TWENTY-THIRD BIENNIAL REPORT

OF THE

Iowa State College of Agriculture and Mechanic Arts

MADE TO

THE GOVERNOR OF IOWA

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LETTER OF TRANSMITTAL

IOWA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS,
AMES, IOWA, November 1, 1908.

To His Excellency, A. B. Cummins:

In accordance with the statute defining the duties of the Secretary of the Board of Trustees of the Iowa State College of Agriculture and Mechanic Arts, I have the honor to transmit herewith the twenty-third biennial report of the Board.

E. W. STANTON,
Secretary.

PRESIDENT'S REPORT.

ORGANIZATION AND HISTORY.

The laws of the State of Iowa provide for the election by the general assembly of a Board of Trustees, one member from each congressional district, whose duty it shall be to manage and control the Iowa State College, at all times supporting the best interest of the institution.

In 1862 a bill was passed by Congress, entitled, "An act donating public lands to the several States and Territories, which may provide for colleges for the benefit of Agriculture and the Mechanic Arts."

Section 4 requires:

> That all moneys derived from the sale of land aforesaid by the States to which lands are apportioned, and from the sale of land script, hereinbefore provided for, shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except as may be provided for in Section fifth of this act), and the interest of which shall inviolably be apportioned by each State which may take and claim the benefit of this act, to the endowment, support and maintenance of at least one college, where the leading object shall be without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislature of the State may provide, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.

The General Assembly of Iowa, September 11, 1862, accepted the grant upon the conditions and under the restrictions contained in the act of Congress, and by so doing entered into contract with the General Government to erect and keep in repair all buildings necessary for the use of the College. By this action of the General Assembly the College was changed from an agricultural institution into a College of Agriculture and Mechanic Arts with the broad and liberal course of study outlined in the following paragraph.

In 1882 the General Assembly passed an act defining the course of study to be pursued as follows:

Section 1. That Section 1621 of the Code is hereby repealed and the following is enacted in lieu thereof: "Section 1621. There shall be adopted and taught in the State Agricultural College, a broad, liberal and practical course of study, in which the leading branches of learning shall relate to agriculture and the mechanic arts, and which shall also embrace such other branches of learning as will most practically and liberally edu cate the agricultural and industrial classes in the several pursuits and professions of life, including military tactics."

THE SCOPE.

Throughout the several courses, the study of the textbook is supplemented by lectures, discussions, library work, and the practical experimental work of the laboratory. The instruction is not merely theoretical but also practical—the student verifying and putting into practice in the laboratory the instruction received.

The Iowa State College offers thirteen four year courses leading to the following degrees:

Course in Agronomy, leading to the degree of Bachelor of Scientific Agriculture (B. S. A.).

Course in Dairying, leading to the degree of Bachelor of Scientific Agriculture (B. S. A.).

Course in Animal Husbandry, leading to the degree of Bachelor of Scientific Agriculture (B. S. A.).

Course in Horticulture and Forestry, leading to the degree of Bachelor of Scientific Agriculture (B. S. A.).

Course in Science and Agriculture, leading to the degree of Bachelor of Scientific Agriculture (B. S. A.).

Course in Veterinary Medicine, leading to the degree of Doctor of Veterinary Medicine (D. V. M.).

Course in Mechanical Engineering, leading to the degree of Bachelor of Mechanical Engineering (B. M. E.).

Course in Civil Engineering, leading to the degree of Bachelor of Civil Engineering (B. C. E.).

Course in Electrical Engineering, leading to the degree of Bachelor of Science in Electrical Engineering (B. S. in E. E.).

Course in Mining Engineering, leading to the degree of Bachelor of Science in Mining Engineering (B. S. in Mn. E.).

Course in Ceramics, leading to the degree of Bachelor of Mining Engineering in Ceramics (M. E. M. in Cer.).

Course in General Science, leading to the degree of Bachelor of Science (B. S.).

Course in Domestic Economy, leading to the degree of Bachelor of Science in Domestic Economy (B. S. in D. E.).

The degree of Bachelor of Agricultural Engineering (B. A. E.) is given to students who have completed a four year course in Civil, Mechanical, or Electrical Engineering, followed by one year's prescribed work approved by the faculty, in Agricultural Engineering and related sciences, under the rules and conditions governing work in other courses.

Two year courses are also offered in Mining Engineering and Clay Working, and a one year course in Poultry Husbandry, for the completion of which, certificates will be given. That many, who are unable to take the full college course, may take advantage of the advancement being made in their chosen work, a two weeks' short course is now offered each year during the winter vacation in Stock and Grain Judging and Dairying. A School of Good Road Investigations is also held during each summer vacation. The interest in all of these short courses is becoming greater, the attendance is increasing and the benefits to be derived from them are constantly increasing.

STUDENT ENROLMENT.

While bigness is not necessarily synonymous with greatness, and while it is true that there has been a craze in American colleges for running up enormous enrolments of students, sometimes lowering entrance requirements to invite poorly prepared students to enter, it is also obviously true that an educational institution must have students, and a steadily increasing enrolment is in some degree a gauge of the appreciation of the work of an institution of learning by the people who sustain it. It is gratifying that our student attendance has in the last decade increased approximately 200 per cent in the regular enrolment, or more exactly, from 530 in 1895 to 1,848 the present calendar year, or 350 per cent. If we add the Short Course winter enrolment to the total, as many universities do their summer enrolment, the increase is much greater.

STUDENT ENROLMENT, 1906-7.

Course.	
Civil Engineering	321
Mechanical Engineering	152
Electrical Engineering	293
Mining Engineering	38
Academy Engineering	1
Science	106
General and Domestic Science	97
Domestic Science	46
Science and Agriculture	12

Animal Husbandry	291
Agronomy	76
Horticulture and Forestry	32
Academic Agriculture	14
Dairy	36
Veterinary	82
Total	1,597
Students in college courses	1,597
Winter Short Course students	765
Special Music students	21
Grand total	2,383

STUDENT ENROLMENT, 1907-8.

Course.	
Civil Engineering	336
Mechanical Engineering	153
Electrical Engineering	301
Mining Engineering	48
Ceramics	5
Science	77
General and Domestic Science	92
Domestic Science	72
Science and Agriculture	6
Animal Husbandry	297
Agronomy	76
Horticulture and Forestry	44
Agriculture	29
Dairy	22
One year Dairy	17
Veterinary	108
Total	1,683
Students in College courses	1,683
Winter Short Course students	642
Special Music students	56
Total	2,381
Short Course students (Extension Department)	3,660
Grand total	6,041
Present enrolment for calendar year 1908	1,848

Short Course students have not yet (October) registered.

ADVANCED REQUIREMENTS.

In keeping with the progress and practice of the institutions of high standing throughout the United States, the Iowa State College has advanced its requirements for admission and for

graduation to a point where thoroughly scientific work can be done. These standards and requirements are now such as to place this college in the rank of the high grade institutions of learning. This grade is given us by the Carnegie Foundation for the Advancement of Teaching, the only agency that has undertaken in any systematic way the standardizing of American institutions of learning.

As a logical result of high standards, students who are well prepared and capable come to us. The proportion of graduates from fully accredited high schools has enormously increased. In the present year's entering class of over six hundred, the great majority are thus prepared for freshman standing. Our graduates are in demand. From one department alone, that of Animal Husbandry, graduates have gone out in recent years to the headship of twenty-two animal husbandry departments in as many different colleges. Upwards of ninety per cent of gradautes from agricultural colleges in the last few years are engaged in actual agricultural work of some kind. Here, at least, is one institution that does not turn its students' sympathies and interests away from the industries.

It is only by sufficiently high requirements and thoroughness that work worthy of being characterized as scientific and technical can be done. To give the energies and resources of the institution to low grade work that would of necessity be empirical and non-scientific in character, telling poorly educated youth how to do many things but making it impossible for them to understand principles so as to become in any important sense capable of independence and initiative, would in the judgment of those charged with this high trust be a perversion of the intent and purpose of the institution in its founding and support. A certain amount of short course work can be done, and appropriately. But the main resources of the institution should and of necessity must be directed to the higher grade of scientific and technical work that gives initiative and direction to the intellectual and industrial activities of the age.

SANITARY AND HEALTH CONDITIONS.

The rapid erection of houses in the vicinity of the college for the accommodation of students, the crowded condition of these houses when occupied, the absence of sewer system or water supply system, have of necessity led to many unsanitary conditions. Realizing the importance of this matter, the college officers and the college trustees, with co-operation of the mayor and the city, peti-

tioned the legislature to authorize a contract between the college and the city for enlargement and use of the college sewage disposal plant. A satisfactory contract has been made, the city has issued bonds for the construction of the sewer, and the work is approaching completion. It was found that a water supply system was also essential and in view of the impracticability on account of distance and an intervening stream of connecting with the city supply, the trustees have granted temporary connection with the college water system. Inasmuch as the college now has an abundant water supply, this seemed both feasible and justified. However, the unsanitary conditions have given to the college authorities the greatest anxiety. A faculty committee on sanitary conditions having been appointed and having investigated reported to the trustees that these conditions were so serious as to make urgent an immediate inspection and, so far as possible, correction by the city. The city board of health did twice in succession issue notices to property owners, in several instances requiring that certain unsanitary conditions be removed. These injunctions, however, were not enforced and in general were not obeyed. Upon the appearance of typhoid fever in October, 1908, in one of these houses which had been condemned, the State Board of Health was called for advice and investigation. Heeding the injunctions of its secretary prompt and vigorous measures have now been adopted for remedying the worst conditions and for enforcing prompt connection with the sewage and water systems. We are trusting at this moment that no serious consequences will result to the health of the students and that very soon the conditions will be as wholesome and as sanitary as can be found anywhere.

The college hospital occupied for a number of years was built for summer use only. It was uncomfortably cold and inconvenient. The trustees after tearing down the old East Cottage which had become dilapidated and unusable, have reconstructed the West Cottage for hospital purposes. A college hospital for sick students is a practical necessity. The city has no hospital. The crowded condition of the boarding houses is such as to make the outbreak of any contagious disease a very serious menace. Humane considerations alone require that the college sustain or afford the opportunity for maintaining a hospital. For this purpose a voluntary hospital fee is collected from the students upon registration and from this fund the hospital expenses are met save that a college physician as a sanitary officer is maintained, a part of whose salary is paid from the college funds. The wisdom of this provision

has been again and again demonstrated. We should certainly within the last three years have had very serious epidemics of scarlet fever, of smallpox, of typhoid and other contagious diseases had it not been for the prompt and efficient measures adopted to check and control these troubles at the start. The city health officer cannot in the nature of the case devote sufficient time to be sufficiently familiar with all the conditions to serve this purpose. Having paid their hospital fee the students feel free to consult the college physician whenever any occasion calls for such consultation and in this way contagious troubles are detected immediately upon their appearance. I feel very safe in saying that in all human probability many lives have thus been spared that would have otherwise been sacrificed and the general health of the student community has been safeguarded. On the whole, the health of the student body has been excellent. No doubt one condition that contributes to this desirable result is the constantly flowing fountains of pure water in the college buildings.

ALUMNI HALL AND MORAL AND RELIGIOUS CONDITIONS.

Alumni Hall, funds for the erection of which were contributed by students, alumni, faculty and friends and costing furnished $60,000, has been in use for over a year. The students alone gave over $21,000. Aside from the cafe in the basement and sleeping and study rooms on the top floor, the building is given over to the Young Men's and Young Women's Christian Associations. Its primary purpose was to give these associations accommodations and to furnish for the entire student body a building where they could be at home for social purposes. A fine swimming pool has been fitted up in the basement and is not only a source of great pleasure but a means of health.

The Christian Associations have found the building of the greatest assistance to them in their work and influence among the students. Over six hundred young men have enrolled in the classes for systematic daily and weekly study of the Bible. The Y. M. C. A. enrollment is between seven and eight hundred members and the Y. W. C. A. is about one hundred and fifty. The meetings of the associations have been well attended. Each association now has a secretary. These associations unsectarian but frankly christian are having a marked moral and religious influence upon the students. The associations stand for clean living, high ideals and unselfish devotion to worthy purposes. By reason of these influences

many students are turned from careless to earnest living and the splendid enthusiasm with which many of them enter upon their life purposes for christian living and service, it is a joy to see.

Through the agency of these christian associations an effective influence can be exerted upon students that churches working from the outside could not exert.

It is worthy of note, however, that the various churches of the city of Ames are exerting upon the students a very distinct influence. The various congregations are building commodiously so as to accomodate their student constituency.

It is gratifying to note that while these ennobling and helpful influences are increasingly strong and effective, there is no saloon or gambling hall tolerated within the limits of the city or of the county. Whenever a lapse into ways of dissipation occurs in the student body, it is sufficiently singular to provoke comment and unless reform follows speedily, an indefinite and involuntary vacation results for that student.

GROWTH.

The growth of an institution and particularly of an institution like the Iowa State College which is occupying a comparatively new field, must be measured not only by its student enrolment but by the courses of study offered, the departments established and maintained, the laboratory facilities, and the like. The college at first offered but a very limited amount of general instruction in agriculture because as yet in this wide field for the application of scientific knowledge there had been but little systematic or pedagogical arrangement, but every year has added to the stock of information from a scientific side concerning the laws and forces of nature and the bearings of this knowledge upon the industries. The fundamental sciences have developed increasing importance from year to year. Taking as an illustration bacteriology, all that was taught at first in this subject was in the nature of general bacteriology, in the department of botany. By more recent investigations, however, it is found that bacteriology has a very important bearing upon the question of soil fertility and the growing of crops, upon the question of flavors and quality of butter and cheese and other dairy products, also in the analyses of water, in the study of foods and home sanitation; and in veterinary science the study of the cell and of bacteria have become fundamentally important. In some measure, too, a knowledge of bacteriology is important in engineering problems, so that we must now have

laboratories and instructors not only in general bacteriology but in dairy bacteriology, soils bacteriology, domestic science bacteriology, veterinary bacteriology, and some study of bacteriology for the student of engineering. The importance of bacteriology for the engineer is especially evident in the whole series of problems connected with sewage disposal and water supplies as well as in a knowledge of the effect of bacteria upon materials of construction.

That which is true in this particular subject of bacteriology is also true in the other sciences. In chemistry, for example, the importance of chemical engineering or the applications of the principles of chemistry by the engineer, are becoming daily more urgent. Practically we shall be obliged very soon to develop this phase of our engineering courses. The importance of chemistry in the study of foods in the domestic science course is obvious.

In zoology the study of cell life is a subject of central interest not only to veterinary science but to animal husbandry. The requirements in zoological studies now made of our animal husbandry and veterinary students constitute an important part of the work in the earlier years of these courses. Likewise the study of botany or of plant life is increasingly important in all agronomy courses as well as in the courses of horticulture and forestry. Entomology is also an increasingly important scientific study for the student of horticulture and of agronomy subjects. The basal importance and the correlation of the sciences can not be overestimated and the development of the courses of study and the departments of instruction illustrates this in a logical and impressive manner.

The time has now come, however, when we must give to our science departments far more adequate equipment and instructional forces and support than has yet been done. The demand is increasing that we should train men for scientific investigation and to do this students must first of all become thoroughly versed in the fundamental sciences themselves.

There is, moreover, a moral factor involved. Science departments are in a sense, and must be, servants of the technical departments, but for their own dignity and for the requisite enthusiasm and the spirit of initiative in their work, scientific men and scientific departments particularly must have encouragement to expand their own knowledge by research and to engage in some measure in the higher range of investigation and training, otherwise they can not maintain the morale and the discipline necessary to do

properly the fundamental and instructional work needed for technical courses.

EXPANSION.

The time has now fully come when with our student enrolment, our multiplied courses in which instruction is given, our many laboratories and the increasing demands made upon us, we must increase at the top our faculties of instruction. It is no longer possible for one man at the head of a large department to conduct the instruction work, oversee the laboratories and maintain high standards with simply one or more immature and inexperienced assistants. In many of our departments, both in science and technical subjects, we must at the earliest possible moment place by the side of the heads of departments as associate professors, men who are experienced, thoroughly well trained and capable of coordinate work with the head of the department. The situation is now acute. The condition in the engineering department is typical where, as Dean Marston shows, the students have increased at twice the ratio of the faculty or instruction force. This simply can not go on much longer without a serious deterioration in the quality of work that we can do.

Students ought to have the personal contact and oversight of thoroughly strong and capable, efficient men but this can be possible only as there is a reasonable proportion between students and faculty. The complaint and criticism is sometimes made that students, especially in the earlier years, do not have sufficient contact with the older and better known members of the faculty. It is our policy to bring the students from the very first into contact with the strongest men we have in the faculty, to give the students the benefit of this contact at the period the student is shaping his ideals of study and forming his conceptions of college life and gaining his first wide outlook upon the fields of knowledge and of industry. That we cannot accomplish this end as fully as we wish is due to the fact that we have outgrown our present resources.

The courses of study that have been undertaken are logically the outgrowth of the fundamental purpose of the institution. Little, if anything, that is extraneous or foreign to the broad purpose expressed in the acts of congress and the state legislature has come into the college courses. I do not need to argue that a technical institution should not be so narrowly technical as to turn out its students mere tradesmen or mere specialists. This would defeat the purpose most emphasized in the federal and state

statutes providing for the founding and maintenance of this institution. Such studies, however, as are not strictly scientific or technical as are given are such as are necessary to the proper balancing of technical courses. In this respect we have been rather more conservative than most institutions of technology of established reputation. To a certain extent a continuous study of English, especially studies in expression, to a certain extent a study of economic principles and civics, a survey in brief of history, sufficient to make the student of technical courses familiar with the economical, political and industrial developments of the age, and a knowledge of at least one modern language besides his own and the putting within the student's reach of scientific and technical information in another language, as the German, are absolutely essential to the proper training and education of technical students. Demands are being made upon the college today for thoroughly and broadly trained men who are capable of sound judgment and who can enter the industrial field possessed not only of information upon technical subjects but of principles of knowledge and with a disciplined power to use these principles in a sane and successful manner.

THE QUESTION OF SALARIES.

The question of salaries in an institution such as this is a perplexing one. Theoretically considered the question has never been satisfactorily answered as to what should be the financial compensation for those engaged in scientific and instructional work. It is probably true, as the trustees of the Carnegie Foundation have said, (Bulletin No. 2, Carnegie Foundation for the Advancement of Teaching, page 25): "No matter how great the ability of the college professor, as a teacher or scholar, there is no working probability that he will ever be paid more than a minor officer of a railroad or industrial company." The further observation is made that it is not strange that the possibility of teaching seldom presents itself seriously nowadays to the best students in the graduating class; that gifted men do enter the profession of teaching is due solely to the love of teaching, study, and research. These trustees urge in their report that ampler considerations must be paid for this high service to society in order to attract and hold to the teaching profession and to the work of scientific research men of marked ability.

Practically, however, we are not in this institution much at liberty to consider the purely theoretical phases of the question.

With us the situation has become acute and serious. While it is to be expected that a certain number of resignations will occur within any given period and transitions from one institution to another will be more or less frequent, the losses which Iowa State College has suffered within the last two or three years have been out of all proportion to any normal standard. The fact seems to be that other institutions are in the habit of looking to us for well trained men. They are paying better salaries than we do and we have been unable to prevent the withdrawal from Iowa of some of her most valuable men because we could not advance a few hundred dollars in salary. We have lost in this way such men as Professor George W. Bissell, vice dean of the division of engineering. Many times people of the state have criticized the college management for allowing such a man to go. We have by resignation for a more lucrative position lost the head of the dairy department. After some years of training as a specialist in this subject, the dairy bacterologist has resigned and we are unable to find a man to fill his place. We have suffered a most serious loss in the resignation of the dean of the veterinary devision. Dr. McNeil would not have considered resignation if he could have had reasonable assurance of prompt attention to the needs of the division in building and equipment and an adequate faculty. We have lost Associate Professor Rutherford and Associate Professor J. A. McLean from the animal husbandry department. We have lost three associate professors from the division of engineering, and but for their attachment to the state and loyalty to the institution we should have lost the present dean of the division of engineering and the present vice dean. We have lost a large number of our most experienced and capable and efficient assistant professors whom we could in most cases have retained to the great advantage of the college with but a comparatively slight advance in salary. From the head of the animal husbandry department I have the following statement:

"We are face to face with a very serious condition of affairs in our corps of instructors. During the past months, every man, with one possible exception, has had offers from other colleges and from commercial lines of work to take up work elsewhere at salaries ranging from $300 to $1,000 in advance of the salaries now being paid. We have lost Professor McLean to the Mississippi station within the last two weeks. He left a position here, paying $1,800 per year, to accept a position paying $2,000 and a house, thus easily worth $2,300, or an increase of $500. It is more than likely that other men in the department will leave before the close of the present college year, if not at the end of the present semester. These resignations are sure to come, under the present salary system."

These losses have been so many and so serious as to become disheartening to some departments. If the college is to maintain its standing and prestige it must maintain its efficiency and this can only be done by a much more adequate provision for our teaching force. Other states have realized the importance of this matter. Among the sixty-six institutions for higher learning in this country classified by the trustees of the Carnegie Foundation on the basis of salaries paid their professors, including such institutions as Columbia University and Cornell, Johns Hopkins, many of the State Universities, including Iowa State University, Massachusetts Agricultural College, North Carolina College of Agriculture and Mechanic Arts, Pennsylvania State College, Ripan College, Iowa State College does not appear in the entire list because the salaries paid are lower than in any of these sixty-six institutions. (See Bulletin No. 2, Carnegie Foundation, May, 1908, pp. 26 and 27.) In a number of cases where our professors are doing exceptionally strong and satisfactory work, we have been able to retain them against the almost insistent invitations from other institutions only because of their reluctance to leave the work which they have undertaken here and by a virtual promise on the part of the college authorities that at the earliest moment better provision will be made for them and in every instance these assurances are for substantially less salaries than they have been urged to accept elsewhere. How long we shall be able to keep up this unequal contest is doubtful. We do not believe that the state of Iowa can afford or wishes to lose its men, valuable scientific men and technical men, to other states no better able to compensate them for their services than Iowa and needing them no more than Iowa.

To take a single illustration, the veterinary division has by the devotion and ability of its retiring dean built up a strong college of veterinary science. Yet we have no buildings set apart for its use that are in any sense adequate and have been unable for lack of support funds to secure a faculty of experienced men such as should be called for the handling of major subjects in a college of this kind.

The United States department of agriculture recently appointed a commission from the bureau of animal industry for the purpose of "obtaining information regarding the courses of instruction

which are now being given at the various veterinary colleges throughout the United States."

This commission has submitted its report. That portion of the report which refers to the veterinary department of the Iowa State College reads as follows:

> After having visited the Iowa State College veterinary department, on March 25, 1908, and obtained all available information, the following are submitted as the most important points at which that institution must be strengthened in order to come up to the minimum standard of requirements deemed essential by this committee:
>
> 1. The most serious defect of this institution relates to the present organization of its faculty. As now constituted the faculty lacks the requisite number of veterinarians teaching major subjects, and too many of these are recent graduates from this institution without the varied and extensive experience necessary to properly equip them for teaching such subjects in a veterinary college. The faculty should at once be strengthened by the addition of one or more competent and experienced veterinarians.
>
> 2. The course as it now exists contains too little laboratory instruction in pathology, and in the opinion of the committee bacteriology and parasitology should be taught by veterinarians.
>
> 3. The hospital facilities are entirely insufficient for satisfactory instruction in practical work at a modern veterinary college.

In view of the criticism and of existing conditions, the committee of the trustees on the veterinary division have made a report, part of which reads as follows:

> It appears evident that more adequate provision must speedily be made for this division of our college. We should either frankly abandon the veterinary department or provide for creditable work. We believe great credit is due the dean, Dr. McNeil, for achieving results that are so creditable with such meager resources and facilities as have been furnished. We have a four years course of study that is excellent in its outline of subjects. The work done has been thorough. The faculty gathered, while of young men and recently graduated from our own course, are bright and capable and earnest. We ought, however, to provide, as the report and criticism of the United States commission suggest, more experienced men, in part at least, for our faculty. Such men can not be secured for the salaries we are paying.

This is the only school of veterinary medicine within the State, whose work can be under state control and supervision. Iowa as a state must speedily prepare to meet the competition of other states, and particularly of the University of Illinois, which is about to establish a college of veterinary medicine in Chicago with ample equipment and resources. A state like Iowa with its vast animal husbandry interests owes a duty to itself as well as to the general public in establishing and maintaining a thoroughly scientific in-

stitution for veterinary medicine which shall set standards that are sufficiently thorough to insure scientific veterinary practitioners as against the cheap courses offered by private institutions that turn out illy trained veterinarians.

There is an important phase of this subject as affecting the general welfare which has never received sufficient consideration. The United States department is now using trained veterinarians as inspectors in all the large packing houses that by this means the public health may be guarded against unsanitary meats. Municipalities also need the professional advice of trained veterinarians in securing the passage and enforcement of suitable ordinances to assure the purity of milk and other dairy products. In the great battle that science is now taking up against the white plague, tuberculosis, the practitioners and the veterinary colleges must have an increasingly important part.

In our estimates of faculty needs for the coming biennial period we have been very conservative in regard to probable student enrolment. We have reckoned only the normal increase such as has been experienced during the last five years. On this basis our enrolment will exceed 2,000 in regular courses by 1910.

It should also be borne in mind that no departments at the State College are self-sustaining or more, as usually is the case with professional departments such as law and medicine in universities, through special tuition fees. Tuition is free for all departments of the college to residents of Iowa.

VETERINARY DIVISION.

The present total salary appropriation for support funds for veterinary faculty and instructors is $6,400. We must add an additional instructor at an initial salary of probably $1,800. The present student enrolment is so large that it cannot be handled together with the large number of animal husbandry students now taking veterinary studies without this increase in faculty. At least $2,000 of the salary of a new dean will have to be paid from the support funds; a small portion may be paid from the station funds for the work which the head of the department will be expected to do in connection with the experiment station. $6,000 will be needed for three associate or full professors of major subjects. This will make the total appropriation needed for the faculty of the veterinary division $9,800, and increase of $3.400.

GENERAL AND SCIENCE DIVISION.

Mathematics.—The department of Mathematics, now registering in class work 901 students, has at present one full professor, who gives one-third time to the department, one associate professor who is also vice dean of the junior college, two assistant professors and four of the rank of instructors.

Mathematics faculty needed:

Three associate professors at average salary $1,500 to $1,800.
Three assistant professors, salaries from $1,000 to $1,500.
Three assistants, salaries $800 to $1,000.

Present salary budget for the department	$ 7,700
Amount needed	12,300
(Including in each case one-third salary of dean and head of department.)	
Increase needed	$ 4,600

Chemistry.—The salaries paid in the Chemistry department are lower than those in any similar institution in our acquaintance. Chemistry is so fundamental to science for technical courses that nearly all students are required to take it. With 964 students at present enroled, including in the department all students in agricultural chemistry, all freshman engineering students, all freshman and sophomore students in veterinary medicine, all students in domestic science and most of the students in the general science, there are in the department, one full professor, head of the department, two associate professors, three instructors and three laboratory assistants. The demands of this department under its capable head, Professor Bennett, are modest. He does not ask at present for general chemistry any father additions of professorial rank, but that the extremely meager salaries of the instructors and assistants ranging now from $500 to $750 be sufficiently increased for meritorious service to enable the department to retain capable and successful teachers and laboratory assistants by slight advance in salaries, instead of annually to see these newly trained assistants depart necessitating the continued use of inexperienced help. The efficiency of the department would be greatly increased and the many students taking chemistry now demand what they should have, thoroughly competent and experienced instructors.

For advances in position	$1,000
One additional instructor	500
Addition to budget in chemistry	1,500

Botany.—Botany is a basal science in agronomy and soils, animal husbandry and horticulture. It is also one of the two optional biological sciences one of which is required of all students in the General Science course.

The laboratory rooms, herbarium, thanks to the industry of Professor Pammel and his assistants, and the general facilities for botanical work are now excellent. The upper floor of the New Central Building is mostly given over to this department.

The faculty consists of

One full professor, head of department.
One associate professor having in charge the work in bacteriology.
One instructor and a small part of the time of three student assistants.

This force is almost ridiculously inadequate. There must be more adequate provision.

Needs of instructional force in botany:

One professor	
One associate professor	$1,500-$1,800
One assistant professor	1,000- 1,500
Three assistants one-half time each, total	1,000
Involves an increase of	700

Bacteriology.—The time has fully come when bacteriology should be placed in a department by itself with a thoroughly trained bacteriologist in charge aided by competent specialists in dairy bacteriology, soils bacteriology, bacteriology of foods in domestic science, veterinary bacteriology and bacteriology related to purity of water and sewage disposal.

This will require for the coming year:

One professor of bacteriology	$2,250
One associate professor in dairy and soils bacteriology	1,800
Three laboratory assistants,	
One full-time	1,000
Two one-half time at $500 each	1,000
Total	$6,050

The veterinary, domestic science and engineering students taking bacteriology could be cared for by this force.

Zoology.—The department of zoology has under the present arrangement of courses and with the present largely increased attendance of students at the college, reached the absolute limit of its re-

sources. As an emergency a student assistant has been put in charge of three laboratory classes that could not be otherwise provided for.

At present there are
One professor in charge.
One assistant professor.
Two instructors one-half time each.
One student one-fourth time.
It will be absolutely necessary to provide

Advance of assistant professorship to associate professorship $1,400 to $1,800	$ 700
Assistant professorship from $1,100 to $1,500	400
One new instructor	1,000
One student assistant	200
Total	$2,000

The demand by the United States department of agriculture for well trained entymologists has so exhausted the supply that it is nearly impossible to secure competent men and not possible at all except as the college can offer at least as much compensation as is paid by the government.

English.—The importance of the continuous study of English, especially of drill in expression, in argumentation, and in clear and vigorous theme treatment in subjects of particular interest to the students in their technical studies, can not be overestimated. The preparation in English of many of the high school graduates who enter college is lamentable. Often instead of patient and thorough discipline in grammer and self-expression, the time of such students appears to have been spent, while in the secondaary schools in a premature study or merely reading of English classics. While an introduction to English classics is certainly desirable, to substitute cursory reading of literature for thorough discipline in grammer and simple and clear self-expression of thought in speech or writing, is a serious and absurd mistake.

The college, however, has to deal with conditions as they exist. The drill in English is essential for all students in all courses. There are enrolled in English classes 985 students.

The present force in the department needs to be increased by two instead of one associate professorship and an advance in salary of the present associate professorship from $1,100 to $1,500.

Total increase	$1,500
One additional instructor	800
Grand total	$2,300

Coach for Debating Teams.—From one intercollegiate debating team we now have six each year and plans are being laid for one more. No college interest of a general character is more important than this. The work of coaching these debaters has fallen almost entirely upon the heads of the departments of English and Economics and their assistants. This work in itself, however, has become so extensive and demands so much time that it will be necessary to place over it a faculty member who shall give to it at least one-half time.

Increase of	$750

Public Speaking.—The work in this department has proven so useful that students of several technical courses especially have felt it to be indispensable to them.

The present instructional force will have to be increased by the addition of one instructor	$ 800
We cannot keep our present capable teachers in this department without slight increases in salaries. From $1,000 to $1,200 and from $800 to $1,000	400
Total	$1,200

Economics.—Economic science is of such importance and such keen interest is being manifested in these courses by students who find it possible to elect one or more of them as well as by the students in general science, that an enlarged staff has been found necessary. Assistant Professor Brindley has been secured at an initial salary of $1,200.

In this subject, however, only men who have given considerable time to preparation can teach acceptably. A graduate course and graduate degrees are quite essential as indicative of sufficient preparation. Rural economics is of particular importance and interest. The head of this department, Professor B. H. Hibbard, is by special permission of the board, spending eight months in Germany in addition to his previous graduate studies under Professor Ely in the University of Wisconsin, as further equipping him for his work. The salary of the head of the department, $1,800, is neither sufficient to retain him, nor, in view of the time and expense necessary in preparation, at all commensurate with the kind

of service given. We shall have to increase the salary budget of this department:

Head professorship, $1,800 to $2,250	$ 450
Assistant professorship to associate professorship from $1,200 to $1,800	600
Total	$1,050

The absolute importance of inculcating sound and scientific ideas in economics and finance cannot be overestimated. The educated men and women of the present generation must take direction of public opinion and save us from the quagmires of economic quackery. Men who are leaders in technical and professional and agricultural interests especially should be sane and clear in their ideas on economic matters, the whole subject of finance, of taxation and of industrial organization needs systematic and thorough consideration.

History and Psychology.—The courses in history, as given in this institution, are adapted to the possibilities and needs of students, the major portion of whose time is of necessity given to technical subjects. Here, however, as in the subject of economics, there is great need of a sufficient survey of history, especially of our own country, to make the student familiar with the general evolution of the industrial, political and social development which has led to present conditions and institutions, that he may be an intelligent citizen.

There should be an advance in position from assistant to associate professorship and correspondingly increased responsibilities. Also an advance from instructorship to assistant professorship involving an increase in the salary budget of a total of $850.

Psychology and the history of education are required by state statute as prerequisites for state certificates. Aside from the intrinsic value they are therefore among the required subjects for those who take up teaching even in the technical lines.

Domestic Economy.—The courses in domestic economy have been organized on a thoroughly scientific basis. Students in foods enter the laboratories in these subjects having already been required to take the basal science studies. Chemistry, bacteriology, physiology and physics especially furnish the principles, the very vocabulary of the work in foods. Instead of merely empirical work, learning how to make good bread, a lesson which any good mother ought to be able to teach her own daughter, students in this subject should

approach it in as thoroughly a scientific manner as students in any field of applied science. A knowledge of principles and how to apply these principles constitutes scientific education. A mere knowledge of how to do things by prescription or receipt is not education but merely information. And information thus received does not enable its possessor to extend his knowledge as an understanding of principles would, but of necessity limits his power to the empirical rule learned or to blundering and unintelligent experience. Graduates of our domestic economy course should be as well equipped either to teach the subject or to apply its principles in homes of their own as the technically trained agriculturist or engineer. There is great need for such well educated women.

Needed instruction force besides head of the department:

One assistant professor	$1,000
One instructor	850
One instructor (new)	750

Making a total increase in the salary budget to the department of $1,000.

Well prepared teachers in these subjects are very few in the entire country and we can not secure them for less salaries than indicated.

Modern Language.—It is altogether probable that an additional instructor here will enable the department to carry its work. We have lost from this department this year two of its most capable teachers because of the small salaries paid. It is unfortunate that strong and successful teachers should be turned away for lack of a small advance in salary, yet this has been the case in a large number of instances.

Additional teacher	$1,000

Civics.—The work of this department has increased to the point where an assistant in addition to its one professor is necessary. This is particularly urgent as the head of this department has very important duties as chairman of the committee on entrance requirements and secondary school relations. As a result in a large part of the work of this committee our relations with the high schools of the state have been put on a very satisfactory basis. The great majority of our students now come to us fully prepared by the high schools for freshman standing.

Additional assistant	$ 800

Library.—The following is the report of the library committee of the Board of Trustees:

To the Board of Trustees: Your library committee deems important that the particular attention of the general assembly be called to the immediate need of strengthening the library, and of providing as soon as possible a suitable building for its permanent home.

In all institutions of learning, and especially where scientific and technical subjects are taught, and where research is undertaken, the library factor is becoming increasingly important. A vast amount of important literature is being produced, particularly in agricultural and technical lines, that must be made available for all students and all investigators in those particular directions. To secure this requires in the first place adequate funds for purchase of books, periodicals and reviews, and in the second place provision of adequate catalogue facilities to make this material available. It is highly important that the bulletin output in various scientific and technical lines should be thoroughly catalogued.

There must also be adequate room for stacks and files, large reading rooms for general library purposes and a large number of seminary rooms where students of particular subjects may gather with the literature that will be of special interest to them, placed at their command.

The faculties of this institution are using the library very much more than ever before and are directing their students to its use. We now have elected a reference librarian, whose business it will be to co-operate with the members of the faculties and the students in the use of our library materials.

The immediate and pressing needs of our library are, first, a library building adequate for our present and future needs; second, very much larger appropriation for books and periodicals and for library assistants, such as cataloguers. Many of the institutions of the country with no larger student enrollment than our own have many more library assistants, and very much more money for library purposes than we have.

This is so vital a matter that we shall be seriously handicapped and retarded in our development as an institution, and it will be impossible for us to maintain the leadership, such as is now accredited us, unless there can be prompt and adequate provision made for our library.

It is increasingly important and vital to the work of the college and the stations, that the library and the library facilities be greatly increased. We must have for the development of the library competently trained librarians and assistants. A cataloguer is provided for by special appropriation, $600. This *one* cataloguer, however, is unable to catch up with the cataloguing work, and keep up with the new material coming in. We need an increase in the library force of at least one assistant librarian whose salary will need to be not less than $800 to $1,000.

Increase of $1,000

ENGINEERING DIVISION.

Pres. A. B. Storms, Iowa State College, Ames, Iowa.

DEAR PRESIDENT STORMS: I would respectfully report as follows concerning the needs of the Engineering division as to instruction force:

GENERAL SITUATION IN THE ENGINEERING DIVISION AS TO NEEDS FOR ADDITIONAL APPROPRIATION FOR INSTRUCTION FORCE.

The statistics which I have presented in the biennial report of the dean of the Engineering division show that between 1897 and 1908 the attendance of engineering students increased from 137 to 843, while the number of purely engineering instructors in the same time increased from 8 to 28. Thus the number of engineering students per instructor increased in this time from 17 to 30. It appears also from these same statistics that the increase in the attendance of engineering students per year has averaged over 40 per year for the last four years.

These figures show very clearly the urgent necessity for additions in the instruction force in the Engineering division.

They also show that during the period specified, the Engineering division has grown from a small department to a great engineering school, whose methods and facilities for instruction have required in that period to be entirely revolutionized.

NEEDS OF THE ENGINEERING DIVISION AS TO ADDITIONS TO THE INSTRUCTION FORCE.

The statistics qouted above show clearly that a very material increase to the present instruction force in the Engineering division would be required to provide a satisfactory number of instructors, or, in other words, to keep the number of engineering students per instructor within reasonable limits.

In addition to this, they show that barely to keep up with the normal growth in engineering attendance of the last few years

requires the addition of about two faculty members per year, or four per biennial period. In view of this general situation, the needs of the several departments as enumerated below are being stated very modestly by the heads of departments.

Needed Faculty Increases in Mechanical Engineering.—Professor Meeker in his report shows clear need of the following:

	Salary.	
1 Pattern Shop Instructor	$ 1,000.00	
1 Assistant Machine Shop Instructor	800.00	
1 Drawing Instructor	1,000.00	$ 2,800.00

Needed Faculty Increases in Civil Engineering.—In this department there is extremely urgent need for an assistant professor of mature age and experience to have charge of the instruction in Civil Engineering laboratory work, which is becoming constantly more important. There is also urgent need for an instructor to devote his full time to the instruction in Field Surveying under the assistant professor who has responsible charge of that work. There is also need for an instrument room assistant to keep the surveying equipment in repair and to give out instruments, receive them when returned, etc.

	Salary.	
1 Assistant Professor for Engineering Laboratory	$ 1,500.00	
1 Instructor in Field Surveying	1,000.00	
1 Assistant	800.00	$ 3,300.00

Needed Faculty Increases in Physics and Electrical Engineering.—Professor Spinney's report will be found presenting the urgent needs of the work in Physics and Electrical Engineering. I am familiar with the situation and believe that Professor Spinney has understated the needs and that the force is so badly overworked at present that at least two new instructors should be provided.

	Salary.	
2 Instructors in Physics and Electrical Engineering	$ 2,000.00	$ 2,000.00

Needed Faculty Increases in Mining Engineering and Geology.—In this department the new course in Ceramics has been established by recent act of the state legislature and one new instructor should be provided.

	Salary.	
1 Instructor in Ceramics	$ 1,000.00	$ 1,000.00

Needed Faculty Increases in Chemical Engineering.—In a previous report I have detailed the urgent need for a course in Chemical Engineering.

	Salary.	
1 Associate professor	$ 1,800.00	$ 1,800.00

Needed Faculty Increases for Architectural Engineering.—In a previous report I have detailed the urgent need of a course in Architectural Engineering.

	Salary.	
1 Associate professor	$ 1,800.00	$ 1,800.00

Total increases needed for members of Engineering division faculty	$12,700.00

GENERAL NEEDS OF THE ENGINEERING DIVISION AS TO PROMOTIONS OF THE PRESENT MEMBERS OF THE ENGINEERING FACULTY.

The statistics which I quoted at the beginning of this report partially show the fact that the division within eleven years has grown from a small department to a great engineering school. This has required, as there indicated, an entire revolution in our facilities and methods of instruction.

In 1897 and for a number of years previous, each department consisted practically of one full professor with an instructor or two to help, and in the case of the Mechanical Engineering department, with a few foremen in charge of shops. All of the students received instruction mainly direct from the heads of the Engineering departments, who were men of maturity and long experience.

At the present time these conditions no longer exist. In each department a large number of men are required to give the instruction properly, and the tendency at first was, of course, to employ comparatively young and inexperienced men at low salaries. We have now reached the point where this policy can no longer be continued without disaster. Under it our students would not receive instruction of the grade to which they are entitled.

In each important subject of engineering, students are entitled to receive instruction from a mature, experienced man, who can be considered an authority in the subject which he teaches. Such men are entitled to have responsible charge each of his own work, and men of the right calibre cannot be secured unless they are given such responsible charge and allowed full credit for what they accomplish. The plan can no longer be tolerated of expecting each

instructor to look to the head of the department for the initiative for each feature of his work.

To secure men of the calibre now needed in our engineering faculty requires not only this policy of giving them responsible charge of their several lines of work, but also provision of salaries which will be sufficiently large to equal, approximately, the salaries which such men can command in outside work or in other engineering schools of similar rank to ours.

The present situation also requires some system by which efficient members of our engineering faculty can be confident of receiving some promotion from time to time to reward them for good work. In the past we have too much followed the policy of making promotions only when absolutely forced to do so by reason of outside offers better than we are paying to the members of our faculty.

I believe that we should adopt some general policy as to adequate salaries for the several grades of men in our engineering faculty. For example, the heads of departments ought to receive salaries equal to those given the heads of equal departments in sister schools, such as those in Illinois, Wisconsin, Minnesota, etc. The same is true of associate professors, assistant professors and instructors. I believe that we should adopt the general policy of paying our instructors say $900 to $1,200 per annum, assistant professors say $1,200 to $1,600 per annum, associate professors say $1,600 to $2,000 per annum, professors says $2,000 to $2,500 per annum.

The figures mentioned are to some degree tentative and should be very carefully considered by the college authorities before absolutely decided upon. The exact amount paid each man should be made to depend somewhat upon length of service with us, although length of service alone should not entitle anyone to promotion, which should depend upon merit.

There are many instances in our Engineering division where the present members of our faculty are, by every principle of justice, entitled to promotion. For example, the vice-dean of the division receives from us $2,750.00 per year and during the past year refused the equivalent of $3,400.00 per year and the title of dean at another engineering college. We obligated ourselves to pay him a salary of at least $3,000.00 per year within a reasonable time.

Without going into details of other cases, I would say that I believe justice would require—

For promotions in Engineering faculty.....$ 5,000.00

RECAPITULATION.

To recaptulate the total increases recommended in this report for the Engineering faculty are as follows:

For new instructors	$12,700.00	
For promotions	5,000.00	$17,700.00

Respectfully submitted,

A. MARSTON,
Dean of Division of Engineering.

Ames, Iowa, Oct. 8, 1908.

AGRICULTURAL DIVISION.

Farm Crops.—It will be impossible to keep the present instructional force of the farm crops department for another year without a substantial increase in the salaries.

We will have to have additional help another year. Two new courses have been added to those already offered by the department; because of which we are very heavily drawing upon our department budget for student assistants. The following is a conservative estimate relative to the instructional force of the farm crops department for the coming year:

Title	Present Salary	Recommended Salary	Increase
Professor (head of department)	$1,600	$2,000	$ 400
Assistant professor	1,200	1,500	300
Assistant professor	1,200	1,500	300
Instructor	.....	1,000	1,000
Total	.....	.....	$2,000

Agricultural Engineering.—With the increase of students, which is expected during the coming biennium, it will be necessary to require full time of the shop assistants, who are only giving a part of their time to instructional work. This with an assistant to replace the student assistant now employed for part time, should be sufficient to handle the work of the department.

The salaries paid to the instructor and assistants, at the present time, are so low that the department can not expect to retain them after they have become experienced.

The salaries paid to men in similar work at other colleges are much higher.

Professor, one-half time	$1,250
Assistant professor	1,400
Two instructors	1,000
Assistant	500

This involves an increase to the department budget of $1,385.

Soils Department.—The work of the department of soils along the lines of physics and fertility has developed symmetically, but the time is at hand for rounding out the scope of the department's work by the addition of strong courses in soil bacteriology. A splendid laboratory has been fitted in the new Agricultural hall for this work.

We strongly recommend that a competent professor of soil bacteriology be secured for work at the beginning of the fall semester, 1909.

The recommendation is made that this instructor devote one-half time to college work and one-half time to experiment station work.

Nearly 100 students were registered for laboratory work in soils last semester. It is practically impossible for one instructor to teach so large a number successfully. On the present basis of increase in the number of students in laboratory work in soils, we will have a registration of, at least, 150 before the close of the next biennial period.

Again the lectures in soil physics and in fertility were delivered in 1907-08 to a class which numbered more than 70 students. A class of this size is too large for the most effective work, but a division into sections has been impossible because of lack of instructors.

For these reasons, we recommend the addition to our teaching force of one instructor for work in physics and fertility.

Professor in soil bacteriology (provided for under bacteriology).	
One instructor	$1.000

Dairy Department.—A dairy chemist is needed. Some of the work that should be done by a chemist under the direction of the head of the department is now being done at Coe College. Other dairy departments, notably Wisconsin, have merited much praise

for their excellent work in dairy chemistry. At that station such names as Babcock, Farrington, Woll and Hart are famous for their work along this line of investigation. There are still problems in dairy chemistry to be solved. Why not have them solved at Ames?

Additional instructional force,	
One dairy chemist	$1,000

Animal Husbandry Department.—We are face to face with a very serious condition of affairs in our corps of instructors. During the past six months, every man, with one possible exception, has had offers from other colleges and from commercial lines of work to take up work elsewhere at salaries ranging from $300 to $1,000 in advance of the salaries now being paid. We have lost Professor McLean to the Mississippi station within the last two weeks. He left a position here paying $1,800 per year, to accept a position paying $2,000 and a house, thus easily worth $2,300, or an increase of $500. It is more than likely that other men in the department will leave before the close of the present college year if not at the end of the present semester. These resignations are sure to come, under the present salary system.

While we will need one or possibly two additional instructors during the next biennial period, the most urgent need is more money for the present positions, regardless of whether the present men remain or not. If they go, it will require higher salaries than are now being paid to get other men to fill the positions. This applies to every man from the head of the department down. Why should the head of the animal husbandry department in Iowa, a department which has more long course students enrolled at the present time than are to be found in all the departments of any other agricultural college in America, receive $250 less than in Missouri, $500 less than in Minnesota, $750 less than in Illinois, and $1,250 less than in Cornell University? What applies to the head of the department applies equally to all of the other positions in the department.

If the student attendance continues to increase from year to year, we will need at least one additional man in the animal husbandry department, and an assistant in the poultry work.

A very conservative estimate of the increased needs from an instructional standpoint for the coming biennial period is as follows:

	Biennial Period.
Head of department, $250 per year	$ 500
Associate professor, $250 for first year, $500 for second year	750
Associate professor, $250 for first year, $500 for second year	750
Associate professor and superintendent of dairy farm, $250 fist year, $400 second year	650
Assistant professor in charge of poultry work, $300 first year, $500 second year	800
Assistant professor, $200 per year	400
Additional instructor in animal husbandry	1,000
Additional assistant in poultry	1,000
Grand total for period 1909-1911	$5,850
Annual increase	$2,925

It should be noted that under the head of animal husbandry is organized all the animal husbandry work, including dairy and poultry husbandry, thereby effecting a considerable economy of administration. If, as some other institutions are doing, we separated these lines of work into separate departments the expense of administration would be considerably increased.

Horticulture and Forestry.—The teaching of the department so far as the number of students is concerned is very largely with the junior college, in which the classes are very large and constantly increasing. In 1900, for example, our freshman enrolment for one subject, namely, horticulture 2, was 37. In 1908 the enrolment for the same subject was 165 and for the current year it promises to be nearly 200. This rapid increase in the number of students, and particularly in the demands for laboratory work where large sections can not be handled successfully, is, I fear, causing undue encroachment upon the time of members of the staff which should be given to the section work. A study of the situation makes it evident that with the probable increase in enrolment in the next biennial period an additional instructor in the department will be required at a salary of $1,200 per year.

One additional instructor	$1,200
Gardener, increase in salary	150
Total increase	$1,350

EXPENSE OF TECHNICAL EDUCATION.

It will thus be noted that the present administrative force can carry this part of the college interests without any important additional expense. So far as administration is concerned, it costs but little more to handle 2,500 students than 1,500.

The large expense of a technical institution of learning is in its instruction force and its laboratories and its equipment.

Upon this point Dean L. H. Bailey of the Cornell University has recently said:

> They tell me that these colleges (agricultural and technical) are now demanding enormous sums, but this is because we have never known how much money they have needed to make them effective. Never have they had money enough or freedom enough to work out their problems fundamentally. Agricultural education and experiment is the most expensive to maintain of all education because its laboratories are so large, so various and so expensive in their upkeep. Institutions centering about the city ideas receive no end of money and study. The open country is just coming to its own. With men and money working in state institutions and national institutions, the rural problem can be solved. Schools and colleges are worth only what they cost.

The time has come, however, when we shall be obliged to pay heads of important departments salaries ranging from $2,250 to $2,500 instead of $1,800 to $2,100 as at present in the general departments of science. The present discrepancy between the salaries of men in technical lines and those of professors in the basal sciences is noticeable and indefensible.

Some advance will have to be made soon in the salaries of our leading scientific men or we shall lose them, and we can not with the range of salaries now being paid in other institutions like the state institutions adjoining us, secure other competent men in their places at our present salaries. It would be a far wiser and in the end a more economical policy to retain those we now have who have been tried out from a large number of workers in the last decade, and who have proven their efficiency and who are thoroughly loyal to Iowa and its educational and industrial interests.

In some cases to lose our present men would mean to step back several years and start over again where we were years ago.

We can not believe that Iowa wants any but the best.

In this connection it is significant that many of the larger cities are establishing and equipping poletechnic high schools. Cleveland is putting into one such high school $800,000. Other cities as St. Louis, Kansas City, Los Angeles, New York City, are expending approximate amounts for similar high schools. Such educational facilities even for secondary schools are expensive, but more progressive communities are thoroughly convinced that it pays large dividends. There is no better investment than that which increases

the intelligence and the industrial efficiency of the people. Shall a state like Iowa be slow to appreciate the importance of such education? Its citizenship is universally engaged in or indirectly dependent upon the main industries of agriculture and the mechanic arts. According as these industries flourish will our people be prosperous and contented. It is, however, increasing important from year to year that scientific truth and methods be extended. The days of easy carelessness are passing. We are at the parting of the ways. We must either progress or recede.

Total increase needed for instruction.....$55,560

INCREASED EXPENSE OF DEPARTMENTS.

The departments are not having sufficient appropriations for their current expenses. These department budgets have in several cases been cut so low as to cripple them in their work.

At least $15,000 in total will be necessary to meet these items of increased expense and minor equipment.....$15,000

The fires and lights and incidentals appropriation will necessarily increase (estimated) .....$ 4,000

DIVISIONS.

I.—*Educational.* All instructional work having to do with students comes under this head. This constitutes the college. For the support of this collegiate or instructional work the educational support fund and these only may be used. The entire faculty of instruction, the expenses of maintenance of buildings and grounds, the equipment of laboratories and all expenses connected with the college are chargeable to these educational support funds.

These funds as shown in the Secretary's report are derived,

1. From federal sources.
2. From state appropriations.
3. From donations.

The total of these funds for the fiscal year closing June 30, 1908, amounted to $223,940.78.

To these funds may appropriately be added,

4. Janitor fees $23,144.14
5. Tuition of foreign students..... 2,810.00

$26,954.14

making a total educational support fund of $250,894.92.

All other student fees are merely for laboratory materials or mimeograph notes used by the students and do not add to the college resources.

II.—*Agricultural Extension.* This work is now supported by an annual appropriation from the state of $27,000.

1—Scope:

The purpose of this division is defined in the bill of appropriation (Chapter 216, Iowa Laws, 32 G. A., page 219):

Be it Enacted by the General Assembly of the State of Iowa:

Section 1. Agricultural extension and experiment work. That the Iowa State College of Agriculture and Mechanic Arts is hereby authorized to continue and to extend the system of agricultural extension work, authorized by the Thirty-first General Assembly. Under this system the said college shall be authorized to conduct experiments in the various portions of the State and to give instructions in agriculture wherever, in the judgment of the college authorities, it shall be advisable, with reference to the various lines of agricultural work maintained upon the college grounds at Ames, Iowa. The college authorities are authorized to give instructions in corn and stock judging at the agricultural fairs, institutes and clubs, and to aid in conducting short courses of instruction at suitable places throughout the state; to give lectures and demonstrations on the growing of crops and fruits, on stock raising, dairying, land drainage and kindred subjects, including domestic science. This work shall be so planned as, in the judgment of the college authorities, is best calculated to carry to the communities remote from the college the benefits of the instruction given by the teachers in the State College and the results reached in the work of the Experiment station.

2—Organization.

Under the provisions of this act, the Agricultural Extension has been organized by the board of trustees under the following regulation:

That the Agricultural Extension work be established as a department in the agricultural division of the college, and the head of such Agricultural Extension department shall bear the same relation to the dean or head of the Agricultural Division as is borne by heads of departments in the Division of Agriculture. The head of said Agricultural Extension work and other instructors, lecturers and employees therein shall be appointed in the same way that has hitherto been observed in the appointment of heads, professors, instructors, and employees of other departments, such as Animal Husbandry or the like.

3—Lines of Work Undertaken.

Aside from correspondence which has been very heavy, numbering in outgoing and incoming letters, circulars and other pieces,

75,000 within the past year, this department has placed in the field instructors in the following subjects:

Animal Husbandry—R. K. Bliss and R. E. Drennan.
Farm Crops—M. L. Mosher.
Domestic Economy—Miss Edith Charlton and Miss Neale Knowles.
Soils—A. H. Synder.
Public Schools—Prof. A. V. Storm.

The Public School division is undertaken with the purpose of "promoting the introduction of agriculture and domestic economy into the public schools of Iowa."

To introduce these subjects into the schools successfully it is necessary:—

First: To develop favorable sentiment.

Second: To provide a body of subject matter to be taught.

Third: To prepare the teachers to conduct the work successfully.

Professor Storm has been devoting his time to these problems. He has met over sixty public engagements, has traveled over 3,000 miles, has addressed granges, farmers' institutes, teachers' meetings and institutes, short courses, public schools, etc., besides attending to a large correspondence.

During the summer of 1908, a short course for teachers was held at Sheldon, Iowa, in conjunction with the county teachers' institute. Extension workers in the various subjects gave illustrative talks to teachers and conducted studies in methods. The very keen interest shown proves the timeliness of taking up this line of extension work.

4—County Experiment Stations.

In co-operation with the county authorities there have been established by the agricultural extension department at the county farm, county experiment stations in the following counties: Sioux, Story, Marshall, Cedar, Montgomery, Page and Henry. The work has been for the most part demonstration rather than experimentation. The value of this demonstration work has been very evident. No amount of literature can bring home to the average man the importance of some economic principle so effectively as an actual demonstration before his own eyes. The picnic gatherings at the harvesting of the crops in these county demonstration plats have been largely attended by people who showed keen interest in the results.

5—Short Courses.

Short courses have been organized and carried forward with distinct success at Newton, Mt. Pleasant, Red Oak, Avoca, Cedar Rapids, Spencer, Storm Lake, Manchester, Marshalltown, New Providence.

There have been enrolled in these short courses, 2,342 men and 1,318 women, a total of 3,660.

How much of intelligent enthusiasm for their business and how much of increased success and happiness, to say nothing of the transformation of failure into success, have resulted from this extension work to the people of the state no statistics can tell. That these results have been evident may testify.

III.—*Experiment Stations.*

1—Agricultural Experiment Station.

The funds for the Agricultural Experiment Station are derived,

(1) From federal government, $23,000, to reach $30,000 ultimately.

(2) From state, $25,000.

For live stock experimentation,

(1) From federal government, $7,500.

(2) From state, $7,500.

The report of the director of the Agricultural Experiment Station presents fully the work carried on under this provision. It is sufficient in this connection to call attention to the varied lines of experimental work undertaken and to its systematic and scientific character, insuring reliable results.

It is obvious that this investigation work pays many fold its cost to the nation and to the state.

Other equally important investigations remain to be taken up or are under way.

2—The Engineering Experiment Station.

Particular attention is called to the report of Professor A. Marston, director of the Engineering Experiment Station, as showing succinctly the important work undertaken and awaiting this department of the institution.

As with the Agricultural Experiment Station, so here, the work undertaken and its support are entirely distinct from the instructional work of the college. The Engineering Experiment Station can use such funds and such only as are appropriated for this purpose. And none of these funds can be used for instructional purpose.

The time is already come when to continue our prosperity as a state we must develope the sources of wealth that lie at hand and must encourage the manufacturing interests that co-operate with agriculture in the prosperity of the people.

