unit characters. The calculation of Mendelian ratios. Methods of keeping records.

106. Grain Grading and Marketing. *First semester. Two hours. One class period and two hours laboratory work per week. Prerequisites: F. C. 1 and junior standing.* Mr. Schafer. Grain marketing, grain classification, and the establishment of grades according to quality and condition.

109. Special Problems. *Each semester. Variable credit. For senior and graduate students.* Mr. Schafer, Mr. Gaines, or Mr. Hermann.

110. Seminar. *Each semester. One hour. Prequisite: Junior standing.* Mr. Schafer and Mr. Gaines. A review of current literature on farm crops subjects and reports on research or special topics pertaining to farm crops.

111. Cereal Genetics. *Second semester. (Given in alternate years; given in 1939-40.) Three hours. Three class periods per week. Prerequisite: F. C. 104. For senior and graduate students.* Mr. Gaines. Lecture and library course covering the present information on the genetics of wheat, corn, barley, and oats.

112. Experimental Methods. *Second semester. (Given in alternate years; given in 1939-40.) Two hours. One class period and two hours laboratory. For senior and graduate students.* Mr. Schafer. Methods used in conducting and interpreting experimental work in field crops.

113. Research in Farm Crops. *Each semester. Variable credit. For graduate students.* Mr. Schafer, Mr. Gaines, or Mr. Hermann. Original investigation of selected topics.

114. Crop Ecology. *Second semester. (Given in alternate years; given in 1940-41.) Two hours. Lectures, reading, and reports. Junior standing. Entrance by permission.* Mr. Hermann. Climatic, edaphic, biotic, physiographic, economic, and sociological factors influencing crop production. Methods of crop ecology.

SOILS

1. Soils. *First semester. Three hours. Two class periods and three hours laboratory work per week. Prerequisite: Chem. 3.* Mr. Vandecaveye and Mr. Kardos. The origin of soil materials; methods of formation; mechanical composition and classification; texture and structure as affecting capillarity, temperature, aeration, and as affected by tillage, cropping, and organic matter; porosity and capillary capacity; tillage and cropping as affecting moisture and plant food.

2. Pedology. *Second semester. Two class periods and three hours laboratory work per week. Prerequisite: Chem. 3 (Chem. 46 suggested) or junior standing.* Mr. Vandecaveye and Mr. Kardos. A study of the soil as a natural body developed under the influence of environmental conditions. The natural laws governing the origin, formation, and distribution of soils. Designed to meet the needs of students in Forestry and as an elective cultural subject.

16. Soil Management Under Irrigation. *First semester. (Given in alternate years; given in 1939-40.) Two hours. Two class periods per week. Prerequisite: Soils 1.* Mr. Vandecaveye. The methods of using irrigation water; penetration and movement of water in the soil; drainage requirements resulting from irrigation; the handling of alkali problems in connection with economic crop production.

102. Soil Fertility. *Second semester. Three hours. One class period and six hours laboratory work per week. Prerequisites: Chem. 115 and Soils 1.* Mr. Kardos. Constituents of soil fertility with special emphasis on the availability of plant nutrients and on

Exhibit 7, from the 1939 WSU catalogue, showing course offerings in Farm Crops and Soils.

the application of factors that may have a temporary or permanent influence on the soil and on its management. Students are encouraged to obtain soil from their home place for use in the laboratory.

103. Soil Biology. *First semester. (Given in alternate years; given in 1939-40.) Three hours. One class period and six hours laboratory work per week. Prerequisites: Bact. 10 and Chem. 115.* Mr. Vandecaveye and Mr. Kardos. The factors affecting the biochemical activities of soil and crop organisms as related to the elaboration of plant food and to productivity in general.

107. Plant Nutrition and Soil Management. *Second semester. (Given in alternate years; given in 1940-41.) Three hours. Two class periods and three hours laboratory per week. Prerequisites: Soils 1, Bot. 1, Chem. 46.* Mr. Vandecaveye and Mr. Kardos. The external factors influencing plant growth. The application of scientific principles in correcting abnormal soil conditions, soil management practices, and the use of fertilizers in maintaining the productivity of soils in semi-arid and humid areas.

108. Climatology. *First semester. Two hours. Two class periods per week. Prerequisites: Four hours of physical or biological science, and junior standing.* Mr. Kardos. The physical factors influencing the climate with special attention to its relation to agriculture. Practice work in keeping and interpreting meteorological records.

109. Special Problems. *Each semester. Variable credit. Class periods and laboratory by arrangement. Prerequisite: Soils 102.* Mr. Vandecaveye, Mr. Wheeting, or Mr. Kardos. Special assignment of problems selected to stimulate the initiative and imagination essential to successful research work.

111. Soil Physics. *First semester. (Given in alternate years; given in 1940-41.) Three hours. Two class periods and three hours laboratory work per week. Prerequisite: Soils 1. (Physics 5 or Soils 102 suggested.)* Mr. Vandecaveye and Mr. Kardos. The physical constitution and colloidal properties of soils; their measurement and relation to structure, water movement and absorption, aeration, and temperature. Practical applications to tillage, irrigation, drainage, and erosion problems.

112. Seminar. *Each semester. One hour. Prerequisite: Senior standing.* Mr. Vandecaveye. A review of current literature on soils subjects and reports on research or special topics pertaining to soils.

115. Soil and Land Classification. *Second semester. (Given in alternate years; given in 1939-40.) Three hours. Two class periods and three hours laboratory work per week. Prerequisite: Soils 102 or 111.* Mr. Vandecaveye and Mr. Kardos. Influence of parent material, climate, and vegetation on the development of soil profiles. Classification of soils emphasizing Washington soils, particularly in relation to problems of land utilization. Practice in field work and mapping of an assigned area.

Exhibit 7 continued.

200. Methods for Soil Investigation. *First semester. Three hours. Two class periods and three hours laboratory work per week. Prerequisites: Soils 102 and Chem. 131.* Mr. Vandecaveye or Mr. Kardos. Fundamental principles in methods of soil analysis and in the more important lines of soil investigations in the United States and some foreign countries.

201. Colloidal Properties of Soils. *First semester. Variable credit. Lectures and discussions. Prerequisites: Soils 102 and Chem. 131 (Chem. 134 suggested).* Mr. Vandecaveye or Mr. Kardos. The application of physical and colloidal chemistry to soil constituents with emphasis upon the physical and chemical nature of organic and inorganic colloids as affecting soil reaction, base exchange, and the soil solution.