Already, with very meager support given for this work, twenty-two bulletins have been issued upon subjects of the most vital importance to the people of the state, and as the results of investigations reaching back in some cases many years.

No wiser economy could be practiced by the state than to give to this investigation work so well begun the modest support asked, $15,000 annually instead of $3,500. Every dollar of money appropriated for this purpose will be utilized fully in extending these investigations. And the results will be given promptly to the people of the state.

REPORT OF ENGINEERING DIVISION.

Pres. A. B. Storms, Iowa State College, Ames, Iowa.

DEAR PRESIDENT STORMS: I would respectfully report as follows concerning the work of the Engineering division during the biennial period from July 1, 1906, to July 1, 1908, and its needs for the next two years.

HISTORY AND ORGANIZATION.

The work in mechanical and civil engineering was necessarily established in our college at the opening of its work in 1868, to comply with its objects as stated in the national law by which it was endowed, which devoted the college "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Our Engineering division as it stands today, is the result of forty years of steady and normal growth, during which time it has developed along the exact lines of our great charter. In this development, and in response to urgent demand, electrical engineering was added in 1891, at about the same time that other engineering schools were first introducing electrical courses. In obedience to laws passed by the Iowa legislature, mining engineering was introduced in 1892, and ceramic engineering in 1906. An engineering experiment station was added by the legislature in 1904, and in the same year another act of the legislature made the college the state highway commission.

Thus the Engineering division is now organized in four departments, viz.:

Mechanical Engineering.

Civil Engineering.

Physics and Electrical Engineering.

Geology and Mining Engineering (having charge also of Ceramic Engineering).

With these is closely associated the work of the

Engineering Experiment Station.

The Engineering and the Agricultural divisions are associated in the work of the

Iowa State Highway Commission.

The normal growth and development of the division, and the necessity of keeping its work constantly up to the best standards have called, during recent years, for a thorough revision of the courses of study, and now seem to require the establishment of new 5-year, optional engineering courses in addition to, and parallel with, the regular 4-year courses now offered. The demands of the state and the necessity of keeping up with its advances also seem to demand the addition of new courses in chemical engineering and in architectural engineering in the immediate future.

CERAMIC ENGINEERING.

The new courses in ceramics have been provided in obedience to the act of the legislature requiring the same. It is hard to exaggerate the possible importance of this work to the clay, cement and quarry industries of Iowa. Its graduates can readily find remunerative and responsible employment. We already have five students enrolled. A building and equipment for this work are urgently needed, and have been most strongly demanded by the clay and cement organizations of the state, to provide for both instruction and investigation.

REVISION OF COURSES OF STUDY.

During the past three years all the engineering courses of study have been thoroughly revised, and the entrance requirements were raised. The courses have been brought to a uniform basis of 18 credit hours per week, and have been improved in many particulars, without startling change. The result has been most satisfactory in every particular.

FIVE-YEAR ENGINEERING COURSES OF STUDY.

In modern times the entire structure of our civilization has become more and more closely and indispensably dependent upon applications of modern scientific knowledge of physical and chemical forces and properties of matter, for the use and benefit of man. It is only through the engineer that the use and benefit of such forces and such properties of matter can be secured, hence more and more the engineer has become indispensable in the activities of modern civilization. Just recently there has been an awakening to the immediate absolute necessity for the conservation of the natural resources of the earth, which conservation can only be secured through the aid of engineers, not only in carrying out the detailed work, but also in the direction of national policies of the widest scope. At the present time, too, engineering knowledge is being found essential in the general administration and direction of most great business, manufacturing and transportation enterprises, and in the regulation of public utilities.

Hence there is now a very strong demand for a broader and more liberal training for engineers, and in response to this demand our engineering faculty has voted to recommend the establishment by the college of optional five-year engineering courses in mechanical, civil, electrical, and mining engineering, leading to the advanced degrees of M. E., C. E., E. E., and E. M., instead of to the bachelors degrees given for completion of four-year courses. The greater part of the added year of work will be of non-technical nature.

Besides our own college, the Universities of California, Minnesota, Michigan, Wisconsin, and Nebraska, Cornell University and the Massachusetts Institute of Technology are examples of engineering schools which are establishing engineering courses longer than four years.

It is not anticipated that there will be election of the five-year courses by any large number of students at first. All of the added subjects are already taught here, though in part of them additional advanced work will be necessary.

CHEMICAL ENGINEERING.

From the accelerated modern development of engineering comes also the demand for engineers especially trained in chemistry, for service in the many modern industries in which chemistry plays a vital part. We not infrequently have calls to supply training

in chemical engineering, and I recommend that the college at once establish a four-year course in chemical engineering, which, besides the general technical and non-technical work of the other engineering courses, shall provide special training in technical chemistry.

This work would be established in direct co-operation with our present work in general chemistry, and only the services of one new associate professor at $1,600 to $2,000 per year would be required to give the instruction. Until a considerable number of students entered the course, his services could partly be utilized in connection with the present work in assaying, metallurgy, etc., and in connection with the chemical side of our engineering experiment station work. The same is true of the new apparatus.

I believe that until a new chemical building can be erected, quarters for the work in chemical engineering could be provided in the engineering buildings. Probably $2,500 to $4,000 would be needed for new apparatus.

ARCHITECTURAL ENGINEERING.

There is no school of architecture in Iowa, and we often have calls to give instruction in this line, which is of increasing importance to the state. I recommend that the college at once establish a four-year course in architectural engineering.

For this, also, one new associate professor at $1,600 to $2,000 per year, and $2,500 to $4,000 for new apparatus should be sufficient. Quarters would have to be found for several years in the engineering buildings already built or appropriated for. The apparatus and the services of the professor could be partly utilized in carrying on present work until a considerable number of students entered the new course.

STATISTICS OF PAST GROWTH OF ENGINEERING DIVISION.

The past rate of growth of our engineering work has been very rapid, and has steadily continued throughout the biennial period which has just closed, as is shown by the tables below:

TABLE NO. 1.

ATTENDANCE OF ENGINEERING STUDENTS AT IOWA STATE COLLEGE.

Year	M. E.	C. E.	E. E.	Mn. E.	Ceramics	Total
1894-5	44	35	68	0	...	147
1895-6	38	38	66	2	...	144
1896-7	23	32	77	3	...	135
1897-8	30	27	76	4	...	137
1898-9	65	52	135	2	...	254
1899-00	86	77	167	6	...	336
1900-01	117	119	180	12	...	428
1901-02	144	163	230	16	...	543
1902-03	165	176	216	20	...	577
1903-04	174	231	233	39	...	677
1904-05	155	263	249	39	...	706
1905-06	139	281	259	47	...	726
1906-07	152	319	293	39	...	803
1907-08	153	336	301	48	5	843

TABLE NO. 2.

NUMBER IN ENGINEERING FACULTY AT IOWA STATE COLLEGE AS COMPARED WITH NUMBER OF ENGINEERING STUDENTS.

Year	No. of Engineering Division Instructors		No. of Engineering Students	
	Total	*Purely Eng.	Total	Per Instructor
1894	10	8	147	18
1895	10	8	144	18
1896	10	8	135	17
1897	10	8	137	17
1898-9	11	9	254	28
1899-00	13	11	336	31
1900-01	15	13	428	33
1901-02	15	13	543	42
1902-03	21	19	577	30
1903-04	25	22	677	31
1904-05	26	23	706	31
1905-06	26	23	726	32
1906-07	30	26	803	31
1907-08	33	28	843	30

* Remainder in Physics, Geology, Good Roads, and Engineering Experiment Station.

A study of table No. 2 shows that the growth in the engineering faculty has not kept pace with the growth in attendance.

RECENT NEW BUILDINGS.

During the biennial period just closed, a material improvement has been effected in the shop and engineering laboratory facilities of the division, though much is still lacking in this particular.

A new forge shop was completed and put into use in 1907.

A new machine shop has just been completed and put into use (1908), from the appropriation made by the last legislature. It is by far the best of our shop buildings, and would be a credit to any engineering school in the country.

The structural and hydraulic laboratory (formerly "Old Engineering Hall") has been entirely reconstructed, as to its interior, into a modern engineering laboratory building, fireproof throughout except as to the roof. By the expenditure of less than $10,000 in this work, the college has secured a thoroughly good building which would probably have cost at least $30,000 if built new.

THE GEORGE W. CATT LIBRARY.

By will, Mr. George W. Catt, an alumnus of the civil engineering department, left his engineering library to the division. With the other engineering books and periodicals belonging to the college, this library has been installed in a large room, well suited to the purpose, in the third story of "Engineering Hall," and placed in charge of a regular librarian. This arrangement for the engineering library has been of great value in our work.

NEEDS OF THE ENGINEERING DIVISION AS TO FACULTY.

The rapid growth of the Engineering division creates constant needs.

As to the faculty, we need more members, so as to reduce the number of students per instructor shown by table No. 2 to more reasonable figures. We owe our students more constant personal supervision and assistance in their work than can be provided with the present force.

We also need better provision for the salaries of good men in our present number, salaries more nearly corresponding to those in Illinois, Wisconsin and Minnesota, and more nearly to what the same men can command in outside work.

We should have some arrangement whereby a good man can receive promotion as his experience and his value to us increase, without waiting till some better offer elsewhere forces his loss, or promotion in his case without corresponding treatment of equally meritorious colleagues.

In 1907 we lost 25 per cent of the members of the engineering faculty to other engineering schools and to outside practice. In rank these men ranged from instructors to vice dean. Their loss was most deplorable.

The increases in salary made in the Engineering division during the biennial period were absolutely forced by such conditions. Only loyalty of our men prevented further most serious losses, including,

this year, the able head of our mining engineering department, now vice dean of the division.

NEEDS OF THE ENGINEERING DIVISION AS TO NEW BUILDINGS.

In addition to the new building already provided for by the last legislature, our most pressing need as to new buildings is undoubtedly for a ceramics building.

This building and its equipment are estimated to cost $15,000. The work was established by act of the legislature, which, therefore, is under obligation to support it.

In addition, we need an engineering shop and store house, estimated to cost $5,000, in which we can make and repair much laboratory apparatus, and which will permit a general cleaning up of the material now stacked out doors around our shops. The building would be a duplicate of our present foundry, and would be so located as to be devoted to that work eventually.

NEEDS OF THE ENGINEERING DIVISION AS TO EQUIPMENT.

Our need in this respect is perhaps the most pressing of any, as owing to our rapid growth we have sadly fallen behind in this respect. Exact lists of the apparatus most urgently required are being submitted to you by the different departments. It will not total less than $40,000, which is only a fraction of the sums recently appropriated in Illinois.

In this connection, it should be noted that no provision has yet been made for the equipment of the new $30,000 engineering building authorized by the last legislature, which is to be built next spring. $5,000 should be provided for this in addition to the department lists now being submitted to you.

RECAPITULATION OF NEEDS OF ENGINEERING DIVISION.

1. Materially increased support, for faculty increases and general appropriations.
2. New Ceramic building and equipment.....$15,000
3. New equipment for departments.....40,000
4. Equipping new building.....5,000
5. New shop and store house.....5,000

Respectfully submitted,

A. MARSTON,
Dean of Division of Engineering.

Ames, Iowa, Sept. 21, 1908.

ADVANCED DEGREES, JUNE, 1907.

POST GRADUATE STUDENTS.

DIVISION OF AGRICULTURE.

Agronomy Course:
Delfin Sanchez de Bustamante, B. S. A.
Ebenezer B. Watson, B. S. A.
Animal Husbandry Course:
John Julian Hooper, B. Sc.
Alfred Ernest Parr, B. Sc.
Ernest Thompson Robbins, B. S.
Horticultural Course:
Victor Ray Gardner, B. S.

DIVISION OF ENGINEERING.

Degree of Civil Engineer:
Herbert A. Bennett, B. C. E.
John Edgar Van Liew, B. C. E.
Degree of Mechanical Engineer:
Mark P. Cleghorn, B. S. in E. E.
Frank D. Elwell, B. M. E.

DIVISION OF SCIENCE.

C. Edgar Bartholomew, B. S.

HONORARY DEGREES.

I. B. Schreckengast, M. Ph.
J. C. Blair, M. S. A.

CANDIDATES FOR MASTER'S DEGREE, JUNE, 1908.

SCIENCE COURSE.

Fogel, Estelle Denis, B. S., A. B.—The Plant Ecology of Canada and Alaska. Degree: Master of Science.

Walker, Evahn Russell—The Medicinal Plants of Iowa. Degree: Master of Science.

AGRICULTURE.

Bower, John—A Study of the Moisture in Butter. Degree: Master of Scientific Agriculture.

Buckman, Harry O. Degree: M. S. A.

CANDIDATES FOR ADVANCED DEGREES IN ENGINEERING.

ELECTRICAL ENGINEERING COURSE.

Shane, Adolph, B. S. in E. E. Candidate for Degree of Electrical Engineer.

CIVIL ENGINEERING COURSE.

Cleghorn, John C., B. S. in Mn. E. Candidate for Degree of Civil Engineer.
Garver, Herman F., B. C. E. Candidate for Degree of Civil Engineer.
Morrison, Joseph, B. C. E. Candidate for Degree of Civil Engineer.
Weakley, Frank M., B. S. in Mn. E. Candidate for Degree of Civil Engineer.
Taylor, George A., B. C. E. Candidate for Degree of Civil Engineer.
Lathrop, Jay C., B. C. E. Candidate for Degree of Civil Engineer.

MECHANICAL ENGINEERING COURSE.

Wells, M. E., B. S. Candidate for Degree of Mechanical Engineer.

HONORARY DEGREE.

Corbett, Virginia, M. Ph.

CHANGES IN THE FACULTY.

During the period July 1, 1906, to June 30, 1908.

RESIGNATIONS.

PROFESSORS.

1907.

Herbert Wm. Dow, Assistant Professor of Mechanical Engineering.
Christian Larsen, Assistant Professor of Dairying.

1908.

M. Stalker, Lecturer Veterinary Division.
George Welton Bissell, Vice Dean of the Division of Engineering, and Professor of Mechanical Engineering.
Miss Georgia Witter, Professor of Domestic Economy.
Walter A. Stuhr, Professor of Histology, Pathology, Therapeutics.
Lewis Eugene Ashbaugh, Associate Professor of Civil Engineering.
Frank French, Associate Professor of Civil Engineering.
Hugh Potter Baker, Associate Professor of Forestry.
Frank Jordan Ressler, Director of Music.
Miss Bessie B. Larrabee, Assistant Professor of English.
Leslie M. Hurt, Assistant Professor of Physiology and Sanitary Science..
Fred Rasmussen, Assistant Professor of Dairying.
Mary Raush, Domestic Economy, Extension Department.
Adrian M. Newens, Professor of Public Speaking.
Dr. Harriman, College Physician.

INSTRUCTORS AND ASSISTANTS.

1907.

Will H. Ogilvie, Editor Agricultural and Experiment Station Bulletins.
Daily Martin Curl, Instructor in Forge and Foundry.
Henry Josef Quayle, Instructor in Zoology.
Miss Anna M. Wilking, Instructor in Domestic Economy.
Miss Edith Stevens, Laboratory Instructor in Chemistry.
Horace Lyman Blackman, Assistant in Drawing.
Will G. McKay, Laboratory Assistant in General Bacteriology.
C. M. McCormick, Assistant in Drawing.
W. J. Lynch, Assistant in Animal Husbandry.
M. E. McCulloch, Assistant in Farm Crops.
E. C. Place, Assistant in Chemistry, Experiment Station.

1908.

Mrs. Mary Elizabeth Ressler, Instructor in Instrumental Music.
Miss Elizabeth Cronin, Instructor in Mathematics.
John Berg, Instructor in Civil Engineering.
M. J. Reinhart, Instructor in Civil Engineering.
E. B. Watson, Instructor in Soils.
Victor Ray Gardner, Instructor in Horticulture.
Miss Margaret Stanton, Instructor in History.
Miss Jeanette Bartholomew, Instructor in Chemistry.
Arthur Eugene Miller, Instructor in Agricultural Engineering.
Henry Howard Urmston, Instructor in Mechanical Drawing.
A. C. Gaugh, Instructor in Forge and Foundry.
C. E. Marsh, Instructor in Physics and Electrical Engineering.
Martin G. Lewis, Instructor in Mechanical Drawing.
C. W. Clements, Instructor in Forge and Foundry.
Ellen M. Geyer, Instructor in English.
E. P. Humbert, Instructor in Farm Crops.
John L. Coulter, Instructor in Economic Science.
R. L. Gribben, Assistant in Animal Husbandry.
A. E. Bobst, Laboratory Assistant in Chemistry.
J. W. Jones, Horticulture, Extension Dept.

June, 1908.

F. W. Bouska, Associate Professor of Dairying, Dairy Bacteriologist.
Wilbur M. Wilson, Associate Professor of Mechanical Engineering.
Miss Florence Lucas, Instructor in French.
Miss Georgia Hopper, Instructor in German.
Miss Maude Ageton, Instructor in History.
L. E. Carter, Instructor in Agricultural Journalism and Bulletin Editor.

APPOINTMENTS.

PROFESSORS.

1906-7.

Hugh G. Van Pelt, Assistant Professor of Animal Husbandry and Superintendent of Dairy Farm.

Miss Helen Donovan, Assistant Professor of Domestic Economy.
Fred Rasmussen, Assistant Professor of Dairying.

1907-8.

Mrs. Alice Dyne Feuling, Professor of Domestic Economy.
C. B. Stanton, Associate Professor in Railway Engineering.
J. E. Kirkham, Associate Professor in Structural Engineering.
Chas. H. Stange, Assistant Professor of Histology, Pathology and Therapeutics.
Chas. A. Scott, Associate Professor of Forestry.
Alexander S. Thompson, Director of Music.
Clara Dutton Thompson, Vice Director of Music.
Roy A. Norman, Assistant Professor of Mechanical Engineering.
Howard C. Ford, Assistant Professor of Surveying and Irrigation.
Wm. E. Madson, Assistant Professor of Physiology and Sanitary Science.
A. V. Storm, Schools, Extension Department.

1908.

Arthur MacMurray, Professor of Public Speaking.

ASSISTANT PROFESSORS AND INSTRUCTORS.

1906-7.

Miss Margaret Stanton Instructor in History.
Henry Howard Urmston, Instructor in Mechanical Engineering.
A. C. Gaugh, Instructor in Forge and Foundry.
Roy H. Porter, Instructor in Mechanical Engineering Laboratory.
L. E. Carter, Instructor in Agricultural Journalism.
G. E. Marsh, Instructor in Physics and Electrical Engineering.
Miss Clara Baker, Instructor in English.
Martin G. Lewis, Instructor in Mechanical Engineering.
C. W. Clements, Instructor in Forge and Foundry.
Miss Louise Peters, Instructor in German and Spanish.
W. G. Raymond, Instructor in English.
Ellen M. Geyer, Instructor in English.
Ingeborg Lommen, Instructor in German.
John L. Coulter, Instructor in Economic Science.
M. I. Evinger, Assistant in Civil Engineering.
Harry Ness, Assistant in Zoology.
Margaret Forgens, Cataloguer.

1907-8.

Wm. Kunerth, Instructor in Physics.
E. W. Hamilton, Instructor in Agricultural Engineering.
Miss Edith Charlton, Extension Dept., Domestic Economy.
Miss Neale S. Knowles, Extension Dept., Domestic Economy.
Harry G. Bell, B. S. A., Instructor in Farm Crops, 1907.
B. W. Crossley, B. S. A., Instructor in Farm Crops, 1907.
Frank M. Okey, B. C. E., Instructor in Civil Engineering, 1907.
Miss Helen F. Smith, A. B., Instructor in Mathmatics, 1907.

Miss Maude Ageton, B. A., B. S., Instructor in History, 1907.
John E. Brindley, A. M., Instructor in Economic Science, 1907.
Mabel Campbell, B. S., Instructor in Domestic Economy, 1907, 1906.
Herman Horneman, Instructor in Dairying, 1907.
R. W. Crum, B. C. E., Instructor in Civil Engineering, 1907.
Miss Fredrica V. Shattuck, A. B., Instructor in Public Speaking, 1907.
Miss Sadie Jacobs, A. B., Instructor in English, 1907.
Miss Georgia Hopper, B. A., Ph. M., Instructor in German and Spanish, 1907.
Joseph B. Varela, Instructor in Mechanical Drawing, 1907.
Joseph Frederick Barker, B. S. A., Instructor in Soils, 1908.
T. R. Minert, B. M. E., Instructor in Mechanical Drawing, 1908.
Winfield S. Dudgeon, B. S., Assistant in Botany, 1907, 1905.
E. N. Wentworth, B. S. A., Assistant in Animal Husbandry, 1907.
Miss Emma Leonard, B. S., Reference Librarian, 1907.
Orma J. B. Smith, B. S., Assistant in Horticulture, 1907.
Miss Caroline Laird, Assistant Librarian, in Charge of Engineering Library.
Laurenz Green, B. S., Asisstant in Horticulture, 1907.
Miss Lililan M. Lister, Laboratory Assistant in Chemistry, 1907.
John T. Bates, B. M. E., Instructor in Mechanical Laboratory, 1907.
R. E. Carr, Assistant in Agricultural Engineering, 1907.
R. W. Getchell, B. S. A., Laboratory Assistant in Chemistry, 1907.
Miss Mabel Rundall, B. S., Assistant in English, 1907.
Miss May Pardee, Assistant in English.
Charles L. Mundhenk, Brass Instruments.
J. W. Cameron, Instructor in Forge Work.
Mrs. Eleanor Holloway, Assistant Librarian.
Royal Jeffs, B. S. A., Assistant in Botany.
John Sawin, Instructor in Foundry.
J. Wershow, B. S., Laboratory Assistant in Chemistry.
R. M. Deming, Assistant in Civil Engineering.
Miss Edith Charlton, Domestic Economy, Extension Department.
Miss Neale S. Knowles, Domestic Economy, Extension Dept.
R. A. Drennan, Animal Husbandry, Extension Dept.
James A. King, Farm Crops, Extension Dept.
L. C. Burnett, Assistant in Farm Crops, Agricultural Exp. Sta.
John H. Crisswell, Assistant in Farm Crops, Agr. Exp. Sta.
Matt L. King, Agricultural Engineering, Agr. Exp. Sta.
Robert Lorenzo Webster, Assistant in Entomology, Agr. Exp. Sta.
Scott S. Fay, Assistant in Soils, Agr. Exp. Sta.
Stella Hartzell, Assistant Chemist, Agr. Exp. Sta.
B. A. Madson, Assistant in Chemistry, Agr. Exp. Sta.
F. E. Colburn, Photographer, Exp. Station.
Dr. Chas. Tilden, College Physician.

June, 1908.

Mrs. Mary P. Fairfield, Instructor in French.
Mrs. Daisy Arville, Instructor in Spanish.
F. W. Meyer, Gardener.

DIVISION OF AGRICULTURE.

Dr. A. B. Storms, President Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.

DEAR DOCTOR STORMS: The enrollment of students in the Division of Agriculture at the close of the present biennial period has reached a total of 551 in the collegiate courses and 642 in the winter short course, making a total of 1,193 in all. At the close of the previous biennial period the enrollment was 349 in the collegiate courses and 737 in the short course. The slight decrease in the short course is attributed to the holding of local short courses in various parts of the state. The enrollment in the collegiate courses has made an increase of 202 since 1906. The present rate of increase is therefore approximately one hundred a year. The indications are that this rate of increase will be fully maintained during the coming biennial period. Our present rate of annual increase is greater than the total number of agricultural students enrolled in this institution ten years ago. The students are coming better prepared to take up college work. The courses in agriculture have been extended and strengthened in such a way as to combine in a high degree the advantages of scientific, technical and practical training. The popular demand for thorough, well organized instruction in agriculture is shown by the large enrollment, coming not only from the farms and cities of Iowa, but from all parts of the United States and foreign countries as well.

While the progress has been substantial and highly gratifying in point of numbers, we have been unable to make many urgent provisions for the work on account of limited funds. The rate of increase has exceeded the means of support. The completion of the new agricultural building will furnish the best equipment in this line possessed by any agricultural college in America, but buildings and laboratories are not all. They are of secondary importance. The highest efficiency in educational work depends primarily upon men; men of character, high attainments, originality, and devotion for their work. The educational institutions that have attained the highest rank are without exception the institutions that put a high estimate on strong men, and that have been able to secure and retain the services of men of recognized ability and leadership in their respective lines. This is particularly true in agricultural and technical work,—where the demand is so large and competition so keen. Unfortunately this institution, by reason of its limitations, has been slow in recognizing this basic standard in educational work. Many of the departments in the Division of Agriculture have suffered seriously, and the injury will be even greater in the future unless more adequate provision is made for our instruction staff.

No more important work can be undertaken by the state and nation than that of training its men in the highest efficiency for agricultural and industrial work. The supreme national problem of conserving our national resources has been brought into unusual prominence by the action of President Roosevelt during the past season. This has served to emphasize the value of the work of the land grant colleges that were founded for this distinct purpose, with great wisdom and foresight by federal and state aid, in the days when our country's resources were being dissipated by internal war.

The highest conservation of our natural resources comes not alone from prudence in consumption and in husbanding these resources, but a greater saving would be affected in working up these raw materials and exporting only manufactured articles, or finished and condensed products. The German political economists have for many years adhered to the policy of importing raw material and exporting products in a highly finished state. They then gained, as they put it, a double advantage: "One that we do not deplete our natural resources; the other that our people will be able to rise to a higher standard of living, for those who do quality work are better paid."

Waste consists not only in misuse of natural resources, but waste in opportunity to realize to the highest extent the efficiency of human labor and human ingenuity. This is the distinct purpose and field of the land grant colleges of America.

The condition of the work and the needs of the departments in the division of agriculture are partially set forth in the following reports from the heads of departments in this division.

Respectfully submitted,

C. F. CURTISS,
Dean.

ANIMAL HUSBANDRY.

Dean C. F. Curtiss, College, Ames, Iowa.

Dear Dean Curtiss: In response to your request for a report of the work of the Animal Husbandry department during the past year, and the needs of the same, I submit the following:

I am pleased to be able to report that the year 1907 and 1908 has been in every respect a most prosperous and successful one for the Animal Husbandry department. From an instructional standpoint, the work in each and every one of the numerous courses has been of a higher standard than in any previous year since I have been connected with the department. This was due to the fact that we were able to retain practically all of our very efficient corps of instructors. They were familiar with the work, thus knew wherein it could be strengthened, and were anxious to make every course a strong one. I feel very grateful to all of the men who have worked so hard to build up our work. They are the right men for the work, and I earnestly hope that we will be able to retain each and every one of them for many years to come.

The enrollment for the year in question shows a marked increase over that of former years. I submit the following statement of the same, which is self explanatory:

STUDENTS ENROLLED DURING YEAR 1907-1908.

Animal Husbandry	I.,	Fall Semester	189
" "	II.,	Spring "	184
" "	III.,	Fall "	115
" "	IV.,	Spring "	104
" "	VI.,	Fall "	33
" "	VII.,	Spring "	29
" "	VIII.,	Fall "	60
" "	VIII.,	Spring "	37
" "	IX.,	Fall "	52
" "	X.,	Spring "	24
" "	XI.,	Fall "	144
" "	XII.,	Spring "	134
" "	XIII.,	" "	26
" "	XIV.,	" "	27
" "	XV.,	" "	32
" "	XVI.,	" "	26
" "	XVII.,	" "	26
" "	XVIII.,	" "	8
" "	XIX.,	Fall "	10
" "	XXXI.,		45
Graduate students			4
Total in Regular Work			1,310
Short Course students			522
Grand total			1,832

Student Contests.—Students from the Animal Husbandry department entered two live stock judging contests, and in each instance did highly creditable work. At the American Royal Live Stock Show, held at Kansas City, Missouri, the five young men who represented the Iowa State College won the champion trophy and every prize for which they competed, making the highest team and individual records ever made in any contest, and in every respect did the best work that has ever been done by a judging team to date.

The team of six young men who represented this college at the International Live Stock Show, Chicago, Illinois, in December, 1907, won the highest honors for all classes of stock, highest in horses, highest in cattle, the horse trophy, eighty per cent of the money offered, and three $250 Armour scholarships, a record which has never been approached by any other college competing in these contests.

Short Course Work.—The annual short course was held as usual during the early part of January, and was the most successful from the standpoint of work accomplished of any ever held. While the attendance was not up to that of the previous year, that can easily be accounted for by the number of district short courses held. These district courses quite naturally will reduce our attendance here, but we had all we could accommodate to good advantage. The equipment was the best ever furnished, and the instructional work was very much superior to that of former years.

Fair Judging Work.—The department furnished student judges for sixty-six fairs in Iowa and for twelve fairs in other states. The work of our students has been, as a rule, very satisfactory. Members of the corps of instruction judged eleven fairs in Iowa and five in other states.

Lecture Work.—In addition to conducting the Animal Husbandry work at the Red Oak short course, members of the corps of instruction spoke at nineteen different county institutes and three state meetings in Iowa, and six in other states.

Correspondence.—The correspondence is rapidly growing from year to year. The addition of the poultry and dairy farm work has increased the correspondence very materially. If the work increases during the coming year, we will need some additional office help.

Needs of the Department.—It is of vital importance to the Animal Husbandry department that the herds and flocks belonging to the Farm department be materially strengthened and maintained in first class condition. The recent tuberculosis trouble has seriously reduced our beef herds. I earnestly hope that at least $10,000 per year be expended for the next five years in the purchase of more animals and in the maintenance of the same. This is not as much as some of our neighboring states are putting in this work. Iowa should lead and not follow in her live stock equipment.

There is a strong and constantly growing demand for the establishment and maintenance of a packing house at the college. I have asked Professor Dinsmore to thoroughly investigate this matter and make a report on the same by September 1st, 1908. This is a line of work which we cannot afford to overlook, as the Iowa people are in earnest about the same.

We are in need of more money to complete our herd book files. This is a very important feature of the Animal Husbandry course, and I earnestly hope that ample provision will be made for the same in the near future.

If we are to encourage graduate work in our department, some provision must be made at once for equipment. We are in very urgent need of a laboratory building and incubator building, each about 30 x 60 feet, on the poultry farm, if we expect to do at all satisfactory work along poultry lines.

Respectfully submitted,

W. J. KENNEDY,
Professor of Animal Husbandry.

Ames, Iowa, June 12, 1908.

HORTICULTURE AND FORESTRY.

Dean C. F. Curtiss, Ames, Iowa.

Dear Sir: The Department of Horticulture and Forestry reports for the current year an enrollment of 494 under-graduate and 2 graduate students, a total of 496. The department enrollment for the college year closing June 30, 1906, when the last biennial report was rendered, was 322 under-graduate and 2 graduate students, a total of 324. Should a similar increase in enrollment be experienced during the next biennial period, as doubtless will be the case, an increase in the instructional force will become an imperative necessity. In view of these considerations preparations should be made to add at least one member to the instruction force. In this connection, permit me to urge that measures should be adopted to secure greater permanency in the department staff. Since 1900 the department has experienced no less than 10 changes in its corps of workers and three of these have occurred during the current year. Professor Baker accepted a more lucrative position in charge of the Forestry Department of the Pennsylvania State College; Professor V. R. Gardner took the place of Assistant Professor of Horticulture in the MacDonald Agricultural College at largely increased salary, and Mr. Erdmann resigned the position of gardener to go into commercial floriculture. Each of these men were doing excellently here. Their departure involved a distinct check in the progress of the work because it necessitated the installing of new men in their places. The department has been fortunate in securing good men to fill the vacancies, but it is evident that each of them must in some degree become familiar with the horticultural conditions existing in Iowa in order to give the best instruction so far as its application to local problems is concerned. They are making excellent progress in this direction and each semester's experience will the better fit them to do good work. It is of the greatest importance to the efficiency of the department that the salary fund be made adequate to retain such men.

Orchard, Garden and Forest Planting.—The department quarters in the new Agricultural Hall soon to be occupied will afford ample class room facilities. Many superior advantages in equipment for laboratory and field work in horticulture and forestry are afforded in the department orchards, nurseries, greenhouses, gardens, campus, arboretum, planted groves, forest nursery, forest garden and wooded areas. It should be said, however, that some of these features are new and others are not complete, so that much remains to be done in properly developing them. Provision also needs to be made for maintaining them in accordance with the methods

and ideas of up-to-date scientific horticulture and forestry and in harmony with the high standards which this institution demands in all of its work.

Since there are no large commercial orchards in the vicinity of the college for horticultural students to observe, it is absolutely necessary to develop here on the college farm suitable orchards of commercial varieties to provide means for giving practical instruction along this line. This is being done as rapidly as possible. The tract newly purchased for the department has already been partly cleared and the planting of suitable orchards has begun. Other portions which are adapted for forestry purposes are being used for forest planting.

These portions offer conditions similar to those which are found on thousands of acres of land in the aggregate throughout Iowa. The forestry experiments which are here being carried forward are therefore of very great importance to the whole state because the results here obtained will have general application.

The tract above mentioned is proving a very valuable addition to the field equipment of the department. Permit me here to call attention to the very great need of making the tract more accessible. In working this land we are at present greatly handicapped because of the long, circuitous route which must be traveled with a team in order to reach the fields. The distance by a possible direct route through a sub-way under the Chicago & Northwestern Railway tracks is but three-fourths of a mile, while by the present route it is necessary to drive one and three-fourths miles, thus making the distance of the round trip three and one-half instead of a possible one and one-half miles. I would request that this matter be taken up with the Chicago & Northwestern Railway Company and an effort be made to induce the company to provide a sub-way under their tracks for a road to this new portion of the college farm.

Library.—The department has a large and very valuable library including many rare books, and it affords excellent facilities for research. Nevertheless further treatises on horticultural and forestry subjects, reference works and maps are needed. The present funds are insufficient to secure all of the current works which are desired and therefore little can be done towards completing the collection of valuable works of the earlier authors. One of the most valuable and complete horticultural libraries on this continent has been brought together by years of search and travel by a veteran seedsman in one of the eastern states. This library can be secured for this institution at a very reasonable cost. It should be purchased and installed in the new library rooms alongside of the famous Downing library which is now in possession of the department.

Museums and Herbaria.—In giving instruction in any physical science the advantage of having the materials to be studied before the eyes of the student for observation and of putting them into his hands for examination cannot be overestimated. Particularly is this true in the study of scientific horticulture and forestry. Material along the lines of models of the various classes and varieties of fruits, herbarium specimens of different types of horticultural plants used in the work of the department, examples of the results of different cultural methods upon plant development, are needed in addition to the collections of living plants in the greenhouses, gardens, orchards, ornamental grounds and forest areas of

the college. Since commodious herbarium and museum rooms have been provided in the new building the work of making the present collections more accessible and of suitably developing these important features of instructional and investigational equipment should be pushed forward vigorously. Adequate funds for accomplishing this work are greatly needed.

The department already has an extensive and valuable collection of indigenous and exotic woods but the speciments should be cleaned, polished, relabelled and rearranged in the new forestry museum room. All of the department herbarium specimens are now stacked in store rooms and are practically inaccessible. Cases should be provided for them and the material should be properly mounted, systematically arranged and filed so that they may be of some use.

Arboretum.—The arboretum was at one time much more extensive and contained a better collection than it does at present. Inroads upon it have been made from time to time in locating new buildings and roads and in extending the campus. It was designed to contain a pretty complete collection of economic and ornamental plants of interest in horticulture and forestry. It is now planned to make that part which pertains to forestry a part of the Forest Garden. This now contains coniferous trees only, but it should be developed by adding as complete a collection as possible of deciduous trees.

The Campus.—The campus, far famed for its beauty and dignified simplicity, is barely maintained by the present campus funds. It should be developed by immediately establishing permanent plantings of long-lived trees to take the place of the soft wood species which were started in the early years of the institution to get rapid growth. These trees are many of them mature and beginning to break down. The landscape and architectural plans for the development of the campus are now sufficiently stable in character so that it would be possible to take up immediately the matter of campus planting, adopt permanent landscape plans and carry the work forward to lasting and increasingly beautiful and harmonious results. The campus as it is exerts an educational value upon all students and visitors which is beyond estimate, but it might be much more effective in this way were it more fully and more perfectly developed and better maintained and at the same time its usefulness to students in landscape gardening would be greatly enhanced. I therefore desire to urge that if possible a liberal appropriation be secured for the campus work. The sum of $10,000 per an num might be wisely devoted to this purpose. It takes years to grow trees of the grandeur befitting these surroundings. If oaks were planted here now they would show something of their beauty to the next generation but more to their children and to their children's children. The matter of adequate permanent planting should therefore be provided for at once.

Conservation of Natural Resources.—In forestry, conservation and utilization go hand in hand, and in the conservation and utilization of timber and timberlands in this state the forester enters a virgin field. In Iowa there are in the aggregate thousands of acres of land occupied wholly or in part by tree growth and by far the greater portion of this is unprofitable land. The valuable species, as the oak, walnut, sugar maple, hickory and ash have been cut out, used on the farm or sold for what it would bring on the local market. The poorer species, mainly elms, and others that naturally

fall into the class of perishable woods, but which are very hardy and propagate readily have been left to occupy the ground. The land which these species of perishable woods occupy is entirely capable of producing the best quality of oak, walnut, maple or white pine timber. This fact is demonstrated by the white pine and European larch plantations now on the campus.

The necessary work in forestry in this state is educational propaganda. Farmers must be taught that the forest crop is a crop that requires husbanding in scientific lines, and that to as fine a point as any crop produced on the farm. If the farmers go on from year to year cutting out the desirable species without giving thought to the future crop, the result will be the future generation will cut white elm logs if any at all. But on felling a tree, if the farmer would plant in its stead a half dozen acorns or as many white pine seedlings of suitable size the land will become profitable in the production of high priced woods. To demonstrate these possibilities the college has some twenty acres under forest management.

It is estimated that the farmers in the State of Iowa spend from a million and a quarter to a million and a half dollars annually for fence posts. Of the native woods the durable species are becoming exhausted and the farmer must use the more perishable species of or buy high priced posts that have been shipped in. There are few farms in the state on which there is not some growing timber and by proper treatment this kind of material can be made very serivecable. To demonstrate this, the Experiment Station in co-operation with the government forest service is planning to treat with creosote four thousand fence posts or their equivalent during the present season. We estimate that fence posts can be creosoted for about five or six cents each. When well treated, such perishable woods as the soft maple, cottonwood, willow and elm make very satisfactory posts. Ordinarily posts of these woods will not last for more than three or four years, but when treated with creosote they should be serviceable for ten or twelve years. This means a saving of from two-thirds to three-fourths of the present outlay for fencing, which is an enormous sum when totaled. Cottonwoods, willow and maples grow to post size in ten or twelve years; by planting trees of these species and creosoting the posts a continuous rotation can be kept up and every farm can be made self sustaining in fencing material and this on a profitable basis.

The planting of trees on eroding hillsides and the banks of cutting streams is another field in which much good can be accomplished in conserving our wealth of fertility. The forest tract on the college farm does not present eroding conditions and consequently no work of this character is underway.

There are several points along Squaw Creek at which the stream is cutting the banks severely. Professor Baker began in a small way the planting of willows to prevent further erosion but on account of the lack of funds to carry on the work there has been as yet but little done.

Respectfully submitted,

S. A. Beach,
Professor of Horticulture.

SOILS.

C. F. Curtiss, Dean College of Agriculture.

Dear Professor Curtiss: Complying with your request, I respectfully submit the following report regarding the work of the Soils department for the year '07-'08:

The college year just closed marked the completion of the fifth year of work for the Soils department. The enrollment for '07-'08 was much larger than at any previous time and the students almost without exception entered enthusiastically into the work of the year.

It is worthy of note in this connection that almost one-half of the senior class elected advanced courses of soils the past year. This is an unusally large number in view of the fact that a majority of the senior class have opportunity to take comparatively little elective work. The records show also that almost without exception the seniors which elected soils were the strongest men in the class. During the year '07-'08 six of the nine men in the Agronomy courses took their thesis work and a major part of their research work in the Soils department, and nine of the fifteen agronomy students in the class of '09 have already arranged to prepare their theses in this department.

We are pleased to report that the Soils department now leads all other institutions in this country in the number of courses which it offers and in the value and character of its equipment. Our equipment of apparatus is very large and is strictly up-to-date. It includes a great deal of special apparatus which has been made according to specifications prepared by members of the department. The Soils laboratories in the new Agricultural building will be unequaled in floor space and in completeness of equipment.

Courses in Soils.—The following courses were offered by this department during the year '07-'08:

Agronomy L. Soil Physics; (three lectures and three laboratories per week).

Agronomy LI. Soil Fertility; (three lectures and three laboratories per week).

Agronomy LII. Research in Soil Physics; (three laboratories per week).

Agronomy LIII. Research in Soil Fertility; (three laboratories per week).

Agronomy LIV. Advanced Soil Physics; (two laboratories per week).

Agronomy LV. Advanced Soil Fertility; (one lecture and one laboratory per week).

Agronomy LVI. Investigation of Special Soils; (one lecture and one laboratory per week).

Agronomy LVII. Soil Bacteriology; (one lecture and two laboratories per week).

Agronomy LVIII. Soil Seminar; (one hour per week).

Agronomy XVI. Thesis; (five hours credit).

Enrollment for the Year '07-'08.—The following schedule gives the enrollment in the different courses for the year '07-'08:

Agronomy L.	Soil Physics	70
" LI.	Soil Fertility	66
" LII.	Research in Soil Physics	6
" LIII.	Research in Soil Fertility	5
" LIV.	Advanced Soil Physics	3
" LV.	Advanced Soil Fertility	11
" LVI.	Investigation of Special Soils	13
" LVII.	Soil Bacteriology	4
" LVIII.	Seminar	27
" XVI.	Thesis	6
	Total	211

These figures show that the enrollment in Soil Physics and Soil Fertility has nearly doubled the past year. It must be noted also that the enrollment in each of these courses would have reached approximately one hundred if special students, many of whom desired to take the work, had been permitted to classify. The vast majority of these special students, however, are not prepared, especially in chemistry, to pursue these courses with profit.

Division of the Work.—During the year the head of the department has given all of the lectures and has had personal charge of all of the class work except in the case of Soil Bacteriology. He has also outlined and supervised all of the work in the advanced courses including the these, and has assisted with the general laboratory work.

The assistant in Soils has been in charge of the laboratories in Soil Physics and Soil Fertility, and has directed a larger portion of the advanced laboratory work.

Urgent Needs of the Department.—The past year the students of the junior class used every available desk in the laboratory. For this reason, it was exceedingly difficult to provide laboratory facilities for the students in the advanced courses. The present need for increased laboratory space is imperative. This need will be adequately provided for when the new Agricultural building is available.

Two excellent Soil Bacteriology laboratories are being constructed in the new building. Not later than a year from the present time, the department will need the services of an instructor in Soil Bacteriology. I think that I am justified in stating that this will soon be the most urgent need of the department. The bacteriology laboratories will necessitate the purchase of considerable apparatus and equipment. Therefore, we may state briefly that the urgent needs of the Soils department are for a bacteriologist and equipment for this work.

The addition of two or three strong courses in bacteriology will put the work of this department far in the lead of the Soils work offered in any other American college. When the new Agricultural building is ready for occupancy, the time will be ripe to take this forward step.

Respectfully sumbitted,

W. H. STEVENSON,
Professor of Soils.

DAIRYING.

Professor Curtiss, Dean of Agriculture: During the past fiscal year the students taking dairy work have more than trebled in number. Last year 337, including the special dairy students, took the laboratory and class work in the dairy department.

Our laboratories have been very much crowded and we will need additional equipment in order to carry on the work successfully. The demand for well trained dairymen or graduates has exceeded the supply of available men. Our present senior dairy students all have positions waiting for them. The scarcity of well trained men makes it difficult for the department to hold competent assistants. All our instructors have been offered positions at other places with advances in salary from $200 to $800 per year, therefore I would strongly urge upon the Board an increase in salary for my assistants. The constant changing of instructors is not beneficial to the department or the college.

Respectfully submitted,

G. L. McKAY,
Professor of Dairying.

FARM CROPS.

Professor C. F. Curtiss, Dean and Director, Building.

Dear Professor Curtiss: In reply to your memorandum in which you ask for the number of students enrolled in this department, some of its important needs, together with information regarding its progress, I am sending you the following:

The coming semester can hardly be based upon the one just past, due to the fact that a new course known as Farm Crops III, Corn Breeding and Judging, will be added as a required study in the Agronomy course. The number of students, based upon the past, with this addition, is as follows:

Farm Crops	I.	Corn Growing and Judging	160
" "	III.	Corn Breeding and Judging	35
" "	VIII.	Farm Management	20
" "	IX.	Research Work in Farm Crops	10
" "	X.	Adv. Research Work in Farm Crops	5
" "	XI.	Advanced Corn Judging	40
		Total	270

Relative to the progress made by the Farm Crops department, it will be interesting to note the growing interest which has been taken in the corn judging work. The past three years the number of students enrolled in Farm Crops XI, or Advanced Corn Judging, have been 9, 14, 49, respectively. The last class being the largest number of any elective study offered in the division of agriculture.

The two corn teams put out by the Iowa State College the past year were each successful in winning first place. The first, in the student's judging contest at the National Corn Exposition; the second, winning first place in the International students' corn judging contest, held in connection with the International Live Stock Exposition. The last victory won for the third time the Cook Trophy, which is now the permanent property of the institution.

Our course formly known as Agronomy I, Corn Growing and Judging, then a five-hour course, being now divided into a three-hour and two-hour course, known at Farm Crops I, Corn Growing and Judging, and Farm Crops III, Corn Breeding and Judging, respectively, will make it possible for our doing more proficient work along this line in the future.

We expect that there will be two trophies offered this coming year for students' grain judging contests; one with corn, another with small grains. We believe that these contests are good in that they stimulate a great deal of interest by the competition which is necessary for those who make the respective teams.

Farm Management.—Recent information from the United States Department of Agriculture partially assures our having with us a year hence a man who can give his entire time to the studying of farm management conditions throughout the state of Iowa. It can hardly be expected that the entire expenses of this man will be borne by the government, but they have expressed their willingness to consider Iowa first among those states where assistance of this character is to be rendered, due to the fact that we have already taken steps looking forward to a project of this character. It is to be hoped that when this time comes, which I feel very sure is but one year hence, that additional funds may be secured from this institution which will, with that appropriated by the government, be a sufficient amount to carry on this work in a most satisfactory manner. This will be the means of lending most valuable material in connection with practically all the work offered by this department.

Every year since the Farm Crops department has been installed in this institution it has been necessary to make one or two yearly changes in its instruction force, due to an insufficient amount of funds. Personally it gives me considerable pleasure to report that as far as I know at present the instruction force serving throughout this fiscal year will be continued for the next.

Respectfully submitted,

M. L. BOWMAN.

AGRICULTURAL ENGINEERING.

Prof. C. F. Curtiss, Dean of Agriculture.

Dear Professor Curtiss: In answer to your memorandum of recent date I beg to submit the following report in regard to the work and development of the Department of Agricultural Engineering during the past year, and also the present and future needs of the department.

It has been very gratifying to have during the past year the Department of Agricultural Engineering of Iowa State College recognized by the representatives of the various agricultural colleges of the country, as the best of its kind in existence. Recognition has come to the department in other ways of the same significance. A comparison of the instructional staff, the courses offered, the equipment and the building provided to the department with those of other departments in other institutions will give the Agricultural Engineering Department the first place in all except in the amount of room used by the department.

The addition of an instructor to take charge of the carpenter shop has enabled this feature of the instruction offered by the department to be given in a thorough and efficient way. The material offered in the course

in Farm Machinery and Farm Motors has been put in book form and is now used by at least seven other institutions in the country.

The following courses will be offered next year:

Agricultural Engineering
1, Blacksmithing.
2, Carpentery.
3, Farm Blacksmithing and Horse Shoeing.
4, Farm Engineering.
5, Farm Machinery and Farm Motors.
6, Rural Architecture.
7, Dairy Engineering.
8, Spraying Apparatus.
9, Research Junior Year.
10, Research Senior Year.
11, Thesis.
12, Thesis.

The enrollment in the courses taught during the past year was as follows:

Agronomy	XXII.	Research Junior	7
	XXIII.	Research Senior	5
	XXV.	Rural Architecture	9
	XXVI.	Dairy Engineering	14
	XXVIII.	Spraying Apparatus	11
	XXV.	Farm Engineering	117
	XXXI.	Farm Machinery and Farm Motors	110
	XXXII.	Blacksmithing	196
	XXXIII.	Carpentry	229
		Total	698

The department is much in need of additional room for the farm machinery laboratory and also a larger drawing room. At the present time, it is necessary to use a part of the loft of one of the barns for a machinery laboratory. Upon the completion of New Agricultural Hall, it is hoped that sufficient amount of room in Old Agricultural Hall will be alloted to the department to relieve the crowded condition in these two lines of work. Additional laboratory room for the courses in Spraying Apparatus, Dairy Engineering and instruction in the use of cement is much needed. Sufficient funds should be secured for the remodeling of a part of Old Agricultural Hall to provide for the needs of the department.

In regard to future development, it is hoped that it will be possible to relieve the shop instructors of the repair work they are now doing. A higher grade of instruction will then be possible.

The department is much in need of a tool-keeper who will have charge of the department tool and instrument room, and also have general charge of the equipment. With an increase in the number of students in the Farm Engineering and Farm Machinery and Farm Motor courses, an additional laboratory assistant will be needed.

That the work of the department of Agricultural Engineering should fill an important place in the Agricultural college course is borne out by the following facts:

An increase in the area of productive farm lands in the United States will be largely through irrigation and drainage.

It is estimated that 16 per cent of the farm land of Iowa will be benefitted by drainage.

From 20 to 25 per cent of the profits acquired in raising field crops is spent annually for farm machinery.

The capacity of the farm worker depends largely upon the application of power to farm operations through the successful use of farm machinery.

The prosperity and standing of any community is indicated largely by the class of highways constructed and maintained in that community.

In the United States more money is invested in farm buildings than in live stock.

Respectfully submitted,

J. B. DAVIDSON.

THE EXTENSION DEPARTMENT.

Dr. A. B. Storms, President Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.

DEAR DOCTOR STORMS: The department of Agricultural Extension has been established during the past biennial period. The first appropriation made for this work was fifteen thousand dollars. This was increased by the following legislature to twenty-seven thousand dollars. The demand from outside for help from the college in conducting farmers' institutes, stock and grain shows, short courses and other meetings and conventions pertaining to agricultural work, had become so extensive as to seriously interfere with the work of instruction and investigations being carried on at the institution. In order to meet this demand without interference with the work at the institution it was recommended that an appropriation be made distinctly for this work and an Agricultural Extension department be created. This movement has met with general favor. The work has grown in popularity to such an extent that the institution is still overwhelmed with demands notwithstanding the liberal appropriation made. The first short course away from the college was held at Red Oak. This was before the Extension department was established. Short courses were held during the past winter at ten places in the state outside of Ames. At the close of the biennial period we had on file applications for fifty short courses during the coming winter. It is impossible with our present force and equipment to provide for more than about a dozen or fifteen. In addition to the interest in short course work there has come about a strong demand for some provision for secondary education in agriculture, either as a part of the present public school system or by means of separate agricultural high schools.

This movement is not confined to our own state, but has already taken definite form in several other states, and it is destined to become a part of our public school system in some form. Such schools will undoubtedly be of great benefit to the interests which they serve. The agricultural colleges, no matter how efficient or how well equipped they become, can never accommodate a large percentage of the population of the constituencies which they serve. Some form of secondary schools in agriculture must serve the masses, and the work should be so articulated with the work of the agricultural college as to logically lead up to a college course for those who wish to obtain a higher education. The extension work has not only been of very great immediate service to the agricultural interests of the state, but it has stimulated a widespread and deeper interest in the subject of secondary agricultural education. The extension work during the past year is briefly outlined in the report from Professor Holden, Superintendent, which follows.

C. F. CURTISS,
Dean.

Professor C. F. Curtiss, Dean, College of Agriculture, Ames, Iowa.

Dear Sir: The following shows approximately the condition of the funds of the department at the close of the biennial period:

Heading or Name of Fund	Amount Appropriated to June 30, 1908	Amount Used to May 1, 1908	Amount on hand May 1, 1908	Amount Needed to July 1, 1908	Deficit	Credit
Salary fund	$16,583.34	$11,434.12	$ 5,149.22	$ 2,338.26		$ 2,810.96
Stenographic	2,000.00	1,743.19	265.81	235.81		30.00
Furniture	450.00	202.89	247.11	49.67		197.44
Traveling expenses	1,200.00	1,070.45	129.55	107.15		22.40
State Fair						
Stationery, postage, etc.	1,000.00	978.89	21.11	178.89	$ 157.78	
Printing Bulletins	3,000.00	821.89	2,178.11	1,854.11		324.00
Charts, maps, etc.	600.00	557.13	42.87	122.87	80.00	
Office help	650.00	563.84	86.16	336.16	250.00	
Library	50.00	13.15	36.85			36.85
Special help						
Emergency	1,466.66	207.78	1,258.88	400.00		858.88
Total	$27,000.00	$17,593.33	$ 9,415.67	$ 5,622.92	$ 487.78	$ 4,280.53
Balance on hand						$3,792.75

CORRESPONDENCE.

Number of letters, circulars and other mail matter sent from the Extension department during the year.....38,500

Number of letters, circulars and other pieces received by the Extension department 36,500

Total sent out and received..... 75,000

Last year the total reached approximately..... 52,000

MILES TRAVELED, EXPENSES, ETC.—RECAPITULATION.

Name	Miles Traveled	Railroad Fare	Local Expenses	Charges for Time of Students	Total Expenses
P. G. Holden	22,172	$ 443.44	$ 291.01		$ 734.45
A. V. Storm	12,223	244.46	204.54		449.00
A. H. Snyder	11,426	228.52	308.96		537.48
R. K. Bliss	6,341	126.82	152.19		279.01
R. E. Drennan	11,283	225.66	193.85		419.51
M. L. Mosher	11,730	234.60	193.27		427.87
J. A. King	3,295	65.90	124.46		190.36
M. L. Wilson	2,348	46.96	44.70		91.66
P. C. Taff	2,207	44.14	115.00		159.14
W. R. Scott	3,650	73.00	120.50		193.50
Miss Charlton	10,987	213.74	216.20		429.94
Miss Knowles	6,289	125.78	104.50		230.28
Miss Rausch	350	7.00	22.50		29.50
Miss Beyer	1,700	34.00	87.50		121.50
J. W. Jones	1,940	38.00	75.15		113.95
G. R. Bliss	565	11.30	6.50		17.80
J. C. Guthrie	508	10.16	15.00		25.16
Miscellaneous Short Courses	7,060	141.20	300.00	$ 360.00	801.20
Miscellaneous Farmers' Institutes	19,706	394.12	268.50	390.00	1,052.62
	135,480	$2,709.60	$2,844.33	$ 750.00	$6,303.93

Total traveling expenses of members of department.....$6,303.93

Only $361.67 of the railroad fare, $380.23 of the local expenses and $48.00 of the amount charged for time by students (a total of $789.90), was paid by the Extension department. The remainder ($5,514.03) was paid by the local people.

COUNTY EXPERIMENT STATIONS.

County	Miles Traveled	Railroad Fare Paid by County	Expenses Paid by County	Total Paid by Counties	Paid by Department	Total Expenses
Sioux	2,410	$ 48.20	$ 251.80	$ 300.00	$ 125.00	$ 425.00
Story	307	6.14	143.86	150.00	50.00	200.00
Marshall	1,960	39.20	260.80	300.00	75.00	375.00
Cedar	3,124	62.48	237.52	300.00	120.00	420.00
Montgomery	2,193	43.86	256.14	300.00	105.00	405.00
Page	2,600	52.00	248.00	300.00	80.00	380.00
Henry	2,437	48.74	251.26	300.00	110.00	410.00
Total	15,031	$ 300.62	$1,649.38	$1,950.00	$ 665.00	$2,615.00

Does not include the labor of the regular county farm help in preparing the ground, cultivating, etc.

SHORT COURSES.

Place	Receipts	Disbursements	Credits	Debits
Newton	$ 1,538.14	$ 1,416.60	$ 121.54	
Mt. Pleasant	1,136.88	1,125.82	11.06	
Red Oak	2,223.40	2,040.33	183.07	
Avoca	1,103.20	951.67	151.53	
Cedar Rapids	1,300.00	1,700.00		$ 400.00
Spencer	1,007.05	993.44	13.61	
Storm Lake	1,426.66	1,473.98		47.32
Manchester	996.75	1,042.93		46.18
Marshalltown	1,998.42	1,687.36	311.06	
New Providence	209.00	195.34	13.66	
Premium lists	7,000.00	7,000.00		
Total	$19,939.50	$19,627.47	$ 805.53	$ 493.50

The above does not include the donations of cash, merchandise, stock, trophies, etc., amounting to more than $5,000, and also considerable other expense, such as donation of time, teams, halls, etc.

ENGAGEMENTS OTHER THAN SHORT COURSES.

This map shows the number of engagements filled by the Extension department, not including work done at short courses. Each dot represents a trip to the locality, regardless of the length of time spent. 411 engagements have been filled; one or more members of the department have visited 89 of the 99 counties of the State.

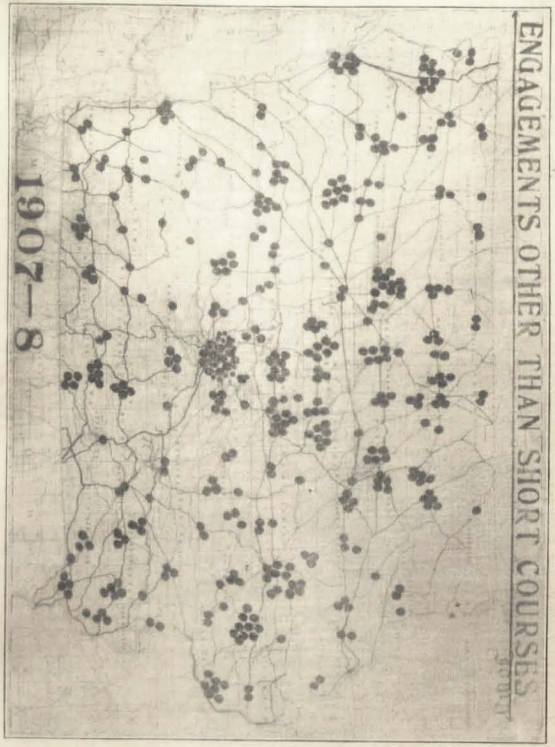
Since this map was made over 100 additional engagements have been filled.

The following is a statement of the attendance at the local short courses held in different parts of the state during the winter of 1907-8:

IOWA SHORT COURSES.

Place	Date	Men	Women	Total
Newton	December 9-14	172	172	344
Mt. Pleasant	December 16-21	228	122	350
Red Oak	January 13-18	127	75	202
Avoca	January 13-18	259	115	374
Cedar Rapids	January 20-25	298	200	498
Spencer	January 27-February 1	219	90	309
Storm Lake	February 3-8	141	47	188
Manchester	February 10-15	184	80	264
Marshalltown	February 17-22	198	118	316
New Providence	February 24-26	206	99	305
Indianola	March 23-25	220	200	420
		2,342	1,318	3,660

The above figures do not include the single admission and day tickets, nor the evening attendance at lectures. In addition to the above who bought full-course tickets there were at least six thousand others who attended the evening lectures or bought single admission or day tickets.



DOMESTIC SCIENCE SHORT COURSES.

Place	Date	No. of Days	Total
Eldora	November 5-8	4 days	175
Hampton	February 23-25	3 days	200
Afton	March 16-21	6 days	125
Cherokee	March 30-April 4	6 days	* 70
			† 200
Colfax	April 5-7	3 days	85
			855
Entire enrollment			5,515

* Town women.
† Teachers.

DAYS SPENT AT ENGAGEMENTS, INCLUDING SHORT COURSES.

Each dot represents a day spent in the locality by some one furnished by the Extension department. This does not include time spent in traveling. In a great many cases the representatives attended two or three sessions of a meeting during the day. The map shows 1,277 one-day engagements within the state, and 75 were filled outside the state.

Since the above map was made about 100 additional engagements have been filled, making a total of approximately 1,452 engagements.

TOTAL NUMBER MEETINGS ATTENDED OTHER THAN SHORT COURSES BY DEPARTMENT MEMBERS.

P. G. Holden	70	Miss Charlton	30
A. V. Storm	60	Miss Knowles	27
A. H. Snyder	66	Miss Rausch	3
R. K. Bliss	23	J. C. Guthrie	2
R. E. Drennan	45	T. Sexauer	15
M. L. Mosher	51	A. E. Quaife	13
J. A. King	13	M. L. Wilson	17
Miscellaneous	91	P. C. Taff	3
	419		110
		Brought over	419
		Total	529

It is with great pleasure that I am able to report to you what seems to me the almost remarkable success of the extension work during the past year. The more so, considering all the difficulties to be overcome in a new work without precedents to guide. It is always particularly difficult and sometimes dangerous to attempt to advise or instruct people along the line of their own particular business.

The people everywhere have taken a wonderful interest. As evidence of this the demands for help have been much more urgent and more numerous than before, covering a wider range of subjects.

The work has been so planned in all lines (short courses, county stations, farmers' institutes, etc.), that an equal or greater amount of energy and expense must be supplied by the local people. For example: The total expense of the Extension department for the year ending July 1st

will be less than $24,000, while the amount contributed by the local people will exceed $26,000; thus more than doubling the efficiency of the state appropriation. There are many other advantages of this method which will be apparent to any one who has given the matter consideration.

Circuits for Farmers' Institutes.—Steps have been taken to arrange the farmers' institutes in circuits as much as possible, that a greater service may be rendered with the same help and at much less expense to the local people.

Summer School for Teachers.—The department is co-operating with Miss Nellie Jones, county superintendent of schools of O'Brien county, in holding a summer short course for teachers at Sheldon, July 13th to 28th inclusive.

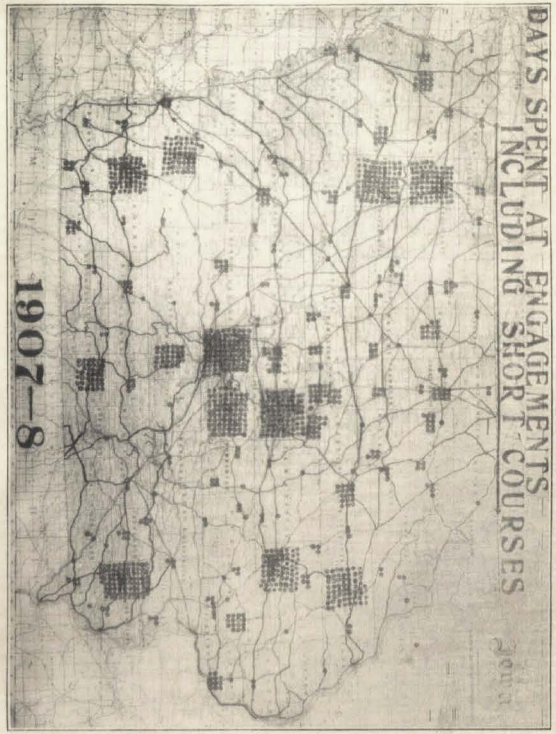
The purpose is to see what can be done to interest the teachers in things more directly connected with the boys and girls' home life. This is a new line of work and we will do our best to make it successful. I am certain that we will succeed.

Professor Storm is preparing an outline of the work. It will undoubtedly be necessary to make changes from day to day as the course develops.

AGRICULTURAL EXTENSION DEPARTMENT.

Inventory July 1, 1908.

6	Office Desks (flat top)	$ 54.00
1	Typewriter Desk	13.50
6	Office Tables	42.00
2	Dozen Office Chairs	35.00
1	Typewriter Chair	4.50
1	Revolving Office Chair	4.00
1	Remington Typewriter (No. 178221)	50.00
1	Remington Typewriter Tabulator	10.00
2	Underwood Typewriters (Nos. 176065 and 185891)	130.00
1	Rotary Mimeograph (No. 10143)	20.00
1	Rapid Roller Copier	25.00
2	Swinging Typewriter Shelves	4.00
2	Indicators and Copyholders	3.50
6	Cases of Shelves	40.00
12	Willow Baskets	2.00
3	Iron-bound Chests	20.00
1	Iron-bound Trunk	10.00
100	Andrus & Church Filing Cases	7.00
50	Besley Filing Cases	8.00
2000	Vertical Folders	8.00
10	Dozen Book Holders	6.00
1	Large Post Binder	5.00
1000	Sheets Papers	9.00
1	Dozen Rolls (Y. & E.) Copy Paper	6.00
4	Cans Neostyle Ink	10.00
1	Dozen Scrap Books	15.00
2	Quires Stencil Paper	3.50
2	Sets Stencils (large)	5.00
1	Set Stencils (small)	1.00



2	Chart Drawing Boards	2.50
2	Chart Drawing Board Stands	1.25
40	Bromide Charts	250.00
120	Cloth Charts	50.00
6	Chart Carrying Cases	20.00
8	Chart Stands	20.00
24	Record Books	52.00
2000	Manila Enxelopes (6 x 8)	2.00
2500	Envelopes (6½)	6.00
1500	Envelopes (10½)	6.00
1000	Buff Index Cards	1.50
2	Balls Twine	.20
1	Insect Case	1.25
1	Corn Product Case	1.25
50	Cases Weed Seeds	125.00
50	Sets Weeds	125.00
6	Germination Boxes	5.00
1	Photo Box	2.00
	Photos and Prints	150.00
	Carpenter's Tools, viz: 2 Planes, 1 Square, 1 Trisquare, 1 Hammer, 1 Mitre Box, 1 Oil Stone, 2 Saws, 1 Mallet, 1 Gauge, 1 File, 2 Chisels, 1 Nail Puller, 1 Brace and 3 Bits	15.00
1	Pair Scissors	.75
	Linoleum	20.00
1	Family Scale	1.50
1	Sanitary Fireless Cooker	5.00
1	Hay Box	5.00
1	Cake Mixer	1.00
1	Toaster and Roaster	2.00
1	Dozen Automatic Fruit Jars	.50
1	Dozen Mason Jars (1 quart)	.50
1	Dozen Mason Jars (2 quart)	1.00
2	Dozen Mason Jars (pints)	1.25
2	Six-Gallon Stone Jars	1.00
1	Small Ice Cream Freezer	1.00
1	Bread Mixer (Eclipse)	1.50
1	Bread Mixer (Universal)	1.50
1	Coffee Percolator	2.00
1	Food Chopper (Universal)	1.50
1	Food Chopper (Gem)	1.50
1	Ice Shaver	.25
1	Ice Clipper	.25
1	Bread Knife	.50
2	Demonstration Outfits for Domestic Economy (one granite and one aluminum, including two trunks)	27.00
	Writing Paper	15.00
	Pens, Ink, Mimeograph Paper, Clips, Rubber Bands, Typewriter Paper and other Office Supplies	20.00
	Postage	15.00

1	Postal Scale	1.00
2	Babcock Milk Testers	6.50
1	Cram's Atlas	3.50
1	Webster Dictionary	2.65
400	Outlines for Short Course Work	25.00
9	Lantern Slides (colored)	7.00
	Code of Iowa and Supplement	5.00
1	Three-section Globe Wernicke Filing Case	35.00
6	Gross Four-ounce Display Bottles	20.00
20	Empty Corn Crates	4.00
400	Cardboard Filing Cases	20.00
1	House Furnishing Outfit for Domestic Science	6.00
1	Omnimetre	2.00
	Total	$1,651.10

Respectfully submitted,

P. G. HOLDEN,
Superintendent of Extension Dept.

Ames, Iowa, May 30, 1908.

In order that the extension work may be of service to a greater number of people throughout the state, the funds should be increased as indicated elsewhere in this report. The extension funds were supplemented during the past year by local expenses met by the communities in which work was given to the extent of about twenty-six thousand dollars, thus virtually doubling the efficiency of the Extension department appropriation. This of itself furnishes ample evidence of the desire on the part of the people of the state for assistance from the college in educational work along agricultural lines, and any appropriation that the state may make for this work will practically be duplicated by contributions from the local committees.

Respectfully submitted,

C. F. CURTISS,
Dean.

SCIENTIFICAL CONTRIBUTIONS FROM MEMBERS OF THE FACULTY DURING BIENNIAL PERIOD.

Publications by members of the Engineering division during the last biennial period.

DIVISION OF ENGINEERING.

L. B. Spinney, Professor of Physics and Electrical Engineering.

Lamp Tests.

A paper setting forth the results of a study of commercial incandescent lamps which was made for the purpose of determining the care with which they are manufactured and selected. Electrical World.

Cost of Operation per Dollar of Income.

An analysis of the cost of operating an average electrical lighting plant in Iowa.—Western Electrician.

Report of Chairman of Committee on Electrical Engineering. Proceedings Iowa Engineering Society, 1907.

Report of Chairman of Committee on Factory Engineering. Proceedings Iowa Engineering Society, 1908.

F. A. Fish, Associate Professor of Electrical Engineering.

Load and Power Relations in Two-Phase to Three-Phase Transformers. (With Professor Adolph Shane.)

Establishes by vector diagram the proof that on balanced secondary load the primaries of two-phase-three-phase transformer circuits are also balanced as to load and power factor.—Electrical World, 1907.

The Work of the Freshman and Sophomore Years of Engineering Courses.

A discussion of recent changes made in the Freshman and Sophomore work at Iowa State College, together with a table showing the work given during these two years at fifteen of the larger universities and colleges. Presented before the Society for the Promotion of Engineering Education, July 2, 1907.

Adolph Shane, Assistant Professor of Electrical Engineering.

Load and Power Relations in Two-Phase to Three-Phase Transformers. (With Professor F. A. Fish.)

Establishes by vector diagram the proof that on balanced secondary load the primaries of two-phase-three-phase transformer circuits are also balanced as to load and power factor.—Electrical World, 1907.

W. B. Anderson, Instructor in Physics.
A Spectroscopic Study of the Spark Spectrum in Various Gases at High Pressure.
Astrophysical Journal.

M. P. Cleghorn, Associate Professor of Mechanical Engineering.
Gas Power Plants and Report of Tests.
Published in Iowa Engineer, November, 1907.
Cost of Gas Power.
Continued article published in Power Magazine, March and April, 1908.
Producer Gas Power.
Paper read before the Iowa Brick and Tile Association, January 22d and 23d, 1908, and later published in the Iowa Engineer, September, 1908.

F. C. French, Associate Professor of Civil Engineering.
Demonstration of Cement Tests.
Paper read before the Iowa Cement Users' Convention, January 24, 1907.

M. J. Reinhart, Instructor in Civil Engineering.
Standard Sand for Cement Work.
Paper read before the Iowa Cement Users' Convention, January 24, 1907.

M. I. Evinger, Assistant Professor of Civil Engineering.
Tests of Cement, Mortar and of Concrete Building Blocks.
(With Professor A. Marston.)
Part I. Tests of the effects of ensilage, manure, sheep dips and cinders upon the strength of cement mortars.
Part II. Tests showing the strength of concrete building blocks cured in water and in air.
Paper read before the Iowa Cement Users' Convention, January 25, 1907.
Tests of Reinforced Concrete Pipes.
Waterproof of Concrete Blocks.
Improvement of Sand by Grading Sizes.
Vol. IV, No. 111, of Engineering Experiment Station. M. I. Evinger, Editor.
Reprint of three thesis submitted for the A. U. Miracle Award Competition for the most meritorious papers on cement and concrete subjects by students of the Iowa State College.

A. Marston, Dean of the Division of Engineering and Professor of Civil Engineering.
Report of Committee on Roads and Pavements, (Chairman).
Iowa Engineering Society, January, 1907.
Report of Committee on Sanitary Engineering, (Chairman).
Iowa Engineering Society, January, 1908. Data and discussion of water works, sewers and sewage disposal plants in Iowa.
Sewers and Drains, Parts I and II.
American Correspondence School Instruction Papers and Cyclopedia of Civil Engineering.

Rainfall and Run Off in Storm Sewers, (discussion).
Transactions American Society of Civil Engineers, Vol. XLVIII, June, 1907.
Tests of Cement Mortar and Concrete Blocks. (With M. I. Evinger.)
Paper read before the Cement Users' Convention, January 25, 1907.
Tile Drainage in Iowa.
Iowa Brick and Tile Association, Sioux City, 1907.
Tests of Cement Pipe.
Iowa Cement Users' Association, Des Moines, January, 1908. Reprinted by various technical journals.
Some Unsolved Problems in Drainage Engineering.
Iowa Drainage Association, Ft. Dodge, February, 1908. Reprinted by various technical journals.
Sewer System and Sewage Disposal Plant at Fairmont, Minn.
Engineering Record, Vol. 57, 1908.
Has Specialization Been Overdone in College Courses?
Iowa State Teachers' Association, Des Moines, December, 1907.
Five Year Engineering Courses of Study.
National Educational Association, Columbus, Ohio, July, 1908.
The Duty of the State in Road Improvement.
Good Roads School, Council Bluffs, 1907. Reprinted in Engineering Record.
A Small Sewage Disposal Plant in Central Iowa.
The Cornell Engineer, Ithaca, N. Y., 1907.

F. M. Okey, Instructor in Civil Engineering.
Comparative Sizes of Drain Tile.
Paper read before the Iowa Brick & Tile Makers' Association, at Des Moines, January, 1908.
Advantages of Tile Drainage.
Paper read before Farmers' Institute, New Hampton, Iowa, February 24, 1908.

S. W. Beyer, Professor of Geology and Mining Engineering.
Mineral Statistics for Iowa, 1906.
Mineral Statistics for Iowa, 1907.
Quarry Products for Iowa.
Iowa Geological Survey, Volumes XVII and XVIII.
Condition of Portland Cement Industry in Iowa for 1907.

I. A. Williams, Associate Professor of Mining Engineering.
Physical Tests of Iowa Limes.
Iowa Engineer, 1907-08.
Physical Tests of Iowa Limes.
Eng. Exp. Sta., 1908.
Quarry Products of Iowa, (with S. W. Beyer).
Iowa Geological Survey, Vol. XVII, 1907.
Effect of Fine Grinding on the Properties of Portland Cement.
Trans. Am. Ceramic Society, Vol. X, 1908.

IOWA HIGHWAY COMMISSION.

Addresses and Papers by Thos. H. MacDnoald.

Paper. "Reinforced Concrete Culverts for Highways."
Development of this form of construction in Iowa and method of designing, 1907. Iowa Cement Users' Association, Ames, Iowa.
Paper. "Manufacturing in Iowa as Related to Road Improvement."
Iowa State Manufacturers' Association, Ottumwa, Iowa, June, 1908.
Paper. "The Rural Carriers and Road Improvement."
Rural Carriers' Association, Des Moines, Iowa, August, 1907.
Paper. "Road and Bridge Improvement."
Threshermen's Convention, Des Moines, Iowa, April, 1908.
Report of Committee on Roads and Pavements for 1908 (Chairman)
Iowa Engineering Society.
Data and progress of paving, curbing, and road improvement during the year. Published in annual report of the society.
Talks on Road and Bridge Subjects:
Madison County Farmers' Institute, January, 1908.
Annual Meeting of Supervisors, Clinton, Iowa, August, 1908.
Scott County Farmers' Institute, January, 1908.
Decatur County Road Meeting, Leon, Iowa, January, 1908.
Johnson County Farmers' Institute, North Liberty, February, 1908.
Mahaska County Farmers' Institute, March, 1908.
Jefferson County Rural Carriers' Association, May, 1908.
Meeting of Supervisors and Trustees of Green County, February, 1908.
Osceola County Farmers' Institute, Sibley, January, 1908.
Polk County Farmers' Institute, Ankeny, February, 1908.
Cedar County Farmers' Institute, Tipton, January, 1907-8.
Rural Carriers' Association, Ames, August, 1908.
Marshall County Farmers' Institute, March, 1908.
Emmet County Road Meeting, Estherville, March, 1908.
"Highway Improvement Work in Iowa."
Article for Good Roads Magazine, December, 1906.
"1906 Revision of Manual for Iowa Road Officers," July, 1906.
148-pp. bulletins, 3,000 copies.
"Road and Bridge Improvement for 1908."
16-pp. bulletin, 10,000 copies.
"Second Annual Report of Iowa Highway Commission."
64-pp. bulletin, 10,000 copies.
"Announcement of 1907 Road School."
8-pp. bulletin, 15,000 copies.

DIVISION OF SCIENCE.

R. C. Barrett, Professor of Civics.
"The Government of Iowa."
A. A. Bennett, Professor of Chemistry, and
Miss Lola A. Placeway, Associate Professor of Chemistry.
"General Chemistry and Qualitative Analysis."
Text book.

J. B. Brindley, Instructor in Economic Science.
"History of Railway Taxations in Iowa."
J. P. Anderson.
Iowa Erysiphaceæ.
Proc. Ia. Acad. Sci. 14:15-46. Cont. Dept. Bot. I. S. C. 35:34.
R. E. Buchanan, Assistant Professor of General Bacteriology.
"Some Relations Between Bacteria and the Horticulturist."
Trans. Ia. Hort. Soc., 1906:143-146.
"Notes on the Algæ of Iowa."
Proc. Ia. Acad. Sci., 14:47-84. Contr. Bot. Dept. I. S. C., 34:40.
"Biology of Bacillus Radicola."
Centr. f. Bak. u. inf. 2 Abt.
Winfield S. Dudgeon, Assistant in Botany.
"A Study of the Variation of the Number of Ray Flowers of Certain Compositæ."
Proc. Ia. Acad. Sci., 14:89-106. Cont. Bot. Dept. I. S. C. 36-20.
H. S. Fawcett, Assistant in Botany.
"The Vitality of Weed Seeds under Different Conditions of Treatment and a Study of Their Dormant Periods."
Trans. Ia. Acad. Sci., 15.
Estelle D. Fogel, Instructor in Botany.
"Dissemination of Some Economic Fungi."
Trans. Ia. Hort. Soc., 1906:105-108.
Harriette S. Kellogg, Curator of the Herbarium.
"Economic Fiber Plants of Iowa."
Trans. Ia. Hort. Soc, 1906:94-100.
Charlotte M. King, Assistant in Botany.
"Phrenological Notes for 1906."
Trans. Ia. Hort. Soc., 1906:203-208.
"Phenological Notes for 1907."
Trans. Ia. Hort. Soc., 1907:230-255.
L. H. Pammel, Professor of Botany and Estelle D. Fogel.
"Catalogue of Poisonous Plants of Iowa."
Trans. Ia. Acad. Sci., 14:147-176. Cont. Dept. Bot. I. S. C. 37:1.
L. H. Pammel and Charlotte M. King.
"Results of Seed Investigation for 1907."
Bulletin Ia. Agr. Exp. Sta., 99:14.
L. H. Pammel, Charlotte M. King, and R. E. Buchanan.
"The Vitality, Adulteration and Impurities of Clover, Alfalfa, and Timothy Seed."
Bull. Ia. Agr. Exp. Sta., 88:69.
L. H. Pammel and Luella Robb, Student.
"Some Seeds of the Genus Pyrus."
Proc. Ia. Acad. Sci., 15.
L. H. Pammel, Professor of Botany.
"Dr. Edwin James."
Annals of Iowa, 8:161-184; 277-295. Cont. Dep. Bot. I. S. C. 32:43.
"Some Municipal Water Problems."
Trans. Ia. Acad. Sci., 14:115-146. Cont. Dept. Bot. I. S. C., 33:34.

"Some Seed Studies."
Soc. Prom. Agr. Sci., 1907:——.
"The Contamination of Water."
Bailey's Cyclopedia of Agriculture, I:288-291.
"Some Diseases of Rocky Mountain Plants."
Proc. Ia. Acad. Sci., 13:89-144. Cont. Bot. Dept. I. S. C., 29.
"Some Pytopathological Problems."
Soc. Prom. Agr. Sci., 1906.
"The Report of the Botanist."
Proc. N. Amer. Florists and Ornamental Horticulturists, 1908.
"President's Address."
Ia. Park and For. Assoc., 1906:19-38.
"Some Present Day Horticultural Problems."
Trans. Ia. Hort. Soc., 1906:114-116.
"Recent Investigations on Mycological Subjects."
Trans. Ia. Hort. Soc., 1906:497-501.

DIVISION OF AGRICULTURE.

S. A. Beach, Professor of Horticulture.
"An Experiment in Spraying Apples."
Iowa State Horticultural Society, 1906.
"Spraying and the Care of Orchards."
Northeastern Iowa Horticultural Society, 1906.
"Report of the Central Experiment Station."
Iowa State Horticultural Society, 1906.
"The Apple Outlook."
"Orchard Management."
Maryland State Horticultural Society, 1906.
"Plant Breeding at the Ames Station."
Iowa State Horticultural Society, 1907.
"A Successful Fruit Growers' Organization and Its Significance."
New York State Fruit Growers' Association, 1908.

C. A. Scott, Associate Professor in Charge of Forestry.
"Work of the Forest Service in Nebraska."
Address, Nebraska State Horticultural Society. Published in 37th Annual Report of the Society.
Annual Reports of the work on the Niobrara, Dismal River, North Platte and Garden City National Forests, 1906 and 1907.
Reports to the Forester, not published.
Report of Forest Conditions within the "Williston-Ft. Buford-Nesson Projects" (Reclamation Service Projects) and recommendations relative to needed work.
Report on Forest Conditions on "Interstate Project" (Reclamation Service Project in Wyoming and Nebraska) and recommendations for action of Forest Service.
"Planting Plan for Ft. Riley Military Reservation, Ft. Riley, Kansas."
"Planting Plan for Farm Woodlot for E. S. Cogswell," Kirwin, Kan.
"Planting Plan for 50 Acres of Forest Plantation on Miller's Island in Cimarron River," for T. L. Miller, Lakoma, Oklahoma.

A. T. Erwin, Associate Professor of Horticulture.
"Methods of Securing Highly Colored Fruit."
Northwestern Iowa Horticultural Society.
"Comparative Merits of the Liquid and Dust Spray."
Iowa State Horticultural Society.
"Some Important Orchard Problems."
Southeastern Iowa Horticultural Society.
"Horticulture in Our Rural Schools."
Southeastern Iowa Horticultural Society.

W. H. Stevenson.
"Iowa's Farming Opportunities."
"Farming," and reproduced in the 1906 Iowa Year Book of Agriculture.
"Farm Manures."
Series of articles in "Successful Farming."
"A New Soil Sampler."
Experiment Station Bulletin 94:1-32.
Secretary's Report of the 1908 Annual Meeting of the Iowa State Drainage Association.
102 page pamphlet.
"Clover Growing on the Loess and Till Soils of Southern Iowa."
Experiment Station Bulletin, 98:41-66.
"Soil Management in Relation to the Permanent Pasture."
"Wallaces' Farmer," and reproduced in 1907 Iowa Year Book of Agriculture.
"An Inventory of the Land."
"Farmers' Tribune."
"Drainage Facts of Interest to Iowa and Minnesota Farmers."
Series of articles "The Farmer."
"Soil Sampling, With Special Reference to a New Sampler."
Address before American Agronomy Society, Ithaca, New York.
"The Call of Agriculture."
Address before the Agricultural Fraternity of the University of Nebraska.
"Drainage, a Factor in Soil Improvement."
Address before Eagle Grove Co-operative Association.

M. L. Bowman, Associate Professor of Farm Crops, and
L. C. Burnett, Assistant in Farm Crops.
"Oats."
Bulletin 96.

M. L. Bowman.
"Treatment of Smut in Oats, Wheat and Barley."
Bulletin 89.
"Alfalfa in Iowa."
Press Bulletin No. 3.

P. G. Holden, Superintendent of Extension Department.
"Some Lessons from Corn Shows."
Successful Farming, February, 1907.
"Getting a Start With Alfalfa."
Successful Farming, March, 1907.

"Harvesting and Storing Seed Corn."
Successful Farming, October, 1907.
"Increasing the Yield of Corn," by Securing a Better Stand.
Successful Farming, March, 1908.
"Increasing the Value of the Corn Crop."
Successful Farming, April, 1908.

A. V. Storm, Professor Extension Department.
"Minimum Qualifications of the Elementary Teacher."
Proceedings National Educational Association, 1907.
"Agriculture in the Public Schools."
Mail and Times, Des Moines, 1907.
"Farmers in the Making."
Iowa Agriculturist, June, 1908.

A. H. Snyder, Instructor in Soils, Extension Department.
"Farm Manures."
Extension Bulletin 1.

W. H. Stevenson, Professor of Soils, and
A. H. Snyder.
"Clover Growing on the Loess and Till Soils of Southern Iowa."

M. L. King, Experimentalist in Agricultural Engineering.
"Some Tests Upon Alcohol."
Gas Power.
"Alcohol Tests."
Gas Review.
"The Work of the Experiment Station."
Brown-Cochran Co., news sheet, State Fair.

E. W. Hamilton, Instructor in Agricultural Engineering.
"Gas Engine Troubles and Remedies."
Gas Review.
"Make and Break Spark Peculiarities."
Gas Review.

J. B. Davidson, Professor of Agricultural Engineering.
"Application of Power to the Work of the Farm."
Address before School of Agriculture, University of Nebraska.
"Haying Machinery."
Farmers' Tribune.
"Road Drainage."
Paper before the Iowa Drainage Association.
"Gas Engine Instruction for Agricultural Students."
Gas Review.
"Setting the Fuel Supply Valve."
Gas Review.
"The Size of Gasoline Engines for Farm Purposes."
Gas Review.

J. B. Davidson (with L. W. Chase, University of Nebraska).
"Farm Machinery and Farm Motors."
A text book, published by Orange Judd Co.

J. B. Davidson with M. L. King.
"The Comparative Values of Alcohol and Gasoline for Power and Light."

Bul. 93, Iowa Agricultural Experiment Station.
"Modern Silo Construction."
Bul. 100, Iowa Agricultural Experiment Station.

R. K. Bliss, Instructor in Animal Husbandry, Extension Department.
"Agricultural Extension in Iowa."
Iowa Agriculturist, December, 1907.
"Pork Production."
Extension Bulletin 4.
"The Problems of Modern Farming."
National Home Magazine, October, 1907.
"Testing and Feeding Dairy Cows."
Circular for Dairy Special Trains, 1907.

R. E. Drennan, Instructor in Animal Husbandry, Extension Department.
"Testing Dairy Cows on the Farm."
Extension Bulletin 3.

G. R. Bliss, Instructor in Horticulture, Extension Department.
"A Profitable Strawberry Crop."
Orange Judd Farmer, 1908.
"Forestry for the Iowa Farmer."
Iowa Agriculturist, 1907.
"Horticultural Extension at Iowa State Fair."
Fruitman and Gardener, 1908.
"The Horticultural Extension Department."
Fruitman and Gardener, 1908.
"Potato Culture" (Selection).
Guthrie County paper, 1908.
Many minor articles by Mr. Bliss were published by the Iowa Agriculturist, I. S. C. Student, the Alumnus, Orange Judd Farmer, and Fruitman and Gardener. Six short articles of his were accepted for use by the National Congress of Horticulture.

Miss Edith G. Charlton, Instructor in Domestic Economy, Extension Department.
"Short Course Work in Iowa."
Buffalo Illustrated News, October, 1908.
"The Short Course at Simpson College."
Farmers' Tribune, April, 1908.
"Home Life in Virginia."
Breeders' Gazette, 1908.
"Three Articles on Good Health in Country Homes."
Successful Farming, 1908.
"Short Course Work."
Iowa Agriculturist, June, 1908.

EQUIPMENT.

The request is most urgently renewed at this time with the sanction of the Board of Trustees that an appropriation of not

less than $20,000 annually be made for equipment. The continually recurring and growing needs for equipment make it impossible to secure adequate provision with a less amount than this. Only gradually could we then gain on our needs and keep up with the recurring demands. Every department of the institution that has any technical work carries with it a large laboratory.

This is notably true in all the departments of agriculture, such as the dairy farm, farm crops, animal husbandry, of horticulture and poultry. The farm itself is a laboratory of instruction, all its resources being used for this purpose. The farm never has been, and in the nature of the case never can be a source of financial profit to the institution. It is the laboratory using the greatest possible variety of crops and animals for instructional purposes. Much of the time of employees is used in preparing materials for classes. To place the farm on a commercial basis would be "penny wise and pound foolish" from the standpoint of educational efficiency.

In the Engineering division very much of the present equipment is antiquated. The engineering shops are only partially furnished. The work in ceramics is entirely without equipment. It will take at least $5,000 to provide for this branch of work so earnestly asked for by the brick, tile and cement interests of the state, and provided for in the law requiring the college to teach in this subject, but not provided for so far as building and equipment are concerned.

The equipment likewise in the Veterinary division is very urgent and also in the department of Domestic Science.

The last two or three biennial reports have called attention to the necessity for much more adequate provision for equipment. But $5,000 annually for the biennial period was granted. This seems almost pitiful in the presence of $90,000 of needs. Partial provision has been made from time to time for the equipment of the dairy and poultry farms, the engineering shops, etc. It is now of the utmost urgency, however, that fairly complete equipment shall be provided. A carefully prepared list of needed equipment is summarized herewith:

EQUIPMENT NEEDED BY THE ENGINEERING DIVISION.

President A. B. Storms, Iowa State College, Ames, Iowa.

Dear President Storms: Attached hereto are the reports of the different Engineering departments concerning needed equipment.

I would say that in preparing these reports, only equipment quite urgently needed has been included. I would also say that to the amounts presented by the separate departments an addition should be made for general equipment needed for the entire division and which is of such nature as not properly to be included in the report of any one department. With this addition the equipment needed for the Engineering division will be as follows:

Mechanical Engineering department		$15,655.00
Civil Engineering department		15,272.00
Electrical Engineering and Physics department		16,128.50
Mining Engineering and Ceramics		6,350.00
General Engineering division equipment—		
Engineering library	$200.00	
Engineering museum, models, specimens, etc.	400.00	
Photographic room	200.00	
Dean's office	200.00	1,000.00
Total		$54,405.50

Respectfully sumbitted,

A. MARSTON,
Dean of Division of Engineering.

DETAILED STATEMENT.—MECHANICAL ENGINEERING DEPARTMENT.

During the last two biennial periods, the college has been allowed the sum of $10,000 for equipment. Of this fund of $5,000 per year the portion allotted to this department has varied from $800 to $525 per year. This equipment fund has been of great assistance and we have purchased many small pieces of equipment which have strengthened the department courses.

There are, however, a great many larger and more expensive pieces of equipment needed. We have not been able to purchase these because the equipment fund of one or even two years would not cover the cost of any one of these machines.

Our steam and engineering laboratories are especially weak in equipment. Visitors from other institutions are ready to admit that our shop system will compare favorably with other institutions but are free to criticise our arrangement of laboratories and lack of apparatus. The heating and lighting service of the institution has encroached upon and practically entirely occupied the building originally intended for laboratory purposes. The department urges that all possible pressure be brought to bear to secure funds to complete the construction and equipment of the heating plant and power station thus making possible the removal of the heating and lighting equipment from the laboratory building.

The items of equipment listed below are needed to bring up and maintain the work of our laboratories and shops at the high standard set by the institution:

Machine Shop:		
1 48" Planer	$ 2,800.00	
1 42" Universal Milling Machine	1,400.00	
1 20 H. P. Induction Motor	600.00	
1 5 Ton Traveling Crane	900.00	
		$ 5,700.00

Forge Shop:		
1 Bolt and Nut Machine	$ 800.00	
1 Power Shear and Punch	450.00	
1 Heavy Forge	80.00	
1 20 H. P. Induction Motor	600.00	
		1,930.00
Pattern Shop:		
4 Pattern Makers' Lathes	$ 1,200.00	
1 Moulding Machine	500.00	
1 Trimmer	125.00	
1 20 H. P. Induction Motor	600.00	
		2,425.00
Engineering Laboratory:		
1 25 H. P. Steam Turbine Testing Plant	$ 1,800.00	
1 25 H. P. Steam Driven two stage Air Compressor	1,200.00	
1 100 H. P. Surface Condenser	750.00	
1 10 H. P. Gas Engine	450.00	
2 10 H. P. Induction Motors	900.00	
1 Junker's Gas Calorimeter	200.00	
Laboratory furniture, tables, chairs, record files, report cases, apparatus racks	300.00	
		5,600.00
Total		$15,655.00

The larger part of the prices on the equipment listed above has been obtained through correspondence with manufacturers during the last two years. The equipment as outlined is in no sense show equipment but would be put into service immediately after installation.

DEPARTMENT OF ELECTRICAL ENGINEERING.

We have been unable during the biennial period just closed, to add very materially to our equipment in this department. There remains a great deal to be desired in the way of additional equipment in order that we may be in a position to carry forward to advantage the work in the various laboratories of the department. Below is given an itemized list of the various pieces of apparatus which should be provided for the laboratories of Physics and Electrical Engineering. In most cases the prices of the items as obtained from catalogs and quotations of the leading firms are specified. It has been impossible to specify with accuracy certain items, but these in every case, have been carefully estimated.

Mechanics:

6 Balances, Sartorius, slate base, beam graduated for rider, capacity 200 grams, $70.00	$ 420.00
4 Spherometers, $25.00	100.00
6 Micrometer Calipers, $5.00	30.00
6 Vernier Calipers, $7.00	42.00
1 Geryk Vacuum pump power, Duplex A, 2" x 5"	175.00
1 Barometer, Standard U. S	70.00
1 Dividing Engine (Sci. Shop C-83)	209.00
1 Gyroscope electrically operated, Queen & Co	40.00

1 Set Gaertner's Laboratory Supports	150.00	
1 Engine Lathe, screw cutting, English and Metric	225.00	
1 Jack Shaft, hangers and pulleys (est.)	50.00	
1 Circular Saw with Tilting Table (est.)	150.00	
Tools for shop (est.)	100.00	
2 Adjustable Laboratory Tables I. I. C., $20.00	40.00	
1 Scientia "Lathe Bed Apparatus" for Young's Modulus, etc. (Sci. Shop C-1755)	95.00	
1 Extra Micrometer Screw for above	15.00	
1 Cathetometer (Societe Genevoise, Sci. Shop C-76)	154.00	
		$ 2,065.00
Heat:		
1 Apparatus for Mechanical Equivalent of Heat, with platinum thermometer and bridge, I. I. C., C-828	$ 108.00	
2 Calorimeters with Felt Protectors, $30.00	60.00	
1 Searl's Conductivity Apparatus, C-826	27.00	
		$ 195.00
Light:		
1 Double Projecting Lantern	$ 150.00	
3 Student Spectrometers, full divided circle, with vernier reading to 30 seconds, $75.00	225.00	
1 Webber's Photometer, E-4200, Queen & Co	175.00	
3 Micrometer Microscopes, $9.00	27.00	
3 Reading Telescopes, $15.00	45.00	
2 Compound Microscopes, $40.00	80.00	
1 Interferometer	160.00	
1 Epidiascope with 50 ampere lamp (Sci. Shop C-967) duty free	345.00	
1 Planer lens system for same, C-973	109.00	
1 Lummer-Brodhun Sight Box, No. 1	75.00	
		1,391.00
Sound:		
4 Tuning Forks, electrically operated, $20.00	$ 80.00	
2 Kundt's Tubes, $10.00	20.00	
1 Monochord (est.)	25.00	
1 Wave Trough	40.00	
1 Wave Machine (Cady), (Sci. Shop C-1000)	110.00	
		275.00
Electricity and Magnetism:		
1 Leed's Potentiometer, No. 1 with standard cell, coils adjusted to 1-50 of 1%, $275.00, 10%	$ 247.50	
2 Ballistic Galvanometers, $67.50	135.00	
10 D'Arsenval Galvanometers, wall, $35.00	350.00	
1 Electrostatic Machine, large, enclosed	175.00	
1 Wireless Telegraph Demonstration set—Receiver, W-2A Queen & Co., $60.00; Sender, $50.00	110.00	
1 Queen Ayrton Universal Shunt Box, E-8808	30.00	

12 Testing Keys, Queen & Co.:		
6 E-9180 at $1.50	$ 9.00	
4 E-9190 at $4.00	16.00	
2 E-9182 at $2.50	5.00	
	30.00	
1 DeKa-Ampere Balance, 1-100 amperes, E-8703 Q. & Co.	240.00	
1 Condenser of Epinus, E-7230	16.00	
6 Condensers Mica, Students 1 M. F. at $35.00	210.00	
2 Commercial Mica Condensers, Adjustable, $100.00	200.00	
1 4-inch Spark Induction Coil with Rheostat	85.00	
1 2-inch Spark Coil (Sci. Shop C-337)	27.00	
1 Thompson Double Bridge for low resistance	300.00	
10 Resistance Boxes 1, 2, 3, 4, to 400 ohms at $30.00 (1-5%)	300.00	
5 Resistance Boxes (1-5%) 1, 2, 3, 4, to 4000 at $40.00	200.00	
6 Wheatstone Bridges and Rheostats (1-5%), 1 to 5000 ohms, at $50.00	300.00	
2 Weston D. C. Ammeters, portable, 0 to 25 amp., at $65.00, less 15%	110.50	
4 Wall Ammeters, Weston D. C., 0 to 15 amp, at $15.00	60.00	
1 Magnetic Balance	40.00	
1 Hysteresis Apparatus	150.00	
2 Weston D. C. Voltmeters, double scale, 0 to 15, and 0 to 150, at $65.00, less 15%	110.50	
		3,426.50
Photography:		
4 Cameras, 4 x 5, with Zeiss Lenses and "between the lens" shutters, at $24.00	$ 96.00	
2 Cameras, 5 x 7, with Zeiss lenses, and Focal plane shutters, at $40.00	80.00	
1 Copying Camera	90.00	
Other apparatus, including Printing Frames, Hard Rubber Trays, Print Washers, etc	25.00	
Fitting up 4 dark rooms in old Dynamo Lab. (est.)	100.00	
		391.00
Dynamo Laboratory:		
1 Induction motor, D. C. generator set, 75 K. W. capacity, to furnish D. C. supply for laboratory. This will be necessitated next year when the Power Co. cease to generate D. C.	$ 1,800.00	
1 Tirrill Regulator for the above D. C. machine. Much trouble is experienced on account of changing voltage due to varying load	100.00	
1 Single Panel Swbd. for above set, with circuit breaker and switch	70.00	
1 Polyphase wattmeter for above induction motor.	170.00	

1 D. C. ammeter for above D. C. generator	70.00	
1 D. C. voltmeter for above D. C. generator	70.00	
1 Synchronous motor, A. C. generator set, 30 K. W. capacity, to furnish A. C. supply for such purposes as require steadier A. C. supply than the power department can give	1,600.00	
1 Switchboard for this plant	70.00	
3 Meters for this plant	300.00	
1 Tirrill regulator for this plant	130.00	
1 60 Cell Storage Battery and housing for same	625.00	
1 10 H. P. Series Motor and Controller	250.00	
2 7½ K. W. Rotary Converters, at $350	700.00	
2 10 H. P. D. C. Motors for above converters, at $170	340.00	
3 A. C. Voltmeters, at $40	120.00	
6 A. C. Ammeters, at $35	210.00	
2 10 K. W. Wattmeters, at $70	140.00	
1 Weston Standard D. C. Lab. Voltmeter	105.00	
1 Case for instruments	60.00	
1 Additional Panel for Student Switchboard	50.00	
1 Switchboard for present Rotary Converter set	80.00	
1 Switchboard for present Induction Motor	70.00	
1 Switchboard for new Rotary Converter set	80.00	
Estimated cost of concrete floor and wire trenches in new laboratory	400.00	
Moving present equipment to new laboratory and installing, estimated at	600.00	
5000 feet of wire	175.00	
Total		$ 8,385.00

Summations:			
Mechanics	$ 2.065.00		
Heat	195.00		
Light	1,391.00		
Sound	275.00		
Electricity and Magnetism	3,426.50		
Photography	391.00		
Total apparatus for Physical Lab.		$ 7,743.50	
Total apparatus for Dynamo Lab.		8,385.00	
Grand total			$16,128.50

DEPARTMENT OF MINING ENGINEERING.

For Ore Dressing Laboratory:		
1 2" x 6" roll jaw crusher	$ 125.00	
1 4" x 19" centrifugal rolls	500.00	
1 2 stamp, gravity stamp mill	300.00	
1 Wilfley table	450.00	
1 Trommel	75.00	

1 Set Collom jigs	100.00	
1 Frue Vanner	400.00	
1 10 H. P. motor	300.00	
For placing machinery, launders, separators, settlers, classifiers, etc., in building	750.00	$ 3,000.00
Additional for Ceramic Laboratory:		
1 Pug Mill	$ 100.00	
1 Rotary screen	75.00	
1 Combination clay mixing and washing machine	850.00	
1 Large drying oven	30.00	
1 Orsat apparatus for gas analysis	45.00	
For placing apparatus	250.00	1,350.00
Working Collections:		
Minerals, ores, rocks		1,000.00
Laboratory Equipment:		
Models, maps, photographs, and lantern slides		1,000.00
Total		$ 6,350.00

CIVIL ENGINEERING DEPARTMENT.

Cement Laboratory:		
10 Double desks, slate tops, and lockers, at $75.00	$ 750.00	
2 Sets Briquett molds, at $30.00	60.00	
2 Vapor baths, at $40.00	80.00	
Tanks for soaking briquetts	200.00	
2 Briquett testing machines	300.00	
1 Drying oven and gas plant	50.00	
2 Vicat needles	20.00	
2 Sets sieves	25.00	
Plumbing	100.00	
1 Motor, wiring, shafting and belts	300.00	
Miscellaneous	250.00	$ 2,135.00
Testing Laboratory:		
2 30,000 lb. testing machines	$12,000.00	
3 Transverse machines, small	450.00	
3 Micrometer calipers, 1-10000	40.00	
1 Extensometer	160.00	
1 Laying off gage	15.00	1,865.00
Hydraulic Laboratory:		
1 Underground reservoir	$ 700.00	
1 Centrifugal pump, 6"	500.00	
Piping and rack for friction tests	1,000.00	
20 Gages, at $20.00	400.00	
1 Motor and wiring	600.00	3,200.00

Astronomy and Railway:		
1 Altazimuth instrument	$ 1,200.00	
1 Precise level and rods	300.00	
1 Set railway curves	75.00	
Establishing monuments	200.00	
2 Transits, complete	500.00	
2 Levels	300.00	2,575.00
Total		$ 9,775.00

ENGINEERING ANNEX AND CIVIL ENGINEERING INSTRUMENT ROOM.

Office Equipment.—Additional bookcase space is badly needed. The professor has not enough room for his books and there is no space at all in which his assistant, may keep any books which it is necessary for him to use in his work. The following units from the Globe-Wernicke catalog would satisfy the demand:

1 EX Base	$ 1.75	
1 E 13½ unit	4.50	
1 E 13½ combination unit	4.75	
3 D 12¼ units	9.75	
1 DX Top	1.75	$ 22.50

There will also be needed additional filing case space for correspondence and miscellaneous information in connection with the work in surveying. The following from the Globe-Wernicke catalog would satisfy this demand:

1 1701 L Base	$ 3.75	
1 1701 VL unit	18.00	
1 1701 VL combination unit	18.00	
1 1301 TC unit	5.00	
12 No. 1 transfer cases	2.40	$ 47.15

We also have a goodly number of catalogs representing various sorts of equipment, which are of considerable use in class work. These catalogs are at present in a shape not very handy for use, but could be made a very efficient factor in class room work by systematically filing them. In order to accomplish this, the following sections from the Globe-Wernicke catalog would be needed:

1 2501 L base	$ 4.50	
3 2501 VL units	67.50	
1 2501 combination unit	22.50	
1 1701 CI one row No. 35 unit	10.50	
1 1701 X top	4.50	$ 109.50

The department has very poor facilities for filing away drawings, both those made by students and such blue prints as we have collected from manufacturing firms dealing in supplies connected with our work. In order to properly take care of these drawing, the following would be needed:

For drawings 24"x36" and 18"x24" the following equipment, manufactured by the Economy Drawing Table Co. of Toledo, Ohio:

1 Base	$ 2.00	
3 Filing case sections, at $18.00	54.00	
1 Top	3.00	
		$ 59.00

For filing drawings 12"x18" and 8½"x11", the following from the Globe Wernicke catalog:

1 1701 L Base	$ 3.75	
1 1701 LBX unit	15.00	
1 1701 VL unit	18.00	
1 1701 CI 35 unit	13.50	
1 1701 X top	4.50	
		$ 54.75

For filing roll profiles, which are not readily accommodated by drawers, the following units manufactured by the Globe Wernicke Co. would serve very well:

2 No. 325 upright VS units, at $20.00 ..... $ 40.00

There would also be needed one office table, and I find that tables of this sort were bought some years ago from L. Harbach Sons of Des Moines for $17.15. We have at present no good way of storing our tracings cloth and blue print and Van Dyke papers. For this purpose, we need 3 tin tubes, which would cost $1.00 each, total $3.00.

Drafting Room Furniture.—To take care of the drafting work in the new drafting room in the north end of the second floor of engineering annex, the following equipment will be needed:

1 Case for drawing boards. Some years ago a case of this sort was bought from L. Harbach Sons of Des Moines for	$ 130.00
22 Drawing tables, 39x84. The Economy Drawing Table Co. of Toledo, Ohio, manufactures tables which, with a few changes, would satisfy our requirements for this work. These tables would cost $25 each, or a total of	550.00
48 Stools, at $2.35	112.80
This is the price obtained on stools bought some years ago from L. Harbach Sons of Des Moines.	
1 Office table for the drawing room, similar to the one asked for in connection with office furniture	17.15
50 Drawing boards, at $1.00	50.00

In this connection, it might be said that we have some drawing boards now on hand, but are in need of more and many of those we now have are not in very good condition.

Instrument Room Equipment.—It is the purpose when department is finally established in the new instrument room on the ground floor of the engineering annex, to install the individual locker system for dispensing equipment. This system will do away with the services of any regular man in the strument room and will allow the money which has heretofore been spent for that purpose to be applied for the employment of additional help in the field, which is much needed. To provide for the instruments which

we at present have in the instrument room, and some which we probably shall get in the next two years, 70 lockers will be required, these lockers to be fitted with locks and duplicate keys furnished. It is estimated that these lockers would cost not over $500.00. To take care of the keys, one key-case will be needed. The purpose is to make this case large enough to accommodate 100 keys, and estimate that it would cost $15.00.

There will also be needed one large bulletin board, on which to post the assignments for the field work sections. If made after the same general pattern as those at present in use in engineering hall, it is estimated that this board would cost $15.00.

Instrumental Equipment.—The classes in surveying and field work are becoming rapidly larger and it is only by the most careful planning that the equipment which we now have can be made to do the necessary work. To relieve the pressure and plan for future larger classes, and also to supply some deficiencies which are now noticeable, the following additional equipment will be needed:

10 Surveyor's compasses, at $50.00 ..... $ 500.00

In regard to these compasses, I wish to call attention to the fact that we have at present only two compasses, and I deem it essential that compass work in the Freshman year shall precede transit work in the Sophomore year.

3 Alidades for traverse tables, ... $ 20.00

In regard to these instruments, I may say that we have at present the tripods and boards for these traverse tables, but that they are useless owing to the fact that the alidades are wanting.

12 Hand levels	$ 130.00
2 Planimeters	80.00

I found at the close of last school year that the one planimeter which we had was entirely inadequate to do the necessary work.

1 Level trier	$ 40.00
5 New York level rods	36.00

I find that there is only one rod of this sort in the instrument room, and inasmuch as on certain classes of work these rods are used to a considerable extent, I feel that we should supply this demand.

12 Rod levels	$ 36.00
30 Plumb-bobs for chaining work	15.00
2 Bar magnets, for remagnetizing needles	1.00
1 Burt solar attachment	50.00
3 Saegmuller solar attachments, at $50.00 each	150.00
1 Shattuck solar attachment	30.00

In regard to these solar attachments, I may say that last year it was well-nigh impossible for all of the students to take the necessary solar observations, because of the fact that the instrument room has only two solar attachments, both of these being of the Burt type. It is necessary to increase the supply and also to introduce other forms so that the students may be well acquainted with all sorts of solar attachments.

3 Plane tables, Johnson movement.....$ 450.00

We have at present in the instrument room, one plane table with the ball and socket movement. This movement is not as good as the Johnson movement, and we need more plane tables in order that this part of the work may be satisfactorily taught. The plane table is an instrument which, especially in the West, is being universally used, and with our present equipment we are much handicapped in this respect.

18 Rods for use with hand level.....$ 18.00
12 Stadia boards, estimated to cost $2.00 each..... 24.00

I shall not be in favor of the style we now have, but will favor introducing a somewhat different form of stadia board, as those we have at present are continually being broken and some more substantial form is needed.

1 Transit with solar attachment and reversion level .....$ 300.00

In order to keep pace with the growing classes, it will be necessary to add one or two instruments to the equipment, I feel, for some years. We at present have no transit with reversion level and as a level of this sort introduces some features which are worthy of study, I think it would be well to have at least one transit furnished with this level.

1 Dumpy level .....$ 100.00
1 Y-level 150.00
2 Protractors 23.00

We have at present in the instrument room no large protractor, and in certain parts of the surveying work it is essential that students have access to a good protractor, and I therefore recommend the purchase of these protractors, to be kept in the instrument room and loaned to the students the same as other equipment.

The same line of argument will apply to the following:

1 Steel straight edge .....$ 4.00
1 Beam compass 10.00
2 Drop spring bow pens..... 6.00
2 Railroad pens 6.00
3 Contour pens 6.00
1 20" slide rule of the ordinary type..... 12.00
1 Fuller slide rule 25.00
6 Stadia slide rules, at $12.00..... 72.00

We are doing considerable work in topographical surveying, and we find that the supply of Stadia slide rules is entirely inadequate.

4 100' steel tapes, standardized.....$ 15.00
1 300' steel tape, standardized..... 11.00
1 300' steel wire tape..... 12.00
1 500' steel wire tape..... 18.00

The standard tapes will be needed in connection with base line work. We have at present one standard tape, 300' long, and I find that when we come to this part of the work we are much handicapped by lack of additional tapes. The steel wire tapes I aim to use in giving the students some experience in chaining long distances down slopes. Heretofore, they have had no experience whatever in chaining of this sort.

10 Sets of chaining pins, with rings, at 40c.....$ 4.00

This is intended simply to supply the loss that necessarily takes place from time to time.

Repair Shop.—The instruments used by students receive probably the hardest usage of any surveying instruments in the country. With our present facilities for repairing them, we not only are put to additional expense to send them away for some little repairs which might easily be made with proper equipment, but those which it is not worth while to send off for repairs we sometimes can not mend here at all. I strongly recommend the establishment and equipment of an up-to-date repair shop for surveying instruments, this repair shop to be in the charge of a man well suited to do this sort of work. I believe that such a shop is maintained by the department of physics, and other institutions I know of have a repair shop for each department. I am not entirely familiar with the cost of equipment of this sort, but I estimate that such a repair shop could be fitted out in fair shape for $250.00.

Triangulation System.—I propose, as soon as I am able, to lay out a triangulation system covering the entire campus. The corners of this triangulation system would greatly simplify the work of assigning problems, and would also do away with ninety per cent of the stake driving which is now necessary. These stakes are undoubtedly a nuisance, and this triangulation system would do away with that.

In addition, it would make it very simple for the instructor to check the work of the students, inasmuch as all the distances between the corners of the triangulation system and all the angles between the sides would be known. In connection with this system, I would establish standard bench marks at different points, as might seem best. Also, I would establish somewhere near engineering hall a standard of length, so that all tapes might be compared with this standard and the error noted. This triangulation system, with the accompanying bench marks and standard of length, would also be of considerable service in laying out roads and sewers, sidewalks, and buildings upon the campus. I estimate that such a system could be put in for between $100 and $150, and I strongly urge the authorizing of this work.

Grand total .....$ 4,497.00

SURVEYING DEPARTMENT.

For this department the professor has submitted a detailed list, copy of which is attached.

Total equipment needed for Surveying Department.....$ 4,497.00

RAILWAY ENGINEERING DEPARTMENT.

For this department Professor Stanton reports needed equipment as per detailed statement attached, amounting to.....$975.00

ENGINEERING LABORATORY DEPARTMENT.

Added equipment is urgently needed for our engineering laboratory, which includes the hydraulic laboratory, the cement laboratory, and the laboratory for general tests of materials of constructions. Professor Stanton present the needs of these laboratories in a detailed statement attached hereto.

Total equipment needed for C. E. Laboratories.....$ 7,200.00

DEPARTMENT OF PRACTICAL ASTRONOMY AND GEODESY.

This work has been carried on for years with practically no independent equipment, although it gives most of our instruction in higher surveying. A list of equipment needed is furnished by the professor in detailed statement attached.

Total needed equipment for Practical Astronomy and Geodesy..$ 1,600.00

GENERAL AND MISCELLANEOUS EQUIPMENT FOR CIVIL ENGINEERING DEPARTMENT.

This includes equipment for the structural engineering work, for the blue print room, for the drafting department, and office equipment, exclusive of that needed for the new building or stated in Professor Ford's report.

Models, samples of steel, reinforcing bars for reinforced concrete, etc., for structural engineering....$	300.00	
Drafting department equipment	200.00	
Equipment for blue print room and filing cases, book cases, etc., for offices, and miscellaneous equipment	500.00	
Total general and miscellaneous equipment.....		$ 1,000.00

Total equipment needed for the Civil Engineering department, exclusive of that provided for in previous requests for $5,000, for equipment of new Engineering Laboratory, $15,272.00.

EQUIPMENT NEEDED BY THE SCIENCE DEPARTMENTS.

Chemistry Department.—		
Apparatus for laboratory of physical chemistry.....$	800.00	
Apparatus for preparing distilled water.....	300.00	
Special equipment for agricultural chemistry.....	500.00	
		$ 1,600.00

Botany Department.—We find that our work is very seriously impaired for the want of enough microscopes in the bacteriological laboratory, for we have thirty students at one time and only have ten microscopes for these students, we will therefore need twenty-five microscopes either of the Spencer Lens Co.'s make or of the Leitz make, at $65.00 per microscope, making a total of $1,625.00. And in this same labortaory one centrifuge at $35.00 and 2 Abbe camera lucidas at $15.00 each. In the physiological laboratory, auxanometer, clinostat, balances, etc., $500.00. Ten microscopes for vegetable pathological laboratory at $32.00 each, total $320.00; 2 Abbe camera lucidas at $15.00 each, total $30.00; 12 dissecting microscopes at $12.00 each, total $144.00; 1 B. & L. micritome, $23.00; 1 Minot Automatic rotary micritome, $83.00. For arranging museum material, $1,000.00. We have a large amount of material that has not been arranged on account of lack of funds. This should be placed in the show cases as soon as possible.