202. Advanced Soil Fertility. *Second semester. Variable credit. Lectures and discussions. Prerequisites: Soils 102 and Chem. 131.* Mr. Vandecaveye or Mr. Kardos. A critical study of the nature of soil solutions and of the factors influencing soil productivity. Causes and effects of soil reaction, and principles underlying the liberation, absorption, and fixation of nutrient elements in soils.

203. Advanced Soil Microbiology. *Second semester. Variable credit. Lectures and discussions. Prerequisites: Soils 102, Bact. 110 and Plant Path. 110 (Chem. 131 or 141 suggested).* Mr. Vandecaveye. Occurrence of the most important groups of soil microorganisms, including bacteria, actinomyces, fungi, algae, and protozoa, with special consideration of their activities and influence on soil fertility as affected by soil type, composition, reaction, moisture, and climate.

204. Soil Development and Morphology. *Second semester. Variable credit. Lectures and discussions. Prerequisites: Soils 102 and Chem. 131.* Mr. Vandecaveye or Mr. Kardos. Origin, nomenclature, and classification of soils with emphasis on the physical, chemical, and climatological factors that influence soil development.

214. Research. *Each semester. Variable credit. Prerequisites: Soils 102 and Chem. 131.* Mr. Vandecaveye, Mr. Wheeting, and Mr. Kardos. Original investigations of selected problems in various phases of soil science.

AGRONOMY

100. Soil Conservation. *Second semester. Three hours. Two class periods and three hours laboratory per week. Prerequisite: Junior standing.* Mr. Schafer and Mr. Vandecaveye. The physical

Soils

1. SOILS. *Each sem. 4 hrs. 3 lectures and 3 hrs. laboratory a week. Prerequisite: Chem. 2 or 3.* STAFF. An introductory course dealing with the origin, formation, mechanical composition, classification, productivity, and management of soils.

10. SOIL CONSERVATION. *2nd sem. 3 hrs. 2 lectures and 3 hrs. laboratory a week. Prerequisite: Soils 1.* VANDECAVEYE. A study of the physical properties, tillage, and management of soils, and of crops and cropping systems as applied to soil conservation and soil-erosion control.

16. SOIL MANAGEMENT UNDER IRRIGATION. *1st sem. (Given in 1948-49 and alternate years.) 2 hrs. 2 lectures a week. Prerequisite: Soils 1.* VANDECAVEYE. Irrigation methods; penetration and movement of water in soils; and methods of handling alkali problems under irrigation.

102. SOIL FERTILITY. *Each sem. 4 hrs. 2 lectures and 6 hrs. of laboratory a week. Prerequisite: Chem. 115 or 121; Soils 1.* MOODIE and MCCREERY. Principles of soil fertility; analysis of soils and crops; influence of fertilizers, manures, and soil amendments on soil productivity. Students are urged to obtain soil from their home places for laboratory use.

103. SOIL MICROBIOLOGY. *1st sem. (Given in 1949-50 and alternate years.) 3 hrs. 1 lecture and 6 hrs. laboratory a week. Prerequisite: Bact. 10; Chem. 115.* VANDECAVEYE and MOODIE. Occurrence and activity of soil microorganisms as applied to soil fertility; their influence on organic matter transformation and nitrogen economy in soils.

104. SOIL CLASSIFICATION. *2nd sem. 3 hrs. 2 lectures and 3 hrs. laboratory a week. Prerequisite: Soils 1; permission of the instructor.* H. SMITH. Description and identification of soil profiles; systems of soil classification and interpretation of soil survey data; practice in soil surveying and mapping.

109. SPECIAL PROBLEMS. *Each sem. 1-5 hrs. Lectures and laboratory arranged. Prerequisite: 6 hrs. of soils; permission of instructor.* STAFF. Special assignment of problems selected to stimulate the initiative and imagination essential to successful research work.

111. SOIL PHYSICS. *1st sem. 4 hrs. 2 lectures and 6 hrs. laboratory a week.* MCHENRY. Constitution and colloidal properties of soils; their measurement in relation to the structure, water movement, aeration, temperature, tillage, and erosion of soils.

112. SEMINAR. *Each sem. 1 hr. Prerequisite: senior standing.* STAFF. A review of current literature on soil subjects and reports on research or special topics pertaining to soils.

200. METHODS FOR SOIL INVESTIGATION. *1st sem. 1-6 hrs. Lectures and laboratory arranged. Prerequisite: Soils 102.* STAFF. Fundamental principles in methods of soil analysis and in the more important lines of soil investigations in the United States and some foreign countries.

201. COLLOIDAL PROPERTIES OF SOILS. *1-6 hrs. Lectures and discussion. Prerequisite: Soils 102; Chem. 131 (Chem. 134 suggested).* STAFF. Physical and colloidal chemistry as applied to soils with emphasis upon the nature of organic and inorganic colloids in relation to reaction, ion exchange, and solutions of soils.

202. ADVANCED SOIL FERTILITY. *2nd sem. 1-6 hrs. Lectures and discussion. Prerequisite: Soils 102; Chem. 131.* STAFF. A critical study of the factors influencing soil productivity; causes and effects of soil reaction; principles affecting the liberation, absorption, and fixation of plant nutrients.

203. ADVANCED SOIL MICROBIOLOGY. *1-6 hrs. Lectures and discussion. Prerequisite: Soils 102; Bact. 10; P. P. 29 (Chem. 131 or 141 suggested).* STAFF. Methods of investigation; critical study of the bacteria, actinomyces, fungi, algae, and protozoa in relation to their activities and influence on soil formation and fertility.

204. SOIL DEVELOPMENT AND MORPHOLOGY. *2nd sem. 1-6 hrs. Lectures and discussion. Prerequisite: Soils 102; Chem. 131.* STAFF. Origin, nomenclature, and classification of soils with emphasis on the physical, chemical, and climatological factors that influence soil development.

211. ADVANCED SOIL PHYSICS. *2-6 hrs. Lectures, conferences, and laboratory problems. Prerequisite: Soils 111, 201; Chem. 131.* STAFF. Critical study of selected topics in soil physics supplemented by laboratory problems.

214. RESEARCH. *Each sem. 1-16 hrs. Prerequisite: Soils 102; Chem. 131.* STAFF. Original investigations of selected problems in various phases of soil science.