Grand total $2,790.00

Domestic Economy.—Estimate of expense for necessary equipment:

Additional laboratory .....$	400.00	
Chairs, blackboards and tables (for east, west and basement kitchens)	150.00	
Ovens for east, west and basement kitchens.....	60.00	
Tables for sewing laboratories.....	50.00	
Sewing machines	100.00	
Total		$ 760.00

Economics Furniture.—		
Sectional book cases.....$	75.00	
Filing cases	35.00	
8 or 10 maps.....	40.00	
Equipment for stereopticon	45.00	
Total		$ 195.00

Dr. Hibbard has a lantern and slides for the stereopticon but no equipment. The $45 asked for includes a stereopticon stand, $30; rheostat, $10; and electrical connections $5. Such equipment is absolutely necessary for the lecture work along the lines of child labor, sweat shops, etc.

Zoology Department.—Minor apparatus for the use of individual students consisting of small pieces too numerous to be separately listed is most urgently needed. This is due to the large increase in the number of students already entered this year and to be expected in the next two years. This expectation is based on the size of the present freshman class which will affect the number taking work in this department mostly next year and the year after. This minor individual apparatus may be estimated at $8.00 per student; for 80 students $640.00.

Twenty additional tables at about $10.00 each, total $200.00, are needed. We have this term put into use old Margaret Hall dining room tables which were discarded by the college authorities several years ago.

Desks for the work in physiology have been presented as urgent needs for three years past. As these have to be made to order, the least number that it would be economical to obtain at one time would be twenty at an estimated cost of $600.00.

The increase renders necessary also additional microscopes. The estimated number needed is 15 at $48.00, or $720.00.

A large list of major apparatus, a considerable part of which should be obtained within the next few years is on file. Some items on it have been obtained each year for several years back. Among the most important items which should be purchased in the coming biennial are as follows: Microscopic project apparatus, $80.00; Zeiss epidiascope, $400.00; lantern slides, $60.00; embryological models, $100.00; kymograph, $275.00; spectropolarimeter, $62.00. Total, $977.00.

Summary of Equipment:

Individual apparatus	$ 640.00	
Tables	200.00	
Desks	600.00	
Microscopes	720.00	
Major apparatus	977.00	
Total		$ 3,137.00

LIBRARY.

Books.—The present appropriation of $2,400 is utterly insufficient for the purchase of books. Divided between some thirty-three departments it is hardly sufficient in some cases to purchase the current literature, to say nothing of the purchase of books. In view of the appropriations being made by other state institutions doing technical and scientific work, our appropriation seems almost absurdly small. Wisconsin receives for its library annually $25,000, Missouri University $14,000, Kansas University $8,700.

We need not less than $5,000.00 annually for books	$5,000.00
Increase	2,600.00

Library Furniture.—

Card cabinet	$ 150.00	
Newspaper rack	15.00	
Periodical rack	18.00	
Desk	15.00	
Charging System	125.00	
Total		$ 323.00

EQUIPMENT NEEDED IN AGRICULTURAL DIVISION.

Agricultural Engineering.—A change in the heating system to Agricultural Hall, during the next year, will necessitate the purchase of motors to operate the shop machinery. The high pressure steam, which has been furnished to the department engines in past years, will be discontinued. Two motors will be needed when the wood shop is moved into the old building.

The department, at present, has the use of a stereopticon owned by the Horticultural department. When the latter department moves into New Agricultural Hall, it will be impractical to borrow their stereopticon.

Additional equipment in the forge shop will enable the department to economize instruction and at the same time handle class sections of the usual size handled by other departments.

The department now has the use of three levels belonging to the Iowa Highway Commission and which cannot be retained indefinitely.

Agricultural Engineering offers an opportunity for the design and construction of special apparatus for the instructional purposes. A small sum could well be used in this direction.

1 15-H. P. A. C. induction motor for forge shop	$ 300.00	
1 10-H. P. A. C. induction motor for wood shop	200.00	
1 5-K. W. transformer motor and control for elevator	265.00	
3 Architect's levels, at $45.00	135.00	
3 Philadelphia rods, at $14.00	42.00	
1 Stereopticon	200.00	
10 Hand forges, at $25.00	250.00	
Piping to exhaust fan	100.00	
10 Sets of blacksmith's tools	50.00	
1 Farrier's anvil	18.00	
1 Wand drill	15.00	
1 Band saw	120.00	
Special apparatus	200.00	
Total		$ 1,895.00

Animal Husbandry Department.—If we hope to maintain our present standing among the colleges of this country, it is very essential that we materially strengthen our herds and flocks at once. This is true of each of the various classes of live stock, namely horses, beef cattle, sheep, swine, dairy cattle and poultry. In addition we should have an abattoir, where we could kill our own animals and study the various phases of meat cutting and curing. Several other colleges have already made provision for this work, and others anticipate doing so the present year.

We are also very much in need of more buildings and equipment on the poultry farm. This is a line of work which is attracting wide attention. The poultry interests of our state are so important that we cannot afford to overlook the work at the college.

After careful consideration we have decided that the following named amounts are absolutely necessary for this work:

For purchase of horses	$ 5,000.00
For purchase of beef cattle	5,000.00
For purchase of dairy cattle	5,000.00
For purchase of sheep	2,000.00
For purchase of swine	2,000.00
For purchase of poultry	1,500.00
Total	$20,500.00

BUILDINGS AND EQUIPMENT NEEDED ON POULTRY FARM.

Poultry Farm.—The poutry farm being situated so far from the college campus, makes it necessary to invest more in instruction buildings, residence, heat and light than would be the case if college laboratories and town living facilities could be obtained.

21 pens, 12'x12', to cantain 525 birds, at $125 each	$ 2,625.00
Equipment for above (trap nests, feed hoppers, grain cans, water dishes, grit, shell and bone hoppers)	630.00
Incubator building, brick, 35'x60'	4,000.00

Equipment for above (incubators, tables, testers, thermometers, hygrometers, oil tanks, pedigree trays, balances, etc.)	1,000.00
Instruction building, 35'x60', two stories and basement	4,000.00
Equipment for above (lockers, dishes, sinks, chairs, models, specimen cases, dissecting apparatus, balances, charts)	2,000.00
Fattening building, 20'x70', with feed and killing room 30'x50'	3,500.00
Equipment (fattening crates, feed bins, mixing machine, scales, feed carriers, cramming machines, indoor brooders, etc.)	1,500.00
15 colony houses, at $60.00	900.00
15 pens, 20'x20', to accommodate 1,500 head	4,500.00
Equipment	450.00
Fencing, 1,000 rods, with 70 gates	1,500.00
Barn, horse, wagon and implements	2,500.00
House for poultryman	2,500.00
Stock	1,500.00
Completing present buildings, and grading	600.00
Total	$33,705.00

Amounts invested in Dairying, Horticulture and Poultry at Iowa State College, together with the census valuation of the dairy, horticultural and poultry products of the state, according to the last U. S. census:

	Buildings.	Land.	Stock.	Salaries and Maintenance.	Census Value of Products.
Dairying	$78,000	$20,000	$ 3,500	$ 4,150	$27,516,000
Horticulture	26,300	5,485	.....	5,100	11,341,000
Poultry	6,080	2,000	225	900	19,508,000

WHAT OTHER STATES ARE DOING IN POULTRY HUSBANDRY.

Instruction and Experimentation. Figures compiled from report of Committee of the American Poultry Association, on Education and Experimentation in Poultry Husbandry, 1907.

Note this year's figures are not yet published, but many institutions mentioned below now possess from 50 to 100 per cent greater amounts invested than stated.

Amounts include both Instruction and Experiment Station appropriations, although in some cases no instruction is given, and in others, hardly any experimentation.

	Land	Stocks	Buildings	Equipment	Total	Salaries and maintenance	Total	Census value of products
Canada at Guelph	$ 750	$ 1,800	$ 4,200	$ 1,500	$ 7,450	$ 5,335	$13,585	$25,000,000
Connecticut	500	2,500	2,500	1,851	7,351	5,128	11,490	2,507,526
Iowa	2,000	225	6,080		8,305	2,250	10,555	19,508,000
Maine	5,000	5,000	5,700	2,400	18,100	2,000	20,100	2,902,000
New York (Cornell and Geneva)	700	1,650	5,900	2,150	10,400	14,650	25,050	14,791,000
North Carolina		1,000	8,100	1,350	10,450	2,400	14,800	4,500,000
Rhode Island			13,687		13,687	8,150	21,837	1,055,000
Utah			5,000	1,680	6,680	3,500	10,180	687,131
Pennsylvania		300	2,000	500	2,800	2,250	5,050	16,319,968
West Virginia	1,000	1,000	4,000		6,000	1,500	7,500	3,721,427

In the number of regular agricultural students, excluding short courses, Cornell University has approximately ninety, and ranks first, but I. S. C. follows second with seventy.

Iowa State College has invested in dairying, $1.00 for each $288 worth of dairy products; horticulture $1.00 for every $357; and poultry $1.00 for every $2,414, or approximately eight times as much invested for dairy and horticulture as for poultry.

Iowa State College and Experiment Station expends annually:

$1 for each $4,046 worth of dairy products.

$1 for each $ 929 worth of horticultural products.

$1 for each $8,125 worth of poultry.

The highest ratio of equipment to production is in Rhode Island—$1 to $77 of products, or proportionately 31 times as much as Iowa.

Utah has $1 invested for every $103 worth of products, or proportionately 23 times as much as Iowa.

In salaries and maintenance, Rhode Island is expending $1 for every $129 worth of products or proportionately 63 times as much as Iowa.

DAIRY DEPARTMENT.

In presenting the needs of the department it is felt that only equipment that is absolutely necessary for the proper presentation of the subject of dairying should be asked for. Be assured then that whatever equipment is asked for is a conservative estimate of the needs of this department for the biennial period 1909-1911.

(1) In the creamery floor, our equipment is very good. This is due not entirely to equipment furnished us in the regular way, but in a large measure to the apparatus loaned us by creamery package companies.

2 Churns, estimated cost	$ 350.00
2 Cream vats	400.00
1 Starter can	100.00
2 Pasteurizers with coolers	700.00

Besides the above brine connections should be made with coolers. At present the water supply in summer time is too high, 68 degrees, for ef-

fective cooling. This necessitates the use of much ice in cream vat, which is not a very good practice.

Estimated cost .....$ 100.00

(2) In ice cream making the only equipment that we have is a three gallon hand freezer. The importance of this phase of dairying is such that there should be a freezer of the latest type, a brine continuous freezer, that would enable the demonstrator to show methods as they are used in live up-to-date ice cream manufacturing concerns. An ice crusher is also needed.

Estimated cost of such a freezer with brine connections	$ 300.00
Ice crusher	80.00

(3) In cheese making there is a need for different molds for the different variety of cheeses as Edam, Cheddar, etc. With the increasing number of students taking the dairy course the supply of such articles ought to be increased.

Estimated cost of supplies.....$ 75.00

(4) For Farm Dairy Laboratory. In milk testing there is the need of several cream scales and also for a number of hand Babcock testers. Several hand churns and a table for printing are also required. Last year's class numbered over 130 students and the department was considerably handicapped on account of a lack of supplies in teaching the above subject. Knowing the possibilities of teaching this subject with better equipment and the importance of it, the present equipment is entirely inadequate.

The following apparatus is much needed:

20	Four bottle hand Babcock testers	$ 100.00
1	24-bottle steam tester	5.00
6	Barrel or swing churns	60.00
3	Lever workers	18.00
1	Table worker	10.00
1	Printing table	12.00

(5) City Milk Supply. For the better fitting our students in the handling of city milk supplies, it is necessary that there be placed on the creamery floor the following:

1	Milk bottle filler	$ 200.00
1	Sterilizing oven	150.00
	Pipe fittings	50.00

There have been calls for men to fill the position of managers of the city milk supply. We should not recommend men who have had no practical experience along that line. At least, there can be no assurance that they will be a credit to the department and to the college.

(6) Bacteriological Supplies. Owing to the absence of the bacteriologist the supplies for the bacteriology laboratory can not be definitely stated. There is a need, however, for a number of high power microscopes and other supplies of a general nature.

6	Microscopes, estimated cost	$ 400.00
	Sundry supplies	200.00
	Total	$ 3,310.00

SOILS DEPARTMENT.

1. For the Advanced and Post-Graduate Soils Laboratory in the New Agricultural Building. (We have at the present time no equipment which is available for this laboratory.)

4	Analytical balances with weights	$ 300.00
1	Centrifuge and motor	50.00
1	Copper steam bath	20.00
1	Kjeldahl nitrogen apparatus	20.00
20	Condensors	40.00
1	Carbon apparatus	50.00
2	Microscopes	75.00
1	Motor and shaker	50.00
4	Copper ovens	40.00
2	Sets brass sieves	20.00
1	Large still	50.00
2	Digestion shelves	50.00
3	Scales, Harvard Tripp	25.00
1	Battery filter-chambers with connections	60.00
1	Hot plate, 24"x16"	10.00
	Total	$ 860.00

2. For the Soil Physics and Soil Fertility Laboratory.

1	Motor and centrifuge	$ 50.00
6	Copper ovens	60.00
30	Condensors	60.00
2	Digestion shelves	50.00
1	Analytical balance with weights	75.00
1	Motor and mill for grinding samples	75.00
	Total	$ 370.00

3. For the Soils Bacteriology Laboratory. (We have at the present time no equipment for this laboratory.)

1	Hot air sterilizer, B. & L. 6024 (about)	$ 25.00
1	Hot air sterilizer, Eimer & Amend B. 1279	36.00
2	Arnold Steam sterilizers, 32x32x41 cm. B. & L. 6048	56.00
2	Autoclaves, automatic eclipse, copper, Spencer 1122 I. B.	150.00
1	B. & L. No. 13237 Electric Centrifuge for alternating current	22.50
1	Abbe Camera Lucida	12.00
10	Ocular micrometers, at $1.50 each	15.00
1	Mechanical stage for microscope, Spencer No. 124	14.40
4	Harvard balances with weights, B. & L. No. 8106	20.00
1	Good standard balance with weights, about	60.00

10 Microscopes, triple nose-piece, 2-3, 1-6 and 1-2 objectives, without case, Leitz or Spencer, at $65.00 each	650.00	
4 Roux metallic thermo-regulators, at $16.00 each	64.00	
Total		$ 1,124.90
Grand total		$ 2,354.90

VETERINARY DIVISION.

The equipment for the Veterinary division is not yet itemized but extensive equipment will be necessary as soon as the department enters a new building.

REPORT OF THE LEGISLATIVE COMMITTEE OF THE BOARD OF TRUSTEES.

Acting upon the President's Biennial Report, the Legislative Committee of the Board, having been empowered to act, adopted the following budget for inclusion:

Increase in support fund, annual		$75.000.00
Increase for the Agricultural Experiment Station, Annual,		
Soils investigations	$10,000.00	
Farm crops investigations	7,500.00	
Horticulture and forestry investigations	7,500.00	
Veterinary investigations	6,000.00	
Beef cattle investigations	5,000.00	
Dairy manufactures	4,000.00	
Dairy cattle investigations	3,000.00	
Swine investigations	3,000.00	
Sheep investigations	2,000.00	
Poultry, feeding and diseases	2,000.00	
Total		$50,000.00
Increase, Engineering Experiment Station, annual	$11,500.00	
Increase, repair and improvement fund, annual	22,000.00	
Library (books), annual	2,600.00	
For equipment, annual	20,000.00	
Increase in Agricultural extension	8,000.00	
For furniture,		
1. New Hall of Agriculture	30,000.00	
2. Ceramics building	5,000.00	
Sidewalks and grading	11,000.00	

Buildings,	
Completion central heating plant	50,000.00
Ceramics building	15,000.00
Gymnasium, auditorium and armory	150,000.00
Abattoir, laboratory and meat curing building	25,000.00
Poultry buildings	10,000.00

REPAIR AND IMPROVEMENT FUND.

The Repair and Improvement fund, from which, under present limitations upon the expenditure of the millage tax funds, all minor improvements as well as all repairs must be done, is inadequate at present for the large number of repairs and minor improvements urgently needed, such as a small barn for the Public Grounds department where the team can be kept and the tools; improvements to the Old Farm house occupied by Dean Curtiss and requiring to make it comfortable repairs to the extent of $1,500; a fire house for keeping hose cart and hook and ladder apparatus for fire protection; the painting of a number of buildings and repairs upon same; the repairs of fences, barns, and out buildings belonging to the farms, etc.

Some of the main expenditures from this fund during the last biennial period can be noted by referring to the secretary's report, under Building and Equipment Funds, Sec. "a". It will be noted that the repairs on heating, lighting and water plants have amounted to over $10,000. This covers all plumbing, the keeping of pumps, tanks and systems in order, together with the power transmission and apparatus. These items can not be estimated at less than $5,000 a year. It will be noted that another group of items of large aggregate come under such heads as Repairs to College Buildings, Improvements Necessary in Laboratories, Some Additions to Building Fund, such as remodeling of Old Engineering Hall and installing of heating plant in the same, the Installation of Machinery in the New Machine Shops, the Extension of the Sewer System, the General Maintenance of the Sewage System and Disposal Plant, Farm Improvements, Tiling, Fencing, etc., and such salaries as are appropriately charged in whole or in part to this fund. The college employs a head carpenter and an assistant carpenter and a painter, and the fund is administered by the college custodian. It will be necessary in the near future to erect a number of small buildings. The college plant is now valued in its buildings at approximately $1,600,000. Three per cent seems a modest estimate for keeping up these buildings and making the

improvements necessary. The present fund of $23,000 should be increased to $45,000 at least.

The trustees after some years of experience find it utterly impossible to meet the demands from the present fund. In this connection, Mr. W. J. Dixon, for several years chairman of the building committee having this fund in charge, and at present president of the Board of Trustees, makes the following statement:

President A. B. Storms, College.

Dear Mr. President: In response to your request as to the amount of funds required to properly keep in repair the different college buildings, I would state that a fair valuation of all the college buildings would be $1,600,000,00. Some of the newer buildings like the Central Building, Engineering Hall and the new Hall of Agriculture would require but a small amount for general repairs, but we have a large amount of older college buildings, that require a large sum to keep in repair annually. Our present repair and contingent fund is $23,000.00. This is hopelessly inadequate to keep the buildings in proper repair and make the minor improvements that have to be made from this fund.

I would say that the minimum amount needed to keep in repair our college buildings would be three per cent of their value or about $50,000.00, and our present repair and contingent fund should be increased to $50,000.00 by the next General Assembly.

Yours very truly,

W. J. DIXON.

October 28, 1908.

INCREASED GENERAL EXPENSES OF RUNNING THE COLLEGE PLANT.

According to the secretary's books practically no appropriation from the support fund was necessary up to the year 1900 for fires, lights and janitors' services, this expense being met by the so-called janitor's fee of students. The student enrolment has increased from 940 in 1900 to a present enrolment of 1,848. The addition of new buildings, the increased number of laboratories requiring heat and power, the short courses in winter vacation which necessitate the operation of the entire college plant during the severest weather, have, in spite of the most efficient management we could secure, necessitated an increasingly large appropriation from the support funds to supplement the student janitor fee for these particular bills of expense. This item is $16,000 for the year 1908-09. The necessary appropriation from the support funds for this purpose for the biennial period 1909-1911 will, it is carefully estimated, amount to $20,000 annually. This entirely consumes, and more, the advance made in the support funds to the college by the last legislature, leaving the institution no better off for its

current educational needs in equipment and instruction than before. It should be estimated, therefore, that at least one-third of the increased appropriation for the support funds which is now asked will be needed to meet these expenses incidental to the mere operation of the college plant. It should also be borne in mind that out of the support funds must be provided the means for housing and caring for the Experiment Stations, Good Roads Commission, etc., as well as for the college proper.

PUBLIC DOCUMENTS.

The legislature is respectfully requested to add to the free depositories for state publications the library of the Iowa State College. The national congress has already done this for government publications and documents and it is quite desirable that state documents should also be accessible to students.

WALKS AND GRADING.

With an extensive campus, making it necessary for all students and instruction force to walk considerable distances to and from their boarding and dwelling places, the total absence of any sidewalks, the muddy condition of roads and paths, the rough, ungraded condition of the grounds where new buildings have been constructed, made grading and sidewalk construction very urgent and necessary. The legislature appropriated $5,000 for the biennial period for these particular improvements. While not one-half what was necessary, the amount of money has been expended with such care as to add very substantially to the improvements of the grounds. Grading to the extent of $2,500.00 has been done, mostly about Central building, which now presents a very neat and attractive appearance. Somewhat heavy grading has also been done south of the Dairy building, filling in a deep pit between the building and the new electric line. 27,880 square feet of excellent cement walk have been made, the citizens living to the west of the campus having contributed $235.00 towards the construction of the walk leading to the west gate. Walks are now completed about Central building and leading from Morrill Hall to Engineering Hall and from Engineering Hall south to the Chemistry building and in front of the shops to the driveway and thence to the west gate. Walk has also been constructed from the Dairy building to the driveway.

The following estimates on the walks and grading that need next to be done have been submitted by Professor Marston and Professor Erwin:

For grading and other landscape work about the new Agricultural Hall	$ 4,000.00
We find that it will require approximately five thousand cubic yards of dirt for grading and in addition to this there will be quite a little landscape work required.	
For sidewalks	5,000.00
There is pressing need for fully eight thousand linear feet of cement walks on the campus at this time.	
For drives	2,000.00
Most of the drives on the campus are too narrow. In many places they are entirely worn through and they should also be supplied with a good curb and gutter throughout. $2,000 will not cover this item, but it would make a good beginning. On account of its relation to the landscape work which the college is giving and also on account of the fact that the Good Roads commission is located here, it is very important that the college should maintain better examples of good road construction on the campus.	
Total increase for public grounds work..	$11,000.00

WATER IMPROVEMENTS.

The last legislature appropriated $10,000 for improvement of water supply at the college. The extensions and improvements contemplated and necessary at the present time have been completed. A large reservoir, a pump house with supply and delivery mains, a 14 inch well centrifugal pump, a 30 H. P. electric motor and an Underwriter's fire pump have been installed. From the report of the superintendent of construction, Professor Meeker, the following statement is quoted:

In connection with the closing up of this appropriation I would say that the reservoir, well, centrifugal pump with its direct connected motor drive have been given a thorough trial. The results have been most satisfactory. The pump delivered water for five consecutive hours at the rate of 24,000 gallons per hour. The builder's guarantee was 15,000 gallons per hour. At the end of the run there was no indication of any decrease in the supply of water. It would seem that we have a first class well. The Underwriter's fire pump that has been installed has a capacity of 1,000 gallons per minute, enough to supply four fire streams. When this is connected to our new boiler installation, the college water supply system will be on a most satisfactory basis.

The new apparatus and construction are first class in every respect and looking back over the expending of the fund, I do not know how any part could have been better expended or how we could have lessened any item of cost without impairing the value of the installation.

(Signed) W. H. MEEKER.

HEATING PLANT.

The appropriations already made for central heating and power plant were known to be insufficient to complete the system. As much has been done as was estimated could be and the system is in a very satisfactory condition so far as it has been carried. It is believed the economy as well as the convenience will be all that was anticipated. It is thoroughly substantial. The main tunnel is constructed of cement reaching from the plant to a point north and west of Central building, from which a tunnel branches to the southward, entering Central building, and to the westward connecting with another tunnel that leads to the shops and Engineering Hall. On this tunnel already completed we now carry the director's house, the New Hall of Agriculture, Central building, Morrill Hall, in which the library is placed, Engineering Hall, the Engineering shops, Chemistry building, and Alumni Hall. The report of the superintendent of construction is as follows:

President A. B. Storms, College.

Dear President Storms: In response to your recent request I am hereby submitting a statement of the expenditures and present condition of the Heating Plant and Tunnel Fund.

The Thirtieth General Assembly made an appropriation of $54,500 for a central heating plant. This sum was later increased by the sum of $15,832, appropriated by the Board of Trustees from the Special Building Tax. This total amount of $70,332 was expended in the erection of a building and the construction and equipment of about 850 feet of tunnel, the purchase and installation of a 250 horse power engine and generator unit together with one 250 horse power boiler. The building includes an engine room large enough for the future needs of the college and a boiler room planned to be enlarged when all the college buildings should be heated from this station.

The Thirty-second General Assembly gave the college an additional appropriation of $60,000. The Board of Trustees made available the sum of $30,000 for the year July 1, 1907, to June 30, 1908. The balance is now available and is being expended. The secretary's books show that at the present date $45,750.47 of this fund of $60,000 has been expended.

The expenditures to date are classified below:

Balance in engine-generator set	$ 157.15
Balance in 250 H. P. Sterling boiler	1,320.00
Balance in architect's fee	154.08
3,000 ft. concrete tunnel construction	14,046.65
Motor generator set	2,236.45
Pipe covering	4,017.82
Tunnel piping	9,530.65
Power house piping	4,771.32
500 H. P. Sterling boilers	3,852.50
Green chain grate stoker	1,413.28
Roney mechanical stoker	771.88
Moving and erecting Aultman-Taylor boiler	747.18
Miscellaneous power house equipment	1,378.46
Boiler feed pump	220.00
Fire brick masonry for boiler setting	895.86
Superintendence and inspection	237.19
Total	$45,750.47

The balance of $14,250.00 will be expended approximately as follows:

Balance in boilers	$ 3,800.00
Balance in Green stokers	1,100.00
Balance in Roney stoker	455.00
Balance in pipe covering	1,000.00
To complete power house piping	1,800.00
To erect Sterling boilers	3,000.00
Induced draft apparatus	1,500.00
Miscellaneous	1,500.00

Respectfully submitted,

W. H. MEEKER.

October 9, 1908.

The following buildings remain to be connected and the necessary tunnels must be built for this purpose: Margaret Hall, Old Agricultural Hall, Horticultural building, the Dairy building, Experiment Station barn, and Stock Pavilion. The estimate of necessary expenses to complete the system is $50,000.00 and an appropriation is asked for this purpose.

BUILDINGS.

It is a pleasure to witness the transition from one report to another of items that pass from the column of need to that of possession. The burning of the old Main building left the college almost destitute at the very beginning of its period of phenomenal expansion. For five years its growing classes met in Emergency Hall, a shed scarcely fit for sheep. The department of Botany was jumbled into the dining room of Margaret Hall, to be jostled into corners

whenever the room was needed for general purposes, as banquets, social gatherings, etc.

These conditions have now changed. The new Central building is an architectural achievement that reflects credit upon its designers and upon the state. Costing less by hundreds of thousands of dollars than a number of other college buildings in the country, but superior to most if not to all of them in its harmony, dignity, adaptation to its purpose and substantial character, it will stand for centuries a worthy Central Hall for a great institution of technical education. In this building the Botany and Bacteriology department has commodious quarters, ample and well lighted laboratories and lecture rooms, and a large and valuable herbarium. The Botany section of the Agricultural Experiment Station also has its work here. The executive offices are in this building and the departments of English, Modern Language, Mathematics, History, Civics, Economic Science and Public Speaking.

Some of these departments will of necessity be crowded out soon with the growth of the college, but the recitation rooms, laboratories and offices are entirely satisfactory in character.

The heating and ventilation are of the most approved methods. Much better work can be done by students and faculty in well lighted, well ventilated and comfortable rooms than is possible under unsanitary and uncomfortable conditions.

The engineering shops built for the accommodation of the Engineering departments when they enrolled about two hundred or less had not been enlarged or new shops built until the last biennial period. This need had become so urgent that the legislature made special appropriations to meet it in part and also authorized and approved plans for an additional building designated Engineering Annex. With the special appropriations old Engineering Hall, that had become dilapidated and practically useless, has been entirely remodeled, the interior completely rebuilt of concrete and steel and thus equipped the Engineering division with an excellent hydraulic and testing laboratory. A new forge shop has been built and put into commission, and also a new machine shop that is entirely satisfactory and adequate. With the new annex to be next constructed from the millage fund this division will be able to care for its eight or nine hundred students far more creditably.

The need that must now be urged is for equipment for these shops and an instruction force that can man them and care for the students. These needs must be met from equipment and support funds, and as explained in that portion of the report dealing with

these subjects, can only be provided for as the support fund and the equipment fund are materially increased.

Soon the Agricultural division of the college and the Agricultural Experiment Station will be able to occupy its new building. The new Hall of Agriculture, like the Engineering Hall and Central building, is a credit to the state and to the cause of agricultural education and research. It stands opposite Central building across the central campus, and when the necessary grading is done will give to the college as a whole a balanced and a harmonious appearance appropriate to its main divisions of technical work.

GYMNASIUM AND ATHLETICS.

Attention to the physical health of students is recognized as an important duty of educational institutions. I wish to bear personal testimony, after twenty-five years of observation and experience, to the markedly improved physical health of students in the present age over that of a generation ago. This improvement, I believe, is due very largely, if not almost entirely, to the attention being given to physical culture and to the varied forms of athletic exercises. I believe the corresponding physical improvement has also been accompanied, and perhaps quite naturally, by a far better moral tone and by cleaner living. Physical culture under competent directors sets constantly before the student correct ideals concerning physical training and the conditions of health and strength. Students in physical training must live temperately and give proper attention to matters of food and sleep, of fresh air and exercise, and are taught to understand the proper relationship between physical health and intellectual power. The anæmic student with drooping shoulders, pale face and a sentimental intellectuality, is no longer an ideal that is cherished.

The enquiry most often raised as to possible injurious effects of athletics has been concerning the danger of over training. Under a competent and conscientious physical director, however, this danger is reduced to a minimum. Wishing to assure myself upon this point from the highest authority, I wrote the surgeon general's department of the United States army, having in charge the physical inspection and examination of college men who seek commissions into the army, among them a number from our own institution. After having passed through the hands of a number of officials, the authentic reply received is as follows:

Fort Leavenworth, Kansas, Sept. 17, 1908.

The President, Competitive Examining Board,
Fort Leavenworth, Kansas.

Sir: In reply to your endorsement on letter from the President of Ames College, dated September 11, 1908, I have the honor to make the following remarks.

In my opinion there can be no question as to the value of systematic physical culture for young men when given under competent direction. This is fully demonstrated by the marked improvement in the physical condition of recruits during their first year of service in the army. It would seem that this training might continue until a high degree of physical culture was reached, without injury to the individual. Of course this training must be given under competent instructors.

It is not believed that the severe strain college athletes are subjected to during inter-collegiate contests is permanently injurious to them, if they have been properly trained. In the large number of college men whom I have examined physically, few have shown the bad effects of over training.

It is my personal opinion, that, the value of the physical training incident to inter-collegiate contests can not be over estimated.

Very respectfully,
ARTHUR W. MORSE,
Captain Medical Corps, U. S. Army.

It should be noted that the wide extent of benefits of athletics or physical culture is not observed in any spectacular way from the hundreds of students daily and weekly receiving great benefit from systematic athletic work under the eye of the physical director, while only here and there is an athlete who stands out distinctly because of his position on some college team in inter-collegiate contests. Almost without exception colleges and universities everywhere are recognizinz the importance of gymnasium equipment and athletic grounds. Most institutions, like the Iowa State Normal School, at Cedar Falls, are building their gymnasium with as great care and with as much expense as any of their college buildings. It is almost the only building that is of use and interest to an entire student body.

At Ames we have absolutely no provision for the men except out of doors, and even there the grounds as at present set aside and graded are altogether inadequate. There is not even suitable room for the students to play. Grounds have been set aside by the trustees which, when graded, will answer the purpose much better than anything we now have, but the only building that can be used for physical culture or athletics is a small shed built by the students themselves. It is due the sons and daughters of Iowa gathering at the college at Ames that they should have a chance for proper physical development and training. I have seen many even under

the present conditions, when such exercises are prohibted for a good part of the college year by inclement weather, entering college in undeveloped physical condition and even with very erroneous ideas about coddling themselves, who have grown strong and capable and hardy under college training. The students have become thoroughly aroused to the importance of this and to the need of a gymnasium. Their loyalty to the college and appreciation of the opportunities which the state and the nation thus offers for education is worthy of consideration. In constitutes a very important moral asset of the state and of the college. It will be a bitter disappointment to them if the gymnasium cannot now be assured and provided for.

It is estimated that a suitable building, plans for which have been drawn, would cost approximately $150,000.

It should be noted that such a building as this one proposed would serve three important purposes, at least for the time being.

1. *Armory.*—It would serve as an armory, enabling the college to carry forward its military drill regularly through the college year. At present, with no drill grounds except the open campus, drill is practically prohibited for a very large portion of the year. The college is thus actually not meeting the requirements of the federal government in any adequate measure. The excellent results attained under our commandant with these limitations and hindrances are due to his recognized ability as a tactician and instructor as well as his standing as a military officer. Such a building would furnish stack room for arms, suitable office, and drill room.

2. *Auditorium.*—Another very important use of such a building would be that of an auditorium. The utter lack of any building or room where even half the enrolled students can be brought together at once is painfully evident to every one who knows anything about conditions at the college. It is often extremely desirable that convocations be held in which as nearly as possible all students and all faculty should be brought together. This has been impossible and is impossible under present conditions. This is a very serious limitation. The moral effect of being able to bring home certain important considerations of policy and of college interest to the entire college united at one gathering, the sense of college unity that comes from such occasional gatherings are of so much importance as to make an exceedingly strong argument for such a building as the one proposed. It is very earnestly hoped

that a direct appropriation can be made for this building which would thus serve as a gymnasium, an armory, and an auditorium in one.

WOMAN'S BUILDING.

This college stands not only for technical work for men, but also for women, domestic economy having rightfully claimed an important place in the scope of its educational work. The scientific aspects of domestic economy, especially in the study of foods, human physiology and home sanitation, have been a comparatively recent development. Men learned the value of scientific knowledge of animal nutrition, of the chemistry of foods for stock before they took up a similar study concerning human nutrition and food values. It scarcely needs to be argued that the latter is of supreme importance.

It is the policy of the college at Ames to furnish thoroughly scientific courses in domestic economy. The basil studies in the natural sciences are already established in the science department. These studies in chemistry, botany, bacteriology, entomology, physics, and physiology are now grouped in proper sequence in the Domestic Science course, leading young women to take this course to a thorough preparation for scientific study of their own particular subject. Curiously enough, the college is well equipped now for doing this exceedingly important work except in one particular, the utter lack of a building with lecture rooms and laboratories. The demand for Domestic Science courses is rapidly increasing. The present class numbers .... The laboratories and recitation rooms are inaccessible, partly in an old and unsuitable building in the rear of Margaret Hall, partly in the attic of Old Agricultural Hall up three long flights of stairs, partly on the one corner of the ground floor of Margaret Hall. None of these accommodations are at all suitable and any considerable increase in the number of students, such as we have had during the last two or three years, will render these accommodations utterly insufficient. The importance of this work, the only phase of technical work for young women, and its increasing importance in the educational system of the country requires a separate and new building adapted to its purposes at the earliest hour possible.

Two years ago the legislature authorized the erection of an addition to the woman's dormitory, Margaret Hall, of a wing, estimated cost $45,000. This addition to the dormitory facilities is

very much needed as probably twenty-five young women desiring to enter the college this year particularly for work in domestic economy, did not enter because not able to get rooms in Margaret Hall. However, if they had entered, we could not have accommodated them in the Domestic Science laboratories and it seems to the trustees and the college officers that the more important need is for a building that will provide for the Domestic Economy laboratories and work. We, therefore, ask permission to delay the erection of the wing to Margaret Hall and to first erect from the millage tax a woman's building for domestic economy.

VETERINARY BUILDING.

By noting what is said under Veterinary division, the necessity for a veterinary building is evident. Plans and specifications have been prepared for a building that will cost approximately $150,000.

Because of a lack of space and the proper arrangement of lecture and clinic room, much of the practical instruction, so necessary for the education of the student, must be omitted. The laboratory classes have been divided and sub-divided in order that the individual student may receive proper attention, and our largest class room is crowded to its utmost capacity.

The Veterinary division of Cornell University, at Ithica, and the College of Veterinary Medicine of the Ohio State University have commodious, well equipped veterinary buildings. Through the generosity and foresight of the members of the legislature of Pennsylvania, the Veterinary department of the University has received the sum of $200,000 with which to construct and equip a modern veterinary building, and the great state of Iowa, with her extensive agricultural and kindred interests, can ill afford to be behind in appropriating funds for her veterinary school, when in other lines she is so far in advance of other states. $150,000 could be used for this purpose, and not one cent squandered.

The live stock interests of this state are enormous, aggregating more than any sister state, and the breeder and feeder should have the advice of competent men, regarding the control of existing diseases, and the adoption of measures necessary for the exclusion of infectious animal diseases or their extinction, should they accidentally appear. There are not at this time enough competent men in private practice to care for these vast interests, and for that reason great losses have been sustained from such controlable infectious diseases as hog cholera and tuberculosis.

With the finest and most improved breed of cattle and hogs, and the most magnificent types of horses in the world, and a teeming population whose wealth and health are largely centered in these, we have, because of an almost utter lack of knowledge or appreciation, neglected to protect them to the fullest extent from the ravages of insidious disease, by forgetting to foster and encourage that science which alone can accomplish this. This apparent neglect has cost the stock raiser of Iowa untold millions, and until this condition is righted and veterinary medicine placed upon an equal footing with the other professions, so that it may yield its benefits to the fullest measure, we will continue to record annually the irreparable damage, both to the health and the wealth of the state and nation, inflicted by the influence of contagious animal diseases.

BUILDING OF CERAMICS.

Dean Marston's report contains a statement that demands serious attention, namely, "it is hard to exaggerate the importance of the clay, quarry and cement industries of Iowa. * * * A building and equipment for this work are urgently needed and have been most strongly demanded by the clay and cement organizations of the state, to provide for both instruction and investigation." It will require $15,000 to erect a suitable building for Ceramics laboratory. This can be added as a wing to the Engineering annex, a building already authorized and provided for by the last legislature. It will thus fit in economically with the plans for the annex building. Plans and specifications will be submitted to the legislature for approval.

LIBRARY.

Attention is again called to the increasingly urgent need for a new Library building. The trustees believe they can reach from the millage tax the construction of this building immediately after the erection of the buildings already authorized and the Veterinary building which they ask to have authorized. Plans and specifications are being prepared and will be submitted to the legislature for their approval.

Attention was called in the last biennial report to the altogether inadequate accommodations furnished for students in our present library building, Morrill Hall, and also to the crowded condition of the stack rooms for books. The situation is becoming deplorable. The building is frail and liable to destruction by fire, endangering

the valuable library kept there. It is very frequently the case that twenty-five to fifty students must stand at the windows for lack of chairs and tables for the use of books. In the developing work of the institution and its increasing scientific thoroughness, reference books are more and more in use. The book withdrawals, in spite of the increased number being assigned to small reading rooms in the various buildings, has gone up within the last two years from 28,000 volumes per annum to 56,460.

A new library building is among our most imperative needs. It should be of the same substantial character as the more recent buildings erected, probably of Bedford stone, of a uniform type of architecture with the new Main Hall, Engineering Hall and the Hall of Agriculture. It would be folly to make provision for a library of less size than from 100,000 to 150,000 volumes. In the growth of the institution and the character of its work, this capacity will ultimately be required. We should avoid the mistake that has been made in so many instances of providing too small a reading room. It should be made to accommodate at one time several hundred students.

The library building should also contain an art room where such gifts or acquisitions as the college may obtain, illustrating the history of art and architecture, may be preserved and used. There should also be provision for seminar rooms and a small assembly room.

CHEMISTRY AND ZOOLOGY.

The departments of Chemistry and Zoology are now crowding their quarters to the utmost limit. Chemistry building is the old brick building in the early days of the college used for the Engineering department. It has been remodeled and adapted to Chemistry department uses as best can be done, but is entirely inadequate and quite unsatisfactory. The porous brick makes it very difficult to ventilate properly the building and yet keep it warm. Several classes have to meet here and there as they can find chance openings. Every inch of available space in the building has been finished off, even up into the ridge. The department of Agricultural Chemistry doing its work in the Chemistry building has no office for its professor, not even a cubby hole that he can call his own or where he can be consulted in private. A Chemistry building according to approved model and design is one of the imperative needs of the college.

The Zoology department, occupying quarters in the library building or Morrill Hall, is likewise cramped for room. It has been necessary to take the class in entomology, heretofore meeting in the zoology lecture room where the windows can be darkened and the lantern used, into the chapel, where the lantern can not be used. This is a very serious handicap. The zoology laboratories have crowded into the basement and even to the window sills. The students positively can not be accommodated if there be any increase, as there certainly will be according to the natural rate of growth. The trustees are utterly nonplussed. I am mentioning these needs without any definite idea as to when or how they can be met. It is, of course, obvious that these sciences are fundamental to all our courses of study in technical lines. Students must have their chemistry and their zoology before they can go on in their courses.

APPLICATION FOR ADMISSION TO THE BENEFITS OF THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

By recent action of the Board of Trustees of the Carnegie Foundation for the Advancement of Teaching, the following regulation was adopted:

> Institutions of higher learning, including colleges, universities, and technical schools, whose educational standard, plan of government, and endowment conform to the regulations of the Carnegie Foundation for the Advancement of Teaching, may be recognized as entitled to share in the retiring allowance system of the Foundation.
>
> Applications on behalf of institutions must be made by the board in which the government of the institution is vested. In the case of tax-supported institutions the applications must be accompanied by the approval of the governor, and of the legislature of the state or province in which the institution is situated. The trustees of the Foundation reserve the right to decline the application of any such institution if it is subject to a political control or interference which, in the opinion of the trustees of the Foundation, impairs its educational efficiency.

This is a very satisfactory outcome of the earnest request of the national associations representing state institutions of higher learning. As originally restricted, the benefits of this Foundation did not extend to state institutions of learning and it was very keenly felt that this practical discrimination against them would increase the embarrassment and difficulty of securing and holding strong faculties.

Our Board of Trustees have passed the following resolution:

WHEREAS: Mr. Andrew Carnegie has caused to be established a Carnegie Foundation for the Advancement of Teaching and has donated funds to provide for retiring allowances for teachers in colleges, universities and technical schools of the three English speaking countries of America,and to serve the cause of higher education by advancing and dignifying the profession of teacher in these higher institutions of learning;

BE IT RESOLVED: That in justice to our worthy professors and to realize the high purpose of Mr. Carnegie to promote a genuine teaching profession, we hereby make application for the admission of the Iowa State College to the rights and privileges of the Carnegie Foundation for the Advancement of Teaching; and

BE IT FURTHER RESOLVED: That we respectfully ask the Governor of Iowa and the Legislature to approve of this request.

RESOLUTION FOR LEGISLATIVE ACTION.

RESOLVED: That the request of the Trustees of The Iowa State College of Agriculture and Mechanic Arts to the Carnegie Foundation for the Advancement of Teaching for the admission of said College to the rights and benefits of said Foundation for the Advancement of Teaching be approved.

FOR GOVERNOR'S APPROVAL.

To the Carnegie Foundation for the Advancement of Teaching.

Dear Sirs: In accordance with the regulations of your Foundation, I approve the application of the Board of Trustees of the Iowa State College of Agriculture and Mechanic Arts to have that institution placed on the list of accepted institutions of the Foundation.

Truly yours,

CONSERVATION OF NATURAL RESOURCES.

The watchword of the hour is the urgent importance of conserving the natural sources of prosperity in soil and mine and forest. This institution in its scientific researches, through its college and station work, is serving an increasingly useful function to this end. The great necessity is not knowledge alone but knowledge made effective. The intelligent interest of the people must be aroused. Nothing helps more certainly to do this than to show actual results. A demonstration is often as essential as an experiment. After all is said, the conservation of the people themselves, their industrial interests and industrial habits, their intelligent interest in what they do, their emancipation from the thraldom of ignorance and indifference, is the most important work that presses upon us at the present time. It is the ambition of the workers at the State College to help worthily and efficiently in this major conservation of the people themselves.

Exhaustion of the fertility of the soil by excessive cropping is our besetting sin in America. We are yet a wasteful people. Not only have we with ruinous haste mowed down the forests as with a besom of destruction

but we have also sought to use up the ultimate capital of all prosperity, the fertility of the soil itself.

Unless this ruin can be effectively stayed and American farmers can be general brought to a conscientious and thrifty regard for this fundamental resource in the soil itself, ultimate decay is inevitable for our civilization. We must begin to take serious concern for posterity. This becomes a patriotic, a religious and race obligation. Intelligent, intensive agriculture that shall leave the land as fertile at the end of each generation as at the beginning, an honest husbandry of natural resources of mine and forest and soil, an economic use through manufacturing industries of the many materials that at present lie so largely unutilized, all these together with a wide education that shall increase the industrial efficiency, the political capacity, and the spiritual character of the whole people are imperatively essential if we shall progress and not go backward in the not far distant future.

An European observer says of Americans, especially in the Corn Belt, that they are "unparalleled in their wastefulness, setting up a false economic standard in the industrial life of the agricultural classes, which will prove to be a bad preparation for the less bountiful time that must sometime come."

A German specialist reported to his government recently that Germany need not fear industrial competition with America for at least fifty years to come because of American complacency in the face of the poor industrial training which her people are receiving.

To produce an increasing number of leaders in the fundamental industries, who are "aware" is one of the great functions of such an institution as this, with its college, its laboratories and its experiment stations in continual operation.

AGRICULTURAL ENGINEERING.

Agricultural Engineering, embracing as it does such subjects as drainage, irrigation, farm machinery—its care and operations, farm buildings—their design and construction, should occupy a very useful field of work. The future extension of our farm lands will come about largely through reclamation by either drainage or irrigation. In Iowa it is estimated that there is a total area of 4,000,000 acres at the present time, which would be benefited, if not entirely reclaimed by drainage. Not only do the farmers of Iowa spend annually a large portion of their earnings for machinery, but success in modern farming depends largely upon the successful use of machinery. The fact that more money is invested in farm buildings in the country than in live stock indicates that this is a fruitful field for research, especially so, since it has not been given much attention by investigators in the past.

Severel phases of the work of the department are of such a nature as to be closely identified with the movement to conserve the natural resources of the country. Adequate and proper land drainage tends to prevent the wasting of the fertility of the soil by washing. Irrigation utilizes the waters which otherwise would be wasted. The investigation of and instruction in permanent structures for the farm is an important aid in conserving the materials which now enter into their construction.

HORTICULTURE AS A FACTOR.

Horticulture is to be a factor of ever increasing importance in the conservation and development of the natural resources of Iowa. The steady growth of the country in wealth and population is continually forcing land values higher in this region. The higher the land values the more intensive must be the agriculture which can be profitably maintained. This statement is abundantly verified in the history of the world's agriculture.

As a rule it may be affirmed that the higher land values are found in horticultural districts. More than that, the more intensive the type of horticulture the higher the average value of the land. Not only is this the case in the old world where agriculture has long been highly developed but it also holds for the United States, as is shown by the following statement:

"The census of 1900 reports on the farms of the United States as classified according to the principal source of income from the farm. Where the income from any particular source equaled or exceeded forty per cent of the total income, that source determined the classification of the farm. Thus, in case forty per cent of the income was received from vegetables, it was called a vegetable farm. The horticultural farms were listed under the four sources of income, vegetables, fruits, flowers and plants, nursery products. These farms had a total acreage of 16,514,705 acres, valued at $1,058,464,079, an average per acre of $64.10, as shown in the following table:

FARMS CLASSIFIED ACCORDING TO PRINCIPAL SOURCES OF INCOME.

Class	Acres	Value of all Farm Property	Average value per acre
All farms	841,201,546	$20,514,001,838	$ 24.39
Vegetables	10,156,679	546,921,965	53.85
Fruits	6,149,584	439,933,714	71.54
Flowers and plants	42,662	52,462,419	1,229.72
Nursery products	165,780	19,145,981	115.49
Total for horticulture	16,514,705	$ 1,058,464,079	$ 64.10

"The acreage for all farms is fifty-one times as great as the acreage of horticultural farms, while the value of all farm property is only nineteen times as great as the value of horticultural farm property."

SIGNIFICANCE OF THE RISE IN VALUE OF IOWA LAND.

In the East for the last forty years the value of land which is devoted to general agriculture has been steadily decreasing from the high prices which prevailed immediately following the Civil War, while the land values in Iowa during the same period have been constantly advancing. A careful study of the economic conditions which prevail leads to the conclusion that land values in this state must continue to advance for an indefinite period of time. As Iowa lands rise in value it must of necessity follow that intensive methods of farming will more and more prevail. Since horticultural industries belong preeminently to the realm of intensive agriculture, it is

but reasonable to expect that these will contribute to the wealth and prosperity of the state in increasing proportion as the years pass.

Horticultural activities naturally fall into four principal groups: vegetable culture, fruit growing, floriculture and landscape gardening.

VEGETABLE CULTURE.

Truck gardening has already attained considerable importance in Iowa. Some conception of the possibilities of the development of trucking on favorably located Iowa land may be gained by a study of the conditions which exist on Muscatine Island, which is perhaps one of the best developed market gardening districts in the state. Here intensive methods of culture prevail and land values are correspondingly high. There are in the aggregate many thousands of acres of Iowa land which might be brought up to a higher state of cultivation than is now found in the district referred to. Many of these areas which are now of comparatively little value might be made highly productive by the development of an adequate system of ditches for carrying off flood waters in periods of heavy rainfall, by tiling to remove the excess of water in the soil and by making provision to supplement the natural supply of water by irrigation in times of protracted drouth. In course of time doubtless by such means as these the trucking industries will be placed upon a more stable and satisfactory basis than exists under conditions which now prevail. In carrying forward such development as that just indicated, the horticulturist must seek the cooperation of the agricultural engineer and the soil expert.

In Belgium, where much of the soil originally was not highly favorable to cultivation, farm industry produces enough to support nearly five hundred persons to the square mile. If such remarkable results can be obtained with unfavorable soil, what may not be expected from the naturally fertile soils of Iowa under highly intensive agricultural development? It is estimated that the population of the United States will reach over two hundred millions by 1950. Should this prediction prove true, the agricultural districts of Iowa must become comparatively densely populated within the life-time of persons now living. Especially will this be true of those districts which offer special advantages for the growing of horticultural crops. It is evident, therefore, that the conservation of our natural resources with reference to such districts as those referred to is a question of great moment and one which is worthy of careful consideration by those who are shaping the policies of the state with regard to this matter.

FRUIT GROWING.

The possibilities of fruit growing in Iowa are as yet undreamed of. It is known that very fine fruit can be produced in this state but the uncertainties which have thus far attended the development of commercial fruit growing in this region have very greatly hindered its progress. These uncertainties have arisen from various sources, among which may be named the lack of adaptation of varities to the climatic and soil conditions which here prevail, the lack of proper market and storage facilities, the lack of confidence in their business on the part of commercial growers and their

consequent failure to adopt the more expensive methods of intensive cultivation. All of these things doubtless will become gradually modified until fruit growing shall rest upon a secure basis and the fruit crops shall become staple products of the state.

There are thousands of square miles of Iowa land which are naturally better adapted to fruit growing than to almost any other kind of agricultural industry. This is especially true of portions of bluffs along our rivers and smaller streams and certain other rough broken lands which are not well adapted for cropping and which even in pasturage give meager returns. In very many cases the valuation of land of this kind is too high to permit of its being profitably devoted to forestry.

PLANT BREEDING NECESSARY.

In solving the highly important question of securing varieties best adapted to this region, scientific breeding of orchard fruits must be resorted to. This can best be done and must most largely be accomplished by means of trained experts who shall be employed by the State or by the Experiment Stations of the United States Government in such a way that they shall be at liberty to give their full time to this work and carry it forward systematically through a succession of years. In breeding orchard-fruits, results cannot be obtained in one season, as may sometimes be done in the breeding of grains or vegetables. The generation of the orchard tree covers a comparatively long period of time and no fruit breeder can hope to see many such generations during his life-time. It is, therefore, highly important that work of this character should be undertaken by the State with a full understanding of its significance and maintained in such a way that the State may hope to reap the highest possible benefits therefrom in the shortest period of time.

FLORICULTURE.

The remarkable progress of the florists' industries in Iowa during the past decade has been a surprise even to those most intimately connected with the business. That this growth is to continue at an accelerated rate cannot be doubted. In this development the work of the experts in Chemistry, Soils, Agricultural Engineering, Entomology, Plant Physiology, Plant Pathology and Horticulture are to play an increasingly important part. Already our State Florists' Society is beginning to ask for recognition of the needs of its work in the instruction given at our Agricultural College and in the investigations carried on by our Experiment Station.

LANDSCAPE GARDENING.

In considering the conservation of our material resources there is also need for the preservation of our native scenery. Ambassador Bryce has called attention to the necessity of preserving the water fronts and the accompanying scenery along the rivers and lakes for the benefit of the public. Many of our Iowa towns are situated on streams which afford splendid opportunities for the development of picturesque drives. In many

instances precautions are not being taken to secure possession of these landscape features and preserve them for posterity. The same condition prevails particularly about our lakes in the northern half of the state.

Hence on the one hand there is need for the preservation of our native scenery and on the other for the further planting of trees and ornamentals for the purpose of developing a more beautiful Iowa.

Few of our cities show good street planting. The majority of them have used every imaginable species from evergreens down and they are planted at various spaces and receive unequal care. Our urban population is rapidly increasing and the problems of civic improvement will demand a corresponding increase of attention.

Along the same line the care and improvement of our cemeteries deserves mention, particularly the rural cemetery. In most instances there has been a lack of a "perpetual care clause" in the disposal of the lots with the result that as time goes on their care and maintenance becomes a more difficult problem.

Nurserymen report that the sale of ornamental stock has increased over 500 per cent in Iowa within the past decade, indicating an awakening along landscape lines. To secure the best results, this interest must be wisely directed, and such is a part of the work of the Iowa State College.

CONSERVATION OF THE LAND.

Erosion.—Hundreds of acres of land in Iowa are annually rendered wholly or partially unproductive because the surface has been washed and gullied. In many of the southern states whole farms have been literally abandoned because erosion has cut up and gullied the surface beyond the possibility of profitable cultivation. The fertile surface soil has been washed away and the sterile, ridged and seamed subsoil will not yield even the scantiest harvest.

Professor A. M. Soule, formally of the Tennesee Experiment Station, says: "It is no uncommon sight to see what was a fertile field five or ten years ago a barren tract overrun with sedge brush and briars, due mainly to the washing away of the surface soil and the formation of gullies from six inches to ten or even thirty feet deep. It hardly seems possible that erosion would make such rapid progress in so short a time, but the facts cannot be gainsaid and the picture is so common that it has almost ceased to arouse comment."

The problem of the present day is to conserve these thousands of acres of agricultural lands by means of (1) deep and thorough cultivation, (2) growing crops such as crimson clover for the purpose of increasing the humus content of the soil, (3) seeding down to grass, (4) under-drainage, and (5) reforestation wherever this method is practicable.

Loss of Plant Food.—A conservative estimate places the loss of plant food in farm manures, straw, cornstalks, and other fertilizing materials on the farms of the United States at fifty per cent.

An educational campaign should be inaugurated for the purpose of bringing home to the farmers of this country the great economic importance of conserving to the land the nitrogen, phosphorus and potassium which are the chief food constituents of these so-called waste products.

Again vast quantities of plant food are carried each year from the farms of the United States in the corn, wheat, oats and other agricultural products which are exported. Much of this fertility can be saved for our lands by educating our people to understand that there is more profit in exporting finished products such as beef and pork than in selling from our farms the raw materials with their abundance of plant food. Fully 75 per cent of the plant food which is contained in the grains which are exported from this country may be returned to our farms if the crops are fed and the manure carefully preserved.

DAIRY INTERESTS.

Of the 1,555,300 cows in Iowa about one-third do not pay for the feed they eat. One cow, Colantha's Fourth Johanna, produced in one year over 1,000 pounds of butter fat. Many cows do not produce 100 pounds of butter fat yearly. The average production of the Iowa cow is about 142 pounds. Could this be raised to 200 pounds per cow, the increased value of dairy products as butter fat, based on average price of year 1907-1908, 26 cents per pound, would amount to $7,254,944.

Through the students who come into the class room, through personal contact with the makers and farmers of the state, through the agricultural press, and in every conceivable manner, the department is striving to impress the importance of the testing of the cows, that only the most economical animals be retained.

It is felt that encouraging dairying, in this state, particularly the making of butter, the great natural resources, the fertility of the soil is being conserved. Butter, composed almost entirely of carbon, oxygen, and hydrogen, may be said to consist of air, sunshine and water.

The most economic methods in the manufacture of butter are given much attention. It is possible, through the adoption of better methods in handling the raw material, to increase the value of butter at least 2 cents per pound. This would give to the farmers of Iowa over $4,000,000.

The Province of Ontario has twenty instructors in the field educating the farmers in better methods. Iowa has no one to give undivided attention to this work. It is little use to conserve the natural resources of the soil if wasteful methods in the manufacturing process, or ignorance of principles involved in the caring of the raw materials are productive of unnecessary losses.

POULTRY.

Nationally the poultry products of this country exceed in value six hundred million dollars, being in excess of the wheat crop, and nearly as great as the dairy products. In Iowa the value of poultry products now undoubtedly exceeds twenty-five million dollars, and this state ranks highest in the number of fowls and ducks kept, value of poultry and number of eggs produced. Yet although Iowa stands first in production, she stands second in the money obtained for poultry and eggs, being exceeded by the state of Illinois.

Not only does Iowa occupy this high rank among the other states in poultry products, but a greater per cent of the farmers in this state keep poultry than in any of the other states excepting Rhode Island and Indiana, and as ninety-four out of every hundred farmers in this state keep poultry, it means that more people are interested in it than in any other branch of agricultural activity.

In the prospects for future income from poultry husbandry is found an exceeding interesting state of affairs. From the last report of the Bureau of Labor it is found that the retail prices of eggs and poultry have increased 47 and 37 per cent respectively in the last ten years, being exceeded only by bacon, which has increased 54 per cent. Thus when we consider that in addition to the above the poultry on our farms produce far greater returns on the capital invested than any other farm product, the outlook is certainly bright.

It should be the endeavor of the Iowa State College not only to lead the other states in instruction and experimentation because of the premier rank of the state in the poultry field, but also to aid the farmers of the state by proper instruction to receive more for their products.

CORN STALKS.

The enormous waste of raw materials such as corn stalks is challenging the attention of thoughtful men. Corn stalks make good paper pulp. Large paper manufacturers in New England, especially in Maine, are seeking to encourage the raising of corn in that state for the sake of the stalks. Here in Iowa uncut corn stalks whip in the December winds, losing most of their feeding value and also their value as manure and not utilized at all for any other purposes. The food values of the stalks can be almost entirely saved and returned to the soil by feeding the by-product some three hundred pounds to the ton of stalks, by proper processes of manufacture and the fibers fit for paper utilized. This phase of conservation needs attention and well illustrates the vital cooperation between agriculture and mechanic arts essential to continued development and prosperity.

FUEL.

Perhaps no line of economy is more urgent at the present than economy in fuel. * "The waste in coal mines is very great. Nearly every coal vein has streaks of sulphurous or bony coal mixed with the first-class material. This contains a large amount of carbon, but is not as valuable as some parts of the seam; it is, therefore, left in piles inside the mine or dumped upon the culm bank on the outside. The amount of this low-grade coal varies from ten to fifty per cent in every mine, and under the present system of mining and of coal using this is an absolute loss. As the roofs of the coal mines will not support themselves and as timber is expensive it is the custom to leave great pillars of coal in the mine as supports. As a rule, these pillars are not taken out and so become absolute waste. In most coal mines there are several layers of the coal separated by shale formation. Some of these are narrow and cannot be mined to advantage; others are so broken up and dislocated that it is impossible to take them out. All of these causes and perhaps some others make up a loss of from forty to seventy

* Pres. Charles S. Howe, Science, Oct. 23, 1908.

per cent of the coal in the average coal mine of the country. As we obtain only thirty to sixty per cent of the coal, it is evident that we are exhausting our coal fields twice as fast as the actual amount of fuel used would indicate."

Our Engineering Experiment Station has secured valuable results in boiler tests and coal tests. Other engineering schools have been engaged in similar enquiries. *"The results obtained by these men, all of them engineers, have been of an astonishing character. It has been found that the fine coal, the refuse of mines and breakers, hitherto regarded as of little value and sold at an extremely low price, can be made into briquettes at a comparatively low cost and it is then as valuable as the finest coal that can be obtained."

But perhaps the greatest economizer is the gas producer and the gas engine. *"With the old processes we do not obtain on the average more than five per cent of the heat value of our coals. The steam engine utilizes from four to ten per cent, but the gas producer and the gas engine utilize from eleven to eighteen per cent. Coal converted into gas produces, then, two and one half times as much power as when burned under a boiler. The best Pocahontas coal under a boiler was found to produce .28 H. P. per pound of coal per hour, while with a gas producer the same amount of coal produced .96 H. P., or 3.34 times as much as when used in the ordinary way. A lignite which would produce only .01 H. P. per pound of coal per hour when used under a boiler produced .35 H. P. when used in a gas producer. A still more interesting fact is that the best Pocahontas coal used under a boiler produced .28 H. P. per pound per hour while a lignite in a producer gave .30 H. P. Thus, lignite turned into gas gave more power than the best coal when used under a boiler. These results indicate that there is fuel in all parts of the United States which can be used to produce power through the gas producer and the gas engine, so that the amount of valuable fuel for power purposes has been increased many fold by the work of the Technologic Branch.

"It is true that these results, while they show a great improvement over ordinary methods, look small compared to what should theoretically be obtained. Even the gas engine under the most favorable conditions does not utilize over eighteen per cent of the heat value of the coal. There is still a great opportunity for the scientific man and the engineer to devise methods by which a larger per cent of the energy of our fuels can be utilized. * * * The greater initial cost of the gas plant, the cost of operating and the feeling which the manufacturer has that it is unreliable will retard its use, but if our mechanical engineers, and especially if our engineering colleges, will make the thorough study of this question which it deserves, there is no doubt that within a few years the gas engine will practically supplant the steam engine. The manufacturer wants power and he wants it as cheaply as it can possibly be obtained. If a new form of prime mover will develop two and one-half times as much power as the old without too much initial cost or expense of maintenance, the manufacturer will rapidly install a new form. I believe our engineering colleges should install gas plants and make a thorough and systematic study of their use

* Pres. Charles S. Howe, Science, Oct. 23, 1908.

from day to day. In this way their faults can be remedied and through published reports the manufacturer can be made to feel that they are reliable. At the same time it will be of immense benefit to the students in the mechanical engineering departments to have a thorough training in the principles and the use of this new form of engine."

*"In the past the engineer has been concerned with getting results. If the results were obtained, the waste and destruction of the natural product have scarcely been considered, but in the future, economy of the natural product as well as economy in the final result must receive careful attention. I believe the engineers of the country are capable of solving these problems, and that if they are given the necessary governmental and private aid that the problem of the conservation of our natural resources will be solved."

FOREST CONSERVATION AND UTILIZATION.

Iowa is known throughout the world as an agricultural state, yet within her borders there are approximately two and one-fourth million acres of natural timber lands and 120,000 acres of planted timber. The natural timber land is found in the eastern portion of the state along the river valleys. Pine forests of considerable extent formerly existed in the extreme northeast part of the state, but the more valuable forests of hardwoods occurred in the southeastern portion. The average stand of virgin hardwoods was estimated at 4,900 feet b. m. per acre. During the eighties and nineties the forest products of the state were valued at from $6,000,000 to $12,000,000 annually. This does not truly represent Iowa products, as many of the logs that furnished the output were rafted down from Minnesota and Wisconsin. However, Iowa logs have the distinction of commanding the maximum price paid in the United States for logs at the mill.

The output of the mills have fallen off very rapidly since 1900. The valuable virgin timber throughout the state has been cut. With but few exceptions the timberlands of Iowa are now owned by farmers and used for pasture lands and woodlots. Much of the land is too rough for pasture land, but on account of the most valuable species having been cut out and the ground largely occupied by the inferior, but hardy, species, it has become unprofitable as timber producing land. Under proper forest management these lands can be reforested with valuable species that will yield a good return to the owner. To demonstrate the practicability of such work, the college has under forest management some twenty acres of cut over timber land that has grown up with species practically worthless except for fuel. This land is being under-planted with white pine and catalpa. Other desirable species will also be planted as rapidly as the ground can be prepared.

White pine will in thirty-five or forty years yield a valuable return in logs suitable for building materials. The catalpa will in fifteen or sixteen years yield on an average 4,000 posts per acre and the sprouts from the stumps will yield an equal number of posts of a higher grade in ten or twelve years. Catalpa posts are more durable and more satisfactory than the white cedar posts that are today the common posts on the market.

* Pres. Charles S. Howe, Science, Oct. 23, 1908.

In contrast to the eastern third of the state, in which is found our natural timberland, the western two-thirds of the state is a rolling prairie country and native timber is found only in narrow belts along the water courses. It is in this region that we find the planted timber. The groves and windbreaks consist very largely of soft maple and willow, both are very perishable woods. The farmers throughout the prairie region of this state buy from one and a quarter to one and one-half million dollars worth of fence posts annually. The department of forestry is carrying on an experiment in post preservative treatment with creosote to demonstrate the practicability of treating such perishable species as the maple and willow. If this treatment proves successful, which it promises to do, every farmer in the state can economically grow all the posts required to keep up the fences on his farm. When properly treated, willow posts should be serviceable for twelve or fifteen years, while without treatment they seldom last more than five or six years.

It is certainly within probability that sooner or later the radiant energy of sunlight and the sources of power in falling water will be utilized for heating, lighting and power purposes. There are here stored exhaustless resources. At some day near or remote an Edisonian genius or a Marconi will discover the means for utilizing the energy of sunlight, waterfall and magnetism for the manifold needs of the race even as already wireless telegraphy, the electric light and the electric motor have caught the elusive secrets of the ether and of the magnetic current. Patient research has yet its promise and its rewards.

IMPORTANCE OF AN ENGINEERING EXPERIMENT STATION TO THE MANUFACTURING INTERESTS OF IOWA.

Iowa has heretofore been regarded as almost wholly an agricultural state. The population of the state actually fell off between 1900 and 1905, showing the absolute necessity of manufacturing development if the resources of the state are to continue to grow. Already the manufacturing industries of Iowa are of considerable value. At the present time some $5,000,000 is being invested in new cement factories alone, whose annual product will, it is estimated, amount to the sum of $3,000,000. During the same year that these plants are being built, a large beet sugar factory has been installed at much expense.

In all manufactures in which the raw material is the product of the farms, or in which the finished material finds its market largely on the farms, Iowa furnishes a favorable location. Cheap coal is abundantly available for power.

What is needed more than anything else is an Engineering Experiment station which can conduct technical researches to solve the problems frequently encountered by the industries already established, and which can independently develop new possibilities in the manufacturing lines. It is undoubtedly true that the waste products of the farms of Iowa would alone make the state enormously wealthy if they could be utilized to the fullest possible extent.

Transportation Investigations.—Transportation problems in Iowa are also of great importance, and are proper subjects for the investigations of

an Engineering Experiment Station. Especially is this true for materials for road construction, ballasting railroad lines, constructing bridges, and other permanent structures for highways and railways. Experimentation with reinforced concrete, made from the materials found in Iowa, and as adapted to Iowa conditions, would be of great value to the state.

The state will undoubtedly be covered eventually by a network of lines using electricity or some cheaper motive power and run on the plan of interurban lines. Investigations should be made of the best forms of power for operation of such lines under Iowa conditions.

Power and Fuel.—Another important subject for investigation for an Engineering Experiment Station is the fuels produced in the state and their possibilities for developing power. The best methods of burning these fuels so as to secure the highest efficiency have not been determined and no general investigation conducted elsewhere can meet the special Iowa conditions. The possibilities of water power in the state should also be investigated and must finally be utilized to the utmost available extent.

Power Plants and Electric Light Plants.—The apparatus used in power plants is another subject for investigation. Already the station has made a number of tests of the efficiency of various plants, and a great many tests of the efficiency of the electric lights supplied to the Iowa consumers by the great electric companies.

Tests of Materials.—An increasing large proportion of the work of the department is the testing of materials sent in by the municipalities, county officers, and corporations of the state. Many tests are made of cement, paving brick, building brick and other materials.

Clay Products.—The clay industries of the state of Iowa have an annual output which might be estimated at about $4,000,000. The raw material used, is extremely variable in composition and as yet the manufacture is restricted largely to the cheaper and coarser varieties of brick, tile, etc. There are great possibilities of developing higher and better paving lines of manufacture if an engineering experiment station could properly study the materials available in the state.

Already it is becoming to be the custom in the state to send samples of new clay, and also of the finished products, in to the Engineering Experiment Station to test.

Drainage.—In Iowa several millions of dollars are now being spent in the construction of drainage ditches, and it is possible, by means of efficient drainage, to add untold value to the lands of the state, especially in the northern half and along the valleys of the streams in the southern half. Yet, it is not too much to say that all the money being spent at present is being expended in carrying out plans which are based not on accurate data of drainage engineering in the state, but upon ideas of drainage engineering which are not yet supported by experience, and which vary greatly when applied by different men to the same drainage districts. It will undoubtedly be necessary in the future to do over again much of the work now being undertaken. An Engineering Experiment Station could, to great advantage, undertake the collection of accurate data bearing upon the size of drainage ditches required in Iowa conditions, and upon the various problems of tile drainage. Already the station is taking up ex-

perimentation of tile drainage and obtaining new and original data of utmost value to the state.

Sanitation.—A part of the present work of the Engineering Experiment Station is to make annual tests of the efficiency of the various sewage disposal plants in the state, and to advise the cities owning these plants of points in connection with their operation, which should receive care and attention. The work of the Engineering Experiment Station can be justly extended to water supply problems in the state as well as to sewage. In both of the lines of work there is much need of skilled engineering study of special Iowa conditions.

REPORT OF ENGINEERING EXPERIMENT STATION.

Pres. A. B. Storms, Iowa State College, Ames, Iowa.

DEAR PRESIDENT STORMS: I respectfully report as follows concerning the Engineering Experiment Station and its work, its future plans and possibilities, and its needs for the next biennial period.

HISTORY AND ORGANIZATION.

The Engineering Experiment Station was established in 1904, when the legislature appropriated for that purpose the sum of $6,000 for the biennial period, or $3,000 per year. In 1906 this appropriation was increased to $3,500 per year, and was made annual, thus placing the Engineering Experiment Station upon a permanent basis.

The establishment of such a station grew out of the many demands upon the Engineering department from the people and the industries of Iowa for technical information and assistance, of such nature as could not be supplied by private engineers. In response to this demand the departments had already done much investigation work, but not in a regular and systematic way. The establishment of the station was therefore simply a matter of natural and normal growth.

While the first Engineering Experiment Stations in the country were this one in Iowa and another established in Illinois at the same time, yet similar conditions have now caused strong demands in many other states for similar stations, and the prospects are that the near future will see the establishment of many others. Engineering experiment stations will be absolutely indispensable in the great work of conservation of natural resources upon which

our nation and the world are just entering. Iowa will be proud in the future to have the credit of having been a pioneer in this most important line of work.

In organizing the Engineering Experiment Station, the college trustees established an Engineering Experiment Station staff, consisting of,

The President of the College, ex-officio;
The Dean of Engineering, director;
The Professor of Mechanical Engineering;
The Professor of Electrical Engineering;
The Professor of Mining Engineering;
The Associate Professor of Mechanical Engineering.

INADEQUACY OF PRESENT APPROPRIATION.

At the time of the establishment of the Iowa Engineering Experiment Station, the college most urgently asked for an appropriation of $15,000 per annum, the same sum originally granted by the nation to start each State Agricultural Experiment Station. In cutting this asking down to the very small sum of $3,500 per year, the legislature very greatly crippled the station and very greatly impaired its possibilities for good.

Our sister state of Illinois adopted a much wiser policy in this respect. Their appropriations were made in such a way that any amount needed up to $30,000 to $40,000 per year was available. The result has been that the work of the Illinois station has become noted throughout the entire country, and has been of the utmost value to the state. Even Wisconsin, without any regularly established station, devotes a much larger annual sum to engineering experimentation than our entire income for that purpose.

We feel that our own Engineering Experiment Station has accomplished remarkable results, considering its extremely small income, as is shown in part by the list of bulletins given hereinafter. This has largely been due to the fact that at first we could make use of a considerable amount of data accumulated in the past work of members of the Engineering faculty, or in experimental work done in the departments under their supervision.

Now, however, we find it impossible in the regular work of the station to rely upon desultory work by members of the faculty, who are already overloaded with regular instruction work. We must be able to have regular employees to carry on the investigations demanded by the industries and technical interests of Iowa, which can not wait for possible leisure of men busy in other lines.

I most urgently recommend, therefore, that the state now grant an appropriation of $15,000 per year to the Engineering Experiment Station, this being the sum originally granted to each Agricultural Experiment Station.

THE WORK OF THE ENGINEERING EXPERIMENT STATION.

The work of the Engineering Experiment Station has naturally divided itself into two lines:

1. *Tests of Material and Products,* including analyses of water, sewage, etc., at request of municipalities, corporations, factories, county officers, clay product and cement users, etc., on materials which they supply, and whose quality they wish to know. For such tests, in the case of residents of the state, we charge only the bare cost of the work.

Tests of electric lamps are a special feature of our work, and all cities and other users of electric lights are invited to send samples of lamps to us to test, to determine whether their candle power and efficiencies are up to the guarantee.

After some unsatisfactory experience with employing temporary assistance in such work, we are now very satisfactorily equipped to do testing work of this kind promptly and reliably. We have an engineering chemist regularly employed for the chemical work, and a trained engineering graduate for tests of cement, lime, steel, iron, brick, tile, concrete, etc.

The amount of such testing work is continually growing, and our station is of great value to the state in this work. We have much cement, paving and building brick, sewer pipe and tile, and other materials submitted for test. Also many samples of clay, coal, ores, peat, water, sewage, etc., are sent in for analysis. In our laboratory are being made all the chemical analyses of cement materials, coal and peat for the State Geological Survey.

Our facilities for making such tests and analyses, and the extremely low cost of the work, should be much more widely known to the people of Iowa.

2. *Investigations Along Technical Lines,* important to the present and future manufacturing, municipal, transportation, drainage engineering, materials of construction and other technical industries and interests of Iowa.

Some idea of past investigation work may be gained from the following list of bulletins already published:

Bulletin No. 1.—The Iowa State College Sewage Disposal Plant and Investigations.

Bulletin No. 2.—Bacteriological Investigations of the Iowa State College Sewage.

Bulletin No. 3.—Data of Iowa Sewage and Sewage Disposal.

Bulletin No. 4.—Bacteriological Investigations of the Iowa State College Sewage Disposal Plant.

Bulletin No. 5.—The Chemical Composition of the Sewage of the Iowa State College Sewage Disposal Plant.

Bulletin No. 6.—Tests of Iowa Common Brick.

Bulletin No. 7.—Sewage Disposal in Iowa.

Bulletin No. 8.—Tests of Dry Press Brick Used in Iowa.

Bulletin No. 9.—Notes on Steam Generation With Iowa Coal.

Bulletin No. 10.—Dredging by the Hydraulic Method.

Bulletin No. 11.—An Investigation of Some Iowa Sewage Disposal Systems.

Vol. II, No. 6.—The Good Roads Problem in Iowa.

Vol. III, No. 1.—Tests of Cement.

Vol. III, No. 2.—State Railroad Taxation.

Vol. III, No. 3.—Steam Generation With Iowa Coals.

Vol. III, No. 4.—Incandescent Lamp Testing.

Vol. III, No. 5.—Steam Pipe Covering Tests.

Vol. III, No. 6.—The Assessment of Drainage Districts.

Vol. IV, No. 1.—Tests of Iowa Limes.

Vol. IV, No. 2.—Holding Power of Nails in Single Shear.

Vol. IV, No. 3.—Effects of Coloring and Water Proofing on the Strength and Permeability of Cement Blocks.—The Improvement of Cement Mortar by Grading the Size of the Sand.—Tests of the Impermeability of Reinforced Concrete Pipes.

Vol. IV, No. 4.—Tests and Other Investigations of Cement Drain Tile and Sewer Pipe.

In addition, we have for some time had ready the material for a bulletin on Sewage Disposal in Iowa Since 1905. A large part of the bulletin is written, ready for the press. We have been withholding publication for the present, because of recent important developments in sewage disposal, and a desire to include the outcome in the bulletin.

Below is given brief mention of some of the more important lines of investigation now under way.

Drainage Engineering.—At present, measurements of the actual flow of tile drains and ditches are not available. We have established two gaging stations, one at the college, and one in the north central part of the state. At each station we are measuring the runoff from tile under-drains by weirs, and observing the rainfall, to obtain data by which drainage engineers can compute the sizes necessary to serve given areas. Formerly such sizes have been

largely a matter of guesswork. We are also measuring, at each station, the depths to the ground water level at different distances out from the tile drains, and the rates at which the ground water lowers after rains, so as to give data for determining the proper depths and distances apart at which to lay tile drains. A bulletin is in preparation, for publication at the close of the present season.

Cement Pipe.—We have started a series of tests, to last 30 years, of the strength and durability of cement tile actually laid in the ground.

Concrete.—We have started a number of investigations of concrete, including tests of methods of making it impervious, etc.

Sewage Disposal.—We continue to make examinations and tests of Iowa sewage disposal plants, and are now planning some important special investigations as to the action of different classes of bacteria. We are also continuing experiments to develop satisfactory, inexpensive apparatus for disposing of the sewage of private isolated dwellings safely and without nuisance.

Pavements.—Special studies have been made of asphalt and brick pavements in Iowa. An asphalt testing laboratory, the only one in the west, has just been established.

Fuels.—The peat investigations of the Iowa Geological Survey are being made under direction of our Prof. S. W. Beyer, and the analyses are made by our laboratory.

We plan other important investigations into Iowa fuels, especially coal, including its qualities, and the best methods of mining, storing and burning it.

Clay and Clay Products and Cement Materials.—Profs. S. W. Beyer and I. A. Williams continue their efficient work in these lines, which is co-ordinate to that of the Geological Survey, of which also Professor Beyer has charge. The development of cement manufacture is one of the most important recent developments of Iowa industries. All the analyses of cement materials in these investigations are made by our laboratory.

Power Stations and Factories.—Our Mechanical Engineering section continues such investigations of Iowa power stations and factory methods as present limited resources permit.

Electric Lighting and Engineering.—Our Electrical Engineering section continues its important investigations of actual conditions in electric lighting in Iowa, and its tests of electric lamps as actually sold on the market.

IMPORTANCE TO IOWA OF THE WORK OF OUR ENGINEERING EXPERIMENT STATION.

It would appear from census statistics that Iowa has now reached the point in its development where it will be most seriously handicapped in its future growth unless its manufacturing and transportation interests and facilities can be greatly developed.

Moreover, in Iowa, agriculture and engineering must go hand in hand. A very large percentage of the area of our farm lands requires to be reclaimed or at least greatly improved by drainage engineering. Our agricultural conditions further require that the country roads shall be improved by highway engineers, so as to be in excellent condition at all seasons and under all conditions.

The machinery and motors needed on Iowa farms should in the main be manufactured in the state and the raw materials from our farms should be manufactured into more valuable finished products within our borders.

In the great work of conserving our natural resources, an engineering experiment station must assist in developing clay and cement manufacture and use to take the place of wood, must devise methods of preventing the present waste of the greater portion of our coal and other fuels, and must develop water power and other sources of power to take the place of coal as it grows scarcer.

In all these, and in many other lines, an Engineering Experiment Station is indispensable, and it is impossible to exaggerate the possible future importance of our Engineering Experiment Station to Iowa. I earnestly urge the granting of the support necessary to develop this work.

Respectfully submitted,

A. MARSTON,
Director of Engineering Experiment Station.

EXPERIMENT STATION.

Dr. A. B. Storms, President Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.

DEAR DOCTOR STORMS: The Experiment Station work has been strengthened and organized on a better basis during the biennial period. Instead of the former policy of employing only a portion of a man's time for Experiment Station work and devoting the balance to instruction and extension work, we have adopted the policy

of having men in all of our principal lines of work who devote their attention exclusively to Experiment Station investigations. This enables members of the station staff to concentrate their attention on one line of work, and better results are obtained. The heads of our regular departments have supervision over both instructional and Experiment Station work as formerly. We have published fourteen regular bulletins giving the results of Experiment Station work during the biennial period ending June, 1908. These bulletins are briefly reviewed as follows:

Bulletin No. 86, which was published from the Chemical section in January, 1907, treated of the "Investigations of the Concentrated Commercial Feedstuffs Sold in Iowa." Over five thousand letters were sent out to the dealers in the state. An appeal was also made to the feeders through the press. The resulting samples were carefully analyzed and the results tabulated. Of the various products examined only three showed as high a composition as the United States standard calls for, while some were far below. The wheat by-products were especially faulty in this respect. The bulletin gave also a general discussion of feeding and the relative value of the various feedstuffs.

Bulletin No. 87, also from the Chemical section, contained a report of the examination of condimental stock foods and tonics. Forty-three brands of proprietary stock foods were analyzed, both physically and chemically. The bulletin took up in detail the claims of the manufacturers of these foods, and by citing actual experiments and analyses, showed how little truth there was in many of them. The process of manufacture and the various ingredients used was explained. The cost of composition and the actual value to the farmer and feeder comprised the remainder of the bulletin.

"The Importance of the Invasion of New Weed Pests Into Iowa" was the subject of Bulletin No. 88, which was gotten out by the Botanical section. During the year 1906 about four hundred samples of clover, alfalfa, and timothy seed were sent in to the station by farmers from all parts of the state to be tested for adulteration, impurities and vitality. Seeds of dodder, Canada thistle, foxtail, sheep sorrel, dock and plaintain were some of the impurities revealed. The average germination of the alfalfa samples was 57 per cent. The timothy seed was low also, being about 64 per cent. Of one hundred and thirty samples of clover examined only 2 per cent were pure, there being on an average about 2 per cent of impurities present. A review of the seed laws in other states and suggestions for the improvement of Iowa laws was given. Following the publishing of the result of these investigations the present pure seed law was passed.

Bulletin No. 89, from the Horticulture and Farm Crops section, was a revised spraying calendar. The first part gave in a condensed form remedies for all the common orchard and garden insects, with instructions for preparing the various sprays and washes, and the time and manner of application. The second part gave a review of the damage caused by oat smut, and directions for treating the seed of oats, wheat and barley to prevent smut. Investigations showed that by the use of the treatment recommended, damage from smut could be almost entirely prevented. The method of treatment is simple, and the cost in no way commensurate with the resulting benefit.

Bulletin No. 90, from the Horticultural section, was a handsomely illustrated report on "Evergreens for the Iowa Planter." It gave a general resume of the statutes of tree growing in the state, the reasons why more trees should be grown, the methods of planting, cultivating and pruning The care of evergreens was exhaustively treated, and the reasons for the failure of these valuable trees explained. A list of the different species was given, with their uses and value.

The results of three experiments in swine feeding were reported in Bulletin No. 91, issued from the Animal Husbandry section. The object of the experiments was to determine the comparative value of the supplementary feeds when combined with corn for pork production, and the comparative efficiency of these feeds at different market prices and under varying conditions. Barley, wheat shorts, meat meal and tankage were some of the principal supplements used. Dry lot and pasture feeding, and timothy and clover pasture were contrasted. The results showed the great value of pasture in pork production. Corn and clover pasture gave the cheapest gains. This ration produced 116 pounds more gain per acre than did the same amount of corn timothy pasture.

Bulletin No. 82, also from the Animal Husbandry section, gave the results of experiments to determine whether or not tuberculosis could be transmitted from cattle to swine. Infected and pasturized skim milk were fed to several lots of hogs for a definite period and under different conditions. When the experiment was finished the hogs were shipped to the packing houses at the main slaughter points and inspected by government officers. The results showed that milk infected with the germ of tuberculosis can readily produce the disease in healthy hogs. Disease was not transmitted in the pasturized milk. The amount of infection in the pigs in dry lots was no greater than in those of pasture.

Bulletin No. 93, from the Agricultural Engineering section, gave the "Comparative Values of Alcohol and Gasoline for Light and Power." It was found that the heat value of 94 per cent alcohol was only 66 to 71 per cent that of gasoline, and that it produced only from 58 to 85 per cent as much light. On this basis alcohol would need to sell for from 11 to 17 cents a gallon to be equal to 20 cent gasoline for lighting purposes. Alcohol was found to be from two to four times as efficient as kerosene for lighting. In the power tests a specially designed alcohol engine, which would doubtless have given results more favorable to the alcohol, was not available. In a regular gasoline engine 94 per cent alcohol was found to have from 68 to 85 per cent as much power value as gasoline. To compete with 20 cent gasoline for power purposes the alcohol would need to be sold at from 13 to 17 cents a gallon. It was found difficult to start the engines with alcohol, but when once started the alcohol had a less disagreeable odor and was more pleasant to handle. There was found to be much less danger from fire when alcohol is used.

Bulletin No. 94, on "A New Soil Sampler," was issued from the Soils section. This bulletin gave directions for constructing a new machine for taking samples of soil from the field to the laboratory in their natural con-

dition. By means of this sampler it was found possible to conduct laboratory tests under field conditions. Directions for operating the sampler and treating the samples were also given, together with tests of some of the samples collected in this way. The advantages claimed for the new sampler are the rapidity with which the samples can be secured, the unchanged physical condition of the soil, and the adaptibility of the sample of use in determining the physical characteristics of the soil.

Bulletin No. 95, also from the Soils section, treated of maintenance of fertility on the Missouri loess soils of the western part of the state. A general discussion of the values of the various elements of plant food was given. The sources of plant food were also given, and the danger of soil exhaustion pointed out. The soil of the Missouri loess area, being light and subject to excessive plant food, offered a peculiar problem. The bulletin recommended the use of plenty of barnyard manure, and the adoption of a permanent rotation in which some legume like clover or alfalfa should be a leading feature.

Bulletin No. 96, from the Farm Crops section, was a discussion of "Oats." Tests of varieties, results of fanning the seed bed and treating it for smut, value of thorough preparation of the seed bed, and comparisons of the various methods of seeding, were reported. Iowa raises an average of 29.5 bushels to the acre. The results of the experiments cited in this bulletin show that this yield may be substantially increased by the use of better varieties, better quality seed, treatment for smut, better preparation of the seed bed, and drilling. The conclusion reached was that 40 bushels to the acre was not too high an average to expect.

Bulletin No. 97, from the Dairy section, treated of the methods of determining the moisture content of butter. The law limiting the legal amount of moisture in butter to 16 per cent made it imperative that some simple and accurate plan of determining the moisture content be evolved. The old methods in use were either inaccurate or expensive and difficult to manipulate. After a great deal of study and experimentation the Dairy section worked out a method which proved entirely satisfactory. The results were accurate enough for all practical purposes, and the method of operation so simple that any creameryman can make the tests. The bulletin described the manner of making the test, and gave the results of a comparison of this plan with some of the older methods.

Bulletin No. 98, from the Soils section, was a discussion of clover growing in southern Iowa. Clover occupies an increasingly important place in Iowa agriculture. Its value as a feedstuff, as a soil builder, and as a necessary factor in a well balanced rotation, is coming to be realized by the majority of farmers. On the loess and till soils of southern Iowa, however, clover is a rather uncertain proposition. It was to learn the cause of this, and to suggest a remedy if possible, that the experiments reported in this bulletin were undertaken. It was found that either phosphorus or barnyard manure applied to the soil greatly increased the yield of clover, and the certainty of obtaining a stand. The bulletin goes into clover growing in considerable detail.

A continuation of the seed investigations was given in Bulletin No. 99, from the Botanical section. The 1907 investigations of the purity and vitality of the seeds commonly sold in Iowa showed that in most respects the

law was being fairly well obeyed. In other cases some improvement could be desired. The large seed companies were not nearly so much at fault as the smaller dealers throughout the country. Complete vitality and germination tests of the various seeds were given. In October, 1906, a series of extension bulletins started. These are not distributed to the general mailing list, but are used as substitutes for text books at the various short courses and farmers' institutes. They are written in a popular style and aim at a concise and interesting presentation of facts already known rather than to give the results of new experiments. The first of this series was from the soils division, and was on the subject of "Farm Manure." The bulletin was devoted to a discussion of the amounts of fertility removed from the soil by growing crops, and how this fertility can best be conserved and renewed. A treatise on the value of barnyard manure follows, a comparison of liquid and solid manure, the waste of manure, methods of preserving manure, and how manure should be applied.

Bulletin No. 2 of this series was issued in December of the same year. It is from the Division of Household Economics, and is entitled "Healthful Homes." Some of the points discussed are the location of the house, the necessity for good air, arrangement of rooms, care and ventilation of the cellar, heating, plumbing, the water supply, sewage disposal, avoiding doctor bills, lighting the house, sanitation, the use of disinfectants, tuberculosis and health rules.

In addition to this there is a large amount of Experiment Station work in progress at all times that does not get into the bulletins until the work is completed. Considerable of this work is described in the reports which follow from the heads of the several sections. Many of our investigations extend over a period of years. The results at first may be of comparatively little value, but as the records of investigations extend over a longer period they become of greater significance. This is particularly true of the origination and introduction of new varieties of grains and fruits and of the rotation and management of soils. It also applies in a large degree to investigations in stock feeding. It is the policy of this station to verify results carefully before giving them to the public. Laws and Gilbert, the celebrated investigators of England, grew wheat on the same field for over thirty years in succession without fertilizers. The results for the first few years were not of particular interest, but as the work advanced and was finally extended over a long period of years the records became of far-reaching interest and scientific value. The sections have in progress a large amount of work, as indicated by the following reports from the heads of the respective sections.

The needs of additional funds for the Experiment Station work are indicated by the outlines of the work now in progress. Much of this work is hampered and delayed by reason of inadequate funds.

The Experiment Station in Iowa is more meagerly supported than that of any other state of anything like equal rank in agricultural production and interest. The state of Illinois appropriates over half as much for soil work alone as we have for all lines of agricultural investigation. The soil investigations alone, if properly carried on in this state, would require as much money as we have available for all lines of investigation. While our soil is comparatively new, it is already beginning to show signs of exhaustion in some localities, as indicated by the reports of investigations conducted by the Soils section and by the many inquiries received by the head of our Soils department. The completion of a careful soil survey of the state would be worth many hundred thousands of dollars to the agricultural interests of Iowa. This important work, which has been so well provided for in other states, ought not to be longer delayed in Iowa. There are new problems constantly arising. Within the past biennial period a wide interest has been aroused in the subject of tuberculosis in domestic animals. Some investigations have been conducted by the Veterinary section of our Experiment Station. If substantial headway is to be made in combatting with this disease a large amount of work will need to be undertaken. At present the demands of this line alone would practically exhaust our entire resources for investigational work. We have not been able thus far to employ a veterinarian to devote his entire time to investigations in that field. Our live stock interests are so extensive and the health of the domestic animals of the state is a matter of so much importance that we ought to have at least one man devoting his entire time to this subject. There have been occasional outbreaks of comparatively unknown diseases that have thus far baffled the skill of all the veterinarians' efforts. It is properly the function of the Experiment Station to investigate diseases of this character. The report of the Veterinary section in another place gives an account of the progress made in serum inoculation as a means of preventing hog cholera. This method was originated by the Bureau of Animal Industry, and most of the investigations have been carried on under the immediate direction of Dr. W. B. Niles, at Ames. Dr. Niles is a graduate of the Veterinary department of the Iowa State College. This method has been quite carefully tested by the Veterinary section of our Experiment Station during the past year, and the results on the whole have been highly encouraging. Undoubtedly a large percentage of the hogs exposed to cholera may be saved by the serum inoculation, and it may be used effectively as a means of checking the spread of the disease.

It is not likely that it will come into general use in the near future, for the reason that it can not be applied successfully by the inexperienced man or the average stockman. It will need to be handled by competent and intelligent veterinarians. The cost of securing the treatment will be amply justified by the saving effected, and as the method comes into more general use it will have a large influence in reducing the annual loss from hog cholera.

The increased appropriation requested of the legislature for extending and strengthening the Experiment Station work during the coming biennial period is urgently needed. The investigations of the Experiment Station, in addition to their great economic value to the state, have an important bearing upon the educational work carried on by the institution, as our students are enabled to keep in close touch with the investigations being carried on in the several lines.

Respectfully submitted,

C. F. CURTISS,
Director.

CHEMICAL SECTION.

The section has continued its work along the following lines:

1. The Transmission of Sugars by Pumpkins. This work was done in co-operation with the Horticultural section, with Professor S. A. Beach and Mr. E. E. Little.

Conclusions: The characteristic of tending toward a high sugar content is variably transmissable and not so constant as the tending toward a low sugar content. That is, an appreciable percentage of offspring from a high sugar pumpkin will contain a low percentage of sugar; while the offspring from a medium-sugar pumpkin seldom show a high sugar content and the offspring from a low never show a high sugar content and seldom even a medium sugar content.

Twelve pumpkins were selected from those analyzed in 1906 and of the pumpkins grown from the seeds from these twelve parent pumpkins one hundred and five were analyzed in 1907.

Three of the twelve parent pumpkins were selected for high sugar content. These produced fifty-six offspring of which twenty-three were high, sixteen were medium and seventeen low in sugar.

Six of the twelve parent pumpkins were selected for medium-sugar content. These produced thirty-three offspring of which two were high, sixteen were medium and fifteen were low.

Three of the twelve parent pumpkins were selected for low sugar content. These produced sixteen offspring of which none were high, seven medium and nine low in sugar.

II. THE RELATION OF FEEDS TO THE FORMATION OF RENAL CALCULI IN RAMS.

This work was co-operative with the Animal Husbandry section of the Experiment Station, with Professor W. J. Kennedy and Mr. E. T. Robbins in charge of the experiment for the co-operating section.

It has for some time been known that the feeding of roots was often attended by the formation of kidney stones or renal calculi. However, the exact conditions attending the formation of renal calculi in man or animals are unknown.

These stones are combinations of lime with uric acid and phosphoric acid. Uric acid is an organic acid, containing a large amount of nitrogen.

This led us to study specially the relations of root feeding to the excretion of nitrogen and phosphorous by the kidneys.

At the same time we studied the effect of these roots on the digestibility of the ration, on the general health of the animal and on his carcass.

The vast amount of analytical data we have accumulated has not yet been completely summarized, and the following is only a brief review of our results.

I. Effect of mangels and sugar beets on the kidney:

Both roots seem to affect the kidney similarly.

A small calculus was found in one kidney of Ram VI. This ram was fed sugar beets. The membrane about the calculus and extending down into the urethra was pigmented a decided black.

In the kidney of Ram III the same kind of pigmentation occurred as in Ram VI. Ram III was fed mangles. No calculus was present.

The kidney of dry fed Ram VIII was normal in all respects.

II. Effect on live weight:

Both sugar beet and mangel fed rams gained in weight throughout the experiment. Dry fed Ram VIII gained, while Ram V lost in weight.

III. Dressing Percentages:

The sugar beet ram dressed the highest of the three rams slaughtered at the end of the 1907-08 experiment with 52.52 per cent. Mangel fed Ram III followed with a dressing per cent of 48.90 per cent. The dry fed lamb VIII dressed 41.92 per cent.

Ram No.	Feed	Live Weight lbs.	Dressed Weigh lbs.	er cent. Dressed Weigh	Per cent. Blood
8 (Lamb)	Dry	130	54.5	41.92	3.78
3	Mangels	182	89 9	48.90	3.89
6	Sugar beets	228	119.75	52.52	3.84

IV. EFFECT ON COMPOSITION OF THE BODIES.

Ram	Feed	Water	Fat	Protein*	Ash
8	Dry	42.34	39.62	17.06	0.92
3	Mangels	32.27	52.85	14.25	0.60
6	Sugar beets	28.83	57.70	12.93	0.54

* Nitrogen x 6.25.

The bodies of the sugar beet ram and the mangel ram were much fatter than the dry fed ram. This was especially true of the superficial fat about the kidneys. The increase in fat accounts for the gains in weight made by the root fed rams and in part for the low percentage of body nitrogen given in the above table as protein. On a fat free basis, the carcass of Ram VIII contains 28.25 per cent protein, Ram III 30.28 per cent and Ram VI 30.56 per cent. This shows that the feeding of mangels and sugar beets is accompanied by a replacement of the "red-flesh" of the animal by fat. The disappearance of the flesh is largely due to the washing out of the nitrogen by the large amount of water ingested with the roots.

During period I all rams were on dry feed. Then followed four periods of twenty days each. These twenty day periods were divided into a ten day preliminary period and a period of ten days during which the rams were under observation. During each of the ten day preliminary periods the rams fed sugar beets or mangels received increasing amounts of these roots until during period five and six they were offered 8,000 grams of roots daily. These roots contained from eighty-seven to ninety per cent of water. The immediate effect of this increased ingestion of water was an increased voiding of water with the urine and later, also, with the feces.

The following table giving the performance of Ram II is typical of the root-fed rams:

URINE EXCRETION OF RAM II (MANGEL FED).

Period	Water Ingested (grams)	Urine Excreted (grams)	Specific Grav	Nitrogen Excreted (grams)
1	2839	1782	1.01857	6.9215
2	3524	2502	1.01992	12.3780
3	6114	4148	1.01810	17.1070
4	8922	5999	1.01799	24.1990
5	8597	4343	1.02150	20.6710
Average	5999	3755	1.01922	16.2553

The specific gravity does not, as is so often stated, vary inversely as the volume of urine excreted. The volume of urine excreted, after a certain point is reached, has only a miner effect on the specific gravity taking the averages of ten day periods. With the excretion of low amounts of urine such an inverse relation does exist; a fall in urine being accompanied by a raise in specific gravity and conversely the same. However when the urine excretion in rams passes the two thousand cubic centimeter mark the density varies only to a minor degree.

The reason why the specific gravity does not vary markedly is that the increased excretion of water by the kidneys is accompanied by an increased excretion of dissolved solids. These increased excretable solids are made up both of ash materials and organic compounds high in nitrogen. The figures in the last column of the above table show how, with the increased excretion of urine the nitrogen excreted during the second period averages nearly twice that excreted during the first and the excreted nitrogen of the fourth period is nearly four times that of the first.

About the third period of this investigation we began to notice that the volume of urine excreted together with its density had some relationship to the weight of nitrogen excreted.

This relation may be stated as follows: The factor resulting from the division of the weight of nitrogen in a given volume of urine by the integers of the specific gravity following the cipher is constant.

In the following table the nitrogen in one hundred cubic centimeters of urine is taken as the quotient for the determination of the factor and Ram No. VIII as normal in urine excretion.

GRAND AVERAGES FOR THE FIVE PERIODS.

	olume of Urine	Specific Gravity	Nitrogen in Centi-grams	Factor	Difference
Ram VIII	1031	1.025	584	0.02297	
Ram II	3687	1.019	1626	0.02303	-|-0.00006
Ram III	3007	1.021	1505	0.02387	-|-0.00090
Ram VI	3041	1.023	1717	0.02431	-|-0.00134
Ram V *	512	1.044	712	0.03317	-|-0.01020

* Ram V excreted so abnormally small an amount of urine and this urine varied so in its nitrogen content, that his nitrogen and urine excretion are considered to be governed by pathological conditions not referable to his feed.

Although the average volume of the urine of Ram No. VIII was not one-third of that of Ram No. II, the proportion of nitrogen remained about the same and the factor varied only a few points in the fifth place.

We do not know in what forms this nitrogen in the urine occurs; and next year we shall make a special feature of studying this point.

Whatever may be the forms of nitrogen excreted or wherever these excretable forms may be produced in the body one thing is certain: the more water forced through the animal body and excreted as urine, the more nitrogen that urine carries from the body.

This throwing off nitrogen with the increased ingestion of water may lead to the explanation of the added nitrogen requirement of dairy cows which are forced to ingest the greatest possible amount of water; this ingestion being followed by an increased milk flow without detriment to the quality of the milk. However, only a portion of the added water ingested goes to increase the milk flow. The rest is voided as additional urine, which takes with it an additional amount of nitrogen. This calls for an additional amount of nitrogen over and above that required for milk solids and body maintenance.

VI. Our report on the effect of feeding sugar beets and mangels on the digestibility of the ration is not yet ready, the analytical work on the feces not yet having been completed.

We propose to repeat the experiment next year, using a larger number of animals.

III. IOWA'S DAIRY RATION.

This work is co-operative with the Animal Husbandry section, Dairy division, with Professor W. J. Kennedy and Professor H. G. Van Pelt in charge. A vast amount of data was collected and a large number of feeds analyzed. These analyses of feeds, as soon as completed, will be tabulated showing the weight of digestible nutrients in each hundred pounds of each feedstuff.

None of these investigations are yet concluded, and will be continued next year.

CORROSION OF WIRE FENCE.

The section in addition to having the foregoing investigations under way has also taken up:

I. The Causes of the Rapid Corrosion of Fence Wire. The work will be continued next year in co-operation with the Agricultural Engineering section. Professor J. B. Davidson and Mr. M. L. King are in charge of the co-operative work.

The Chemical section is now engaged in a study of the causes underlying the rapid rusting of wire fencing, both woven, plain, and barbed. We have received specimens of fencings that have seen constant service for twenty to twenty-five years and that are still in splendid condition. Again there are examples on the college farm of fencings that have been in service only a year or two that are very badly corroded. Manufacturers state that they never before made better wire than they are putting on the market today.

During the past few months we have been engaged in a general study of the question with a view of outlining such a series of tests as would bring us to some definite conclusion relative to what causes rapid corrosion, and what steps may be taken to prevent it.

It is impossible to get a wire that will not eventually rust. But when we know more of the causes that attend such rapid corrosion that a fence is rendered useless in four or five years, we may be able to suggest specifications for wire and fencings that will increase their period of service.

The following is a preliminary report of our findings and an outline of the work we plan on pursuing during the coming year:

WOVEN WIRE FENCINGS.

The Knot.—Aside from the quality of the wire itself and the character of the galvanizing, the life of the fence is dependent on the "knot" or "tie" or "joint" as the method of attaching the vertical to the horizontal wires is variously called.

In this last regard woven fencings may be placed into two classes; one class including all those fencings in which the knot is not a continuation of the vertical or horizontal wires, the other class including those fencings in which the knot is a continuation of these wires. This last class includes electrically welded fences.

A poor knot, allowing the joints to sag or slip, means a poor fence from a structural point of view and, in addition, since rusting spreads from centers of inceptive corrosion, the life of the fence depends largely on the ability of the knot to keep in place and to withstand corroding influences since this is the point where the wire receives the roughest usage in the construction of the fencing and where the galvanizing is most apt to be broken. In placing the knot the vertical and horizontal wires on some makes of fence are injured so that they readily break at the joint.

In our experiments the knot is being tested with regard to:

1. Its ability to hold in place.
2. The degree to which the horizontal and vertical wires have been injured.
3. Its rust withstanding power.

The Horizontal Wires.—The horizontal wires of a fence should have sufficient elasticity to admit of their being stretched taut on the posts and at the same time be able to take care of the expansion in summer and contraction in winter. These wires are made usually of a high carbon steel. Somes makes are advertised as spring steel. While tensil strength is a prime essential, all other considerations should not be sacrificed to it and a steel should not be so hard and brittle that it will not admit of a fair degree of bending. Many of the fencings show a weakness in this regard.

In our experiments the horizontal wires will be tested: (1) For tensil strength; (2) the degree to which they can be bent without breaking; (3) percentage of galvanizing material carried.

Vertical Wires.—The vertical wires are usually made of a softer steel than the horizontal. They should be stiff enough to give the fence rigidity and should be well galvanized.

Vertical wires on different makes of fencings will be tested in this regard during the coming year.

CORROSION OF FENCE WIRE.

Obvious Facts (Easy to Interpret).—There are certain obvious facts regarding the corrosion of fence wire that may be readily verified by even the most superficial observation.

The first of these is that corrosion is readily communicable by contact. When inceptive corrosion takes place (that is, the wire begins to rust at a certain point) and the "rust" spreads entirely or partially over its surface, then where the vertical wire comes in contact with the horizontal strands "corrosion by contact" takes place and rusting creeps out on the cross wires. If a new strand is spliced to an old one the new strand corrodes more rapidly than it would have, had it been spliced to another new strand—the external conditions of location and exposure, of course, being the same. New fencing braced or stayed with old corroded wire begins to rust at the contact and even old corroded wire hung on a new fence induces "rusting." The use of old wire in repairing or in erecting new fencing shortens the life of the latter.

The invasion of rust into a wire by contact is independent of physical injury done the new wire (such as breaking the galvanizing); but depends directly on the fact that the contact of the iron of the corroded wire with the zinc galvanizing of the new wire facilitates chemical action, just as in an electric battery, resulting in the rapid deterioration of the new strand. The theory regarding this action will be given later.

The second obvious fact is that the wire corrodes first (inceptive corrosion takes place) wherever a strand is injured and the galavanizing broken or checked. The points of sharpened barbs go first. Often a wire bent for splicing, or one bruised by a hammer opens the strand to rust. In woven fencing poor workmanship at the junction of the vertical and horizontal wires, resulting in checking the galvanizing, leaves a way for

rust to enter, and a few such places shorten the life of the whole fence. The so-called electric weld ruins the galvanizing at the joints and opens the whole fence to rapid deterioration.

The third observation is that vertical wires corrode more rapidly than horizontal and that corrosion spreads from the top downward more rapidly than from the bottom upward. That is, if a vertical wire is injured near the top and corrosion sets in, rusting will spread down the wire and the whole become corroded more rapidly than if inceptive corrosion had taken place near the bottom. The reason for this is that the products of corrosion—"rust"—are washed down the wire and by contact expose the surfaces, wherever they touch the new wire, to the chemical action of electrolysis, to be explained further on.

Obvious Facts (Not Readily Explainable).—The fourth fact is that the bottom horizontal wire and sometimes the next lowest wire is almost always in good condition—quite free from corrosion. And that the vertical wires are usually good for a few inches from the bottom up.

Illustrative of this general soundness of the wires at the bottom: There is a woven wire fence north of Agricultural Hall. This fence was erected in 1899. It contains 1,526 vertical wires of the crimped type. Of these vertical wires only twenty-five, or 1.63 per cent, are good, while 98.37 per cent are badly corroded over a greater portion of their length. The horizontal wires, with the exception of the bottom one, are also badly corroded. Although the vertical wires show general corrosion they are almost uniformly good for a short, though variable, distance from the bottom up.

Then again, a horizontal wire will be corroded badly for some length with an intervening space of sound wire followed by another corroded space. Such spaces of corrosion may occur on wire unrelated to the general corrosion of the fence and where "corrosion by contact" is an impossible explanation for the presence of rust. It is doubtful, though possible, that defective galvanizing may have given rise to these areas of corrosion. But there is another and more probable explanation.

Electrolysis of Wire.—In looking over the fence north of Agricultural Hall several things are obvious:

1. The bottom horizontal wires and the lower portions of the vertical wires (that is, the part of the fence that is down in the weeds and snow and wet) are in good condition.
2. Most of the vertical wires that are good over a considerable portion of their length, are either on posts or else are in the orchard.

Another illustration in point is the nickle plated telephone arm in the office of the Chemical section. This arm, which extends diamond shape, has for two years been subjected to the same corroding influences of the acid, laboratory air. Three sides of the diamond are corroded, although the uncorroded side had been filed so that the protective coat of nickle was broken and the metal beneath exposed.

Water mains in cities paralleling electric tram-ways are subject to rapid deterioration by corrosion, due to "electrolysis." The location of the rusted areas on the telephone arm are partially due to the direction of the electrical current intermittently passing through the receiving and transmitting wires—but always passing in the same direction. Also the fact that the vertical wires in the above mentioned fence are uncorroded where they

are in close contact with the posts and where they are well de-electrified by the weeds and grass near the ground, and more than this the universal evidence of the soundness of the bottom horizontal wires points to the absence of "electrolysis" at these points.

There is abundant proof that electrolytic action accompanies corrosion; that its presence induced from outside sources (in the case of water mains) hastens corrosion, and that its absence in the case of the lower portions of fencing retards corrosion.

But what causes electrolysis? Doctor A. S. Cushman * has used the action of the electric battery to define this term. "Reduced to its simplest terms" an "electric battery usually consists of a strip of zinc and a strip of some other metal immersed in a more or less dilute solution of some salt. Common salt would do, but for special reasons some other soluble salt, like chloride of ammonia (sal-ammoniac) is usually selected. If now by means of a wire or other metallic conductor the zinc strip is connected with the other metal, an electric current flows through the circuit. A current of water naturally flows from a high point to a low point. So, also, an electric current flows from a high potential metal to a low potential metal. Whenever there is a difference in height between two bodies of water and the two are connected by a conducting medium (a pipe or ditch) a current will flow from the higher to the lower. In general, whenever a difference of 'potential' exists between two metals and they are so connected by conductors that a circuit is established a current of electricity will flow; or, whenever a difference of potential is established between two points in a metallic conductor or circuit, a current of electricity will flow. If in the case of the battery referred to, the current is allowed to flow through a specially constructed 'apparatus' it can be caused to ring a bell. In the same way it could be caused to saw wood or run a street car. In other words, electric currents, however small, represent energy and can be made to do work."

In nature it is impossible to get something for nothing. "If work is being done in one place, something is being, so to speak, undone in another place to balance it exactly." Every time the electric bell is rung in the house the zinc in the battery is corroded, or oxidized or burned "to just the degree that energy is used to make the bell ring." Whenever, through the agency of a liquid conductor like a salt solution, a current of electricity moves in a circuit, this is known as electrolysis. Whenever electrolysis goes on, some chemical reaction takes place, which for all practical purposes can be likened to the oxidation or burning of some metal. "In a battery iron could be made to take the place of zinc. If two pieces of iron containing different amounts of impurities are dipped into a dilute salt solution and the ends connected by a conductor, it will be found that a difference of potential exists, an electrical current will flow, and, if continued, at least one of the iron pieces will be destroyed by oxidation."

There is a difference in potentiality between iron and zinc. This explains the rapid oxidation taking place at the points of barbs where both metals are exposed.

* Farmers' Bulletin No. 239.

It has been suggested that the uneven distribution of such impurities in wire as manganese may cause corrosion through the difference in potential thus established.

We have made several analyses of wire but no conclusion can as yet be deduced.

ALCOHOL.

The Chemical section has obtained permission from the Department of Internal Revenue to mash grains and other substances for the manufacture of alcohol. The permit provides that we may use a still not larger than three gallons, and that all distillations shall be made in the presence of a deputy revenue officer. The Dubuque office of internal revenue has been instructed to hold an officer subject to our request.

A Chicago distillery, through E. H. Sargent & Co., kindly donated fifty pounds of brewer's yeast and fifty pounds of barley malt for use in this experimental work.

The Farm Crops section has furnished us three grades of corn on which they hold records of yields. These will be used in calibrating our methods, and to give us a standard yield of alcohol with which to compare our future work.

The manufacture of alcohol is being taken up as follows:

Alcohol from:

Corn.
Sugar beets.
Potatoes.

This will be followed by making the carbohydrates of apples, corn cobs, stalks and other waste materials on the farm into alcohol.

SWEET CLOVER.

A study of the composition, palatability and digestibility of sweet clover is being made. These plants (Melilotus alba and M. ossicinalis) are familiar as rank weeds growing along the roadsides. Our first analysis of sweet clover hay was made for Roy Wood of Soldier, Iowa, and is as follows:

Water	11.86
Crude fat	3.32
Crude protein	19.91
Crude fiber	23.24
Carbohydrates	32.19
Ash	9.48

The protein is very high. Later Director Curtiss sent us a sample that he had received from Frank Cloverdale. This was a very well cured sample with most of the leaves on, and analyzed better than the first.

Water	6.86
Crude fat	3.91
Crude protein	22.55
Crude fiber	23.49
Carbohydrates	33.16
Ash	10.03

The Farm department has several acres planted with sweet clover this year, and we propose to run digestion experiments both on the green forage and the cured hay.

DIGESTION EXPERIMENT WITH SWINE.

In co-operation with the Animal Husbandry section, the Chemical section has in progress an experiment relative to the influence condimental stock foods have on the digestion of corn by swine. Four lots of six animals are being fed for sixty days. Two animals from each lot will be fed for periods of ten days each, in digestion cages designed after the Gies' metabolism cage. This provides for a collection of the feces free from urine. Each animal will be under observation two periods of ten days each during the experiment. The rations compared are corn alone, and corn with stock foods.

In addition to the foregoing, the section has made fifty analyses of feeds and stock foods for the farmers of the state. We have examined three samples of amber mica sent in under the supposition that it was gold. We have also made an examination of six stomach contents, in supposed stock poisoning cases; finding no poison. Also one mixture found in a pasture that proved to be paris green and salt.

We have also made the following analyses for the Animal Husbandry section, other than those made in co-operative work:

WORK DONE FOR ANIMAL HUSBANDRY DEPARTMENT.

Laboratory	Name of Feed	Water	Fat	Protein	Crude Fiber	Ash	Nitrogen Free Extract
1581	Corn Meal	10.53	4.87	10.70	2.11	1.46	70.33
1582	Corn and Cob Meal	12.80	4.20	9.91	6.51	1.63	64.95
1583	Oil Meal	7.11	7.27	34.66	9.20	5.50	36.26
1586	Buffalo Gluten Meal	77.20	3.68	26.06	7.32	2.16	53.61
1587	Cabbage	91.05	0.39	2.25	1.50	0.93	3.88
1589	Alfalmo	17.37	2.00	12.14	22.11	11.76	34.62
1590	Sugar Beets	84.94	0.15	1.57	1.36	1.23	10.75
1591	Beggas	87.58	0.65	1.93	2.03	1.83	5.98
1592	Meat Meal	8.11	10.00	66.75	.....	3.51	11.63
1593	Turnips	90.16	0.27	1.75	1.38	1.06	5.38
1594	Corn	9.46	5.11	10.20	1.96	1.72	71.55
1598	Cotton Seed Meal	7.12	9.92	45.80	5.01	4.93	27.22

We will have a bulletin ready for publication next year on "The Effect of Condimental Stock Foods on Digestibility," and doubtless one on the "Influence of Feed on the Formation of Renal Calculi."

In our digestion experiments it is necessary to have additional help for a part of each day in handling the feces and urines and getting the analyses on them started before decomposition sets in. We have during the past year employed students to assist in this work. During the coming year we are planning on work with twenty animals in the mangel and sugar beet experiment, instead of six as this year. We cannot handle the work without help additional to our regular force.

Respectfully submitted,

LOUIS G. MICHAEL,
Chemical Section.

ANIMAL HUSBANDRY SECTION WORK.

INVESTIGATIONS CARRIED TO A DEFINITE CONCLUSION DURING THE CURRENT YEAR.