NOTE: Courses that may be taken for graduate credit when soil science is a minor field are: Soils 102, 103, 104, and 109, except where these courses are a part of the undergraduate curriculum of the individual's major field.

Students entering advanced work for the M.S. or Ph.D. degree in farm crops or soil science must have completed the respective undergraduate curriculum or its equivalent.

Exhibit 8a, from the 1948 WSU catalogue, showing course offerings in soils.

Soil Science

The freshman year is the same as that described for the General Course in Agriculture except that F. C. 1 and Hort. 1 are required for graduation.

Sophomore Year

First Semester—	Hours	Second Semester—	Hours
Principles of Economics (Econ. 12)	4	*Humanities*	3
Introductory Geology (Geol 1)	4	*Introductory Botany* (Bot. 6)	3
Quantitative Agricultural Analysis (Chem. 115 or 121)	3 or 4	*General Bacteriology* (Bact. 10)	4
Introductory Botany (Bot. 5)	3	*Soils* (Soils 1)	4
Military	1½	*Plane Trigonometry or College Algebra* (Math. 2 or 3)	3
Physical Education	½	*Military*	1½
		Physical Education	½

Junior Year

Soil Fertility or Soil Microbiology (Soils 102 or 103)	4 or 3	*Organic Chemistry or Agricultural Organic Chemistry* (Chem. 44 or 46)	4 or 3
Engineering Physics or General Physics (Phys. 1 or 5)	5 or 4	*Engineering Physics or General Physics* (Phys. 2 or 6)	5 or 4
Elective	8 or 10	*Humanities or Social Science*	3
Physical Education	½	Elective	5 or 7
		Physical Education	½

Senior Year

Introductory Plant Physiology (Bot. 24)	3	*Soil Classification* (Soils 104)	3
Soil Microbiology (Soils 103) *or Soil Fertility* (Soils 102)	3 or 4	Elective	14
Humanities or Social Science	3		
Elective	8 or 7		

Courses printed in italics are required for graduation.

It is recommended that students planning to enter the field of agricultural extension, soil conservation, or commercial agriculture choose from these courses for their elective hours: Ag. 1; Ag. Econ. 5, 11; A. E. 12, 19; A. H. 1; D. H. 1; For. 1; F. C. 2, 3, 5, 111, 112, 114; Hort. 13, 20, 112; P. H. 5; P. P. 29; Soils 10, 16.

It is urged that prospective graduate students choose from these courses for their elective hours: Bot. 23; Chem. 11, 116 or 122; Engl. 5, 20, 26; F. C. 112; French 1, 2; German 1, 2, 11; Math. 4, 5, 6; P. P. 29.

Exhibit 8b, from the 1948 WSU catalogue, showing the Schedule of Studies for the Sophomore through Senior years for Soils.

In 1947, S. P. Swenson, a Crop Scientist with the Department since 1941, replaced E. G. Shafer as Head. His tenure in this position was relatively short, for he accepted the Deanship of the College of Agriculture in 1949. He was replaced as Chairman by B. R. Bertramson, who received training in soils at Nebraska and came to Pullman from Purdue. During 1949, McHenry and Dregne resigned and were replaced respectively by Drs. Walter Gardner and H. M. Reisenaur. Gardner took over the teaching of Soils Physics at both the undergraduate and graduate levels, while Reisenauer initiated a research program in Soil Fertility and continued the development of a Soil Testing Laboratory.

Dr. Wheeting retired in 1951. In anticipation of this, Mr. Warren Starr, formerly with the Soil Conservation Service, was hired by the Department to continue Wheeting's work in the inventory of Washington soils. Starr was joined by Ray Gilkeson, who completed work on an M.S. degree at WSU in 1952. Both were to become quite heavily involved in teaching as time went on; Starr in Soil Conservation and Soil Geography, and Gilkeson in Forest Soils, Soil Development, Morphology, and Classification, Soil Inventory, and Air Photo Interpretation.

Other significant changes in Faculty occurred in the 1950's. Dr. Vandecaveye retired in 1953, which interrupted the teaching of Soil Microbiology within the Department for a number of years. Additions to the Faculty included Drs. James Kittrick in 1955, Al Halvorson in 1957, and Fred Koehler in 1958. Kittrick came as a Soil Mineralogist trained under M. L. Jackson, at Wisconsin, and Koehler, trained in Soil Fertility at Missouri, initiated an extensive research program on soil fertilization for wheat. Halvorson replaced Mike Reisenauer in Soil Testing.

During the 1950's there was a decided increase in specialization of

teaching at both the undergraduate and graduate levels: Smith in Morphology, Development, and Classification; Moodie in Fertility and Chemistry; Gardner in Physics; Kittrick in Mineralogy; and Starr in Conservation. They were aided in the early fifties by Chairman Bertramson, who took over the Soil Chemistry course for 2 years. Courses had been renumbered; 100 through 400 at the undergraduate level, in the 500's at graduate level, and in the 600's for Research and thesis. The introductory course in soils, Soils 201, was largely team-taught and benefitted from graduate student-instructor help: McCreery until 1954, Dave Miller until 1957, and Steve Rawlins until 1960. The courses and curriculum available during much of this period are shown in Exhibit 9.

In 1960, Dr. R. L. Hausenbuiller, a 1951 graduate of WSU, transferred to Pullman from the Irrigated Experiment Station, Prosser, to take over teaching of the introductory soils course. Dr. H. H. Cheng, with training from Iowa, joined the Faculty in 1965 and was the first to introduce coursework in Soil Biochemistry. He taught at the graduate level primarily. Dr. Brian McNeal came to the Department from the Regional Soil Salinity Laboratory, Riverside, California, in 1969. McNeal developed courses in Soil Chemistry at both undergraduate and graduate levels.

Concern over environmental problems resulted in the 1969 hiring of Dr. Bobby Carlile to do research on waste disposal in soil, and the addition of Dr. Gaylon Campbell, in 1971, on a joint appointment in Agronomy and Soils and Environmental Science. Both Carlile and Campbell had earned their doctorates at WSU. With the Teaching Faculty now at its all-time high, approximately 20 undergraduate and graduate courses were being offered students at WSU (see Exhibit 10). One graduate course, Soil Organic Matter, was taught cooperatively at the University of Idaho.

Soils **SOILS**

201 SOILS 4 (3-3) I II Prereq Chem 102. Chemical, physical, and biological properties of soils.

300 SOIL AND WATER CONSERVATION 3 (2-3) II Prereq Soils 201. Occurrence of erosion; erosion control and water conservation; land management practices and conservation planning.

302 SOIL FERTILITY 4 (2-6) II Prereq Soils 201; Chem 215 recommended. (g) Factors influencing the productive capacity of soils.

304 SOIL MORPHOLOGY AND CLASSIFICATION 3 (2-3) II Prereq Soils 201. (g) Soil profiles; soil-forming processes; systems of classification; field practice in soil description and survey.

399 DIRECTED STUDIES FOR HIGHEST HONORS V 1-4 I II S Prereq 3.00 gpa and recommendation of major department.

411 PHYSICAL PROPERTIES OF SOILS 3 (2-3) I Prereq Math 101; Soils 201. (g) Moisture, structure, aeration, temperature, tillage, and erosion in relation to soil management and to plant growth.

499 SPECIAL PROBLEMS V 1-4 I II S

500 SOIL CHEMISTRY 3 (3-0) II 1959-60 a/y. Prereq Chem 215; Soils 302. Soil as a chemical system; organic constituents; ionic exchange reactions and equilibria.

501 SOIL ANALYSIS 4 (2-6) I 1959-60 a/y. Prereq Chem 215; Soils 302. Quantitative chemical analysis.

502 ADVANCED SOIL FERTILITY 3 (3-0) II 1958-59 a/y. Prereq Chem 332; Soils 500. Nutrient availability; its evaluation and relation to soil characteristics.

504 SOIL DEVELOPMENT 3 (3-0) I 1958-59 a/y. Prereq Soils 304, 500. Soil-forming factors and processes.

505 SOIL MINERALOGY 3 (2-3) II 1959-60 a/y. Prereq Chem 215; Geol 101; Math 107; Phys 102; Soils 302. Mineral weathering in soils; structure and properties of major clay minerals, clay mineral analysis and identification.

511 SOIL PHYSICS 3 (2-3) II 1958-59 a/y. Prereq Chem 332; Soils 201. Physics and physical chemistry of the soil-water system.

512 SEMINAR 1 (1-0) R I II Current literature and research.

599 SPECIAL PROBLEMS V 1-4 I II S

600 RESEARCH V I II S

650 THESIS V I II S

In addition to the courses offered under Soils, credit in the major field will be given for Bact 503.

Schedule of Studies

Major in Soils—Technical Agriculture Curriculum

Students electing this major are required to complete 3 hours of an agricultural animal science, Bot 101 and 102, F C 101 or Hort 101, and Math 101 and 107. The animal science, F C 101 or Hort 101, and either the botany or mathematics should be taken in the Common Freshman Schedule of Studies (see introductory Agriculture).

Sophomore Year

First Semester—	Hours	Second Semester—	Hours
Bact 201 General	4	Chem 240 Organic	4
Geol 101 Introductory	4	Hum or Soc S Elective	3
Hum Elective	3	Soils Elective	3
Soils 201 Soils	4	Spe 100 Beginning	2
Mil or Air S	2	Elective	3
P E	½	Mil or Air S	2
		P E	½

Junior Year

Bot 320 Intro Plant Physiology	3	Hum or Soc S Elective	3
Chem 215 Analysis	3	Phys 102 General	4
F C 101 Field Crops or Hort 101 General	3	Soils 302 Fertility	4
Phys 101 General	4	Elective	6
Elective	4		

Senior Year

Econ 201 Principles	4	Soils Elective	3
Engl 226 Technical Writing	2	Elective	14
Soils Elective	3		
Elective	8		

Courses printed in Roman type are required for graduation, in italics are optional

Preparation for Graduate Study

As preparation for work toward an advanced degree in farm crops or soil science, a student should have completed the equivalent of these courses: (a) For Farm Crops: Bot 320; Chem 215, 240; F C 202 or 205, 205, 404; Math 101; Pl P 229; 7 hours Soils. (b) For Soils: Bact 201; Bot 320; Geol 101; Math 107; 15 hours of soils; 23 hours of chemistry and physics; 6 hours of farm crops, forestry, or horticulture.

Exhibit 9, from the 1958 WSU catalogue, showing course offerings and the Schedules of Studies for Soils.

Soils

R. L. Haustenbuiller, Adviser. For instructional staff see Department of Agronomy and Soils.

Properties and uses of soils are considered in this curriculum. It trains students to work out practical management problems, and should also provide the background essential for those interested in advanced study.

The course of study leads to the degrees of Bachelor of Science in Soils, Master of Science in Soils, and Doctor of Philosophy.

Description of Courses

Soils *For explanation see Index under "Symbols"*

201 Soils 3 Prereq Chem 102. Chemical, physical, and biological properties of soils.

301 Soil Management 2 I Prereq Soils 201. Fertilizers, amendments, and reclamation practices as factors of soil productivity; soil and water conservation.

400 Soil Chemistry 2 I Prereq Soils 201. Water quality, salt and pesticide movement, chemistry of soil use and modification, acid and alkaline soils, fertilizer reactions, agricultural pollution.

401 Soil Analysis 3 (1-6) II Prereq Soils 301 or 400. Chemical characterization of soils for diagnostic purposes. Students supply soil samples and obtain directions early for sampling.

404 Soil Morphology and Classification 3 (2-3) II Prereq Soils 201. Soil profiles; soil-forming processes; systems of classification. Field trips required.

408 Forest Soils 3 (2-3) II Prereq Soils 201, Geol 101 recommended. Morphology and characteristics of forest soils; soil science applied to forestry.

409 Forest Soils Field Trip 1 II Prereq Soils 401 or 408 or c//. One week field trip to study forest soil morphology and soil properties related to forest management.

411 Physics and Hydrology of Soils 3 (2-3) I Prereq Math 107, Soils 201. Water retention and transport in soil; structure, aeration, and temperature in relation to plant growth.

416 Air Photo Interpretation 2 (0-6) Principles of stereophotogrammetry and interpretation. Students supply photos for projects in special applications.

417 Introduction to Environmental Biophysics 2 II Same as Bio P 417.

418 Environmental Biophysics Laboratory 1 (0-3) II Same as Bio P 418.

499 Special Problems V 1-4 May be repeated for credit.

500 Advanced Soil Chemistry 3 II 1972-73 a/y. Prereq Soils 400; Chem 217. Cation exchange, soil acidity and aluminum, salt affected soils, potassium, sparingly soluble salts, phosphorus.