1. Alfalmo and Gluten Feed for Fattening Steers.

This experiment was made to compare alfalmo with other common supplementary feeds for use with corn for steers. Gluten feed was chosen as a basis for comparison since it is a corn by-product, easily obtainable and of increasing abundance in the corn belt, and it is growing in popularity with cattle feeders. Gluten feed is not very palatable. Its value depends upon the protein which it contains. Alfalmo contains only about half as much protein, but is very highly relished by cattle. This experiment should indicate the usefulness of palatability in a ration.

Thirty-four steers were fed in two lots for 140 days. Both lots received a full feed of corn and hay. In addition, lot 1 was fed an average of 3.22 pounds per steer daily of alfalmo, had 2.12 pounds per steer daily of gluten feed. The amount of the alfalmo was based on the advice of the manufacturers. The gluten feed was fed in a smaller amount so as not to obscure the benefits of the palatability of the alfalmo ration by an excessively larger protein supply in the gluten feed ration. The average daily consumption of feed per steer throughout the test was for the steers fed alfalmo, 23.55 pounds of concentrates and 8.57 pounds hay; for the steers fed gluten feed, 20.63 pounds of concentrates and 8.46 pounds hay. The alfalmo steers gained an average of 2.42 pounds daily per steer; the gluten feed steers, 2.11 pounds. The large consumption of feed by the steers getting alfalmo was mainly responsible for their larger gains. They ate 974 pounds of concentrates for each 100 pounds gain, while the steers getting gluten feed ate 979 pounds. In shipping to Chicago the alfalmo fed steers shrunk 56 pounds per steer, while those fed gluten feed shrunk only 36 pounds per steer. Owing to a slightly fatter condition, the alfalmo steers sold for $6.20 at Chicago, while the gluten feed steers sold for $6.05. The steers were worth $4.25 per cwt. when the experiment began. At current prices for feeds the two lots should have sold in Chicago for $6.07 and $5.88 per cwt., respectively, in order to give neither profit nor loss. Selling as they did, the steers fed alfalmo yielded a profit of $1.56 per steer; those fed gluten feed gave a profit of $2.05 per steer.

The above statement briefly summarizes the very extensive data secured, including weights of feed eaten from day to day, individual weights and gains of steers, with notes on their type and data concerning the pigs following the steers. As all corn was ground, the pigs secured only a small amount of corn, viz: 1.31 bushels per steer in lot 1, and 1.73 bushels per steer in lot 2 in 140 days, or 3 and 4.3 per cent, respectively, of the corn fed the steers. Five of the pigs in each lot were fed additional corn, while the other five were fed an equal amount of corn and meat meal together. The allowance of meat meal was .5 pounds daily per each pig receiving it. The corn fed pigs in lot 1 gained 34 per cent as much as the pigs getting the meat meal; those in lot 2 gained 55 per cent as much, and those in a third lot, fed as a check, gained 66 per cent as much as the pigs getting meat meal in the same lot. The pigs getting meat meal were apparently

better rustlers than the corn fed pigs. Thus the benefit of meat meal was more apparent with the pigs following steers than with the pigs in the check lot, which were supplied all their feed in a trough.

This experiment emphasizes the thought that palatability is a very useful characteristic in any feed designed for fattening cattle where the most rapid gains and highest finish are desired, but that a feed which, though less palatable, is fully as nutritious and less expensive may easily yield greater profit.

INVESTIGATIONS IN PROGRESS AT THE PRESENT TIME, TO BE CONTINUED DURING THE COMING YEAR.

1. Range Sheep Breeding.

This flock of range ewes, which has been variously crossed with mutton rams to improve the mutton form, has produced some lambs which closely approach the desired conformation of body and length and weight of fleece, while at the same time retaining much of the density of fleece of the Merino type. The best ten of these cross bred ewes were bred in the fall of 1907 to a cross bred ram. These ewes are mostly Leicester-Merinos. The ram is of the same type, and is one-half Shropshire, three-eighths Merino, and one-eighth Leicester. The lambs produced by their mating give promise of being quite uniformly like their sire and dams in type. The other 30 ewes in the flock were mated to Shropshire, Ryeland and Rambouillet rams as seemed desirable to correct defects in their forms or fleeces. This work will be continued with the object of fixing the type in the progeny of the cross bred ewes and rams.

2. Milk Production by Sheep.

During the spring of 1908, 20 ewes with their 29 lambs have been fed in four lots of five ewes each. The feed of the ewes was weighed. The lambs were weighed before and after nursing, and kept separate from the ewes the remainder of the time. The milk yields varied from 1.5 to 7.5 pounds of milk per ewe in a single day. Composite samples of the milk of each ewe were taken for analysis. The sheep have now been turned to pasture, but the analysis of the milk has not been finished so the results are not yet complete. The experiment will be carried on again during the coming year so as to give more complete data.

3. Lamb Feeding With the Use of Succulent Feed.

During the fall of 1906, four lots of seven lambs each were fattened on grain and hay, supplemented in three of the lots by mangels, sugar beets and corn silage respectively. During the fall of 1907 four lots of ten lambs each were fattened. The succulent feeds used were turnips, sugar beets and cabbage. The experiment will be repeated during the coming fall with mangels, sugar beets and corn silage. So far the cheapest gains have been made with the silage ration and the dry ration in the order named. While succulent feed produced the most rapid gains, especially during the early part of the feeding period, it was not essential to a firm, even covering of flesh in the finished lamb.

4. Tobacco for Stomach Worms (Hæmonchus contortus) in Sheep.

The range flock has been divided into two lots for summer pasturing. The two lots were alike in all particulars, especially as regards the size and thrift of lambs at the first of May when all the sheep were weighed. Tobacco, mixed with salt, was then fed to one lot. At first the mixture is equal parts tobacco and salt, but later it will be made up with a larger portion of tobacco. During the first month, an average of .4 pound of tobacco was eaten by each sheep and lamb in this lot. This lot is on an old and presumably infested pasture, but no other sheep will be allowed on it during the season. The other lot is likewise on an old pasture which has previously been frequented by infested sheep. The presence of the worms in the sheep at the beginning of the season was verified by a microscopical examination of the fœces of several individuals, revealing large numbers of eggs of Hæmonchus contortus. Now, during the early part of the season the lambs are looking well and no benefits of the tobacco can be expected to appear before the summer is more advanced so that lambs will be more subject to infestation.

5. Renal Calculi in Rams.

This work has been carried on in co-operation with the Chemical section. During three years past several rams have been fed mangels during the winter season to determine whether they are in any way responsible for the formation of renal calculi. During the last two seasons the urine and fœces have been collected and subjected to very close inspection and analysis. Until near the close of the past season there was no abnormal characteristic discovered in the urine of the mangel fed rams. Finally it was found that there was an appearance of their salt crystals quite similar to the crystals of calculi, and unlike any found in the urine of the dry fed rams. When some of the rams were slaughtered it was found that the kidneys of the rams fed mangels and the ones fed sugar beets differed in internal appearance from the kidneys of dry fed rams. One calculus was found in the kidney from the ram fed sugar beets. Incidentally, some interesting data is being secured regarding metabolism with especial reference to the excretion of nitrogen. This work will be continued during the coming season on a more extensive scale.

6. Cattle Breeding.

For the purpose of gaining some information on the transmission of various characters, especially color and horns, a herd of Galloway cows was bred to a white Shorthorn bull. The polled, blue gray heifers thus produced, together with two white Shorthorn cows and two red Shorthorn cows have been bred to one of the blue gray bulls of the first cross. The polled heifers from cross bred parents will be bred to a white Shorthorn bull and the horned heifer to a polled bull. So far as the work has gone, the resulting offspring have been so variable and lacking in coincidence of type that no conclusions can be drawn.

7. Silage for Fattening Steers.

During two winter feeding seasons steers on full feed of corn have been given corn silage as part of their ration. In both instances the results

have been unfavorable to silage. During the winter of 1906-07 the carload of steers getting silage made fully as rapid gains and increase in fat during the early part of the feeding period, but for the entire six months feeding both gains and finish were inferior to those obtained without the use of silage. The dry feed steers made cheaper gains, sold higher on the market, and yielded more profit than the silage fed steers. This work was not repeated during the past season, owing to restricted shed room. It will be duplicated on a more extensive scale during the coming season, with a view to ascertaining whether there are any conditions under which silage may be advantageously used for fattening steers.

8. Germination of Seeds in Cattle Fœces.

In co-operation with the Botanical section, a steer is being fed seeds of different agricultural plants and noxious weeds, and the fœces subjected to favorable conditions for germination in clean subsoil sand. The work has just been begun.

9. Feeding Show Steers to Affect the Carcass.

Two Angus yearling steers are being fitted for show. Both are getting the same standard ration of corn, oats, bran and oil meal during the early summer. Later one will have peas added to his ration for the purpose of studying the effect on the finish and the appearance of the carcass.

10. Steers of Beef and Dairy Type for Beef Production.

Some work has been done along this line and the preliminary results published as bulletin No. 81. The work will be continued during the coming year, starting with representative calves of beef, dairy, and dual purpose types, and feeding them on the same ration to maturity. At the conclusion of the feeding experiment the steers will be subjected to a careful slaughter test.

11. Hog Feeding; Oil Meal and Meat Meal.

A lot of ten hogs is being fed oil meal and a similar lot meat meal to balance the corn ration in comparison with a third lot getting corn alone. The supplementary feeds are given in such quantities as to furnish the same nutritive ratio in each instance. The experiment is not yet completed so no definite conclusion can be drawn.

12. Hog Feeding; Preparation of Corn.

Dry and soaked corn, dry and soaked corn meal, and dry and soaked corn and cob meal are being tested for feeding hogs of all ages. During the coming year work will be completed with about 300 hogs, and the results should be of definite value to the feeders of the corn belt.

13. Remedies for Worms in Pigs.

Various substances and patent remedies for worms in pigs are being tested to determine the most efficient and convenient form of treatment for this troublesome disorder. The work was begun two years ago and will be continued throughout the present season.

14. Horse Feeding.

Oats, gluten feed, oil meal, and cottonseed meal are being used with corn for feeding draft horses at work. While the results are not yet complete, the work so far indicates that in times when oats are high in price the ration may be materially cheapened at no disadvantage to the horses by the judicious use of the by-products.

NEW LINES OF INVESTIGATION TO BE TAKEN UP.

1. Digestion of Feeds by Hogs.

Equipment is being constructed for feeding pigs under conditions that will make it possible to collect the urine and fœces without waste. The hogs stand on a wire screen floor and wear a rubber fœces bag attached by means of a harness. A preliminary trial showed the apparatus to be a complete success. Twenty-four hogs will be used at one time, each animal being ten days of each month in a cage and twenty days outside on preliminary feed. The digestibility of various feeds will be determined and a study made of matters affecting metabolism.

2. Forage Crops and Skim Milk for Hogs.

Plots of ground will be sown to alfalfa and to clover during the present summer, and plots sown to annual forage crops the following spring. On these and on ordinary bluegrass pasture and in dry yard, hogs will be fed during the following summer. Skimmilk will be used both in dry lot and pasture feeding to test its value in comparison with the various forms of pasture.

3. Pork Value of a Bushel of Corn When Fed to Cattle.

During recent years the question of the pork value of a bushed of corn when fed to cattle has been the subject of much discussion. To date no definite data has been secured and so far no station has given the subject much consideration. With the hope of securing some reliable information along this line, we wish to conduct the following experiments:

1. Dry shelled corn to cattle 2 to 3 years old.
2. Dry shelled corn to cattle 1 to 2 years old.
3. Dry shelled corn to cattle under 1 year old.
4. Soaked shelled corn to cattle 2 to 3 years old.
5. Soaked shelled corn to cattle 1 to 2 years old.
6. Soaked shelled corn to cattle under 1 year old.
7. Corn meal to cattle 2 to 3 years old.
8. Corn meal to cattle 1 to 2 years old.
9. Corn meal to cattle under 1 year old.
10. Corn and cob meal to cattle 2 to 3 years old.
11. Corn and cob meal to cattle 1 to 2 years old.
12. Corn and cob meal to cattle under 1 year old.
13. Corn fed to the extent of 1¼ lbs. per 100 lbs. live weight of steer.
14. Corn fed to the extent of 1 2-3 lbs. per 100 lbs. live weight of steer.
15. Corn fed to the extent of 2 lbs. per 100 lbs. live weight of steer.

In addition to the above lines of work, each one should be tried on grass as well as on dry lot feeding, making in all some thirty tests on this one point alone. We feel that the work should be started at once as it will take several years to complete the work.

POULTRY SECTION.

Owing to the fact that the poultry buildings have been occupied only since March 9 and the equipment of the poultry farm is yet far from complete, no conclusive experimental, investigational or research work at the farm has been completed during the past year.

An investigational circular on poultry statistics was sent to the Iowa names on the station mailing list under date of January 20. This circular asked for information on the number, varieties and value of poultry kept by the recipient, together with further information regarding the amounts and values of eggs and poultry produced; number, styles and sizes of houses; number, capacity and make of incubators; kind, amounts, and price of feeds, and methods of feeding; farm and poultry papers taken; membership in poultry clubs and associations; poultry diseases and pests, with remedies used in combatting same; and interest in carrying on a co-operative experiment.

The replies received were surprisingly large. Out of a list of approximately 7,600, many of whom kept no poultry or were not interested in poultry husbandry, over 1,600 replies, or 21 per cent of the entire list, were received. Of these nearly 700 were interested in a co-operative experiment to keep account of the cost of producing eggs and poultry for one year. Much valuable information was obtained in these circulars which will be useful as indicating opportunities for the station to be of practical and direct use to the poultryman and general farmer by means of extension bulletins and experimentation.

INVESTIGATIONS IN PROGRESS AT THE PRESENT TIME, TO BE CONTINUED DURING THE COMING YEAR.

1. Breeding for Increased Egg Production.

The egg production per hen in the state of Iowa by the census of 1900 was 64 eggs per year, and by the state census of 1905, 42 eggs per year. Inaccurate as these figures undoubtedly are, they will serve to indicate the great chance there is for improvement in this state when we note the average production of 101 eggs per hen per year in the state of Maine, and the records of many hens that have laid over 200, and a few over 250 eggs per year, as proven by trap nests.

The census of 1905 returned the number of fowls in Iowa as over 22,400,000, and the average price per dozen of eggs at 13 cents. If the yield per hen could be increased but one dozen, the increased returns to the state would be nearly 4,000,000, or an increase of 40 per cent over the present income from eggs sold. Such an average increase is not beyond hopes of realization by improved stock, breeding, feeding, and care.

As a start toward the improvement in egg production, three Barred Plymouth Rock hens and one cockerel were obtained from the Maine Agricultural Experiment Station, which has been breeding for increased egg production since 1898. Two of these hens have egg records of 210 and one of 215 eggs each during their first laying year. The cockerel has been bred from 200 egg hens for the last eight generations. One of these hens (No. 602) laid on April 24 last two eggs in one day. A peculiar feature in connection with this work is that high producing hens, of this strain, at least, have a tendency to lay infertile eggs. This holds true at Maine as well as here. Out of over one hundred and fifty eggs set this spring, but four were fertile, and three hatched. At present the fertility is running somewhat better, but just what causes this infertility is yet to be discovered.

With the purpose of securing new blood lines with which to work, and also improving the size, shape and color of the fowls, three large cockerel bred hens which lay large brown eggs were purchased of S. H. Page of Waverly, a prominent Barred Plymouth Rock breeder in this state. As this variety is the favorite of the farmer, packer and consumer in this region, and is an excellent general purpose variety, it is well that it should receive the most attention. However, the fowls of other varieties on the farm will be trap-nested and as accurate records of production kept as of the Barred Plymouth Rocks, and if high producers develop, efforts will be made to perpetuate and improve them also.

Experimentation in this line will consist in keeping careful trap nest records of the production of all birds and the offspring of those which produce over 200 eggs of legal weight, proper shape, size, color and texture of shell in their first laying year. By careful mating and selection with reference to constitutional vitality, blood lines, production, conformation, breed and variety type, it is hoped to produce males which shall possess prepotency in the direction of increased egg production. These males may be sold to the farmers throughout the state to head breeding flocks.

2. Determination of Sex of Chick Before Hatching by Examination of Air Cell During Incubation.

There are several popular ideas, not to say superstitions, among farmers' wives that the sex of a chick can be foretold by the shape of the egg or the position of the air cell within it. While there is probably no foundation for these beliefs, either in theory or fact, the shapes of their air cell was traced on the shell of several hundred eggs, the eggs divided into two lots, which were hatched separately in pedigree trays, and the chicks punched in the webs between the toes for later identification. Whether or not there is anything to this theory can be told only when the chicks are old enough for their sex to be determined.

3. Laws of Heredity in Sports.

All the eggs from a pen of two hens and a cock which are known to be white sports from Barred Plymouth Rocks are being incubated and the colors of the resulting chicks noted. The offspring will be mated together in various ways with the idea of fixing the white character in as few generations as possible, and also to furnish data on Mendelism.

4. Test of Prepared Roofings.

On eight 8x12 feet colony houses erected this spring, eight different brands of prepared roofings have been used. These will be compared with

each other as to durability, initial cost, cost of maintenance, strength, weight, thickness, structure, effect of change in temperature upon them, etc.

5. Brooding.

Attempts are being made to perfect some method of brooding whereby chicks may be brooded successfully in large flocks, thus cutting down the expense and work of caring for them. To this end, two portable colony houses have been equipped with brooder chambers formed of cloth covered frames and heated by universal hovers. An 8x12 colony house equipped with two universal hovers in the usual manner can handle from 150 to 200 chicks. By using the cloth frames, it is hoped to double the capacity. This scheme seems to be satisfactory, although more improvements and further trials are necessary.

NEW LINES OF INVESTIGATION TO BE TAKEN UP.

1. Poultry Fattening or Fleshing.

Beginning September 1, investigations will be started in the fleshing of cockerels, pullets, capons and hens, also turkeys and geese, with especial reference to general farm conditions. This investigation will secure data on comparisons of breeds; rations for fattening purposes; methods of fattening,—such as pen, crate, range and cramming; amounts and percentages of gain; cost of gain; profit of gain; amounts of various foods necessary to produce one pound of gain; amounts of dry matter necessary to produce one pound of gain; length of time that fattening may be carried on profitably; composition of ration; effect of ration on quality and color of flesh and skin; distribution of fat in the tissues.

For the proper carrying on of this work, we are in urgent need of another building at least 36x60 feet, the basement of which could be adapted for fattening purposes. Such a building is also needed for instructional purposes.

2. Breeding for Improved Market Types.

There is a large investigational and experimental field in the improving of some varieties of fowls for their market conformation by breeding. Work along this line will consist in mating up pens of birds which most nearly meet the market demands and continue a rigid selection of their offspring with the market demands in view. This will necessitate a careful study of the rates of growth of the young stock, their constitutional vitality, anatomy, position and amounts of valuable cuts of meat on the body, rate of increase and quality of flesh produced by fattening, and how far this character may be inherited.

3. Rations for and Cost of Egg Production.

In connection with the breeding for increased egg production, accurate account will be kept of the amounts and kinds of food used, methods of feeding, composition of ration, amounts of food required, and cost to produce eggs during the various months of the year.

4. Incubation.

Practically nothing is known about incubation, either natural or artificial, yet upon this factor the success of large poultry farms is dependent. Much more conclusive experimentation, investigation and research is needed in the comparison of natural and artificial incubation, improvements of machines, conditions for best success in operation, bio-chemistry and embryology of the process, and many other lines. Until the new incubator building is built and more stock kept from which to secure eggs of known parentage, our work in this line cannot be at all extensive. The increase in number of pens for the housing of more stock is also necessary for the successful carrying out of the various breeding experiments.

5. Co-operative Experiment on Cost of Poultry Raising.

Because of the great interest expressed in such an experiment as stated upon the poultry statistics circular sent out last January, co-operative experiments will be started in various localities throughout the state at the commencement of next winter on the cost of egg production and profits of poultry husbandry. The value of such work will be, in addition to the general knowledge obtained, in the creating of greater interest among poultry raisers in their work and that of the station, and the opportunity of improving existing methods more effectually than by the mere issuance of bulletins. This particular experiment is more extension than research in character, and could well be carried on by the Extension department.

6. Poultry Diseases.

The great losses caused by and the meagre knowledge available on poultry diseases create a big demand for investigation and research along this line. Hepatetic enteritis, commonly called blackhead, has nearly destroyed the turkey industry of the east, and is rapidly gaining a foothold in the middle west. Unless its ravages can be checked, the future of the turkey industry in this state is seriously threatened. Iowa now ranks fourth in the number kept. As yet but little information, no cure, and few means of prevention can be secured in regard to this disease. Several diseased and dead fowls have been received here for diagnosis and referred to the Veterinary division. In many instances, diagnosis have been made, but no efficient remedies or preventives are known. A squab raiser in the northwestern part of the state who has 4,000 old birds, reported that he had large losses from squabs dying because of lumps forming in their throats. Several squabs were sent in and the trouble diagnosed by Dr. Stange as fowl diphtheria. Unless these ravages can be checked, this man will fail in his business. The cause of a bumble foot, a common ailment in which abscesses form on the soles of the feet, is entirely unknown. Avian tuberculosis may also be investigated with profit.

These are but a few instances of the need of a poultry pathologist in connection with the station. The poultry diseases which have thus far been investigated by veterinarians have been done from the standpoint of an interesting disease rather than with the purpose of discovering efficient preventives or curatives applicable to commercial poultry conditions. Therefore, an investigator who would take up this line of work should be

well grounded in poultry husbandry as well as pathology, histology, embryology, bacteriology, anatomy, and entomology as regards poultry parasites.

To start this work, the equipment necessary, including a hospital building, separate pens, apparatus, etc., would cost at least $5,000, and an annual appropriation of $3,000 would be necessary for salary and maintenance.

DAIRY FARM SECTION.

We have not completed any lines of work in this section. We have only recently gotten the work in hand and nicely started. Things are now looking very good, and we have every reason to believe that the work will progress very favorably from now on.

INVESTIGATIONS IN PROGRESS.

1. Individuality of Cows.

We have been, during the past year, and are continuing individual cow tests for the purpose of ascertaining the capacity and economy of superior cows of each of several of the leading dairy and dual purpose breeds of cattle, from the standpoint of total milk yield, per cent of butterfat, yield of butterfat, and the cost of the same. We are using animals of different ages, and adopting the best known methods with the hope of securing some very high yearly yields. The work to date has been most interesting and promises to bring out some very important features.

2. Arkansas Cows.

During the summer of 1907, Professor Van Pelt visited Arkansas and selected a number of typical cows and heifers as found in the most isolated regions of the state. These animals are being used for experimental purposes along the following lines:

1. Cows will be given the very best of feed, care and management and detailed records will be made from year to year for the purpose of ascertaining the amount of milk, per cent of butterfat, per cent of solids not fat, total amount of yield of each, and cost of production.
2. A study of the cost of milk and butter production as compared with good representatives of the most highly specialized dairy breeds.
2. A comparison of their ability to digest and assimilate feedings stuffs as compared with good representatives of the leading beef and dairy breeds.
4. Calves from these cows will be fed in comparison with calves of the best beef breeds from the standpoint of economy of meat production.
5. Tests will be made to note improvement in produce from high class dairy and beef sires; also influence of feed and good care on produce from Arkansas sires and dams.

NEW LINES OF INVESTIGATION TO BE TAKEN UP.

1. Feeding Calves on Whole Milk and Separator Skimmilk of Different Temperatures; Also the Use of Prepared Foods in Rearing Young Calves.

Wishing to secure some reliable information pertaining to the best and most economical methods of rearing young calves, the following tests will be made during the coming year on eight lots of calves:

1. Whole milk, warm from cow.
2. Whole milk, cooled to 55° to 60° F.
3. Separated milk, warm from separator.
4. Separated milk, cooled to 55° to 60° F.
5. Hay tea and meal preparation.
6. Prepared calf food.
7. Prepared calf food.
8. Prepared calf food.

The calves used in this test will be under two weeks of age when the work is started, and it will continue at least six months.

2. Feeding Calves Without Milk.

In this test twenty calves, averaging about two months of age, will be used, and will be divided into four lots of five each:

1. Oats 3 parts, shelled corn 3 parts, bran 1 part, oil meal 1 part.
2. Crushed oats 3 parts, corn meal 3 parts, bran 1 part, oil meal 1 part.
3. Prepared calf food.
4. Prepared calf food.

Respectfully submitted,

W. J. KENNEDY,
Animal Husbandry Section.

VETERINARY SECTION.

Hog cholera, being of more economical importance than all other diseases of swine, has naturally attracted much attention; the Bureau of Animal Industry having directed investigations of this destructive plague for nearly a quarter of a century. It not only causes heavy losses in herds throughout the country, but many animals are condemned at the different slaughter houses on account of this disease. During the fiscal year 1906, 26,649,353 hogs were inspected by federal inspectors and of these 151,615, or 6 per cent, were condemned; 14,329 of all condemnations being for hog cholera. These facts indicate that the painstaking researches to demonstrate the cause of and find a preventive or cure for this malady have been of more than scientific interest.

In 1885 an organism was discovered by Salmon and Smith which was, for many years, regarded as the cause of hog cholera. This was later shown to be a secondary factor and one that could probably be ignored in further investigations. Knowledge concerning the exact nature of the cause has

evaded all efforts on the part of investigators. That it is some living organism, however, is conceded by all who have studied this phase of the work.

Hog cholera is very common and has been often described, nevertheless a great many stock men have mistaken ideas regarding its cause and distinguishing features; consequently a brief description of some of the common characters of the disease will be given.

Manner of Spread.—It should be remembered that there can be no case of hog cholera which is not the result of some previous case. That is, every animal which contracts the disease must first be exposed to the specific infectious agent which causes hog cholera and no other disease, and without this causative factor there can be no hog cholera. This organism may be about the body of a diseased hog or may have been conveyed to other locations by various agents.

In view of the above facts we know that farms which have previously been free from the disease always become infected from some diseased herd. This transmission may take place in various ways and is often quite difficult to explain.

A very fruitful means of spreading the disease is the very active and uncontrolled transportation of hogs from one part of the country to another for breeding and other purposes. In this manner hogs in the first stages of the disease, those which have been exposed, but have not had time to develop symptoms, and those which have chronic ulcers in the intestines, yet are apparently healthy, may infect an entire herd. Many such cases are on record; consequently all newly purchased animals should be kept separate from the remainder of the herd for at least three weeks.

Swine may become infected during transportation as a result of diseased animals having previously occupied the crates, cars, vehicles, etc. These animals may show no indications of disease for some time after arriving at their destination.

Streams may convey infectious material from one farm to another when diseased animals are allowed to run to the stream or carcasses of animals dead of the disease are allowed to contaminate the water.

It has been claimed, without very conclusive evidence, that persons, dogs, rabbits, and birds such as crows, sparrows, etc., may convey the infectious material from place to place.

The causative agent may evidently live in the earth about the yards for some time; consequently new outbreaks may occur when susceptible animals are introduced. Chronic cases may also keep the premises infected for a long time. These factors account, largely, for the recurrence of the disease year after year in certain sections of the country.

The disease is spread from animal to animal in the affected herd chiefly by means of the discharges from the bowels and the tissues of animals dead of the disease; also food and drinking water contaminated with these materials. The manner in which hogs feed nearly always insures more or less soiling of food with discharges from the intestines and consequently diseases which are spread in this manner are readily transmitted.

The symptoms of the disease and the changes found in the bodies of hogs with hog cholera vary to a considerable extent, depending upon the organ or organs chiefly affected. The most constant characters are as follows:

Hog cholera is usually an acute, sometimes subacute or chronic, highly contagious, febrile disease of hogs. The symptoms appear in from a few days to three weeks after exposure; the loss of appetite being usually the first indication of disease. The animals leave their food and show a tendency to remain in their beds. Later the appetite is entirely lost and the animals lie about the pens and when compelled to rise the back is arched, the head is lowered, and they move about with much apparent difficulty. There may be some vomiting during the first few days.

Frequently the animals are constipated during the early stage of the disease; this is often followed by diarrhœa. In the more severe cases the skin about the nose, ears, abdomen and thighs will be reddened. There may be some bleeding from the nose and often there is a pus-like discharge from the eyes.

The affected animals lose flesh rapidly, become very weak and die in from one day to several weeks. The longer the duration of the disease the more marked will be the loss of flesh. In other cases the symptoms may become milder and the animal recover. The percentage of animals which die varies greatly in different outbreaks. In some outbreaks it reaches nearly 100 per cent, while in others it may not exceed 25 or 30 per cent.

The most characteristic changes found in the body after death are yellowish button-like ulcers of a variable size and number in the posterior (last) portion of the small, and the anterior (first) portion of the large intestines. This may be accompanied by an inflammation of the lungs and the latter occasionally exists without the ulcers in the intestines. In addition to the above there are usually found small hemorrhages in the other organs of the body, more especially the kidneys, and reddening of the skin on the lower surface of the body.

The younger animals usually contract the disease more readily and in a more fatal form than the older ones, but the latter may also die in large numbers. No breed of hogs, so far as is known at the present time, will resist the disease completely.

The medicinal treatment of hog cholera has, up to the present time, proven to be of no value. The institution of good sanitary conditions is indicated. The healthy animals should be separated from the others into small lots and all removed from the infected pens. This with the subdivision of the small lots if disease appears in them has proven very beneficial in many outbreaks.

The preventive treatment which has been evolved as a result of the work of the Bureau of Animal Industry produces in the treated animals a resistance to the disease (immunity). The resistance is obtained by injecting susceptible hogs with serum from the blood of immune hogs which have been inoculated with large quantities of disease producing blood. In some cases the use of this serum is accompanied by the use of a small quantity of disease producing blood. The methods of producing the high degree of resistance (hyper immunity) in hogs which are to furnish the serum is in general as follows:

Swine which are immune (resistant to the disease) either as the result of natural resistance, exposure to a natural outbreak of the disease, or as a result of treatment by the following method, are inoculated with large quantities of disease producing (virulent) blood. The two methods that

have been used to increase the resistance of the animals intended to produce the serum which will protect non-resistant animals differ only in the length of time during which the treatment with the disease producing blood is continued and the serum is equally potent when obtained by either method.

It has been found that the serum obtained from the blood of these animals will protect susceptible hogs, for some time, from natural infection or artificial inoculation with a quantity of disease producing blood which would ordinarily kill a hog which is not immune. This is proven by the fact that the animals do not die when inoculated with quantities of disease producing blood which constantly kills animals which have not been immunized. A more lasting resistance to the disease may be obtained by treating the animal with a small quantity of disease producing blood at the same time the serum is injected. Thus two methods have been used, (1) serum alone, and (2) serum and disease producing blood.

The following experiments were conducted by the writers with serum and blood obtained from the government experiment farm. All animals used in these experiments had had no known exposure to hog cholera. They were in thrifty condition and in all respects apparently healthy. The animals were kept, as far as possible, under conditions resembling those met with on the ordinary farm.

Experiment No. 1. Six hogs were treated with serum from the blood of hyperimmune hogs. Six days later the treated animals together with four untreated hogs were exposed to a natural outbreak of hog cholera on a farm near the Agricultural College at Ames, Iowa. As a result of this exposure three of the four untreated animals died, two of the treated animals died and one became sick.

Experiment No. 2. Six hogs were treated with the same serum used in Experiment No. 1, and in addition a small quantity of disease producing blood. Six days later the animals were exposed to a natural outbreak, on a farm, with four untreated animals. As a result of the exposure two of the treated animals died and 75 per cent of the untreated. On subsequent test the blood used in Experiment No. 2 was found to be non-virulent (would not produce disease in susceptible animals) and the serum used in Experiments Nos. 1 and 2 did not possess sufficient immunizing properties

These two experiments indicate that a certain amount of resistance was produced in the treated animals, but the degree of immunity was not sufficient to protect the animals from the infection resulting from the exposure to a natural outbreak such as is ordinarily met with on the farm.

Experiment No. 3. Eight hogs were treated with serum in a similar manner and at the same time as hogs in Experiment No. 1. Instead of being exposed to the disease, however, they were kept in a lot away from all sources of infection for forty-eight days. At the end of this time the serum used had been found of low potency (immunizing power) and consequently the animals were reinjected with the same quantity of tested serum. They were then kept in the same lot for twenty-four days more. The serum treatment was now repeated on four, or one-half of the animals, and all eight were immediately exposed, together with four untreated hogs, on a farm where a virulent outbreak of hog cholera existed. Three of the

untreated animals died, while only one of the treated animals succumbed to the disease.

Experiment No. 4. Eight hogs were treated with the same serum and blood as hogs in Experiment No. 2, and were then kept in a dry lot away from exposure. The blood having been found to be non-virulent, the injections were repeated forty-eight days later, using potent serum and virulent blood. The hogs were allowed to remain in the same lot (away from exposure) and were exposed to the same outbreak as hogs in Experiment No. 3 twenty-four days after the last treatment. None of the treated animals died as a result of the exposure, while 75 per cent of the untreated animals exposed at the same time died.

The outbreak to which animals used in Experiments Nos. 3 and 4 were exposed, was much more severe than that to which the hogs of Experiments Nos. 1 and 2 were exposed. In the outbreak of Experiments Nos. 3 and 4 five or six animals would be found dead during the course of a day. The check animals exposed with the treated hogs also died in a much shorter period of time than in Experiments Nos. 1 and 2; all but one check showing marked symptoms of disease and one being dead in five days. The treated animals withstood the exposure to this same outbreak much better (only one of the sixteen dying) than the treated animals of Experiments Nos. 1 and 2 to a less severe type of the disease. This can undoubtedly be explained not by the repeated treatment of the hogs in Experiments Nos. 3 and 4, as Experiments Nos. 5 and 6 will show that repetition is not necessary to produce immunity, but by the fact that the blood was of unknown virulence and the serum possessed but slight immunizing properties in Experiments Nos. 1 and 2.

Experiment No. 5. Six hogs were treated with serum from hyperimmune hogs, two receiving in addition to the serum a small quantity of disease producing blood which had been tested and found virulent. A somewhat larger quantity of serum was used than in previous experiments on account of the larger size of the animals. All treated animals together with four untreated hogs were placed in a Bureau of Animal Industry exposure pen with three sick animals which died within a few days. Three of the untreated animals used as pen checks died while the other became sick, but recovered. None of the treated animals became sick.

Experiment No. 6 included the same number of hogs as Experiment No. 5, and they were treated with the same material at the same time, but were kept from all sources of infection for ten days after treatment and were then exposed under conditions similar to those of Experiment No. 5. All the untreated hogs became sick and 75 per cent of them died. Not the slightest indication of disease was noticed in the treated animals.

The pens in which hogs used in Experiments Nos. 5 and 6 were exposed consisted of a shed about 28 feet long, 10 feet wide and 5 feet high, covered by a board roof. The floor of the pen, which was of wood, was raised from the ground about a foot. The exposure in a pen of this size would evidently be quite severe. However, all treated animals resisted the infection without even a loss of appetite which could be detected.

Post-mortem examinations were made of all experimental animals that died and the abnormal changes were characteristic of hog cholera.

No animal became sick as a result of treatment nor did any untreated hog become sick while running with treated hogs, except when sick untreated animals were in the same pen.

The curative properties of the serum, the maximum duration of the immunity resulting from the treatment by the two different methods and several other questions of considerable practical importance have not been investigated by this station on account of lack of time and facilities.

Conclusions:—

1. The serum of the blood of hogs hyperimmunized by injections of large quantities of disease producing blood will protect susceptible hogs for a variable time against quantities of disease producing blood sufficient to kill non-immune animals.

2. The same serum will protect susceptible animals against infection during exposure to natural outbreaks of the disease such as occur on Iowa farms.

3. Hogs injected with serum and virulent blood at the same time will resist the disease when exposed to natural outbreaks or artificial inoculation of disease producing blood. Undoubtedly young pigs will acquire lasting immunity if they are treated with serum and immediately exposed to infection.

Respectfully submitted,

J. H. McNEIL,
C. H. STANGE,
Veterinary Section.

SOILS SECTION WORK.

Following are the chief lines of investigation carried on by the Soils section during the year 1907-1908:

1. Humus Investigations Under the Adams Fund.

Project.—A study of humus formation under certain methods of soil treatment with special reference to the changes which take place in the plant food content and in the physical condition of the soil.

Expenditures:

Salary of W. H. Stevenson, ¼ of $2,250	$ 562.50	
Salary of I. O. Schaub, 14-17 of $1,700	1,400.00	
Salary S. S. Fay, 6 months	360.00	
Current expense	740.00	
Total		$ 3,062.50

PROGRESS OF WORK.

Collection of Samples.—As this investigation is a study of humus formation under different systems of management, it was exceedingly important that the various plots should be sampled before any treatment was applied. Accordingly during the summer of 1907, samples were collected from the Humeston experiment field representing southern Iowa loess, Manning experiment field representing Missouri loess, Conrad experiment field representing Iowan drift, and from the college experiment field representing Wisconsin drift.

Great care was used in taking these samples so as to make them representative of the plots from which they were obtained. From the three fields first mentioned, four composite series of samples were taken from each plot sampled. The sampling was done with a 1½-inch auger and the point at which each boring was made is shown in Diagram I. Samples were taken to three depths—0 to 7 inches, 7 to 18 inches and 18 to 36 inches, giving a total of twelve samples from each plot. Eight plots were sampled at each station and the various treatments they received are as follows:

1. Continuous corn.
2. Corn and oats in rotation.
3. Corn, oats and clover in rotation.
4. Corn, corn, oats and clover in rotation.
5. Corn, corn, oats and clover in rotation + legumes in corn.
6. Corn, corn, oats and clover in rotation + manure.
7. Corn, corn, oats and clover in rotation + legume and manure.
8. Corn, corn, oats and clover in rotation + legume, manure and phosphorus.

The plots sampled had all received the same treatment previous to the year 1907.

At the college station three composite series of samples were taken from each plot, but otherwise the sampling was the same as at the other fields. The location of borings is indicated in Diagram II. Twenty-two plots were sampled at this station, and they received the following treatments:

1. Continuous timothy.
2. 2 tons peat per acre annually (dry basis).
3. 8 tons cattle manure every four years.
4. 8 tons clover hay every four years.
5. 1 ton timothy annually.
6. 2 tons timothy annually.
7. No treatment.
8. 2 tons oat straw annually.
9. 1 ton clover hay annually.
10. 2 tons clover hay annually.
11. 4 tons clover hay annually.
12. 1 ton clover hay annually.
13. 2 tons clover hay annually.
14. 4 tons clover hay annually.
15. Continuous corn.
16. Corn and oats in rotation.
17. Corn, oats and clover in rotation.
18. Corn, corn, oats and clover in rotation.
19. Corn, corn, oats and clover + 8 tons manure (wet basis) every four years.
20. Corn, corn, oats and clover + 12 tons manure (wet basis) every four years.

21. Corn, corn, oats and clover + 16 tons manure (wet basis) every four years.
22. Corn, corn, oats and clover + 20 tons manure (wet basis) every four years.

Plots 1 to 14 received their several treatments in August after the samples had been taken and have been fallowed since that time.

Plots 15 to 22 grew crop in 1907, but no manure will be applied until fall of 1908.

Each sample was placed in a numbered sack as soon as taken and the number of sack and location of boring were recorded in the collector's note book.

Storage of Samples.—Each sample when it reached the laboratory was transferred to a galvanized milk pan and allowed to air dry. After drying, it was placed in a one-half gallon fruit jar and the cap tightly screwed. The following label, properly filled in for each sample, was pasted on the outside of the jar while a duplicate card was put inside:

Soil Laboratory No.....
Experiment Field .....
Line of Borings No.....
Plot No.....
Type..... Depth.....
Collector..... Date.....

In 1907, 96 samples were taken at each of the fields at Humeston, Manning and Conrad, and 198 at the college, making a total of 486 samples collected in 1907, which have been carefully bottled and labeled.

Laboratory Work.—At the time this work was begun, the analytical methods for the determination of humus were very unsatisfactory, due to the large amount of clay which remained suspended in the humus solution. As the success of this work depended in large measure on this determination, considerable time has been spent in an effort to improve the method. A number of suggestions were tried, but the greatest success was reached by using a very high centrifugal force which removed practically all the suspended clay.

Since this work was done, the chemist of the Tennessee station has offered a method for the removal of the suspended clay which appears to be quite satisfactory. A comparison of the two methods is now being made and the one which proves most successful in economy of time and accuracy of results will be used in our work.

Owing to the large amount of analytical work to be done and the limited number of men engaged, it was necessary that we limit ourselves to the most important samples. Our plans as outlined call for the collection of samples from the Humeston, Manning and Conrad fields only once in four years, and as the system of management practiced on those fields will probably bring about a slow change in the humus, it was decided to store these samples for future work. For the same reason the samples other than the surface from the college field were also stored. This limits our work at present to 66 surface samples.

During the fall of 1907, one man was engaged on this work, while two men have given practically all their time since the first of January, 1908.

At the present time, determinations of the moisture, total nitrogen, humus nitrogen, carbon, and phosphorus have been completed on these 66 surface samples and the data recorded in books kept in a fire proof vault. In addition to the above determinations, total potassium, humus, humus phosphorus, humus potassium and dilute acid extract of phosphorus have been determined on most of these 66 samples. All determinations are made in duplicate so that nearly 1,000 separate analyses have been completed.

Field Work.—No field work is being done away from the college other than the regular cropping and treatments indicated in the previous outline.

At the college station the regular cropping and fallowing is being carried on, and beginning with the spring of 1908 temperature readings are being made three times a week on each of the 22 plots. Other physical studies are to be taken up within a short time. About the first of August surface samples will again be taken from these 22 plots and the treatments applied as in 1907.

2. Crop Rotation and Soil Management Experiments on the Soil Plots Covering About Twenty-three Acres and Located on the Experiment Station Grounds.

The following outline gives the experiments which are being conducted on this field:

North Field: Series 200-400 inclusive; crops and treatments in 1907.

(a) Four year rotation: Corn, corn, oats and clover.

Plots 201 Check—Oats and clover.
202 Legume.
203 Manure.
204 Manure and legume.
205 Phosphorus, legume and manure.
206 Phosphorus and legume.
207 Phosphorus and manure.
208 Phosphorus, potassium and legume.
209 Phosphorus, potassium and manure.
210 Phosphorus and potassium.
211 Phosphorus.
212 Rock Phosphate.
Plots 213-323 (treatment same as 201-212 series) corn.
Plots 301-312 (treatment same as 201-212 series) cowpeas and clover.
Plots 313-323 (treatment same as 201-212 series) corn.

(b) Continuous corn.
Plots 401-412 (treatment same as 201-212 series).

(c) Four year rotation with the use of manure.
Plots 413 Oats and clover.
414 Corn.
415 Corn.
416 Clover.

(d) Alsike clover and timothy.
Plots 419-423 were seeded to alsike clover and timothy in the spring of 1907. These plots will be kept in grass because the soil lacks uniformity to such an extent as to render them unfit for our lines of investigation.

In the fall of 1906 series 100, plots 101-123 inclusive, was abandoned to afford a right-of-way for the electric car line. In 1907 these plots were seeded with clover and timothy. They will be used hereafter in connection with our laboratory work in soils.

South Field: Series 500-1000 inclusive; crops and treatment in 1907. This field, containing about twelve acres, was first laid out in plots for soil experiments in the spring of 1907.

The following outline shows the experiments which were conducted on this field in 1907:

Plots 501 Potatoes—3 cultivations.
502 Potatoes—5 cultivations.
503 Potatoes—8 cultivations.
504 Continuous corn with clover seeded last cultivation.
505 Corn—clover seeded last cultivation and, when a stand is secured, left in meadow one year.
506 Continuous corn with cowpeas seeded last cultivation.
507 Continuous corn with cowpeas seeded last cultivation; corn cut and peas turned under before frost.

508, 509, 510 — Corn without treatment.

601 Continuous corn.

602, 603 — Corn and oats in rotation.

604, 605, 606 — Corn, oats and clover in rotation.

607, 608 — Corn and oats in rotation with clover seeded with the oats.

609, 610 — Corn and oats in rotation, with peas after the oats.

701, 702, 703, 704 — Corn, corn, oats and clover in rotation with three loads of manure applied three years out of four.

705, 706, 707, 708 — Corn, corn, oats and clover in rotation with nine loads of manure applied once in four years.

801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812 — Corn, oats and clover in rotation with six tons of manure applied in spring to corn ground once in three years as follows:
1st Plot—No manure.
2nd Plot—Manure turned under.
3d Plot—Manure on surface.
4th Plot—Manure after corn is up.

901, 902 — Corn and oats in rotation, with rye after oats to be turned under in spring.

903, 904 — Corn and oats in rotation with four tons of manure applied biennially.

905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1013, 1014 — Corn, corn, oats and clover in rotation with manure applied once in four years on clover sod as follows:
1st Plot—No manure.
2nd Plot— 8 tons manure.
3d Plot—12 tons manure.
4th Plot—16 tons manure.
5th Plot—20 tons manure.

These experiments are carried on chiefly for the purpose of securing data regarding important soil problems, such as the effect upon the plant food suppy and the physical condition of the soil of various systems of crop rotation, of applications of fertilizing materials and of different systems of soil management.

The crop of 1908 is the fifth to be grown on the north field. In 1907 all of the crops on this field were a success.

Up to the close of the 1907 harvest none of the data which had been secured from these experiments had been tabulated for publication. However, the four year rotation plots and the continuous corn plots had been carried through the first rotation period in the fall of 1907. We are planning to prepare a bulletin late this fall which shall incorporate the results of these soil studies on the Wisconsin drift.

The loss of the plots in the 100 series will markedly decrease the value of these data, owing to the fact that it will be impossible to compare the effect upon the productive capacity of the soil of continuous corn growing, and of a four year rotation with the effect of several other rotations which were being studied on the abandoned plots.

3. Pot Culture Study of Iowa Soils.

During 1907 three pot culture experiments were in progress. The following outline gives the essential details regarding these experiments:

A. Pot Culture Study of Southern Iowa Loess.

The soil was taken from the experiment field located on this type of soil at Humeston.

1. Object: To determine the effect of rotation, manure, catch crops, and fertilizing materials on the productive capacity of southern Iowa loess.

2. Place: Greenhouse.

3. Outline: Wheat, seeded about January 17, 1907.

Pots 101 Check.
102 Legume.
103 Manure.
104 Legume and manure.
105 Phosphorus.
106 Legume and phosphorus.
107 Manure and phosphorus.
108 Manure, legume and phosphorus.
109 Potassium.
110 Phosphorus and potassium.
111 Lime.
112 Check.

The pots in this experiment were harvested about June 15, 1907. Valuable and interesting data were secured. For instance, the yield of the check pot was 19 grams; of the phosphorus pot 23 grams; of the manure pot 25 grams, and of the manure, phosphorus and legume pot 49.8 grams.

The pots which were used in this experiment were treated again in October, 1907, and were seeded with wheat in January, 1908. The crop is in excellent condition at the time of the preparation of this report.

B. Continuation of Pot Culture Experiments with Iowa Drift Soil.

1. Object: To determine the relative efficiency of various carriers of phosphorus with and without organic matter.

2. Outline:

Pots 1 Check.
2 Check.
3 Legume.
4 Legume.
5 Manure.
6 Manure.
7 Bone meal.
8 Bone meal.
9 Rock phosphate.
10 Rock phosphate.
11 Legume and bone meal.
12 Legume and bone meal.
13 Legume and rock phosphate.
14 Legume and rock phosphate.
15 Manure and bone meal.

16 Manure and bone meal.
17 Manure and rock phosphate.
18 Manure and rock phosphate.
19 Manure, legume and bone meal.
20 Manure, legume and bone meal.
21 Manure, legume and rock phosphate.
22 Manure, legume and rock phosphate.
23 Manure and legume.
24 Manure and legume.

Our experiments up to date indicate that in one or two soil areas, such, for instance, as the southern Iowa loess, phosphorus is a limiting factor in crop production. Therefore, the investigation referred to above was started in the greenhouse in the fall of 1905 to determine the cheapest source of supply of this important element of plant food. The second year's results were obtained about the middle of June, 1907. While it may prove impossible from the data furnished by this experiment to assign definite values to steamed bone meal and rock phosphate as carriers of phosphorus, nevertheless the experiment is certain to yield much valuable data relative to the effect of barnyard manure and green manures upon the productive capacity of Iowan drift.

This experiment also is being continued during 1908.

C. Pot Culture Study of Peaty Swamp Soil.

The sample was taken from the experiment field located on this type of soil near Ontario.

1. Object: To determine the effect of nitrogen, phosphorus and potassium, alone and in combination, upon the productive capacity of this soil. Sugar beets were grown in these pots.

2. Outline:

Pots 1 Check.
2 Nitrogen.
3 Phosphorus.
4 Potassium.
5 Nitrogen, phosphorus.
6 Nitrogen, potassium.
7 Phosphorus, potassium.
8 Nitrogen, phosphorus and potassium.

This simple experiment has been successful. Exactly the same effect, from the application to the soil, of different fertilizing materials is noted in these pots that has been found in the field plots.

4. Field Experiment Plots on the Principal Soil Types of the State.

Data of the greatest value cannot be secured from a chemical analysis of a soil and from pot culture experiments alone. It is necessary to carry on fertility experiments in the field in order to discover methods of maintaining the productive capacity of the soil and of making certain types of soil more productive.

Three groups of extensive field experiments in addition to those on the station grounds are being carried on by the Soils section during the year 1907-1908.

A. Continuation of the experiment fields which were first laid out in the spring of 1905.

1. Near Sioux City upon the farm of Captain W. S. A. Smith. We have at this station, which is about four acres in extent, the very unproductive loess hill soil, which is found in a large area along the Missouri river. Valuable data were secured from these plots in 1905, 1906 and 1907.

These data, together with recommendations regarding methods of soil management for the hill soils of the Missouri loess area, were published in March, 1908, in Bulletin No. 95, entitled "The Maintenance of Fertility, With Special Reference to the Missouri Loess." The experiments on this field were discontinued after the crops of 1907 were harvested.

2. Near Somers on the farm of L. E. Armstrong.

We have at this station, which covers ten acres of land, a typical drained peaty swamp soil. Three years' work on this field has demonstrated the fact that corn, oats, clover and timothy can be successfully grown on the peat soils of this state when they are well drained and when they are underlain by sub-soils other than sand. We expect to publish a bulletin on the peat soils of Iowa this fall at the close of our fourth year's experimental work on this type of soil. The experiments in corn and grass growing are being continued on this field in 1908.

3. Near Ontario on the farm of Doctor Stanton.

This is a peaty swamp soil. In addition to extensive experiments in the production of corn and different grass crops during 1907, carefully planned experiments in the growing of truck crops such as onions, cabbage and potatoes were conducted for the purpose of determining the adaptation of these crops to this particular soil. This field was abandoned in the spring of 1908, chiefly because the farm on which it was located was sold.

B. New soil experiment fields; located in the fall of 1906 and seeded for the first time in the spring of 1907.

1. Near Manning on the Missouri loess on the farm of Martin Petersen; about twelve acres in extent.

Object: (a) To secure data regarding the most practical methods of maintaining and increasing the productive capacity of the Missouri loess soil.

(b) To study crop adaptation with alfalfa, cow peas, soy beans, etc.

Outline: (1) Effect of crop rotation, barnyard manure, catch crops, fertilizing materials and methods of tillage on the productive capacity of Missouri loess.

(One-tenth acre plots arranged as shown in the following outline.)

Four Year Rotation—Corn, Corn, Oats, Clover.*

* Cow peas were grown in 1907 in place of clover.

(a) Plot 101 Check (corn).
102 Legume.
103 Manure.
104 Check.
105 Legume and manure.
106 Phosphorus.
107 Check.
108 Legume and phosphorus.
109 Manure and phosphorus.
110 Check.
111 Manure, legume and phosphorus.
112 Potassium.
113 Check.
114 Phosphorus and potassium.
115 Lime.
116 Check.

(b) Plots 201-216 (same as 100 series) corn.

(c) Plots 301-316 (same as 100 series) oats.

(d) Plots 401-416 (same as 100 series) clover. (Cow peas in 1907.)

(e) Plot 501 Continuous corn.

(f) Plot 601 Corn
602 Oats } Two year rotation.

(g) Plot 701 Corn
702 Oats } Three year rotation.
703 Clover (cow peas '07)

Crop Adaptation.

(h) Plot 801 Cow peas.
802 Soy beans.
803 Alfalfa (manured).
804 Alfalfa (not manured).
805 Alsike (manured).
806 Alsike (not manured).

2. Near Humeston, on the southern Iowa loess, on the farm of M. E. McCulloch; about twelve acres in extent.

The experiments on this station are similar in character and number to those at Manning except that wheat is grown in the four year rotation in the place of oats.

3. Near Conrad, on the Iowan drift, on the farm of William Morrow; about ten acres in extent.

The experiments at this station practically duplicate those at Manning.

The experiments on the three fields just referred to were carried on successfully in 1907 and are being conducted practically without change during 1908.

Owing to a lack of funds, no experiment field has been located on the Mississippi loess. This is an important type of soil, covering an extended area in the southeastern portion of the state. We recommend that provision be made for a field in this section as soon as possible.

4. Experiments Upon the Top Dressing of Timothy Land.

In view of the great importance of the timothy crop, and the fact that for several reasons it is highly desirable to allow a field to remain in timothy for a number of years when once it is seeded down, it seemed that a series of experiments should be conducted with a view to outlining a system of treatment for improvement of timothy meadows. These experiments were designed primarily to test the effect of adding a supply of readily available plant food as a top-dressing.

A series of plots was installed in the fall of 1906, and Humeston, Wayne county, was chosen as the location. Fifteen plots were laid out, as shown by the following diagram:

15	$NaNO_3$ 8 pounds—K_2SO_4 5 pounds Phos. 10 pounds	1-20
14	$NaNO_3$ 8 pounds K_2SO_4	1-20
13	$NaNO_3$ 8 pounds Phos. 10 pounds	1-20
12	Check	1-20
11	$NaNO_3$ 16 pounds	1-20
10	$NaNO_3$ 8 pounds	1-20
9	Manure 4 loads per acre	1-20
8	Disced	1-20
7	Check	1-20
6	Manure 5 loads per acre Phos. 50 pounds	1-10
5	Phosphorus 50 pounds	1-10
4	Check	1-10
3	Manure 6 loads per acre	1-10
2	Manure 3 loads per acre	1-10
1	Check	1-10

A second area was selected, and plots laid out at a distance of about three and one-half miles from the experiment just described. This field had been in timothy continuously for a considerable number of years, but probably not for as long a period as the first field chosen.

The plan of this experiment is very similar to that of the experiment already described, as is shown by the following diagram of plots:

16	Check
17	Manure 6 loads per acre
18	Manure 12 loads per acre
19	Check
20	Phosphorus 10 pounds
21	Manure 6 loads per acre + Phos. 10 pounds
22	Check
23	$NaNO_3$ 8 pounds
24	$NaNO_3$ 8 pounds Manure 6 loads per acre
25	Check
26	$NaNO_3$ 8 pounds
27	$NaNO_3$ 16 pounds
28	Check
29	$NaNO_3$ 8 pounds Phos. 10 pounds
30	$NaNO_3$ 8 pounds K_2SO_4 5 pounds
31	Check
32	NaNO 8 pounds + K_2SO_4 5 pounds + Phos. 10 pounds

5. Field Experiments on Gumbo Soils.

In the spring of 1908 a series of plots, one-twentieth of an acre in size, was laid out on the farm of J. F. Niccolls, near Morning Sun, for the purpose of studying the effect of different methods of soil management upon the productive capacity of gumbo.

The treatment of the different plots is shown in the following outline:

Plot 101 Check.
102 Manure.
103 Buckwheat.
104 Rape.
105 Tile drained.
106 Straw.
107 Clover.
108 Check.
109 Fall plowed.
110 Fall plowed and manured.
111 Spring plowed.
112 Spring plowed and manured.

This is a new line of work, but that it is important is made evident by the fact that there are many thousands of acres of gumbo soil in Iowa which are exceedingly rich in plant food, but are quite unproductive.

6. Investigation in Securing Soil Samples.

It is of the greatest importance from the standpoint of soil investigations, that a soil sampler be used for taking a three or four inch core of soil in the field to a depth of 10 to 16 inches, which shall preserve the natural texture and structure of the undisturbed field soil.

A sampler was perfected about a year ago which gives promise of meeting all requirements. The apparatus has been tested, and laboratory studies have been made with the samples of soil which have been secured with this sampler. The sampler worked so satisfactorily and the tests which were made with it were of such a nature as to justify the publication of a description of the apparatus together with diagrams showing its construction, and a report of the laboratory studies with the samples of soil. The details of this investigation were published in January, 1908, in Bulletin 94, entitled "A New Soil Sampler."

INVESTIGATIONS CARRIED TO A CONCLUSION DURING THE CURRENT YEAR.

1. Soil experiments on the unproductive hill-tops of the Missouri loess; data presented in Bulletin 95.

2. Investigations instituted for the purpose of developing a sampler which would make it possible to secure samples of soil with essentially the same physical properties as are possessed by the soils in the field; results presented in Bulletin 94.

3. Field experiments in clover growing on the loess and till soils of southern Iowa; data presented in Bulletin 98.

INVESTIGATIONS IN PROGRESS AT THE PRESENT TIME, TO BE CONTINUED DURING THE COMING YEAR.

We recommend that all of the lines of soil investigation which are now under way be continued during the year 1908-1909. There are other important lines of work which would prove interesting and profitable, but we are confident that the experiments which have been outlined in this report, with the possible exception of a single additional experiment field, will tax the resources of the section to the utmost during the next fiscal year.

NEW LINES OF INVESTIGATION TO BE TAKEN UP.

We hope to have a sufficient amount of money during the year 1908-09 to justify the location of a new experiment field either on the Iowan till or the Mississippi loess.

BULLETINS PUBLISHED DURING THE YEAR 1907-1908.

January, 1908, Bulletin 94—A New Soil Sampler.

March, 1908, Bulletin 95—The Maintenance of Fertility, With Special Reference to the Missouri Loess.

May, 1908, Bulletin 98—Clover Growing on the Loess and Till Soils of Southern Iowa.

SUMMARY.

The chief lines of investigation carried on by the Soils section during the year 1907-1908 are as follows:

1. Crop rotation and soil management experiments on twenty-three acres of land on the station grounds. Total number of plots, 133.
2. Pot culture study of three Iowa soils. Total number of pots, 60.
3. Field experiment plots on the principal soil types of the state. Total number of fields, 5; total number of plots, 350.
4. Experiments upon the top dressing of timothy land.
5. Field experiments on gumbo soils.
6. Humus investigations. Total number of plots, 28.
7. Investigations in securing soil samples.

Respectfully submitted,
W. H. STEVENSON,
Soils Section.

HORTICULTURE.

I. Cold Storage of Iowa Apples. The handling of Iowa apples in cold storage has been under investigation for the past two years in co-operation with the U. S. Department of Agriculture. Important results have been obtained which should encourage the development of the apple industry in this state and especially in northern Iowa. A report of this work should be published during the ensuing year. It would be well to continue work along this line as a demonstration feature of the horticultural extension effort to educate fruit growers and fruit dealers as to the value of Iowa grown apples for cold storage.

II. Spraying Orchards for the Control of Injurious Insects and Diseases. Orchard spraying experiments have been continued in the Trigg orchard, Rockford, Iowa, since 1906. The treatment has resulted in a marked increase in the amount and quality of the fruit produced. Demonstrations of this kind should be made a part of the horticultural extension work because the results cannot fail to be of very great value to the orchard interests throughout the state. A report on this work should be published during the coming year.

III. Deciduous Trees for the Iowa Planter. For many years a study of trees has been in progress at this institution for the purpose of gaining information as to the hardiness of different species, their adaptability to various climatic and soil conditions, their economic worth and their decorative value. A report on the evergreens has already been issued in Bulletin 90, which was published in 1907. This is to be supplemented by a report on deciduous trees for the Iowa planter which will probably be prepared during the coming year.

IV. The Sand Cherry (Prunus besseyi). Experiments with the Sand Cherry have been given more or less attention at this station since 1885. It has been tried as a stock for various cultivated varieties of different species of stone fruits and tests have also been made of various horticultural varieties which have been derived wholly or in part from this species. The experiments with sand cherry as a stock are to be closed this season. The results will soon be presented for publication, together with a report of progress on the experiments in testing horticultural varieties and hybrids of this fruit.

V. Plant Propagation. General work in plant propagation, and particularly in the propagation of fruits, has long been carried on at this station and much valuable information has thus been gained. In 1906, as stated in the last annual report from this section, this line of effort was given more systematic direction and one of the orchards recently planted on the new horticultural tract was planned so as to gain information as to the comparative value of different stocks for commercial apple orchards in Iowa. This orchard, No. 2, has recently been successfully top-worked with commercial varieties. The experiment is now well started and each succeeding year cannot fail to add to its value.

Similar work with other fruits is being started.

VI. General Work With Orchard Fruits. In the general study of orchard fruits particular attention is now being given to a study of the apple, plum and cherry for Iowa. Some work is also being done with the peach and pear and with other fruits of less local importance. The following statement shows the approximate number of varieties and the total number of trees of different classes in the station orchards at the close of the present fiscal year:

NUMBER OF TREES AND VARIETIES OF DIFFERENT KINDS OF FRUIT WHICH WERE IN THE STATION ORCHARDS JUNE 30, 1908.

Kind	Number of Varieties			
	Named**	Unnamed Iowa Station Seedlings		Total
		Parentage Known	Parentage Uncertain	
Apple:				
Trees	1,429	581	436	2,446
No. of varieties	516	571	418	1,485
Pear:				
Trees	95	91	3	189
No. of varieties	30	91	3	124
Plum:†				
Trees	600 *	166	19	722
No. of varieties	275	158	19	402
Cherry:				
Trees	210		37	247
No. of varieties	55		37	92
Peach:				
Trees	50	452	61	563
No. of varieties	20	452	61	533

* Approximate estimate.

** Including also the unnamed seedlings which have come to the station from outside parties.

† Including sand cherry and hybrids.

In addition to these orchard trees there are several thousand station seedlings under test in the station nurseries.

Much of this material has been originated in the plant breeding work which is being carried on by the Horticultural section of this station. The acquisition of the new tract of land for horticultural and forestry purposes is making it possible to accommodate and develop this work so that we now have one of the most extensive orchard breeding enterprises in existence and one which doubtless will contribute very materially to the horticultural development of Iowa.

The accompanying chart indicates the portions of the new tract which are being planted with orchards. Other portions are being planted with evergreens and other forest trees.

VII. Plant Breeding. In the last annual report of this section attention was called to the fact that one of the most important and logically a leading line of horticultural investigation here is the study which is being made of the principles of plant breeding and the application of those principles to the development of improved varieties for Iowa. A general study of the matter of breeding better orchard fruits is thus being made, including work with apples, pears, plums, cherries and peaches. During the current year that portion of this kind of work which deals with apple breeding has been established as a special project under the Adams Fund. The following is a general statement of the project:

Subject I. Principles:

Study of heredity in the apple, including investigation as to what unit characters or groups of characters in the apple follow Mendel's Law.

Subject II. Methods:

The application of the principles of breeding in the development of desirable winter varieties for the upper Mississippi valley.

EQUIPMENT.

Land, Buildings and Apparatus. This station already has sufficient equipment to start the proposed apple breeding work upon a good basis. There is plenty of land available, including portions already occupied by various orchards and nurseries. The station also has over five thousand feet of glass and an efficient range of hotbeds and propagating beds, also barns, sheds, tools and apparatus of various kinds. Its laboratory and herbarium equipment is somewhat limited, but the new Agricultural building which is nearing completion will offer suitable laboratory rooms and it is expected that provision will be made for necessary equipment of apparatus and herbarium facilities.

Material for Apple Breeding. The orchards and nurseries mentioned above include practically all of the hardiest cultivated varieties known to American horticulture, together with the leading commercial and amateur sorts which can be fruited in this state. They also include native and exotic species of the apple and many of their hybrids.

The relative hardiness, immunity to disease, and general adaptability to this territory of the older apples now in the station collection has to a considerable extent demonstrated in past years and has become a matter of more or less general horticultural knowledge.

Using parents selected from the above mentioned material this station has originated many thousands of seedling varieties, some few of which have come into bearing and produced a second generation. In the progress of the work many of these seedlings have perished or have been discarded. The following is a statement of the number of varieties now in the station orchards and nurseries which have been originated in this work.

STATEMENT OF THE APPLE SEEDLINGS PRODUCED AT THE IOWA STATION WHICH WERE GROWING ON THE GROUNDS OF THIS INSTITUTION JUNE 30, 1908.

Location	Parentage Known	Parentage Uncertain	Total
In nurseries	8,861	265	9,126
In orchards	571	418	1,030
Grand total			10,156

Through the agency of the Upper Mississippi Valley Plant Introduction Garden, it is proposed to add to this important collection whatever species of horticultural varieties the earth affords that may be deemed useful for developing desirable varieties for this region.

Besides the above mentioned material the station has recently added to its collection several lots of crosses from apples of known parentage which were obtained at the Geneva (New York) experiment station and which have there come into bearing.

Taking all these into account, it is apparent that opportunity is here offered to begin immediately observations on inheritance of characters in

the apples, which it is proposed to do. Collections of apples in other localities which contain varieties of known parentage will be visited from time to time as opportunity offers and if it is thought advisable to do so a portion of the proposed breeding will be done in such orchards. The propagation and management of the material thus obtained will, however, be carried on at this station.

In order to produce further material for study, certain crossbred varieties at this station will be selfbred to discover what characters in the apples are Mendelian.

The study of heredity in the apple, particularly with reference to what unit characters or groups of characters follow Mendel's Law, will be made the fundamental and primary object of investigation. At the same time, an effort will be made to gain a better knowledge of the methods of applying principles of breeding in the development of desirable winter apples for the upper Mississippi valley.

VIII. Plant Introduction Garden. Reference has already been made to the Upper Mississippi Valley Plant Introduction Garden. Special arrangements have been entered into with the office of seed and plant introduction in the Bureau of Plant Industry of the U. S. Department of Agriculture whereby the Bureau of Plant Industry has established a garden here to receive and propagate plant material secured in foreign lands by its expert explorers. It is confidently expected that some of this material will prove especially valuable for use in breeding improved horticultural plants for Iowa and adjacent states. It may therefore be justly regarded as a most valuable adjunct to plant breeding enterprises here and at other experiment stations in this interior region of the United States.

The Iowa State College is to be congratulated upon having this plant introduction garden located here, especially because it tends constantly to increase the collection of rare horticultural plants at this institution and thereby adds materially to the value and efficiency of the local equipment.

FORESTRY.

I. Fence Post Preservative Treatment. An investigation of the treatment of fence posts with preservatives and especially the treatment of commonly available soft-wood posts has for two years been carried on here by the station forester in co-operation with the United States Forest Service. Some 3,000 posts, representing the important soft-wood trees growing in Iowa, have been furnished by farmers and others for treatment. A limited number of each lot has been reserved for examination and chemical analysis. It is estimated that an additional year's work will be required to satisfactorily consummate this experiment and the forest service joins with this department in recommending that the work be continued throughout the coming year under the arrangements existing heretofore.

II. Forest Garden. For the purpose of testing the various species of evergreens, both native and exotic, which are adapted to the production of posts, poles, repair material and fuel in Iowa, we established in 1906 a forest garden. The past year was a very unsatisfactory planting season on account of the prolonged dry weather and as a result the loss from trans-

planting was unusually heavy. A portion of the garden was thoroughly overhauled this spring and all vacancies refilled. On account of the limited funds it is not proposed to enlarge the garden any at this time; on the other hand, it seems advisable to replant any missing places in the remainder of the garden the coming spring.

III. Ames Forestry Experiment. Work was begun in the spring of 1906 in co-operation with the United States Forest Service under an outline entitled "Plan for Experimental Work in Forestry at the Iowa State Experiment Station." Under this project the following additions have been made to the plantings this year: 4,200 catalpa and 1,000 white pine. An evergreen nursery has also been established which is designed as a source of supply for the future plantings in this work.

It is recommended that this project be continued the coming year according to the plan originally entered into with the U. S. Forest Service.

NEW LINES OF INVESTIGATION.

During the coming year it is proposed that the forester take up a special study of Hardy Catalpa, European Larch and White Ash to determine so far as possible their desirability for woodlot planting. In view of the demands of the work now in progress upon the funds of the section and the time of the staff, no other new lines of work are projected for the ensuing year.

Respectfully submitted,

S. A. BEACH,
Horticulturist.

AGRICULTURAL ENGINEERING.

The following report in regard to the work of the Agricultural Engineering section has been divided into heads:

I. INVESTIGATIONS CARRIED TO COMPLETION.

The section prepared for publication during the past year a bulletin entitled "The Comparative Values of Alcohol and Gasoline for Power and Light." The data contained in this bulletin concerning lamps using gasoline and alcohol is the first of its nature published as far as known to the writer.

This line of investigation was undertaken for the purpose of making a comparison between (1) the heat value of alcohol and gasoline, (2) their economy in the production of light, (3) their economy in the production of power, and (4) the relative safety of alcohol and gasoline for general use.

The following is a summary of the results of the experimental work as far as completed in regard to the comparative values of alcohol and gasoline in the production of light and power.

1. The higher heat value of 94 per cent alcohol is but 68 to 71 per cent that of gasoline.

2. The lower heat value (the value more nearly attained in practice) of 94 per cent alcohol is but 66 to 69 per cent that of gasoline.

3. When used for the production of light, 94 per cent alcohol will produce from 53 to 85 per cent as much light as an equal volume of gasoline.

4. Alcohol of 94 per cent purity must be sold for from eleven to seventeen cents per gallon to compete with gasoline for lighting purposes at twenty cents per gallon (the present retail price of gasoline in Ames).

5. Alcohol, when used in a generator lamp, will produce from two to four times as many candle power hours as kerosene in a wick lamp.

6. It was found impossible to soot the mantels of any of the lamps with alcohol.

7. Alcohol of 94 per cent purity, when used in engines designed for gasoline, has but 68 to 85 per cent the value of gasoline in the production of power.

8. To compete with gasoline at twenty cents per gallon for use in gasoline engines, 94 per cent alcohol must be sold for from thirteen to seventeen cents per gallon and 90 per cent alcohol from eleven to fifteen cents per gallon.

9. None of the engines could be started readily with alcohol, although a few could be started with less difficulty than others.

10. After having once been started with gasoline and warmed up, the carburetors as designed for gasoline vaporized the alcohol successfully, except in one instance.

11. No doubt the gasoline carburetor can be readily changed to permit the use of alcohol as well as gasoline in the same engine.

12. Experimental work does not include tests of the special designed alcohol engine, which should show better economy in the use of alcohol.

13. Gasoline cannot be used readily in a special designed alcohol engine using high compression on account of pre-ignition.

14. The odor of the exhaust of an engine when using alcohol is not as unpleasant as when using gasoline.

15. Alcohol is much more pleasant to handle.

16. There is much less danger from fire when using alcohol than when using gasoline owing to the fact that alcohol does not vaporize as readily as gasoline and its flame may be extinguished with water.

INVESTIGATIONS IN PROGRESS.

A co-operative experiment has been conducted with the irrigation investigations, United States Department of Agriculture. A report of the work for the past year is as follows:

Report on Co-operative Irrigation Experiment, 1907.—This experiment was continued on a part of the field set apart for this purpose in the spring of 1905. The accompanying blue print shows the area and location of each plot.

The general plan of the preceding year was followed. The plots to be irrigated were carefully releveled in each case except the blue grass and

alfalfa plots, which were so rough as to cause the abandonment of that portion of the experiment last year, and were allowed to remain in this condition until this spring, when it was too late to re-establish the sod which would necessarily be torn away.

The major portion of the work outlined for this year was successfully carried out. That is, yields were accurately measured and parallel conditions were maintained in every respect, except that when considered beneficial the north half of each plot was flooded with approximately two inches of sewage, analyses of which appear later in this report.

The difficulty of securing good help, together with the urgency of other tests being carried on by those in charge, permitted the beets and mangelwurzels to become quite weedy. This together with the fact that only a poor stand was secured caused this test to be worthless as such.

Cabbage.—May 17 one-fourth pound Premium Flat Dutch cabbage seed was sowed in bed 12 feet by 15 feet, surrounded and divided lengthwise into four smaller beds by irrigation ditches. These ditches were immediately filled with water and kept full till all beds but one were soaked to the center. The few seeds thus not receiving the sewage were about four days later in coming up than those receiving the sewage. The setting out of these plants was somewhat delayed or prolonged by early June rains, but in setting out a row it was continued through both plots so that conditions in each were equal.

The north half was irrigated when needed during the summer, the dates being as follows: July 3, August 17, 24, and September 7. The total for the summer was estimated to be eight inches.

In harvesting the cabbage the heads were graded as follows: Large solid, small solid, medium and soft. They were cut at top of ground and weighed with all leaves on with the exception of rows 8, 9 and 10, which were pulled and the dirt shook from off the roots.

Row	Irrigated													Non-irrigated													
	Large Solid		Small Solid		Bursted		Mediumly Soft		Worthless not headed etc.		Total		Missing	Large Solid		Small Solid		Bursted		Mediumly Soft		Worthless Soft, etc.		Total		Missing
	No. Heads	Wt.	No. Heads	Wt.	No. Heads	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.
1	32	461	8	98							40	559	17	24	318	2	21	5	59	19	175	6	57	56	630	1
2	22	315	15	119	4	53	10	124			51	641	6	17	251	5	61	9	99	19	258	5	50	53	719	2
3	24	336	3	23	5	56	15	196	6	61	53	672	4	11	139	10	93	4	46	10	121	12	135	47	534	10
4	16	219	5	50	7	58	23	257	7	48	58	632	0	16	210	5	57	10	97	10	142	13	110	54	616	3
5	24	294	6	54	9	67	12	125	3	18	54	548	3	11	136	10	90	7	49	19	190	9	55	56	520	1
6	13	170	9	72	10	84	20	242	5	33	57	601	0	24	299	4	29	11	72	12	133	2	5	55	536	2
7	20	267	5	51	4	32	10	242	7	50	46	642	11	19	252	6	50	9	66	13	139	1	7	48	514	9
8	25	359	10	118	3	41	14	145	3	20	55	683	2	16	208	12	117	10	84	9	79	9	71	56	559	1
9	19	262	14	159	2	15	15	212	5	35	55	683	2	15	237	17	158	8	73	8	99	4	46	52	613	5
10	12	127	11	135	2	25	17	230	7	60	49	577	8	17	243	12	138	6	64	15	177	4	26	55	548	2
Grand totals.	207	2812	76	909	46	431	136	1875	43	325	518	6288	53	170	2293	84	814	79	709	134	1513	65	562	534	5889	36
Average	20.7	13.6	7.6	11.96	4.6	9.37	13.6	13.78	4.3	7.56	51.8	12.15	5.3	17.0	13.5	8.4	10.22	7.9	8.98	13.4	11.3	6.5	8.65	53.4	11.04	3.6

	Irrigated.	Non-irrigated.
Marketable Cabbage (first quality) per acre	42,280 lb.	34,350 lb.
Marketable Cabbage (second qaulity) per acre	20,050 lb.	16,180 lb.
Marketable Cabbage, total per acre	62,330 lb.	50,530 lb.
Bursted and soft, per acre	8,100 lb.	13,310 lb.
Total feed for stock per acre	70,430 lb.	63,840 lb.

It is thought that the irrigation had no bearing upon the percentage of stand secured. Therefore, the percentage of marketable cabbage and the average weights of same are the important things shown in this table.

Irrigated row No. 1 passed through what was originally the bed of plant, many of which were allowed to stand for transplanting. This accounts for only 40 heads being in this row which should contain 57.

Corn was planted May 11th, cultivated three times in the last of May and during June, and hoed in the middle of July.

During June and July there was no opportunity to irrigate as rains were so frequent as to scarcely give opportunity for cultivation. Corn was irrigated August 20th, 26th and September 7th. Approximately 2 inches of water was applied each time. Total 6 inches.

In harvesting the corn a record was made of the number of stalks in each hill, also the number of ears of each of the following grade: Seed, marketable, nubbins and worthless. This data was summed up for each row and plot showing the grades of ears and weight of each for each row.

These detailed data were collected and arranged to ascertain if a heavier stand could be profitably raised on the irrigated land than on that non-irrigated. It does not appear from these data that such is possible, as the hills which did the best in each case were of the same number of stalks.

However, the irrigated land did raise a larger percentage of good ears and a smaller per cent of nubbins and worthless ears. The yield was as follows:

Irrigated plot	Non-irrigated
1092 lbs.	1055 lbs.
59.8 bu. per acre	57.8 bu. per acre

Last year's yield for these same plots, neither of which were during that season irrigated or ever had been, was as follows:

82.15 bu. per acre	70.7 bu. per acre

Plot shown on map seeded to barley April 10th in drills 12 inches apart. The seed was drilled at the rate of two bushels per acre. Small trenches were made in every other space between the rows.

North plot was irrigated May 10th and June 15th and approximately two inches of water was applied each time.

July 19th plots were trimmed to 48x140 feet and cut. Grain stood well. Irrigated plot was two days later in ripening, but both were cut at same time.

The barley was threshed August 1st, the yield being as follows:

Irrigated	Non-irrigated
375 lbs.	288 lbs.
Wt. per bu. 45.3	Wt. per bu. 44½
Yield per acre in 45 pound bushels:	
54 bu. per acre	41.4 bu per acre

Two plots of one-twentieth acre each were laid off as shown by blue print. Blue grass was irrigated April 24th, May 11th and two inches water applied each time. Total four inches.

Field note made May 11th. Blue grass non-irrigated is quite dry, showing a distinct brown color and growing very slowly. Irrigated grass is growing well. The difference in color shows distinctly at a distance.

June 29th the bluegrass was cut, weighed and samples were taken to determine moisture in grass.

Weight and moisture as follows:

Irrigated	Non-irrigated
758	518
per acre 15160	10360
Moisture 60.38 per cent.	67.26 per cent.

The second crop contained more foxtail than bluegrass. Consequently no more data were taken.

Two plots were laid out containing one-twentieth acre as shown by blue print. This ground was considered too rough to utilize for the experiment last year. It could not be leveled without breaking sod so water was applied by means of portable flumes.

Irrigated April 13th and May 11th. Two inches water was applied each time, making total of 4 inches.

Field note made May 11th reads as follows: "Irrigated alfalfa growing nicely while non-irrigated grows slowly and has smaller, tougher leaves. Difference in color is distinctly visible at a distance."

It was the intention of the Section to weigh the alfalfa up as hay after being cured instead of green as the blue grass was weighed. The weather prevented the hay drying sufficiently for weighing until July 5th. In the meantime the hay had been turned several times losing considerable foliage. In cutting, it was estimated that irrigation had caused as large an increase in the alfalfa as in the blue grass. Therefore, the following data is not considered reliable.

Weights of alfalfa hay:

Irrigated Plot.	Non-irrigated Plot
256 lb.	250.5 lb.
Per acre 5,120 lb.	5,010 lb.

The second crop of alfalfa was too weedy to be cut as alfalfa.

Sewage Water.—Raw sewage was used directly from the septic tank in which the sewage is only areated. Considerable solid matter was carried in the water. The following is an average analysis of 32 carefully secured samples of this water.

	Parts per 1,000.000.
Chlorine	72
Solids on evaporation	1,549
Solids at 180°	1,385
Loss on ignition	1,010
Albuminoid ammonia	13.3
Free ammonia	19.6
Nitrates	.53
Nitrites	3.2
Oxygen consumed in 15 min	19.6
Oxygen consumed in 4 hrs	31.8
Bacteria per c. c.	1,854,500

These determinations were not continued in the laboratory until reactions had entirely ceased, therefore, we are sure that more than 36.6 parts per million of the irrigation water was ultimately available to the crops as soluble nitrates as decomposition progressed.

The co-operative irrigation experiment is being continued this year. The benefits to be derived from the irrigation of grass and hay crops are the main features of this year's work. Italian rye grass, alfalfa, red clover and blue grass are being irrigated with sewage water and timothy by water obtained from College Creek. The other crops irrigated with sewage water are sugar beets, potatoes for alcohol production, and corn.

Investigation Concerning Wagon Draft.—A large portion of the time of the Experimentalist for the past year has been devoted to investigation concerning wagon draft. The following is a report of the progress of the work. The investigation is divided into two parts, dynamometer tests on sample roads and laboratory tests to determine axle friction.

Part I. Dynamometer Tests.

Description and location of sample roads:

1. Sod.—Blue grass sod located southeast of heating plant for Agricultural Hall. Run was about 150 feet long and parallel to the street.

2. Gravel.—A level portion of the road northeast of Margaret Hall about 150 feet long.

3. Common Earth Road.—A stretch of earth road 150 feet long north of the athletic field.

4. Corn Stubble—A 150 foot stretch directly west of the Horticultural orchard in experimental plots.

Wheel Equipment.—

No. 1. Electric steel wheels, cast hub and skein, smooth tires:
- Height of wheels, front..... 28"
- Height of wheels, rear..... 34"
- Width of tire..... 5"
- Weight of wagon empty with driver.....1280

No. 2. Winona wood wheels, cast skein:
- Height of wheels, front..... 36½"
- Height of wheels, rear..... 44½"
- Width of tire..... 3"
- Weight of wagon empty with driver.....1280

No.3. Winona wood wheels, cast skein:
- Height of wheels, front..... 45½"
- Height of wheels, rear..... 53½"
- Width of tire..... 3"
- Weight of wagon empty with driver.....1340

No. 4. Winona wood wheels, cast skein:
- Height of wheels, front..... 44½"
- Height of wheels, rear..... 53½"
- Width of tire..... 4"
- Weight of wagon empty with driver.....1372

No. 5. Winona wood wheels, cast skein:
- Height of wheels, front..... 45"
- Height of wheels, rear..... 54"
- Width of tire..... 1¾"
- Weight of wagon empty with driver.....1200

No. 6. Gillette roller bearings, wood wheels:
- Height of wheels, front..... 43"
- Height of wheels, rear..... 49"
- Width of tire..... 3"
- Weight of wagon empty with driver.....1350

No. 7. Moffett roller bearing, wood wheels:
- Height of wheels, front..... 46½"
- Height of wheels, rear..... 54½"
- Width of tire..... 4"
- Weight of wagon empty.....1925

No. 8. Davenport roller bearing, steel wheels:
- Height of wheels, front..... 40"
- Height of wheels, rear..... 48"
- Width of tire..... 1¾"
- Weight of wagon with driver.....1265

No. 9. Davenport roller bearing, steel wheels:
- Height of wheels, front..... 40"
- Height of wheels, rear..... 48"
- Width of tire..... 3"
- Weight of wagon empty with driver.....1355

No. 10. Davenport roller bearing, steel wheels:
- Height of wheels, front..... 40"
- Height of wheels, rear..... 48"
- Width of tire..... 4"
- Weight of wagon empty.....1405

TABLE OF RESULTS ON WAGON DRAFT

RESULTS OF TEST NO. 1.

Number of Wagons	Blue Grass Sod			Gravel Road			Earth Road			Corn Stubble		
	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.
1	129	244	186.5	83	120	101.5	163	82	122.5	325	266	295.5
2	127	258	192.5	104	126	115	155	100	127.5	386	297	341.5
3	130	235	182.5	80	127	103.5	192	75	133.5	348	260	304
4	140	231	185.5	90	142	116.0	186	86	136	340	247	293.5
5	158	236	197	87	128	107.5	170	73	121.5	400	339	369.5
6	105	233	168.8	72.5	110	91.2	175	72.5	123.8	360	275	317.5
7	130	290	210	90	147.5	118.8	212.5	85	148.8	370	305	337.5

Number of Wagons	Name of Wagon	Wheels		Tire	
		Heights			
		Front	Rear		
1	Electric	28	34	5"	Load 2000 Net.
2	Winona	44 1-2	53 1-2	3"	
3	Winona	45 1-2	53 1-2	3"	
4	Winona	44 1-2	53 1-2	4"	
5	Winona	45	54	1 3-4"	
6	Gillette Roller Bearing	43	49	3"	
7	Moffett Roller Bearing	46 1-2	54 1-2	4"	

Date of taking records, November 15th.

Condition of roads: Ground firm and dry. Traveled road, quite smooth. No frost in the ground.

RESULTS OF TEST NO. 2.

Number of Wagons	Blue Grass Sod			Gravel Road			Earth Road			Corn Stubble		
	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.
1	95	204	149.5	90	130	110	145	60	102.5	255	175	215
2	105	205	155	95	175	135	195	70	132.5	260	145	202.5
3	97	195	146	75	125	100	170	40	105	245	170	207.5
4	95	200	147.5	65	115	90	155	45	100	220	175	197.5
5	87.5	217.5	152.5	65	115	90	142.5	37.5	90	195	180	187.5
6	71	195	133	71	129	100	186	56	121	211	160	185.5
7	100	220	160	85	172.5	128.7	205	95	150	290	195	242.5
8	85	190	137.5	90	135	112.5	167.5	55	111.2	260	162	211
9	85	200	142.5	85	125	105	175	80	127.5	252.5	185	218.7
10	85	182.5	133.7	70	115	92.5	185	75	130	247.5	170	208.7

RESULTS OF TEST NO. 2—CONTINUED

Number of Wagons	Name of Wagon	Wheels		Tire	
		Height			
		Front	Rear		
1	Winona-E. W.	28	34	5"	Load 2000 Net.
2	Winona	44 1-2	44 1-2	3"	
3	Winona	45 1-2	53 1-2	3"	
4	Winona	44 1-2	53 1-2	4"	
5	Winona	45	54	1 3-4"	
6	Gillette	43	49	3"	
7	Moffett	46 1-2	54 1-2	4"	
8	Davenport	40	48	1 3-4"	
9	Davenport	40	48	3"	
10	Davenport	40	48	4"	

Date of taking records, December 11th.

Conditions of roads: Very good only a slight amount of frost. Sod dry and firm. Gravel road with a small amount of loose gravel on surface. Corn stubble dry and firm. Earth road clean.

RESULTS OF TEST NO. 3.

Number of Wagons	Blue Grass Sod			Gravel Road			Earth Road			Corn Stubble		
	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.
1	295	370	332.5	300	307	303.5	420	305	362.5			
2	345	425	390	245	305	275	440	295	367.5			
3	315	520	417.5	245	300	172.5	470	302	386	785		
4	335	390	362.5	270	320	295	440	280	360			
5	420	535	477.5	240	245	242.5	415	255	335			
6	260	350	305	210	260	235	355	257	306			
7	275	370	322.5	235	297	266	460	252	356			
8	297	360	328.5	200	257	228.5	365	230	297.5			
9	225	340	282.5	200	255	227.5	350	247	298.5			
10	230	315	272.5	205	300	252.5	330	215	272.5			

Number of Wagons	Name of Wagons	Wheels		Tire	
		Heighth			
		Front	Rear		
1	Winona E. W.	28	34	5"	Load 2000 Net.
2	Winona-E. W.	44 1-2	44 1-2	3"	
3	Winona-E. W.	45 1-2	53 1-2	3"	
4	Winona E. W.	44	53 1-2	4"	
5	Winona-E. W.	45	54	1 3-4"	
6	Gillette	43	49	3"	
7	Moffett	46 1-2	54 1-2	4"	
8	Davenport	40	48	1 3-4"	
9	Davenport	40	48	3"	
10	Davenport	40	48	4"	

Date of taking records, March 9th and 10th.

Condition of roads: Surface frost all out. Ground loose on top. The sod was very soft and tires cut in badly. The upper one inch of gravel road soft, but hard underneath. Earth road muddy to a depth of two inches.

RESULTS OF TEST NO. 4.

Number of Wagons	Blue Grass Sod			Gravel Road			Earth Road			Name of Wagon
	1st	2nd	Aver.	1st	2nd	Aver.	1st	2nd	Aver.	
1	250	470	360	420	497	458.5	580	320	450	Winona-E. W.
2	245	400	322.5	300	537	418.5	425	200	312.5	Winona
3	205	405	305	235	325	280	375	175	275	Winona
4	167	382	274.5	200	315	257.5	352	160	256	Winona
5	167	345	256	225	335	280	375	185	280	Winona
6	215	380	297.5	317	390	353.5	485	297	391	Gillette
7	135	345	340	205	300	252.5	432	225	328.5	Moffett
8	147	310	228.5	170	257	213.5	397	202	299.5	Davenport
9	150	335	242.5	215	320	267.5	437	255	346	Davenport
10	145	320	237.5	222	345	283.5	430	247	338.5	Davenport
10	180	355	267.5	250	320	285	400	195	297.5	Davenport (snow)

Number of Wagons	Wheels			
	Heighth		Tire	
	Front	Rear		
1	28	34	5"	Load 4000 lb. Net.
2	36 1-2	44 1-2	3"	
3	45 1-2	53 1-2	3"	
4	44 1-2	54 1-2	4"	
5	45	54	1 3-4"	
6	43	49	3"	
7	46 1-2	54 1-2	4"	
8	40	48	1 3-4"	
9	40	48	3"	
10	40	48	4"	
10	40	48	4"	

Date of taking records, March 23d.

Conditions of roads: Muddy and soft, one-third inch of snow, melting. Mud 1 1-2 to 2 inches deep.

Axle Friction Tests.—The object of these tests was to determine the advantage, if any, of one design of wagon axle and bearing over another, pertaining specially to a comparison between ball or roller bearing and the ordinary friction bearing. By determining the actual axle friction from these different spindles, a comparison with the total draft of a wagon on the road can be made and the ultimate limit of improvement from this source determined. It was also desired to determine the difference, if any, in the effectiveness of different lubricants for wagons.

The draft due to rolling friction is so much greater and more variable than that due to axle friction that it seemed necessary to eliminate the former in order that the variations of the latter could be determined. This would not have been necessary if in all wagons to be tested each spindle had been aligned with the spindle on the opposite end of the axle, but with dished wheels this is seldom if ever the case. These facts prevented the adoption of any methods recorded for any such tests if accurate results were to be obtained. Therefore, the Section was compelled to adopt an entirely new method which was slow but finally resulted in as accurate data as could be expected.

The method was as follows: In order to eliminate the rolling friction, the axle was inverted, lifted entirely free from contact with the ground and suspended by means of rigid pipes secured rigidly to the axle while the upper ends of the pipes were suspended by means of leaf springs from a rigid support bolted to the ceiling of the laboratory. The breadth of these springs were parallel to the length of the axle thus making the unit free to move in the plane of the rotation of the wheel penid. Concrete weights which plus the weight of the wheel represented the weight on each bearing or one-fourth the gross weight of the wagon minus the wheels, were then clamped on the wheel in such positions as to be in balance. Also a light scale beam was clamped to the pipe nearest the weighted end and projecting either way from the pipe in a plane parallel to the plane of rotation of the wheel. In rotating the wheel the line of contact between the wheel and axle shifts in the direction of rotation until it coincides with a line determining the tangency of a plane having a deflection from the horizontal equal to the angle of friction. The center of gravity of the wheel and its load move this same distance in relation to the center of gravity of the axle and each move positively a portion of this distance inversely proportional as the ratio of their weights; weight or pipe, scale beam and weights being integral with the axle. Then by shifting the weight on the scale beam to a point where it will prevent any motion of the axle, except vibratory, the product of the weight and the distance shifted is equal to the torque of the resistance of friction due to the relative rotation of the box and axle. Then by reversing the direction of rotation and the torque, the algebraic difference in the torques gives twice the friction torque. The most difficult problem was to determine accurately the state of equilibrium between the friction torque and the known balancing torque. This necessitated the certain detection of a change of .00001 of an inch in the mean position of the axle, while vibrating.

This was accomplished by filling with water a box, one side of which was a thin copper diaphram 7x22 inches. To each side of the center of this diaphram was clamped wood blocks connected rigidly to the axle. Thus the volume of the box depends upon the position of the axle. The only opening from the box to the air was through a small straight horizontal glass tube of considerable length. Any motion of the axle was indicated by a movement of the water surface in the tube and exaggerated by the ratio of the area the portion of copper diaphram moving with axle, to the area of the bore of the tube. This really amounted to a ratio of approximately 8,000 to 1; therefore, since the whole motion, if not restrained by the scale beam was usually not less than .0001 inches. This multiplied by 8,000 is .8" and since one-tenth of this could be determined readily, the range of error was expected to be less than 10 per cent and .00001 inch could be determined readily. This expectation was verified by uniform results obtained from a large number of tests. It might also be mentioned in this connection that this method eliminates from the results the friction between the wheel and the air.

In the following table the results obtained have been tabulated:

Name of Wagon	Diameter of Wheels in inches		Mean radius of axle	Kind of bearing	Load in pounds	Condition of Lubrication	Coefficient of Friction		Draft per ton Pounds		Per cent of draft due to spindle friction	Total draft on muddy road	Per cent of draft in mud due to spindle friction
	Front	Rear					Motion	Rest	Spindle	Total			
Moffett ...	46.5	54.5	1.406	Roller and Ball	261	Cleaned and oiled, Red engine oil	.0001332	.000128					
Moffett ...	46.5	54.5	1.406	Roller and Ball	649	Red engine oil	.0001264	.0001295	.518	68.8	.752	246	.2102
Moffett ...	46.5	54.5	1.406	Roller and Ball	1031	Red engine oil	.000224	.0001925	.997	68.8	1.447	246	.403
Davenport	40	48	1.604	Roller	530	Very dry	.176	.0127	13.5	* 81.2	16.6	* 182.8	7.4
Davenport	40	48	1.604	Roller	530	Oiled with engine oil	.001762	.00651	1.26	69.2	1.82	170.8	.737
Davenport	40	48	1.604	Roller	520	Cleaned and oiled	.001719	†.0242	1.02	69.2	1.47	170.8	.513
Davenport	40	48	1.604	Roller	127	Cleaned and oiled	.00658	.01384					
Winona ...	28	34	1.7	Cast tapered Spindle and Skein	485	Very dry	.0547	.371	4.85	* 72.17	6.73	* 409.4	1.18
Winona ...	28	34	1.7		485	Oiled with hard oil	.00868	.1809	.768	68.17	1.13	405.4	.189
Winona ...	28	34	1.7		485	Cleaned and oiled	.0098	.1595	.862	68.17	1.26	405.4	.212
Winona ...	28	34	1.7	Very rough	99	Cleaned and oiled	.0111	.183	.987				
Milbourn .	38	44.3	1.15	Sewaged steel pipe Smooth	499	Very dry	.0435		2.00				
Milbourn .	38	44.3	1.15		499	Oiled with hard oil	.0114	.2454	.509				
Milbourn .	38	44.3	1.15		499	Cleaned and oiled	.0054	.2384	.242				
Milbourn .	38	44.3	1.15		98	Cleaned and oiled	.0146	.447	.65				

* The total draft was determined by means of dynamometer tests and, of course, the axles were well oiled, therefore in calculating these percentages the difference in draft per ton due to spindle friction for well oiled and very dry axles was added to the total draft per ton as determined on road.

† It is hard to account for this value, but experiment was repeated and the same data resulted.

The compartive tests of lubricants were inconclusive in so far as different brands were concerned and wearing qualities of the oil could not be made advantageously because conditions were so different from those on the road. However, the following well known facts were confirmed. A lubricant must have enough body to prevent its being squeezed out from the bearing, but more body is rather undesirable. Roughness and looseness of the bearing together with slow speed increase the liability of lubricant to be squeezed out. Thus castor-oil or some rather light mineral oil is desirable for carriages while for heavy wagons with cast skeins the grease could scarcely be too heavy and viscous. Between these two limiting types of bearings will be found use for all grades of oil.

Investigation of Silo Construction.—The Section has now in preparation a bulletin on silo construction. The success, durability, convenience and cost of the various types and designs of silos have been investigated, not only in Iowa, but in parts of Illinois, Wisconsin and Michigan. The investigation has included a thorough canvas of the conditions of the silos in the state by circular letters and a personal investigation by the Experimentalist of the various types of silos in use. The Section has also prepared designs for silos to be constructed of concrete and building tile.

NEW LINES OF INVESTIGATIONS.

The Agricultural Engineering Section has arranged to carry on investigations along the following lines. Some of the preliminary work has already been completed.

1. Investigation of the construction, sanitation, ventilation, convenience and cost of dairy barns.
2. Investigation of the construction, sanitation, ventilation, convenience and cost of general farm barns.
3. Investigations of the various kinds of roofing materials in use and the various methods of roof construction.
4. Investigation of the success and durability of cement drain tile and the proper construction of the same.
5. Investigation of the machines and devices in use for the grading and cleaning of grass and grain seeds.

Respectfully submitted,

J. B. DAVIDSON,

Professor of Agricultural Engineering.

FARM CROPS SECTION.

INVESTIGATIONS CARRIED TO A DEFINITE CONCLUSION DURING THE PRESENT YEAR.

Bulletin 96, from this station, entitled "Oats," was issued in March, 1908. The purpose of this bulletin was to show:

1st. That some varieties of oats are better adapted to Iowa conditions than others.

2nd. That the fanning and grading of oats is a very important factor in the preparation of the seed.

3rd. That the loss caused by smut is much greater than is generally supposed, and something that can be easily remedied.

4th. The importance of a properly prepared seed bed.

5th. That the yield per acre is influenced by the amount of seed sown.

6th. That drilling oats is preferable to broadcasting.

Variety Test.—In the variety test during the past ten years, 70 varieties of oats have been grown at the Iowa Experiment Station. The original test started with 13 varieties in the year 1898; during the five years, 1898 to 1902 inclusive, this number was increased to 36. Of these 36 varieties, after having discarded the poorest, only six remained which gave results which would warrant their being continued during the last five years of this experiment. The names of these varieties are Early Champion, Siberian, Green Mountain, Joanette, Silvermine and White Russian. Of these, but one, namely, the Silvermine, can be said to have held a place as the leading oat of the state in yield per acre. During the last five years, 1903 to 1907 inclusive, 44 varieties have been grown; 25 of which with more than a two-year record. The final results of this variety test places the Silvermine and Kherson varieties at the head of the list, producing more bushels per acre for an average of three, four and five years than any of the other varieties which have been tested. The Silvermine ripens in from 95 to 100 days; the Kherson in from 90 to 95 days. The Wisconsin No. 4, or Swedish Select, has also proven itself to be an oat well adapted to Iowa conditions.

Fanning and Grading.—Special attention was called to the 1907 oat crop, which was very light, being from 30 to 50 per cent hull and averaging in weight from 16 to 25 pounds per bushel. Special attention being called to the fact that the larger, plumper grains are the best for seed purposes; that only by thorough fanning and grading can the light, unfilled grains, as well as the small plump ones be discarded.

Loss Caused by Smut.—From the results of the data secured from 362 farmers giving counts of percentages of smut made in 658 fields, it was very clearly shown that the per cent of smut in the oat crop of the state was a serious matter and one which could well receive attention. In the comparative results with 40 fields, the seed of which had not been given

a treatment for smut, with 40 other fields where the seed had been treated for smut, it was found that the fields where the seed was treated had 0.5 per cent smut, while those that were not treated had more than ten times that amount (5.9 per cent), or an actual loss of 5.4 per cent of the crop. This means a loss of 1.6 bushels per acre, when it would have cost but 8 cents per acre for treatment. When this is figured up to a 40-acre field we find that the farmer has sold 64 bushels of oats for about $3.00. The formalin treatment was recommended for eliminating smut in oats.

The Importance of a Properly Prepared Seed Bed.—The preparation of the seed bed is a much neglected operation; in fact, the practice very generally carried on is not to first prepare the ground before the oats are put in, but rather disc and harrow after the oats are put in that the seed may be covered. From the compilation from answers received through a circular letter sent out by the Soils department to the farmers of the state, to which 452 replies were received, it was observed that practically all sow oats on stalk ground, and that 71 per cent sow on unprepared stalk ground. Almost all harrowed in the oats after seeding, while 70 per cent disced the ground after sowing. In the preparation of the seed bed for oats, it is recommended that corn stalk ground should be disced at least twice, lapping the disc half. In addition to this it will pay to double harrow. Some seasons will require more discing. Seldom can the seed bed be prepared with less. The disc drill will be found especially suitable for putting in oats on stalk ground. As to whether the ground should be harrowed afterward depends largely upon conditions. In general it is not necessary when a good seed bed has been prepared before hand. It is essential that the seed be covered and as evenly as possible, at a depth of from 1½ to 2½ inches.

Rate of Seeding.—The amount of seed which should be sown on an acre will vary somewhat with the land and method of seeding. In all the experiments carried on at this station with reference to rate of seeding the disc drill has been used. It will be seen by the following table that three bushels per acre has, in every instance but one, given us a heavier yield than has a less amount. The table shows the results for three years with an early and a medium variety.

SIX EXPERIMENTS SHOWING THE EFFECT OF "RATE OF SEEDING" UPON YIELD OF OATS.

Rate Per Acre	1899	1906			1907	
	Early Champion	Wis. No. 4	Kherson	Silver Mine	Kherson	Silver Mine
4 pks.	35.1	50.9	61.2	54.7	40.9	22.5
6 pks.	41.4	65.0	69.3	61.9	48.7	24.6
8 pks.	41.6	66.8	66.9	62.5	50.9	27.8
10 pks.	41.0	68.7	74.3	65.0	45.6	28.4
12 pks.	38.7	70.8	74.3	77.5	53.1	25.6

Drilling vs. Broadcasting.—The drill is a profitable implement for the farmer to use, one year with another. The oats may be more evenly distributed over the field and covered to a more uniform depth by the use of the drill than any other method. In seasons like 1907 with its cold, dry spring the advantage of using a drill is very much in its favor. It is very evident that the drill not only saves seed but also increases the yield. The data from the Iowa Experiment Station for 1907 shows an increase of over nine bushels per acre in favor of drilling. Figuring that at 33 1-3 cents per bushel we find that less than 35 acres would have paid for a drill last year. So large a difference would hardly be expected in years more favorable for oat production. Under favorable conditions, however, the drill still has its advantages.

Conclusion.—Iowa raises on an average of 29.5 bushels of oats per acre. The highest yield in five years has been 34 bushels. The result of the work at this station shows that the yield of oats in Iowa can be substantially increased. By the use of better varieties, a better quality of seed, treatment for smut, better preparation of the seed bed and drilling, this average should be raised to more than 40 bushels per acre. Oats would not then be merely "A crop necessary for rotation."

INVESTIGATIONS IN PROGRESS AT THE PRESENT TIME TO BE CONTINUED DURING THE COMING YEAR.

CORN.

1. Individual Ear Test.—In this test we have 269 ears of Reid's Yellow Dent corn selected because of special desirable characteristics; many of them being the product of high yielding ears. A portion of the ear is planted; the rest is saved. The best of these will be mated in breeding blocks next year.

2. Breeding Blocks.—There are 28 of these in number, in which are being mated 56 ears; all of which have been selected because of their high yielding qualities, together with other desirable characteristics. The ears used in these breeding blocks were last year given an individual ear test. They are the best of 220 ears which were tested in this manner. None of the 56 ears which we are mating yielded at a less rate than 70 bushels per acre.

3. Germination Box Test.—This experiment was carried on last year and is being continued this year. Ears germinating strong, weak and bad in the germination box are then planted in the field, where special attention is paid to their strength and vigor in the field as well as their relative yields per acre. In this test we are using 300 ears of corn.

4. Number of Kernels per Hill.—In this, the experiment of last year is being continued to determine the influence on the quality and quantity produced by different number of kernels being planted per hill. The following number being used: 2, 2½, 3, 3½, 4, 4½, 5.

5. Cultivation Experiment.—To determine the influence upon the yield per acre with shallow and deep cultivation, the above are being carried on, which in addition to those of the past two years are to be incorporated in a bulletin on corn which the Farm Crops section will put out this coming year.

6. Corn Shrinkage Test.—To determine the shrinkage of corn under crib conditions.

ALFALFA.

1. Method of seeding. Drilling vs. broadcasting.
2. Time of seeding. Spring seeding vs. fall seeding.
3. Soil inoculation. Inoculated vs. non-inoculated.
4. Shrinkage test. To determine the shrinkage of alfalfa stored in mow. Along with this a comparative test is being made with the shrinkage of clover hay.

SMALL GRAIN.

Nursery.—A number of our breeding plots necessarily increase very rapidly from year to year. In the annual report of the Farm Crops section for last year we had an estimate of 186,000 plants which were then in our different plots, from which selections were to be made for this year. The number of plants in our breeding plots for this year will, very conservatively estimated, amount to ten times the number of last year. In order that something of an idea may be had of the work we are doing in this line, a list is here given.

Wheat.—
990 foundation or selection rows; 24 plants to the row.
416 centgeners; 100 plants each.
156 increase beds; 5'x16'.

Oats.—
810 selection rows; 25 plants each.
200 rod rows; 4'x15'.
83 increase beds.
5 varieties from the U. S. Department of Agriculture.
6 varieties from Garton Seed Company, England.

Barleys.—
4 varieties in increase beds for variety test.
23 rod rows from U. S. Department of Agriculture.

OATS.

1. Variety Test.—In this variety test we have 45 varieties as per the following list. In addition to these 45 varieties, there are 83 which have been given Iowa numbers and are now in increase beds.

1. White Alaska.
2. Early Champion.
3. Sixty Day.
4. New Sixty Day.
5. Kherson.
6. Red Texas.
7. Swedish Select.
8. Minnesota No. 6.
9. Lincoln.
10. Silvermine.

11. Early Gotham.
12. Minnesota No. 26.
13. Tartar King.
14. Myriek.
15. Welcome.
16. Portland.
17. Johnson.
18. Canadian.
19. Danish.
20. National.
21. Irish Victor.
22. Siberian.
23. Imported Clydesdale.
24. Domestic Clydesdale.
25. Probesteier.
26. Green Russian.
27. Russian (from Bruner).
28. White Bonanza.
29. Joanette.
30. White Russian.
31. American Banner.
32. Early Triumph.
33. Prosperity.
34. Progress.
35. Regenerated Swedish Select.
36. Regenerated Silvermine.
37. President.
38. Record.
39. Reliance.
40. Winter's Farm Pedigree.
41. Big Four.
42. Colorado No. 37.
43. Great American.
44. Salzer's Two-foot Oats.
45. White Tartar.

83 which have been given Iowa numbers in increase beds.

2. The effect of weight of seed upon yield per acre.
3. The effect of rate of seeding upon yield per acre.
4. The effect of treating seed with formalin for smut upon yield per acre.
5. The effect of the preparation of seed bed upon yield per acre.
6. Comparative results with drilling vs. broadcasting upon yield per acre.
7. The adaptability to Iowa conditions of seed grown under irrigation.
8. Imported vs. home-grown seed.
9. The effect of fanning seed upon yield per acre.
10. The effect of size of seed upon rate of seeding.
11. The isolation of pure strains of oats.

WHEAT.

1. Winter Wheat, variety test of, including the following:
   1. Big Frame.
   2. Turkey Red.
   3. Imported Turkestan.
   4. Malakoff.
   5. Banat.
   6. Buda Pest.
   7. Pester Boden.
   8. Kharkove.
   9. Theiss.
   10. Minnesota No. 529.

   156 varieties with Iowa numbers in increase beds.
2. Drilling vs. broadcasting.
3. The isolation of pure strains of winter wheat.
4. Spring Wheat, variety test of, including the following:
   1. Minnesota No. 188.
   2. Minnesota No. 169.
   3. Minnesota No. 163.
   4. Early Java.
   5. Macaroni.
   6. Emmer.
5. Drilling vs. broadcasting.

BARLEY.

1. Variety Test, including the following:
   1. Black Hulless.
   2. Hanna.
   3. Common 6 Rowed.
   4. Odebrucker.
   5. Mandscheuri.
   6. Fraukish Brewing.
   7. Success.
2. The effect of fall sowing on spring barley.
   (With a view to secure if possible a winter barley by means of selection.)

With the barleys we are securing some assistance from the Department of Agriculture in the furnishing of new varieties. Individual rod row tests are being made with twenty-three (23) varieties of spring barley furnished by the United States Department of Agriculture, namely:

Name of Variety.	G. I. No.
Hulless	22
Sangatsuka	78
Kitzing	167
Manchuria	170
Kitzing	189
Princess	193
Chevalier II	200

Nane of Variety.	G. I. No.
Hanna	203
Little Hulless	335
White Hulless	425
Colorado Hulless	475
Boehmes Beardless	507
Arpa	528
Princess	529
Hannchen	531
Primus	532
Boehmes Hulless	533
Oderbrucker	537
Black Hulless	596
Hulless	598
Hulless	629
Grenshel	609
Del Norte	630

NEW LINES OF INVESTIGATION.

1. In our plant breeding work we began this year testing and isolating strains of winter barley and oats.

2. With oats we are investigating the effect of size and weight of seed oats on the following crop. In this special attention is given to the relative influence on the yield caused by different number of plants per acre; whether less plants and more stooling is as conducive to greater yields as is more plants and less stooling.

Respectfully submitted,

M. L. BOWMAN,
Farm Crops Section.

DAIRY SECTION.

Three lines of investigation have been carried to completion. First, an experiment in growing starters in glucose solutions. This work was carried on from the previous year. Glucose solutions are much cheaper than milk. The object was to ascertain whether they could take the place of milk in growing starters. The results show that glucose starters will ripen the cream the same as milk, but not as rapidly. The slow ripening was overcome by adding a small per cent of milk. A full report was made of the changes that occurred and why these changes took place. This is a very valuable practical bulletin for the dairymen of the country.

Bulletin 80 of our station attracted world wide attention when it made its appearance, it being the only authentic experiment on effects of moisture in butter. This bulletin was a great aid to the government officials in fixing their standards for butter. Some questioned the work of this bulletin owing to the fact that some of the butter was made by outside parties. Consequently it was thought advisable to take up a series of experiments with butter made under our own control. The first of these was carried on under our personal supervision at Strawberry Point creamery, Strawberry Point, Iowa, this being an ideal place for such an experiment. They received 60,000 to 70,000 pounds of milk daily. The cream from this milk was mixed together and then divided into small lots and ripened. Butter was made from it containing various per cents of moisture, from 11 to 15.08 per cent. Part of this butter was scored in New York and sold in the open market and part was held seven months. Other lots of butter were sent to London, Liverpool, and Manchester, England, and sold in the open market. It was found in all cases that the moisture had no effect on the keeping quality of butter or on the selling price. In fact, the butter of high moisture content, held in New York seven months, scored slightly higher than that of the low moisture content. This bulletin will undoubtedly settle the question as to the effects of moisture on butter. The conclusion arrived at in this experiment is that water from 10 to 16 per cent has no effect on the selling price of butter or on the keeping quality of the same.

Owing to the numerous prosecutions by the Internal Revenue Department for high moisture in butter, it was deemed necessary to carry on experiments in regard to the various moisture tests on the market for determining the per cent of moisture in butter. The gravimetrical system is too complicated and too slow for the average creameryman to operate. It was thought advisable to carry on tests with the various devices that have been placed on the market. At the suggestion of the writer a new test was brought out, known as the Ames test of the double aluminum cup, using a parafine bath. This test promises to be the official test for moisture owing to its simplicity and accuracy.

During the coming year it was the writer's intention to carry on experiments with the various kinds of separators and to make a comparison between the efficiency of the hand separator and the small power separator. It is our belief that great losses occur on the farm each year by running these little machines by hand. Another line of work that should be carried on is an investigation as to how extensive tubercle bacillus is found in the milk at the creamery or the benefit of pasteurization that is carried on in most creameries. Still another line of work that could be carried on successfully would be a series of tests to determine why the wide variations exist in the tests at creameries, whether this is due to the method of sampling, dishonesty on the part of the creamerymen or to the kind of sampling tubes or dippers used.

The following is a list of work done for outside parties:

Two hundred and sixty-five samples of cream, four hundred and fifty-five samples of milk, six samples of skim milk and one sample of buttermilk were tested for fat. These samples were received from farmers and buttermakers in the state.

One hundred and sixty chemical analyses of butter were made.

Respectfully submitted,

G. L. McKAY,
Dairy Section.

BOTANICAL SECTION.

Our work during the past year has been along the lines of the study of weeds and methods of eradication, especially by cultivation and by spraying with iron sulphate. Quite extensive experiments were carried on in the vicinity of Ames and in Emmet county. In Emmet county largely for the extermination of mustards. The same work is in progress this year in the vicinity of Ames. From these experiments we found that the iron sulphate was efficacious in destroying mustard and many other annual weeds and was efficacious in destroying the leaves of dandelions.

An experiment was carried on this spring in the destruction of dandelion with iron sulphate. The iron sulphate destroyed the leaves completely, but in the course of two weeks they again made their appearance. The grass was slightly injured and clover growing in the lawn was much more seriously affected.

The experiments with iron sulphate seem to indicate that this material destroys the weed and caused an increase in the crop of oats, largely because the weeds were subjected.

The seed work embraced a study not only of the common argicultural seeds of forage crops, but in addition thereto garden and vegetable seeds. This work has been conducted the present season making a comparison of the germination of these seeds with the germination in the greenhouse and in the incubator. Our experiments showed that the packet seeds are of extremely low vitality. None of this work has been carried to completion. The results of our work for 1907 have been published in bulletin No. 99.

In 1907 the Botanical section issued a bulletin (No. 99) which summarized an investigation of clover, alfalfa, and flower seeds used for planting in Iowa.

The seed examined gave a deficient average of purity, and a low average of vitality, compared with accepted standards, very marked in packet seeds.

The forage seed as a whole shows differences from that of the previous season, dropseed grass and bracted plaintain coming into prominence, and rib-grass showing increase, while quack-grass and Canada thistle were not frequent. From the observations made it seems reasonable to class most of the seed offered for sale as home-grown; that containing rib-grass as grown, presumably, in Canada and elsewhere.

In addition to the above work considerable co-operative work was taken up in connection with a committee appointed by the State Board of Agriculture in regard to weeds found along the roadsides in the state. Thus far a summary of our conclusions were presented to the committee. It was hoped to have a complete report from all the counties; thus far, however, it has been impossible for me to get data, but we hope during the year to complete this data.

We have also continued our investigation on the subject of poisonous plants and have about ready for publication a number of interesting results obtained with reference to poisonous plants.

A press bulletin was published in co-operation with the Veterinary section on "The Danger From Feeding Hay That Contains Ergot." The following is a brief abstract of the same:

Press bulletin of the Iowa Agricultural Experiment Station calls attention to the general prevalence of ergot in the grasses of the state, and the danger of using ergotized hay; the fungus and the conditions of disease caused by it are described, together with symptoms and treatment.

We have also nearly ready for publication a descriptive circular on the common weed seeds of the state, with some results of the study of germination of seeds under different conditions of preservation. These studies have been carried on for four years.

We are continuing our investigation of diseases of plants, and we are now preparing a bulletin on the various epidemics of plant diseases which have occurred in the state, during the last quarter of a century, with an account of wheat and millet disease which has not received much attention in this country.

NEW LINES OF INVESTIGATION TO BE TAKEN UP.