502 Soil Fertility 3 I 1973-74 a/y. Prereq Soils 400; 401. Nutrient availability; its evaluation and relation to soil characteristics.

503 Soil Geography 3 (2-3) I Prereq Soils 401 or 408. Soil development related to environmental and soil distribution locally, regionally, and in other parts of the world.

505 Soil Mineralogy 3 (2-3) II 1973-74 a/y. Prereq Chem 217. Structures, properties, and identification of major clay minerals; solution equilibria and clay mineral weathering.

506 Soil Organic Matter 2 I 1972-73 a/y. Prereq Soils 400; Chem 240; Bact 201. Formation, chemical properties, and significance of the soil organic fraction. Cooperative course taught at the University of Idaho.

507 Biochemistry of Soil-Water Environment 3 (2-3) I 1973-74 a/y. Prereq Soils 400, 401; Chem 217, 364. Biochemical processes in soil-water environment; nutrient cycling; the nitrogen cycle; pesticides in environment; agricultural waste disposal and pollution problems.

511 Soil Physics and Physical Chemistry 3 (2-3) May be repeated for 6 hours credit. II Prereq Chem 331; Soils 411. Physics and physical chemistry of the soil-water system.

512 Seminar 1 May be repeated for credit. Current literature and research.

582 Groundwater Chemistry 3 II Prereq Chem 581. Aquifer characteristics; sources of groundwater solutes; chemical changes during groundwater flow; dynamics of solute flow; measurements of groundwater chemistry.

600 Special Problems or Independent Study Variable credit.

700 Master's Research, Thesis, or Examination Variable credit.

800 Doctoral Research, Dissertation, or Examination Variable credit.

Schedule of Studies

At least 30 of the total hours required for the bachelor's degree in this program must be in upper-division courses.

Freshman Year

First Semester	*Hours*
Engl 101 Composition	3
Math 107 Precalculus	3
Geol 101 Introductory	4
Plant Science Elective	3
Elective	2
P E	1/2
Second Semester	*Hours*
Math 171 Calculus I	4
Chem 105 Principles	4
Spe 112 Fundamentals	3
Hum or Soc S Elective	3
Elective	2
P E	1/2

Sophomore Year

First Semester	*Hours*
Chem 106 Principles	4
Bact 201 Gen Microbiology	5
Phys 101 General	4
Math or Cpt S Elective	4
Elective	2
P E	1/2
Second Semester	*Hours*
Chem 217 Quant Analysis	4
Phys 102 General	4
Bio S 103 Introductory	4
Soils 201 Soils	3
Elective	2
P E	1/2

Junior Year

First Semester	*Hours*
Chem 240 Organic	4
Ag M 344 Irrig and Drainage	3
Soils 301 Management	2
Hum or Soc S Elective	3
Elective	3
Second Semester	*Hours*
Bot 201 Intermediate	4
Soils 400 Chemistry	2
Soils 401 Analysis	3
Elective	6

Senior Year

First Semester	*Hours*
Bot 320 Plant Physiology	3
Soils 411 Phys and Hydr	3
Hum or Soc S Elective	3
Com, Engl, or Spe Elective	3
Elective	3
Second Semester	*Hours*
Soils 404 Morphology	3
Engl Elective	3
Plant Science Elective	3
Soils 416 Air Photo	2
Elective	4

Courses printed in Roman type are required for graduation; those in italics are optional.

Preparation for Graduate Study

As preparation for work toward an advanced degree a student should have completed Bact 201; Bot 320; Geol 101; Math 172; 15 hours of soils; 24 hours of chemistry and physics; courses in agronomy, forestry, or horticulture. A modern foreign language is recommended.

Exhibit 10, from the 1973 WSU catalogue, showing course offerings and the Schedule of Studies for Soils.

Increasing student loads during the 1960's put ever greater pressures on the soils teaching faculty. The problem was compounded when, in 1968, Dawson Moodie reluctantly gave up teaching to chair the Department of Agronomy. He replaced Rod Bertramson, who had become Director of Resident Instruction in the College of Agriculture. To compensate, part of Moodie's course material was redistributed to the Soils 301, Soil Management, and Soils 400, Soil Chemistry, and Fred Koehler was called upon to take over Moodie's laboratory class in Soil Analysis. The redistribution of teaching responsibilities almost appeared as an omen, for Moodie was killed in an automobile accident in 1970. Upon his death, administration of essential Departmental matters was shifted once again to Rod Bertramson. He carried this obligation on a part-time basis until J. C. Engibous, previously with the Fertilizer Division of the International Minerals Corporation, arrived as the new Chairman.

Bobby Carlile resigned in 1973 and was replaced the same year by Dr. Dave Bezdicek, a Soil Microbiologist from Maryland. Bezdicek reinitiated courses in Soil Microbiology for the first time since the departure of Dr. Vandecaveye in 1953, both at the undergraduate and graduate levels.

After 25 years of service in the Department, Warren Starr retired in 1975 and was replaced the same year by Dr. Bruce Frazier, a graduate of Wisconsin with training in Remote Sensing. Three years later, in 1978, Henry Smith retired and was replaced by Dr. William Hendershot. Hendershot resigned after two years to return to Canada and was in turn replaced by Dr. Alan Busacca. Busacca had recently graduated from the University of California-Davis, where he had received training in Soil Development and Morphology.

Three active in teaching retired in 1982-83: Gardner, Gilkeson, and

Hausenbuiller. Gardner retired in 1982 and was replaced a year later by Dr. David Mulla, a recent graduate in Soil Physics from Purdue University. Gilkeson's retirement, also in 1982 and Hausenbuiller's in 1983 resulted in two new replacements: Dr. John Reganold, with training in Soil Inventory and Land Use Planning from the University of California-Davis, in 1983, and Dr. William Pan, trained at North Carolina State University in Soil Fertility, in 1984. Brian McNeal, who resigned in 1983 to become Chairman of the Soils Department at Florida State University, was replaced in 1984 by Dr. James Harsh, a graduate in Soil Chemistry from the University of California-Berkley.

By 1983, the number of formal course offerings available to WSU students had grown to 30 (see Exhibits 11a and b). Several of these courses were taught cooperatively at the University of Idaho. In addition, majors in soils were no longer tied to a single schedule of studies for a degree but could specialize in one of any number of areas with which the science of soils has strong ties and application.

Credit for the teaching of soils at WSU does not belong solely to the regularly assigned teaching staff but must be shared with others as well. Department Chairmen, particularly B. R. Bertramson, C. D. Moodie, and J. C. Engibous, contributed not only through the administration of teaching programs but also in seminars, occasional teaching, and through work with graduate students. Similarly, USDA-Soils personnel, namely, Drs. Robert Papendick and Lloyd Elliott, and Mr. Verlan Cochran made major contributions by directing graduate student research and theses programs.

In Conclusion

The teaching of soils at WSU has been, and continues to be, among the best in the Nation. Since the mid-1940's, much of this has been due to the

Description ...urses

For explanation see Index under "Symbols"

Soils

201 **Soils** 3 Prereq Chem 102. Chemical, physical, and biological properties of soils.

301 **Soil Management** 2 Prereq Soils 201. Fertilizers, amendments, and soil reclamation; soil and water conservation; soils in land use planning and environmental quality control.

315 **Fundamentals of Remote Sensing** 1 Physical basis of remote sensing, characteristics of aerial photographs, reflectance from earth surface features.

316 **Forestry Application of Airphoto Interpretation** 1 (0-3) Prereq stereovision; Soils 315 or c//. Characteristics of aerial photographs, basic photogrammetry applied to forest management.

400 **Soil Chemistry** 3 Prereq Soils 201. Water quality, salt and pesticide migration, chemistry of soil use and modification, acid and alkaline soils, fertilizer reactions, agricultural pollution.

401 **Soil Analysis** 1 (0-3) Prereq Soils 400 or 402 or c//. Chemical characterization of soils for diagnostic purposes.

402 **Soil Fertility** 3 Prereq Soils 301. Plant nutrient requirements, principles of soil testing and tissue analyses, current fertilizer technology, fertilizer reactions in soils.

404 **Soil Genesis, Morphology, and Classification** 3 (2-3) Prereq Soils 201. Soil profiles, soil-forming processes, and soil taxonomy. Field trips required.

406 **Soil Inventory** 3 (2-3) Prereq Soils 404. Design of mapping units and descriptive legends, inventory techniques and field practices, soil interpretations.

407 **Soil Microbial Ecology** 3 Prereq Bact 101 or 201; Chem 240, Soils 201. Basic aspects and significance of soil flora as related to soil ecology, plant growth, and environmental problems.

408 **Soil Microbiology Lab** 1 (0-3) Prereq Soils 407 or c//. Characterization of soil microbiota and microbial processes.

411 **Physics of Soil-Water-Plant Relations** 3 (2-3) Prereq Math 107, Soils 201. Water retention and transport in soil; water, structure, aeration, and temperature in relation to plant growth.

415 **Remote Sensing Applied to Terrain Evaluation** 3 (2-3) Prereq physical geology; Soils 315. Remote sensing and photointerpretation methods applied to terrain—landforms, soils, land use.

417 **Introduction to Environmental Biophysics** 2 Prereq Phys 102; Math 107. Physical principles of biological environments, radiative energy transfer, turbulent transfer of momentum, heat, and water vapor in the lower atmosphere.

418 **Environmental Biophysics Laboratory** 1 (0-3) Prereq Soils 417 or c//. Experimental methods and procedures in environmental measurements; temperature, wind, radiation, and humidity measurements in biological environments.

460 **Microbial Physiology** 5 (3-6) Prereq Bact 201. Concepts of microbial physiology; growth, metabolism, regulation, variation, structural-functional relationships. Cooperative course taught at the University of Idaho. (a/y)

472 **Remote Sensing of Environment** 3 Basic remote sensing applied to inventory of natural resources; use of remote sensing methods in research. Cooperative course taught at the University of Idaho.

499 **Special Problems** V 1-4 May be repeated for credit.

500 **Advanced Soil Chemistry** 3 Prereq Soils 400; Chem 217. Chemical properties of soil colloidal systems. Joint listing with the University of Idaho. (a/y)

501 **Advanced Soil Analysis** V 1-3 May be repeated for credit; cumulative maximum 6 hours. By interview only. Soil research techniques; application of modern instrumentation to soil analysis.

502 **Advanced Soil Fertility** 3 Prereq Soils 400, 401, 402. Methods for evaluating nutrient availability and soil fertility. Joint listing with the University of Idaho. (a/y)

503 **Fertilizer Science** 3 (2-3) Prereq Soils 402. Manufacture, use, placement, and factors influencing choice of fertilizers. Greenhouse project required. Cooperative course taught at the University of Idaho. (a/y)

504 **Advanced Soil Genesis and Classification** 3 (2-3) Prereq Soils 404. Genesis, classification and interpretation of soils, including field investigation emphasizing existing interrelationships. Cooperative course taught at the University of Idaho. (a/y)

505 **Soil Mineralogy** 3 Prereq Chem 217. Structures, properties, and identification of major clay minerals; solution equilibria and clay mineral weathering. (a/y)

506 **Soil Organic Matter** 2 Prereq Soils 400, 407. Formation, chemical properties, and significance of soil organic fraction. Cooperative course taught at the University of Idaho. (a/y)

507 **Advanced Soil Biochemistry and Microbiology** 2 May be repeated for credit; cumulative maximum 4 hours. Prereq Soils 400, 407, BC/BP 364 Biochemical and microbiological processes in soil-water environments; nutrient cycling; pesticide behavior; agricultural waste disposal; nitrogen fixation; advanced techniques.

509 **Chemistry of Plant Nutrients** 3 Prereq Soils 400; Chem 217. Chemistry of plant nutrients in soils, including uptake and utilization by plants. Cooperative course taught at the University of Idaho. (a/y)

511 **Advanced Soil Physics** 2 Prereq Soils 411. Physics of the soil-water system. (a/y)

512 **Seminar** 1 May be repeated for credit. Preparation of visual aids for presenting research information.

514 **Advanced Topics in Soils** 1 May be repeated for credit; cumulative maximum 4 hours. Prereq Soils 400, 404, 411. Analysis of current published research on soils, their uses, and management.

572 **Advanced Remote Sensing** 2 (1-3) Prereq basic remote sensing; digital computer programming. Digital image processing systems applied to satellite and other remote sensing systems. Cooperative course taught at the University of Idaho.

573 **Advanced Aerial Photointerpretation** 2 (1-3) or 3 (1-6) Prereq Soils 315, 316. Flight planning, interpretation of vegetation (disease and insect infestation), landforms, land use, pollution, temporal changes, photo mensuration multistage sampling. Cooperative course taught at the University of Idaho.

600 **Special Projects or Independent Study** Variable credit.

700 **Master's Research, Thesis, and/or Examination** Variable credit.

702 **Master's Special Problems, Directed Study, and/or Examination** Variable credit.

800 **Doctoral Research, Dissertation, and/or Examination** Variable credit.

General Departmental Requirements

A Bachelor of Science degree in Soils requires completion of the core requirements plus courses in one of the areas of specialization. At least 40 of the total hours required for the bachelor's degree in this program must be in upper-division courses.

Core Requirements

The following courses are required of all soils majors. The list includes fundamental courses in soils, supporting courses in science and mathematics, and courses that fulfill General University Requirements: six hours each of Humanities, Social Sciences, and Communications; Soils 201, 301, 400, 401, 404, and 411; Chem 105, 106, and 217; Geol 102; Bio S 103; Bot 201 or Bio S 104; Bot 320; Bact 201; Phys 101 or 201; and Math 107 or 140.

Areas of Specialization

All soils majors select an area of specialization under one of the following options:

Soil Management: This curriculum deals mainly with factors of the soil-plant environment important to agronomic plant production. Beyond the core requirements students should complete Chem 240; Ag M 344; Agron 305; Entom 340; Pl P 329; Soils 402; 3 hours of Ag Ec; 2-4 hours Cpt S or Biom; 6 hours of plant production electives; and sufficient electives for a 120 hour total.

Soil Inventory: Soils as natural components of landscapes are emphasized in this curriculum. Students are trained in techniques of inventory and basics of field identification of soils and soil properties. They should complete, in addition to the core requirements, Soils 406, 415; Chem 240; Geol 306 and 310; Bio S 372; Bot 332, and 460 or 462; Ch E 174; 2-4 hours Cpt S or Biom; and sufficient electives for a 120 hour total.

General: Under this option, in consultation with an adviser, students specialize in an area other than soil management or soil inventory, e.g., soil biochemistry, soil microbiology, or land resource planning. Beyond the core requirements students should complete one course in Soils; one course in Math, Cpt S or Biom; 6 hours Chem, Phys, or Geol, or their equivalent; 11 hours of Bio S or their equivalent; and sufficient electives for a 120 hour total.

Exhibit 11a, from the 1983 WSU catalogue, showing course offerings and areas of specialization in Soils.

Ex. 11b. Schedules of Study for three Options in Soils, 1983.

SCHEDULES OF STUDY - SOILS OPTIONS - B.S. DEGREE

Revised 9/83

CORE REQUIREMENTS

GUR's [H] 6 hrs	Soils 201	3 hrs	Chem 105	4	Math 107 or 140	4
[S] 6	Soils 301	2	Chem 106	3	Bio S 103	4
[C] 6	Soils 400	3	Chem 107	3	Bio S 104 or Bot 201	4
18	Soils 401	2	Chem 217	4	Bot 320	3
	Soils 404	3	Phys 101 or 201	4	Bact 201	5
(Total hours for graduation is 120, of which 40 should be at 300-400 level)	Soils 411	3	Geol 102	4		20
		16		22	Total Core 76 hrs	

OPTIONS

GENERAL

Soils elective	2-3 hrs
Chem, Phys, Geol, or equivalent[a/]	6
Bio Sciences, including plant science, pure or applied[b/]	8
Math, Computer Sci, or Biometry	2
Electives to make 120-hr total	

[a/] Soils 315, 406, 415, 417/18 and 472 apply.

[b/] Soils 402, 407/08, and 460, as well as other biologically oriented agricultural courses, apply.

SOIL MANAGEMENT

Soils 402	3 hrs
Ag Mech 344	3
Chem 240	4
Ag Econ	3
Comp Sci or Biometry	2-4
Plant Protection	
Agron 305	3
Pl P 329	3
Entom 340	3
Plant Production electives	6
Electives to make 120-hr total	

SOIL INVENTORY

Soils 406	3 hrs
Soils 415*	3
Chem 240	4
Geol 306	2
Geol 310	4
Chem E 174	3
Bot 332	4
Bio S 372	4
Bot 460 or 462	3
Comp Sci or Biometry	2-4
Electives to make 120-hr total	

*Soils 315 can be waived as prerequisite. Additional courses in Remote Sensing (U of I) recommended.

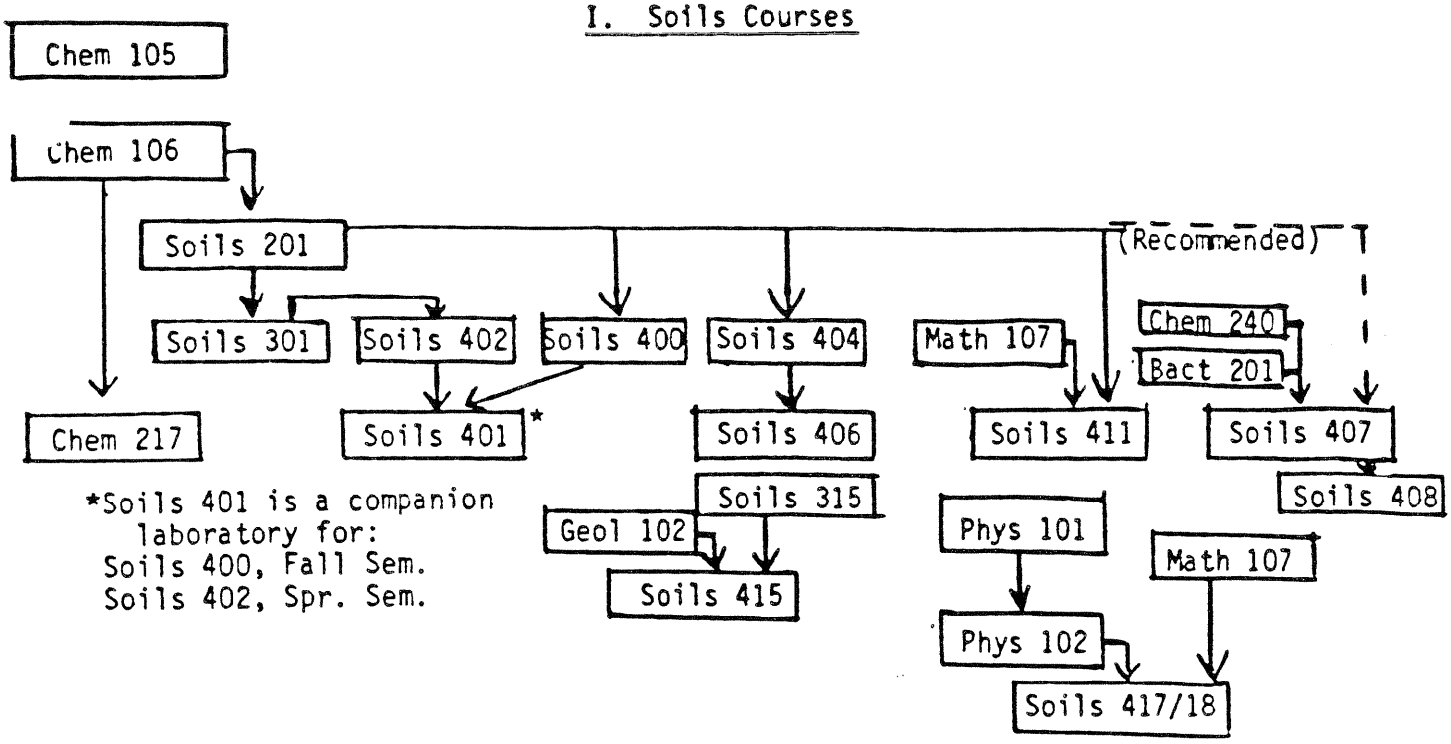
106

Preparation for Graduate Study: Students planning to do graduate work in Soils should take Phys 102 or 202, Math 171, and Chem 240. In addition, one course in both Computer Science and Biometry is strongly recommended.

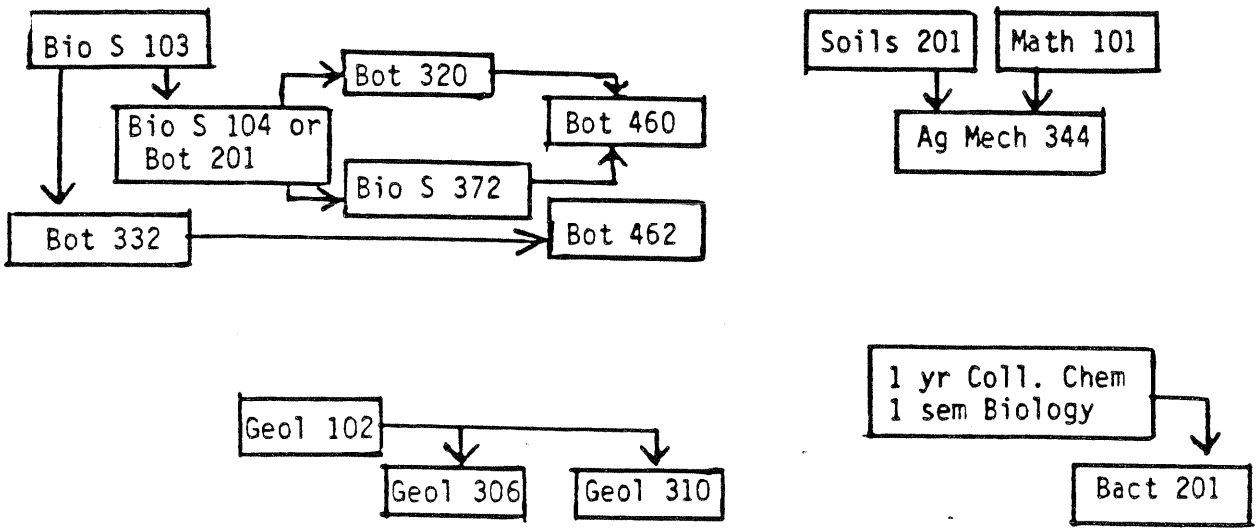
65

COURSE SEQUENCES IMPORTANT TO SOILS MAJORS

I. Soils Courses



II. Non-Soils Courses



guidance of Henry Smith. Smith was not only an exemplary teacher in his own classes, but by offering assistance and inspiration to his fellow teachers, helped maintain high teaching standards throughout the Department.

One of Smith's major goals during his career was to improve all aspects of the oral and visual presentation of educational materials. He did this in part through his teaching of soil morphology and classification at the undergraduate and graduate levels. In addition, he supervised graduate student seminars, giving instruction in the preparation of slides and guidance in seminar presentation . Many of his students won awards at national and regional soil science meetings for the quality of their papers.

Smith published several articles on slide preparation and presentation, and in 1957 gave an invited address on this topic before the Soil Science Society of America. Because of efforts such as these, along with his other achievements in teaching, Smith was selected as the Outstanding Teacher of Soil Science for 1962 by the Soil Science Society of America.

Other examples illustrating the high quality of soils teaching at WSU can be given. One is the publication in 1961 of a 25-minute color film on Water Movement in Soils by Walt Gardner. This film has won widespread acceptance and has been used continuously by a large number of institutions, both in this country and abroad, in a variety of soils courses.

Two teachers of soils have received the R. M. Wade Award for Excellence in Teaching. This program, which is limited to Colleges of Agriculture, is sponsored by the R. M. Wade Foundation. The first

recipient of this award, when introduced at WSU in 1964, was R. L. Hausenbuiller. Four years later, it was awarded to C. D. Moodie.

Another aspect attesting to the effectiveness of soils teachers at WSU is the publication of textbooks and laboratory manuals. The first of these to appear was a comprehensive Laboratory Manual on Soil Fertility put out by Moodie, Smith, and McCreery in 1954. This manual has been in continuous use since its inception. It has been revised several times, initially by Smith and Moodie, and later by Koehler and then Koehler and McNeal.

Three of the soils teachers have been intimately involved in textbook preparation. In 1972, Walt Gardner, with Wilford Gardner, of Wisconsin, joined L. D. Baver in the revision of the latter's book, Soil Physics. Baver's book has been a standard in the teaching of soil physics since its first appearance in the 1940's. In 1968, Hausenbuiller, using the University Press, published a soft-cover introductory text, Soil Science: Principles and Practices, which he used in Soils 201 and 301 for four years. This text was revised and republished in hard cover in 1972, 1978, and 1985. In 1977, a book titled An Introduction to Environmental Biophysics was published under the authorship of Gaylon Campbell. Use of all three of these books continues both in this country and abroad.