We have also started a line of work studying the weed seeds passing through the digestive tract of animals, in co-operation with the Animal Husbandry section.

Another co-operative experiment is being carried on in connection with the Farm Engineering section, a study of the different methods of removing weed seeds from seed.

There has been much complaint on the part of seedsmen that first crop clover does not seed abundantly. The Botanical section is undertaking a study of the subject of the fertilization and the pollination of the clover to find out if there is anything in the commonly accepted theory that the shortness of the seed crop is due to imperfect fertilization.

CONSERVATION OF OUR NATURAL RESOURCES.

With reference to the conservation of natural resources of the state, would say that the prevention of the growth of weeds and the spread of plant diseases and study of the same seems to me would come under this head and this has been fully outlined above.

We have carried on a line of work to prevent the washing of soils along railroads and cuts. From these experiments it appears that American brome grass is an excellent soil binder. The work on grasses calls attention to the value of many native grasses for forage purposes.

The investigations carried on here have been instrumental in the passage of a law controlling the sale of seeds.

Respectfully submitted,

L. H. PAMMEL,
Botanical Section.

ENTOMOLOGY SECTION.

During the larger part of the past year there has been no assistant in entomology in the station. Mr. R. S. Webster has, however, taken up his work very actively, and I hope to be able to give a more satisfactory report of progress a year from now than has been possible for the past two or three years.

1. No investigation has been carried to a really definite conclusion, although some positive results have already been reached in connection with the spraying for leaf rollers spoken of under Par. 2 below.

2. The chief investigation for the present season is to be on the leaf hopper of the apple, Empoasca mali. This insect is one of the most serious pests of the apple in nurseries, and so little has been known of its life history that treatment has so far been very unsatisfactory. Another almost equally injurious insect affects not only the apple, but several other allied plants and trees. This is the Archips rosameana, commonly spoken of as the leaf roller. Not only life history work, but also practical spraying experiments are now being carried on on this insect; the practical work being done in one of the largest nurseries in the state at Shenandoah. Facilities have been offered by the company which would probably have cost us $200 or $300 if they had been paid for out of station funds. Work on the woolly aphis has been carried on for over a year by Mr. Ness as a part of his post-graduate work, and assistance in this direction is now being rendered by Mr. Webster. In addition to the above chief lines, we have in hand a number of minor injurious insects, including especially those of the strawberry and box elder tree, upon which miscellaneous studies have been going on as opportunity offered for several years.

Respectfully submitted,

H. E. SUMMERS,
Entomology Section.

FINANCIAL REPORTS

TREASURER'S REPORT.

The following is a complete statement of the transactions of the acounts for the fiscal year ending June 29, 1907.

Account	Balance July 1, 1906		Fiscal Year		Total		Support Fund		Balance Jane 29, 1907	
	Debit	Credit	Debit	Credit	Credit	Debit	Credit	Debit	Debit	Credit
Support Funds, balance July 1, 1906		$ 21,521.86				$ 21,521.86		$ 21,521.86		
Interest on investment of Endowment Fund				$ 36,042.93		36,042.93		36,042.93		
Interest on lands obtained by foreclosure				85.00		85.00		85.00		
Morrill Support Fund				25,000.00		25,000.00		25,000.00		
State Additional Support Funds				139,166.67		139,166.67		139,166.67		
Agricultural Fellowship		41.71	$ 355.00	510.00	$ 355.00	551.71				$ 196.71
Agricultural Journalism			383.21	466.66	383.21	466.66				83.35
Diploma Fund		700.98	872.11	730.00	872.11	1,430.98				558.87
Donation Fund		297.03		29.80		326.83				326.83
Good Roads School			44.00	44.00	44.00	44.00				
Hospital		695.38	3,971.46	4,390.07	3,971.46	5,085.45				1,113.99
Piano rent		2.00	159.50	159.57	159.50	161.57				2.07
Railroad Damages		88.00				88.00				88.00
Room Rent		60.28	2,351.82	3,902.35	2,351.82	3,962.63				1,610.81
Rosenbaum Scholarship				200.00		200.00				200.00
State Fair Scholarship				200.00		200.00				200.00
Tuition		1,008.57	30.00	1,932.00	30.00	2,940.57				2,910.57
Salaries Morrill Support			25,000.00		25,000.00		25,000.00			
Salaries Support Funds			61,600.51		61,600.51		61,600.51			
Agricultural Dean's Office			503.80	3.80	503.80	3.80	500.00			
Agricultural Engineering			3,565.44	1,934.37	3,565.44	1,934.37	1,631.07			
Animal Husbandry, Poultry			4,802.79	2,874.66	4,802.79	2,874.66	1,928.13			
Botany			3,439.10	969.10	3,439.10	969.10	2,470.00			
Chemistry			10,110.00	6,819.93	10,110.00	6,819.93	3,290.07			
Civics			769.03	53.06	769.03	53.06	715.97			
Civil Engineering			4,764.39	1,350.19	4,764.39	1,350.19	3,414.20			
Dairy			19,268.00	15,877.45	19,268.00	15,877.45	3,390.55			
Dairy Farm			1,956.20	1,202.49	1,956.20	1,202.49	753.71			
Domestic Economy			3,787.15	923.15	3,787.15	923.15	2,864.00			
Economic Science			653.60		653.60		653.60			
Electrical Engineering			6,914.99	2,409.33	6,914.99	2,409.33	4,505.66			
Engineering Dean's Office			324.99	.11	324.99	.11	324.88			
English			4,613.14	703.40	4,613.14	703.40	3,909.74			
Farm			15,916.69	12,336.42	15,916.69	12,336.42	3,580.27			
Farm Crops			4,411.67	2,044.07	4,411.67	2,044.07	2,367.60			
History			1,083.07		1,083.07		1,083.07			
Horticulture			4,251.94	1,220.96	4,251.94	1,220.96	3,060.98			
Junior College Dean's Office			1,096.30		1,096.30		1,096.30			
Library			2,008.34	160.34	2,008.34	160.34	1,848.00			
Mathematics			3,461.93		3,461.93		3,461.93			
Mechanical Engineering			11,047.61	4,501.82	11,047.61	4,501.82	6,545.79			
Military			507.08		507.08		507.08			
Mining Engineering			1,674.52	212.35	1,674.52	212.35	1,462.17			
Modern Languages			3,918.00		3,918.00		3,918.00			
Music			487.61		487.61		487.61			
Preceptress' Fund			194.96		194.96		194.96			
Public Speaking			1,823.35	184.00	1,823.35	184.00	1,639.35			
Soils			1,706.23	382.90	1,706.23	382.90	1,325.33			
Veterinary			3,764.37	2,444.60	3,764.37	2,444.60	1,319.77			
Zoology			2,760.34	676.05	2,760.34	676.05	2,084.29			
Advertising			373.77		373.77		373.77			
Catalog Compendium, etc			2,400.00		2,400.00		2,400.00			
Contingent Expense			1,333.31		1,333.31		1,333.31			
Fires, Lights and Incidentials			58,618.85	37,475.08	58,618.85	37,475.08	21,143.77			
Janitor Fund			11,050.67	49.80	11,050.67	49.80	11,000.87			
President's Office			2,929.72		2,929.72		2,929.72			
Public Grounds			4,728.65	997.37	4,728.65	997.37	3,731.28			
Purchasing Committee			1,652.00		1,652.00		1,652.00			
Registrar's Office			700.00		700.00		700.00			
Sabbath Services			519.08		519.08		519.08			
Secretary's Office			1,239.78		1,239.78		1,239.78			
Treasurer's Office			1,570.25		1,570.25		1,570.25			
Engineering Experiment Station			147.00	147.00	147.00	147.00				
State Appropriations		2,228.59	229,233.70	234,771.58	229,233.70	237,000.17				7,766.47
Total		$ 26,644.40	$ 536,883.12	$ 545,584.43	$ 536,883.12	$ 572,228.83	$ 201,528.42	$ 221,816.46		$15,057.67
Balance Support Funds							20,288.04			20,288.04
Cash to balance as follows:										
Support Funds	$ 21,521.86			1,233.82	20,288.04				$20,288.04	
State Appropriations	2,228.59		5,537.88		7,766.47				7,766.47	
Miscellaneous Accounts	2,893.95		4,397.25		7,291.20				7,291.20	
Total	$ 26,444.40	$ 26,644.40	$ 546,818.25	$ 546,818.25	$ 572,228.83	$ 572,228.83	$ 221,816.46	$ 221,816.46	$35,345.71	$35,345.71

STATE APPROPRIATIONS.

Account	Balance July 1, 1906	Drawn From State Treasury	Expended During Year	Balance June 29,
Agricultural Extension	$ 156.16		156.16	
Books and Periodicals (pro rata)		$ 15,000.00	15,000.00	
Books and Periodicals (new)		2,400.00	2,400.00	
Cataloger		600.00	600.00	
Central Building Additional		28,371.79	28,371.79	
Central Heating Plant	.20	33,782.27	33,782.47	
Central Heating Plant (new)		2,285.37	2,244.23	41.14
Dairy Building, Farm and Equipment		1,924.62	1,924.62	
Engineering Experiment Station (old)	529.81		529.81	
Engineering Experiment Station (pro rata)	758.33		758.33	
Engineering Experiment Station (new)		3,500.00	3,262.26	237.74
Equipment of Dairy Farm		6,600.95	6,600.95	
Equipments of Departments		2,535.49	2,535.49	
Good Roads Experimentation (pro rata)	460.34		460.34	
Good Roads Experimentation (new)		5,000.00	4,850.36	149.64
Land, Additional		5,500.00	5,500.00	
Machine Shop		254.60	254.60	
Remodeling Old Engineering Hall		140.00	140.00	
Repairs and Improvements (old)	323.19		323.19	
Repairs and Improvements (new)		23,000.00	20,232.75	2,767.25
Special Building Tax	.56	103,876.49	99,306.35	4,570.70
Total	$ 2,228.59	$ 234,771.58	$ 229,233.70	$ 7,766.47

TREASURER'S REPORT—EXPERIMENT STATION.

Account	Balance July 1, 1906		Fiscal Year		Total		Support Fund		Balance June 29, 1907	
	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit
Government Appropriation, Adams Fund				$ 7,000.00		$ 7,000.00		$ 7,000.00		
Government Appropriation, Hatch Fund				15,000.00		15,000.00		15,000.00		
State Support Fund		$ 10,194.62		25,000.00		35,194.62		35,194.62		
Salaries			$ 18,143.30		$ 18,143.30		18,143.30			
Agricultural Engineering Section			1,846.08	21.19	1,846.08	21.19	1,824.89			
Animal Husbandry Section			15,797.08	8,701.86	15,797.08	8,701.86	5,095.22			
Botanical Section			2,078.33	18.60	2,078.33	18.60	2,059.73			
Bulletin Section			3,062.67	3.00	3,062.67	3.00	3,059.67			
Chemical Section			3,284.74	68.33	3,284.74	68.33	3,216.41			
Dairy Section			1,238.13	61.01	1,238.13	61.01	1,177.12			
Dairy Farm Section			356.37		356.37		356.37			
Director's Section			1,106.73		1,106.73		1,106.73			
Entomology Section			765.08		765.08		765.08			
Farm Crops Section			3,891.88	1,007.64	3,891.88	1,007.64	2,884.24			
General Expense Section			1,801.60		1,801.60		1,801.60			
Horticultural Section			3,162.23	267.97	3,162.23	267.97	2,894.26			
Photography Section			270.50	758.41	279.59	758.41		487.82		
Soils Section			2,492.20	233.26	2,492.20	233.26	2,258.94			
Veterinary Section			368.92		368.92		368.92			
Total		$ 10,194.62	$ 57,669.53	$ 58,141.27	$ 57,669.53	$ 68,335.89	$ 47,016.08	$ 57,682.44		
Balance	$ 10,194.62		471.74		10,666.36		10,666.36			
Cash to Balance									10,666.36	
Total	$ 10,194.62	$ 10,194.62	$ 58,141.27	$ 58,141.27	$ 68,335.89	$ 68,335.89	$ 57,682.44	$ 57,682.44	$10,666.36	$10,666.36

TREASURER'S REPORT.

The following is a complete statement of the transactions of the accounts for the fiscal year ending June 30, 1908.

Account	Balance July 1, 1907		Fiscal Year		Total		Support Fund		Balance June 30, 1908	
	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit
Support funds, balance July 1, 1907		$ 20,288.04				$ 20,288.04		$ 20,288.04		
Interest on investment of End. fund				$ 35,290.08		35,290.08		35,290.08		
Interest on lands obtained by foreclosure				85.00		85.00		85.00		
Morrill Support Fund				30,000.00		30,000.00		30,000.00		
State Additional Support Funds				155,000.00		155,000.00		155,000.00		
Agricultural Fellowship		196.71	$ 145.00		$ 145.00	196.71				$ 51.71
Agricultural Journalism		83.35	583.34	562.50	583.34	645.85				62.51
Diploma		558.87	758.14	890.00	758.14	1,448.87				690.73
Donation Fund		326.83		3.20		330.03				330.03
Engineering Scholarship				100.00		100.00				100.00
Hospital		1,113.99	3,097.87	3,854.81	3,089.87	4,968.80				1,870.93
Piano Rent		2.07	55.83	167.10	55.83	169.17				113.34
Railroad damages		88.00				88.00				88.00
Room rent		1,610.81	2,974.28	2,182.47	2,974.28	3,793.28				819.00
Rosenbaum Scholarship		200.00	200.00		200.00	200.00				
State Fair Scholarship		200.00	550.00	500.00	550.00	700.00				150.00
Tuition		2,910.57	4,791.29	2,814.00	4,791.29	5,754.57				963.28
Salaries—Morrill Support			30,000.00		30,000.00		30,000.00			
Salaries—Support Fund			66,309.01		66,309.01		66,309.01			
Agricultural Dean's Office			612.56		612.56		612.56			
Agricultural Engineering			4,717.31	2,098.29	4,717.31	2,098.29	2,619.02			
Animal Husbandry			6,337.78	3,349.41	6,337.78	3,349.41	2,988.37			
Botany			4,356.97	1,432.00	4,356.97	1,432.00	2,924.97			
Chemistry			11,533.14	7,062.82	11,533.14	7,062.82	4,470.32			
Civics			652.16		652.16		652.16			
Civil Engineering			6,319.37	1,334.72	6,319.37	1,334.72	4,984.65			
Dairy			25,878.19	24,028.56	25,878.19	24,028.56	1,849.63			
Dairy Farm			2,494.47	1,507.77	2,494.47	1,507.77	986.70			
Domestic Economy			2,971.34	954.40	2,971.34	954.40	2,016.94			
Economic Science			1,340.00		1,340.00		1,340.00			
Electrical Engineering			7,741.45	2,657.49	7,741.45	2,657.49	5,083.96			
Engineering Dean's Office			577.74		577.74		577.74			
English			6,376.52	846.00	6,376.52	846.00	5,530.52			
Farm			16,353.21	13,199.25	16,353.21	13,199.25	3,153.96			

Farm Crops			5,562.81	1,573.15	5,562.81	1,573.15	3,989.66			
History			1,362.37		1,362.37		1,362.37			
Horticulture			4,009.72	905.46	4,009.72	905.46	3,104.26			
Junior College Dean's Office			964.22		964.22		964.22			
Library			2,544.18	186.55	2,544.18	186.55	2,357.63			
Mathematics			3,988.37		3,988.37		3,988.37			
Mechanical Engineering			13,046.40	3,639.68	13,046.40	3,639.68	9,406.72			
Military			562.02		562.02		562.02			
Mining Engineering			2,732.61	121.50	2,732.61	121.50	2,611.11			
Modern Languages			5,150.32		5,150.32		5,150.32			
Music			619.25		619.25		619.25			
Poultry			401.40	1.40	401.40	1.40	400.00			
Preceptress' Funds			447.03		447.03		447.03			
Public Speaking			2,651.48	169.00	2,651.48	169.00	2,482.48			
Soils			1,900.72	553.60	1,900.72	553.60	1,347.12			
Veterinary			4,016.08	2,588.15	4,016.08	2,588.15	1,427.93			
Zoology			2,867.35	733.00	2,867.35	733.00	2,134.35			
Advertising			470.37		470.37		470.37			
Catalog, compendium, etc			2,579.67		2,579.67		2,579.67			
Contingent expense			1,684.46		1,684.46		1,684.46			
Fires, lights and incidentals			46,015.96	33,971.60	46,015.96	33,971.60	12,044.36			
Janitor Fund			11,933.46	77.28	11,933.46	77.28	11,856.18			
President's Office			2,732.73		2,732.73		2,732.73			
Public Grounds			4,528.66	221.94	4,528.66	221.94	4,306.72			
Purchasing Committee			1,621.00	20.00	1,621.00	20.00	1,601.00			
Registrar's Office			460.00		460.00		460.00			
Sabbath Services			483.55		483.55		483.55			
Secretary's Office			1,309.00		1,309.00		1,309.00			
Treasurer's Office			1,916.00	3.50	1,916.00	3.50	1,912.50			
Engineering Experiment Station—New			498.45	498.45	498.45	498.45				
State Appropriations		7,766.47	283,255.51	276,033.20	283,255.51	284,399.67				1,144.16
Total			$ 620,042.12	$ 611,847.33	$ 620,042.12	$ 647,193.04	$ 219,895.89	$ 240,663.12		$ 6,383.69
Balance Support Funds							20,767.23			20,767.23
Cash to Balance as follows—										
Support Funds	$ 20,288.04		$ 479.19		20,767.23				20,767.23	
State Appropriations	7,766.47			6,622.31	1,144.16				$ 1,144.16	
Miscellaneous Accounts	7,291.20			2,051.67	5,239.53				5,239.53	
Total	$ 35,345.71	$ 35,345.71	$ 620,521.31	$ 620,521.31	$ 647,193.04	$ 647,193.04	$ 240,663.12	$ 240,663.12	$27,150.92	$27,150.92

TREASURER'S REPORT—EXPERIMENT STATION.

Account	Balance July 1, 1907		Fiscal Year		Total		Support Fund		Balance June 30, 1908	
	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit
Government Appropriation—Adams Fund				$ 9,000.00		$ 9,000.00		$ 9,000.00		
Government Appropriation—Hatch Fund				15,000.00		15,000.00				15,000.00
State Support Fund		10,666.36		22,750.00		33,416.36				33,416.36
Salaries			18,883.01		18,883.01		18,883.01			
Agricultural Engineering Section			2,130.66	47.36	2,130.66	47.36	2,083.30			
Animal Husbandry Section			14,451.30	7,293.14	14,451.30	7,293.14	7,158.16			
Botanical Section			1,998.50	9.00	1,998.50	9.00	1,989.50			
Buildings Section			1,446.34		1,446.34		1,446.34			
Bulletin Section			3,331.02	1.15	3,331.02	1.15	3,329.87			
Chemical Section			3,074.21	78.35	3,074.21	78.35	2,995.86			
Dairy Section			2,535.98	1,336.17	2,535.98	1,336.17	1,199.81			
Dairy Farm Section			1,197.88		1,197.88		1,197.88			
Director's Section			1,315.06		1,315.06		1,315.06			
Entomological Section			1,044.24	16.00	1,044.24	16.00	1,028.24			
Farm Crops Section			5,518.72	1,201.74	5,518.72	1,201.74	4,316.98			
General Expenses Section			1,885.46		1,885.46		1,885.46			
Horticultural Section			3,778.72	319.70	3,778.72	319.70	3,459.02			
Photography Section			945.73	418.36	945.73	418.36	527.37			
Poultry Section			1,013.91	20.00	1,013.91	20.00	993.91			
Soils Section			3,926.04	1,091.13	3,926.04	1,091.13	2,834.91			
Veterinary Section			792.21	192.44	792.21	192.44	599.77			
Total		$ 10,666.36	$ 69,268.99	$ 58,774.54	$ 69,268.99	$ 69,440.90	$ 57,244.45	$ 57,416.36		
Balance	$ 10,666.36			10,494.45	171.91		171.91			$ 171.91
Cash to balance									171.91	
Total	$ 10,666.36	$ 10,666.36	$ 69,268.99	$ 69,268.99	$ 69,440.90	$ 69,440.90	$ 57,416.36	$ 57,416.36	$ 171.91	$ 171.91

STATE APPROPRIATIONS.

	Balance July 1, 1907	Drawn from State Treasurer	Expended During Year	Balance June 30, 1908
Agricultural Extension		$ 21,500.00	$ 21,317.49	$ 182.51
Books and Periodicals		2,400.00	2,377.30	22.70
Cataloger		600.00	600.00	
Central Heating Plant, new	$ 41.14	30,714.63	30,755.77	
Dairy Building, Farm and Equipment		2,338.93	2,338.93	
Engineering Experiment Station, old	237.74		237.74	
Engineering Experiment Station, new		3,500.00	2,736.53	763.47
Equipment of Dairy Farm		3,399.05	3,399.05	
Equipment of Departments, old		1,972.19	1,972.19	
Equipment of Departments, new		4,028.44	4,028.44	
Good Roads Experimentation, old	149.64		149.64	
Good Roads Experimentation, new		5,000.00	4,835.91	164.09
Live Stock Experimentation		2,250.00	2,250.00	
Machine Shop		14,239.42	14,237.12	2.30
Pure Bred Stock		4,342.15	4,342.15	
Remodeling Old Engineering Hall		6,860.00	6,860.00	
Repairs and Improvements, old	2,767.25		2,767.25	
Repairs and Contingencies		23,000.00	23,000.00	
Special Building Tax	4,570.70	140,838.25	145,409.00	
Walks and Grading		4,650.00	4,640.91	9.09
Water System Improvement		5,000.00	5,000.00	
Total	$ 7,766.47	$ 276,633.20	$ 283,255.51	$ 1,144.16

REPORT OF THE SECRETARY
1906–1908

MEMBERS OF THE BOARD OF TRUSTEES.

Ex-officio—Hon. Warren H. Garst, Governor of Iowa.
Ex-officio—Hon. John F. Riggs, Superintendent of Public Instruction.

	Term Expires.
First District—Hon. H. M. Letts, Columbus Junction	1910
Second District—Hon. Vincent Zmunt, Iowa City	1910
Third District—Hon. J. S. Jones, Manchester	1914
Fourth District—Hon. Ellison J. Orr, Waukon	1910
Fifth District—Hon. W. R. Moninger, Marshalltown	1912
Sixth District—Hon. W. O. McElroy, Newton	1914
Seventh District—Hon. Chas. R. Brenton, Dallas Center	1912
Eighth District—Hon. Geo. S. Allyn, Mount Ayr	1910
Ninth District—Hon. James H. Wilson, Menlo	1914
Tenth District—Hon. J. B. Hungerford, Carroll	1912
Eleventh District—Hon. W. J. Dixon, Sac City	1912

OFFICERS OF THE BOARD.

Hon. W. J. Dixon, Sac City	Chairman
E. W. Stanton, Ames	Secretary
Herman Knapp, Ames	Treasurer
W. A. Helsell, Odebolt	Financial Agent
Ben Edwards, Ames	Custodian

STANDING COMMITTEES.

(A) GENERAL COMMITTEES.

Executive Committee—Trustees McElroy, Orr and Hungerford.

Committee on Faculty and Course of Study—Trustees McElroy, Supt. Riggs, Trustees Hungerford, Letts, Zmunt and Dixon.

Finance Committee—Trustees Allyn, McElroy, Brenton, Hungerford, Jones and Dixon.

Building Committee—Trustees Hungerford, Dixon, Wilson. Additional Members—Trustees Brenton and Letts.

Committee on Rules—Trustees Orr, Zmunt and McElroy.

Committee on Bonds and Contracts—Trustees Wilson and Moninger.

Committee on Endowments—Trustees Moninger, Allyn and Governor Garst.

Purchasing Committee—Trustees Zmunt, Moninger, Orr and Wilson, E. W. Stanton, H. Knapp and W. H. Meeker.

Committee on Interurban Railway—Trustees Moninger, Allyn, Zmunt and McElroy.

(B) DEPARTMENT COMMITTEES.

Committee on Agriculture—Trustees Letts, Orr, Brenton, Moninger, Allyn, Jones and Governor Garst.

Committee on Engineering Departments—Trustees Orr, Jones and McElroy.

Committee on Scientific Departments—Trustees Jones, Supt. Riggs, Trustees Allyn, Orr and Brenton.

Committee on Literary Departments and Library—Supt. Riggs, Trustees Zmunt, Brenton and Hungerford.

Committee on Public Grounds and Assignment of Rooms—Trustees Brenton, Zmunt and Letts.

Committee on College Hospital and Sanitary Arrangements—Trustees Wilson, Zmunt and McElroy.

Committee on Veterinary Medicine—Trustees Allyn, Wilson and Letts.

COLLEGE PROPERTY.

The following summary of the department inventories gives the value of the college property at the close of the last biennial period:

SUMMARY OF COLLEGE INVENTORIES.

Farm proper, 660.38 acres at $125	$82,547.50	
Dairy farm, 200 acres at $125	25,000.00	
Experiment Station Grounds, 60 acres at $125	7,500.00	
Plots for Horticultural Experiments, 13 acres at $125	1,625.00	
Orchard and Arboretum, 25 acres at $125	3,125.00	
Horticulture and Forestry, 55.50 acres at $100	5,550.00	
College Campus, 125 acres at $150	18,750.00	
College Park, 37 acres at $75	2,775.00	
Total for 1,175.88 acres		$146,872.50
Buildings—		
Central Building, including fixtures and furnishings	$412,500.00	
Hall of Agriculture (when completed)	340,000.00	
Margaret Hall	60,000.00	
Morrill Hall	40,000.00	
Chemical and Physical Building	35,000.00	
Music Hall	5,000.00	
Chime and Clock Tower	7,000.00	
College Hospital	10,000.00	
Office Building	7,000.00	
Book Department Building	3,000.00	
Engineering Hall (not including furnishings)	195,000.00	
Engineering Laboratory	25,000.00	
Carpenter Shop	5,000.00	
Foundry	4,000.00	
Machine Shop	18,000.00	
Power Station	2,500.00	

Old Pumping Station Plant	1,000.00	
Fire Department Building	200.00	
Central Heating Plant	35,000.00	
Greenhouses	19,000.00	
Horticultural Laboratory	8,000.00	
Veterinary Hospital	10,000.00	
Agricultural Hall	110,000.00	
Dairy Building (including equipment)	72,000.00	
Horticultural Barn	5,500.00	
Cattle Barn	15,000.00	
Feeding Sheds	2,500.00	
Farm Crops Tool Shed	500.00	
Experiment Station Barn	18,000.00	
Horse Barn and Stock Judging Pavilion	15,000.00	
Corn and Stock Judging Pavilion	15,000.00	
Hog House	1,500.00	
Movable Hog Houses (fifteen)	150.00	
Sheep Barn	1,400.00	
Field Shed	300.00	
Dairy Farm Buildings	12,000.00	
Dairy Farm House	2,500.00	
Poultry Farm Buildings	9,000.00	
North Hall	2,500.00	
Carpenter Shop	500.00	
Residences occupied by—		
President Storms	13,000.00	
Professor Curtiss	5,000.00	
Professor Beach	5,500.00	
Professor Nortensen	2,500.00	
Professor Meeker	2,500.00	
Professor Summers	2,500.00	
Professor Noble	3,000.00	
Professor Stanton	5,000.00	
Professor Marston	5,000.00	
Farm Foreman	2,000.00	
Custodian Edwards	2,000.00	
Experiment Station Foreman	1,300.00	
Farm Laborer	800.00	
Laborers' Boarding Club	500.00	
Faculty Boarding Club	5,000.00	
Total Buildings		$1,581,150.00
General Equipment—		
Waterworks, including water-tower, deep well, pumping machinery, reservoir, fire pump and piping system	46,500.00	
Old Power Plant, including boilers, four high-speed engines, piping, boiler and engine room appliances, etc.	15,500.00	

New Heating Station, including two 250 H. P. boilers with mechanical stokers and induced draft apparatus, one 250 H. P. Corliss engine, directly connected with generator, two boiler feed pumps, feed water heater and piping system, and other power plant apparatus	23,000.00	
Electric Light, including switchboard appliances, pole line and transformers	9,000.00	
Heating Tunnel, complete with steam and return mains	36,000.00	
Sewerage System	7,000.00	
Sewage Disposal System	3,000.00	
College Hospital furniture and Equipment	931.15	
Fire Department	1,500.00	
Furniture of Public Rooms	1,751.41	
Total General Equipment		$ 144,182.56
Experiment Station Equipment—	1907-08.	
Agricultural Engineering Section	$ 599.69	
Animal Husbandry Section	7,607.73	
Botany Section	1,227.88	
Bulletin Section	1,008.38	
Chemistry Section	5,609.41	
Dairy Section	732.36	
Dairy Farm Section	1,025.80	
Engineering Experiment Station	2,267.53	
Entomological Section	1,410.75	
Farm Crops Section	2,938.66	
Horticultural Section	719.95	
Photo Section	2,007.08	
Poultry Section	768.03	
Soils Section	2,345.22	
Veterinary Section	804.33	
Total Station Equipment		$ 31,072.80
Department Equipment—	1907-08.	
Farm Department	$ 30,160.90	
Agricultural Dean's Office	4,572.80	
Agricultural Engineering	7,914.90	
Agricultural Extension	1,651.10	
Animal Husbandry	1,621.15	
Botany	24,277.69	
Chemistry	19,668.00	
Civil Engineering	19,384.36	
Dairy	3,319.17	
Dairy Farm	6,684.47	
Domestic Economy	2,584.02	
Engineering Dean's Office	140.50	
Farm Crops	3,805.07	
Horticulture	1,570.40	

Library	90,267.00	
Mechanical Engineering	34,050.07	
Mining Engineering	14,512.47	
Military	363.00	
Music	1,408.00	
Physics	32,985.95	
Poultry	954.98	
Public Grounds	1,145.90	
Purchasing Committee	1,042.36	
Soils	4,927.29	
Veterinary	4,449.82	
Zoology	19,209.82	
Treasurer and Registrar's office	4,270.34	
Custodian's Department	1,022.17	
Chimes and Clock	9,000.00	
Pipe Organ	2,000.00	
Total Department Equipment		$ 348,963.70
Total College Property		$2,252,241.56

THE ENDOWMENT FUND.

The endowment fund has been increased during the biennial period as follows:

Polk County tract of 40 acres, obtained under foreclosure at cost of $2,418.55 and carried on the books at that price; sold under contract at $126 per acre or $5,040; increase in value	$2,621.45
Donation land sold and proceeds credited to endowment fund	360.00
Total increase	$2,981.45

This makes the total endowment $686,689.97. The following shows its present condition:

Invested in land contracts	$ 5,040.00
Invested in form mortgages	680,950.00
Cash awaiting investment	699.97
Total	$686,689.97

All loans are made through the financial agency, which is under the charge of Agent W. A. Helsell. The following is a summary of the work of the agency for the biennial period:

Uninvested balance at the beginning of the period	$ 789.97
Loans paid	151,550.00
Donated land sold and proceeds credited to agency	360.00
Total to be loaned	$152,699.97

The Agent has loaned during the two years:

On 5 per cent. farm mortgages	$129,600.00	
On 5½ per cent. farm mortgages	3,400.00	
On 6 per cent. farm mortgages	19,000.00	$152,000.00
Balance uninvested:		
In hands of State Treasurer	99.97	
In hands of Agent Helsell	600.00	699.97
Total		$152,699.97

Loans were renewed during the biennial period amounting to $67,500, making a total of new and renewed loans of $219,500. The expenses of the Agency, including salary of agent, amounted to $3,094.51 for the two years, or an average of $1,547.25 per annum. All interest due is paid. The Agency was established in 1884. It has handled loans aggregating $1,993,475.80. Only two loans have been foreclosed. These resulted in a gain to the college of $2,981.48. The agent reports all existing loans as in excellent shape and everything on the books as gilt edged.

RECEIPTS AND EXPENDITURES.

It is not an easy task to prepare a satisfactory statement of the income and expenditures of the college. The industrial character of the institution necessitates, in many of the departments, a close union of the educational and commercial ideas. In the conduct of the commercial side of the work, purchases and sales were made which in no way represent additional cost or additional income. It is the policy of the board of trustees to allow each department to use the proceeds of its sales in the purchase of other needed articles. The purchases balance the sales. Together they constitute a revolving fund which as it goes and comes swells the debit and credit side of the treasurer's cash account, but does not affect the real cost or income of the institution, except as there is a profit or loss in these commercial transactions. The debit side of the dairy account, for instance, shows a gross expenditure for the last year of $25,179.19. The sales of butter and other products amounted to $22,677.56. The balance is $2,501.63, and this is the amount which represents the *cost* of this department of the institution. It would be confusing and misleading to use the larger figures as items in any statement of the college income and expenditures. The Thirtieth General Assembly wisely provided in Chapter 104 of the Laws of 1906 that these sales should be listed separately. They are therefore omitted from the statement of receipts and expenditures which follows, but are shown by themselves in an exhibit attached thereto.

RECEIPTS FOR THE BIENNIAL PERIOD.

These are classified according to their sources.

I. EDUCATIONAL SUPPORT FUNDS.

	1906-7	1907-8
From National Government—		
Endowment fund	$ 36,127.93	$ 35,375.08
Morrill fund	25,000.00	30,000.00
From State—		
Consolidated annual appropriation	135,000.00	155,000.00
Pro rate of annual appropriation of Thirty-second G. A. for first partial quarter	4,166.67	
Annual appropriation for purchase of books and periodicals for the college library	2,400.00	2,400.00
Annual appropriation for library cataloguer	600.00	600.00
From Donations—		
Rental on donated land	29.80	3.20
Clay fund for support of agricultural journalism	466.66	562.50
Totals	$203,791.06	$ 223,940.78

II. STUDENT FEES AND TUITION.

Janitor fees	$ 14,420.93	$ 24,144.17
Agricultural engineering	1,060.50	1,056.50
Animal husbandry (including short course)	2,561.75	2,556.25
Botany	928.90	1,402.50
Chemistry	6,029.52	6,000.66
Civil engineering	1,229.75	1,240.00
Dairy (including short course)	983.50	1,327.00
Diploma account	730.00	890.00
Domestic economy (including short course)	912.65	931.75
Electrical engineering	1,870.00	2,288.65
English	686.88	825.72
Farm crops (including short course)	1,832.75	1,474.00
Good roads school	44.00	
Horticulture (including short course)	224.25	285.70
Public speaking and physical culture	177.50	160.00
Mechanical engineering	2,918.15	2,742.91
Music department, rental of pianos	153.07	161.27
Re-classification (credited to fires, lights and incidentals	132.00	109.00
Special examinations (credited to library)	156.00	182.00
Soils	359.00	542.50
Veterinary department	692.00	977.00
Zoology	400.45	516.10
Tuition from students residing outside of the state	1,902.00	2,810.00
Totals	$ 40,405.55	$ 52,623.68

III. SCHOLARSHIP FUNDS.

Agricultural fellowship fund	$ 510.00	
Engineering scholarship		100.00
Iowa State Fair scholarship	200.00	500.00
Rosenbaum scholarship	200.00	
Totals	$ 910.00	$ 600.00

IV. AGRICULTURAL EXTENSION WORK.

From State—		
Annual appropriation ($5,500.00 of second year's appropriation left as a balance in state treasury.	$ 15,000.00	$ 21,500.00

V. EXPERIMENT FUNDS.

Agricultural Experiment Station—		
From National Government, Hatch Act	$ 15,000.00	$ 15,000.00
From National Government, Adams Act	7,000.00	9,000.00
From State, annual appropriation ($2,250.00 of second year appropriation left as balance in state treasury)	25,000.00	22,750.00
Live Stock Experimentation—		
From National Government, annual		1,125.00
From State, annual		1,125.00
Engineering Experiment Station—		
From State, annual appropriation	3,500.00	3,500.00
Good Roads Experimentation—		
From State, annual appropriation	5,000.00	5,000.00
Totals	$ 55,500.00	$ 57,500.00

VI. BUILDING AND EQUIPMENT FUNDS.

From State (drawn from State Treasury)—		
Annual repair and contingent fund	$ 23,000.00	$ 23,000.00
Annual special building tax	103,876.49	140,838.39
Central building, additional, special	28,371.79	
Central Heating plant, special (old)	33,782.27	
Central Heating plant, special (new)	2,285.37	30,714.63
Dairy building, farm and equipment	1,924.62	2,338.93
Additional land	5,500.00	
Equipment of dairy farm	6,600.95	3,399.05
Water system improvement		5,000.00
Walks and grading		4,650.00
Remodeling old engineering hall	140.00	6,860.00
Machine shop	254.60	14,239.42
Special equipment for college departments	2,535.49	6,000.63
Pure Bred Stock Purchase		4,342.15
Totals from State	$208,271.58	$ 241,383.20

From Students and Others (credited to room rent account—		
Rental of rooms	$ 2,673.41	$ 1,509.94
Sale of wreckage material	983.47	205.26
Net receipts from custodian's store room		126.68
Amount received from Fort Dodge, Des Moines & Southern Railway on improvement account		75.00
Totals from all sources	$211,928.46	$ 243,300.08

SUMMARY OF RECEIPTS.

I.	Educational support funds	$203,791.06	$ 223,940.78
II.	Fees and tuition	40,405.55	52,623.68
III.	Scholarship funds	910.00	600.00
IV	Agricultural extension work	15,000.00	21,500.00
V.	Experiment funds	55,500.00	57,500.00
VI.	Building and equipment funds	211,928.46	243,300.08
Totals		$527,535.07	$ 599,464.54

The foregoing statement of receipts differs from the treasurer's statement in that it does not include fees refunded, transfers from one department to another, or sales of departments.

EXPENDITURES FOR THE BIENNIAL PERIOD.

These expenditures are classified under such headings as will show most clearly the cost of the different lines of work and the investment in buildings and equipment.

The following are the main headings, with the expenditures under each:

		1906-7	1907-8
1.	College educational work	$244,068.48	$ 273,922.08
2.	Agricultural extension work	15,000.00	21,317.49
3.	Experimentation	56,389.36	67,454.27
4.	Buildings and equipment	203,322.79	256,216.88
Totals		$518,780.63	$ 618,910.72

The balance sheet for the biennial period shows as follows:

RECEIPTS.

Cash on hand July 1, 1906		$ 36,839.02
Receipts for 1906-7 on college accounts	$527,535.07	
Receipts for 1907-8 on college accounts	599,464.54	1,126,999.61
Net receipts on college hospital fund held in trust by trustees		1,175.55
Total		$1,165,014.18

EXPENDITURES.

Expenditures for 1906-7	518,780.63
Expenditures for 1907-8	618,910.72
Cash on hand June 20, 1908	27,322.83
Total	$1,165,014.18

The balance on hand is credited to the following funds:

Educational Funds—			
State and national support	$ 20,767.23		
State fund for books and periodicals	22.70		
Clay fund for support of agricultural journalism	62.51		
Diploma account	690.73		
Donation fund	330.03		
Piano rental	113.34		
Scholarships	301.71	$	22,288.25
Agricultural extension			182.51
Experiment funds—			
Agricultural experiment station	171.91		
Engineering experiment station	763.47		
Good roads experimentation	164.09		1,099.47
Buildings and improvement funds—			
Machine shop	2.30		
Walks and grading appropriation	9.09		
Room rent account	819.00		
Tuition transferred to repair account	963.28		1,793.67
Trust funds—			
Railroad damages, to land sold under contract	88.00		
Hospital fund balance	1,870.93		1,958.93
Total		$	27,322.83

Considering in detail the different lines of expenditure, the first in order is the

COLLEGE EDUCATIONAL WORK.

EXPENDITURES.

For What Purpose	1906-7 From Fees	1906-7 From Support Funds	1907-8 From Fees	1907-8 From Support Fund
1. Salaries—				
Professors, assistant professors and administrative officers	.....	$ 86,700.51	.....	$ 96,309.01
Instructors and assistants	.....	42,471.59	.....	50,285.88
2. Department expenses and ordinary equipment—				
Agricultural engineering	1,060.50	331.07	1,056.50	840.44
Animal husbandry (including short course)	2,561.75	1,353.75	2,556.25	1,960.87
Botany	928.90	1,220.00	1,402.50	1,374.97
Chemistry	6,029.52	500.07	6,000.66	920.32
Civics	.....	8.45	.....	7.90
Civil engineering	1,229.75	1,264.20	1,240.00	2,649.15
Dairy	983.50	2,790.55	1,327.00	1,174.63
Dairy farm	.....	753.71	.....	986.70
Domestic economy	912.65	964.00	931.75	1,066.94
Dean's offices, general lectures	.....	19.05	.....	21.60
Economic science	.....	253.60	.....	240.00
Electrical engineering	1,870.00	1,605.66	2,288.65	3,483.96
English	686.88	109.74	825.72	480.52
Farm	.....	2,580.31	.....	2,154.00
Farm crops	1,832.75	1,001.00	1,474.00	1,923.00
Good roads	44.00	.....	.....	.....
History	.....	68.47	.....	72.37
Horticulture	224.25	1,611.00	285.70	1,644.30
Library (gen'l expenses)	156.00	973.00	182.00	967.53
Library (books and periodicals)	.....	2,556.16	.....	2,377.30
Mathematics	.....	204.53	.....	137.97
Mechanical engineering	2,918.15	810.79	2,742.91	2,322.82
Military	.....	207.08	.....	262.02
Mining engineering and geology	.....	862.17	.....	2,011.11
Modern languages	.....	38.00	.....	50.32
Music (including piano rent)	153.07	119.20	161.27	7.98

EXPENDITURES—(Continued).

For What Purpose	1906-1907 From Fees	1906-1907 From Support Fund	1907-1908 From Fees	1907-1908 From Support Fund
Poultry	.....	29.48	.....	400.00
Public speaking	177.50	77.85	160.00	82.48
Scholarship funds department	.....	125.00	.....	800.00
Soils	359.00	425.33	542.50	847.14
Veterinary	692.00	1,269.77	977.00	1,377.93
Zoology	400.45	819.29	516.10	734.35
3. Administrative and general expenses—				
Including clerk hire and other expenses of the executive and administrative offices; cost of catalogs, compendiums, diplomas, advertising, telephone service, interdepartment mail service, proctors, ringing chimes, commencement, Sabbath services, high school inspection work, etc	872.11	15,497.27	758.14	16,057.49
4. Maintenance of buildings and grounds—				
Buildings: heat, light and janitor service	14,552.93	32,044.64	24,253.17	23,900.54
Grounds: labor, equipment and supplies	.....	3,756.53	.....	4,306.72
Totals	$38,645.66	$205,422.82	$49,681.82	$224,240.26

SUMMARY.

	1906-7	1907-8
Salaries	$129,172.10	$146,594.89
Department expenses and ordinary equipment	48,172.90	58,051.13
Administrative and general expense	16,369.38	16,815.63
Maintenance of buildings and grounds	50,354.10	52,460.43
Totals	$244,068.48	$273,922.08
Charged against the following funds:		
National and state support funds	$205,297.82	$223,440.26
Student fees	38,645.66	49,681.82
Scholarship funds	125.00	800.00
Totals	$244,068.48	$273,922.08

The foregoing represents the cost of maintenance of the educational part of the college. The sales of departments, reported separately, as the law directs, are as follows:

Sales of departments connected with educational work—	1906-7	1907-8
Agricultural engineering—net receipts from repair work done by this department	.....	$ 319.19
Animal husbandry	$ 264.41	130.30
Botany	16.00	.....
Chemistry	18.55	2.10
Civil engineering	110.19	68.22
Dairy	14,875.70	22,677.56
Dairy farm	727.49	1,507.77
Electrical engineering	527.75	328.60
English	3.90	.....
Farm	12,322.85	13,126.96
Farm crops	188.82	67.97
Fires, lights and incidentals	7,750.20	4,707.22
Horticulture	991.96	572.01
Mechanical engineering	356.44	509.45
Poultry department	.....	1.40
Public grounds	743.93	216.35
Veterinary department	1,726.15	1,510.70
Zoology	64.29	58.00
Mining engineering	212.35	121.50
Totals	$ 40,900.98	$ 45,925.30
Sales of Experiment Stations—		
Agricultural experiment station	$ 10,023.53	$ 9,846.34
Engineering experiment station	147.00	498.45
Total sales	$ 51,071.51	$ 56,270.09

If these sales are added, in the case of each department, to the amounts given in the preceding expense budget, the gross expenditures on account of each department can readily be found. A full exhibit of these gross expenditures is given in the report of the State Executive Council, pages 750 to 753.

AGRICULTURAL EXTENSION WORK.

The Agricultural Extension department was established by the legislature in 1906. The scope of its work, as originally planned, is set forth in Chapter 185 of the laws of that year. The last general assembly continued and extended the work. The following is the law governing this department and making an annual appropriation for its maintenance:

CHAPTER 216, LAWS OF 1907.

Be It Enacted by the General Assembly of the State of Iowa:

SECTION 1. Agricultural extension and experiment work. That the Iowa State College of Agriculture and Mechanic Arts is hereby authorized to continue and to extend the system of agricultural extension work authorized by the Thirty-first General Assembly. Under this system the said college shall be authorized to conduct experiments in the various portions of the state and to give instruction in agriculture wherever, in the judgment of the college authorities it shall be advisable, with reference to the various lines of agricultural work maintained upon the college grounds at Ames, Iowa. The college authorities are authorized to give instruction in corn and stock judging at the agricultural fairs, institutes and clubs, and to aid in conducting short courses of instruction at suitable places throughout the state; to give lectures and demonstrations on the growing of crops and fruits, on stock raising, dairying, land drainage and kindred subjects, including domestic science. This work shall be so planned as, in the judgment of the college authorities, is best calculated to carry to the communities remote from the college the benefits of the instruction given by the teachers in the State College and the results reached in the work of the experiment station.

SEC. 2. Appropriation—how paid. For the purpose of carrying out the provisions of this act, there is hereby appropriated out of any funds in the state treasury, not otherwise appropriated, the sum of twenty-seven thousand dollars ($27,000.00) annually for the agricultural extension work; said appropriation to be available on and after the first day of July, 1907; to be paid quarterly upon the order of the board of trustees of the Iowa State College of Agriculture and Mechanic Arts.

Approved April 13, A. D. 1907.

The following are the more important regulations of the board relative to the extension work:

1. Experiment work shall not be done by the department. Other departments of the college are organized and fully equipped for carrying on experiments and experiment work by this department would result in duplication.

2. It is declared to be the primary object of this department to give to the people of the state the direct benefits of the results of experiments carried on at the college and to give them instruction along the lines followed by the college. This work of instruction and

demonstration can be best accomplished by lectures at farmers' institutes, clubs and farmers' picnics, fairs and short courses. The work should be planned to be in harmony and close touch with that of the different college departments.

3. The extension work is planned as a department of the agricultural division of the college, and the head of such department shall bear the same relation to the dean of that division as is borne by the heads of the other departments in the division of agriculture. The head of said agricultural extension work and all other instructors, lecturers and employes therein shall be appointed in the same way as is observed in the appointment to similar positions in other departments.

4. It is directed that the local expenses of lectures, demonstrations, short courses and other forms of agricultural education shall be borne by the communities in which they are held, and so far as possible the traveling expenses of lecturers and workers in attendance on such work shall be met by the communities or organizations served.

The following is a statement of the expenditures of the department for the last biennial period:

AGRICULTURAL EXTENSION.

EXPENDITURES FOR 1906-1908.

	1906-7	1907-8
Salaries—		
Staff including extension secretary	$ 10,065.38	$ 13,668.86
Extra help for short course work		255.78
Labor—		
Stenographic and office work	1,576.88	2,817.38
Miscellaneous labor	48.38	165.17
Supplies and other expenses—		
Maps, charts, department supplies, exhibit expenses and apparatus	606.78	1,118.22
Bulletins and circulars	44.40	654.37
Furniture	302.58	271.33
Stationary and office supplies	546.53	495.14
Office equipment	189.03	
Postage	607.80	713.00
Telephone rental and tolls	76.46	120.06
Traveling expenses	935.78	1,038.18
Totals	$ 15,000.00	$ 21,317.49

The annual appropriation for the conduct of extension work is $27,000. The expenditures for 1907-1908, as shown above, amount to $21,317.49, leaving a balance to the credit of the fund of $5,682.51. The funds available for 1908-1909 are therefore the following:

Cash balance	$ 5,682.51
Appropriation for 1908-9	27,000.00
Total	$ 32,682.51

The following is the expense budget for the year:

AGRICULTURAL EXTENSION BUDGET 1908-9.

Salaries—		
P. G. Holden, superintendent	$ 3,200.00	
A. V. Storm, agriculture in public schools; two months at $2,000; ten months at $2,200	2,166.66	
A. H. Snyder, soils, two months at 1,600; ten months at $1,700	1,683.33	
R. K. Bliss, animal husbandry, two months at $1,400; ten months at $1,500	1,483.33	
R. E. Drennan, animal husbandry, two months at $1,000; four months at $1,200; six months at $1,500	1,316.66	
G. R. Bliss, horticulture, eleven months at $1,000	916.66	
J. A. King ,farm crops, two months at $65	130.00	
Edith G. Charlton, domestic economy	1,000.00	
Neal S. Knowles, domestic economy, two months at 75 per month and 10 months at $1,000 per annum	983.33	
H. C. Pierce, poultry ten months at $200 per annum	166.66	
A. E. Nelson, general work, ten months at $66.66 per month	666.60	
H. C. Horneman, dairying, six months at $1,200 per annum	600.00	
M. L. Wilson, farm crops, twelve and five-sevenths weeks at $50 per week	635.71	
G. E. Stayner, secretary	1,000.00	$ 15,948.94
General Expenses—		
Stenographic help, department labor	$ 2,000.00	
Traveling expenses	1,300.00	
Stationery and office supplies, postage, freight, express and drayage, telegrams and telephones, department supplies	1,700.00	
State Fair	200.00	
Furniture	200.00	
Per diem for special lectures	200.00	
Printing, bulletins, and postage on same	1,000.00	
Charts, maps, photographs	1,300.00	
Fund for weed, seed and insect collection	2,326.29	
Library	25.00	
Balance, for future assignment	6,482.28	16,733.57
Total		$ 32,682.51

The trustees ask of the general assembly that the annual appropriation for this extension work be increased to $35,000.

EXPERIMENT FUNDS.

The college receives annual appropriations for experiment work along the following lines:

1. Agricultural experiment station.
2. Horse breeding experimentation.
3. Engineering experiment station.
4. Good roads experimentation.

The work is considered separately under these headings.

AGRICULTURAL EXPERIMENT STATION.

The cash balance to the credit of this fund at the beginning of the biennial period was $10,194.62. This was larger than usual, principally because the new congressional appropriation known as the Adams fund was not received until just before the close of the preceding period. The receipts for the two years, as already shown, were as follows:

	1906-7	1907-8
From National government, Hatch Act	$ 15,000.00	$ 15,000.00
From National government, Adams act	7,000.00	9,000.00
From State, annual appropriation ($2,250 of 1907-8, appropriation left as a balance in the state treasury.)	25,000.00	22,750.00
Totals	$ 47,000.00	$ 46,750.00

The following are the expeditures for the biennial period classified as recommended by the National Department of Agriculture:

AGRICULTURAL EXPERIMENT STATION EXPENDITURES.

	1906-7	1907-8
Salaries of station staff	$ 18,143.30	$ 18,883.01
Salaries of station assistants	5,929.20	8,963.47
Labor, including stenographic and clerical	9,933.69	11,860.31
Publications	2,136.74	2,158.92
Postage and stationery	941.26	1,375.44
Freight and express	572.58	830.86
Heat, light, water and power	2,317.30	2,018.67
Chemical supplies	782.08	745.58
Seeds, plants, and sundry supplies	2,869.43	4,678.05
Fertilizers	96.71	252.52
Feeding stuffs	4,885.21	5,572.27
Library	2.50	.....
Tools, implements and machinery	889.87	1,172.78
Furniture and fixtures	300.47	96.15
Scientific apparatus	461.14	972.29
Live stock	5,665.81	5,560.64
Traveling expenses	1,110.19	1,483.65
Contingent expense	15.00	15.00
Buildings and land	617.05	2,629.38
Totals	$ 57,669.53	$ 69,268.99
Less sales and transfers between sections	11,141.27	12,024.54
Total expenditure of national and state funds	$ 46,528.26	$ 57,244.45

SUMMARY.

Cash balance, July 1, 1906		$ 10,194.62
Income from national and state appropriations, 1906-7	$ 47,000.00	
Income from national and state appropriations, 1907-8	46,750.00	93,750.00
Total		$103,944.62
Expenditures, 1906-7	$ 46,528.26	
Expenditures, 1907-8	57,244.45	103,772.71
Cash on hand, July 1, 1908		$ 171.91
Total		$103,944.62

The expeditures of the station are subject each year to investigation by an expert representing the agricultural department at Washington. The following shows the station funds available for the coming year:

Balance in hands of college treasurer, July 1, 1908	$ 171.91	
Balance in hands of state treasurer, July 1, 1908	2,250.00	$ 2,421.91
Income from national government	26,000.00	
Income from state	25,000.00	51,000.00
Total		$53,421.91

This amount has been apportioned by the board of trustees as follows:

AGRICULTURAL EXPERIMENT STATION BUDGET.

1908-9.

Salaries of station staff and assistants		$29,834.14
Expenses of sections—		
Bulletins and bulletin office	$ 3,200.00	
General expenses, including heat, light and janitor service	2,100.00	
Director's office	1,250.00	
Animal husbandry	2,600.00	
Farm crops	2,300.00	
Soils	2,600.00	

Agricultural engineering	700.00	
Horticulture and forestry	2,600.00	
Dairy	700.00	
Veterinary	400.00	
Botany	700.00	
Entomology	700.00	
Dairy farm	1,000.00	
Poultry	700.00	
Chemistry	1,200.00	
Photographic supplies	500.00	
Balance unappropriated	337.77	23,587.77
Total		$53,421.91

The salaries of the station staff and assistants are given in detail in the salary budget, found further on in this report. The list, as there given, aggregates slightly more than the amount used in this exhibit for the reason that the salaries there listed are for the college year beginning September 1, 1908, instead of the fiscal year, beginning July 1. Changes in salary go into effect September 1, and therefore, at first, effect the college year more strongly than the fiscal year.

The increasing demand of the farmers of the state for the enlargement of the work of the station makes additional funds necessary. The college trustees ask that the annual appropriation be increased in the sum of $50,000.00.

HORSE BREEDING EXPERIMENTATION.

The last legislature made provision in Chapter 217, Laws of 1907, for the conduct by this college of experiments looking to the developing of a hardier type of horses. The appropriation was made contingent upon the allotment to this experiment by the United States department of agriculture of an amount equal to that to be furnished by the state. The amount of the appropriation was limited to $7,500 annually.

With the approval of the board of trustees, a contract was entered into between the director of the college experiment station and the national agricultural department under which the department agreed to furnish the station in 1907 with three gray Shire mares, valued at $1,125, to be used for the purposes of this experiment. The joint fund, contributed in equal parts by the department and the college, thus amounted to $2,250. To this fund the board added $4,000 of the amount appropriated by the last general assembly for the purchase of pure bred stock. Professor Kennedy was authorized to visit England and Scotland to secure the horses necessary for carrying on the experiment to the best advantage. He bought in all eight horses, six mares and two stallions. One of the stallions was purchased on the farm account; three of the shire mares for the national government, to be used in this experiment; and the remainder of the stock, one stallion and three mares, from the pure bred stock appropriation, as shown in the exhibit giving the expenditures of this appropriation. The following exhibit gives in detail all charges against the joint experiment fund:

HORSE BREEDING EXPERIMENTATION.

EXPENDITURES.

Kibby Bedon Firefly, difference in exchange for three-year old mare	$150.00
Three shire mares purchased in England	975.00
Traveling expenses of Professor Kennedy purchasing eight horses in England	671.72
Exchange on drafts	2.00
Portion of Professor Kennedy's salary charged to this account; ten months at $250 per annum	208.33
Portion of salary of horseman charged to this account	187.30
Feed for stock	55.65
Total	$2,250.00

It is agreed between the college and the department of agriculture that each shall own the stock it furnishes for this experiment work. The agricultural department has promised to furnish for the coming year additional stock valued at $5,000.

ENGINEERING EXPERIMENT STATION.

This station was established in 1904. The first appropriation for its maintenance ($3,000 annually) ran simply for the biennial period. In 1906 the legislature established the work upon a permanent basis and increased the appropriation to $3,500 annually. The department is under the direct supervision of a committee of the engineering faculty. The character of the work, and the results accomplished are set forth in the report of Dean Marston. The following is an abstract of the expeditures for the biennial period:

ENGINEERING EXPERIMENT STATION.

EXPENDITURES.

	1906-7	1907-8
Salaries—		
A. Marston	$ 250.00	$ 250.00
G. W. Bissell	200.00	33.34
W. H. Meeker		166.67
L. B. Spinney	200.00	200.00

S. W. Beyer	100.00	100.00
I. A. Williams	100.00	100.00
M. J. Reinhart	100.00	
F. M. Okey		458.34
M. I. Evinger	295.00	129.50
C. E. Ellis	399.96	566.66
Equipment	805.18	615.00
Bulletins, publishing and mailing	372.96	138.40
Postage	92.53	5.03
Stationery and office supplies	12.12	6.85
Stenographic help	2.10	
Power and lights	2.00	9.10
Telephone rental	17.50	6.00
Laboratory supplies	21.64	25.57
Fitting up chemical and ceramic laboratories	252.05	9.10
Furniture	17.00	
Gasoline and oil	178.74	107.76
Chemicals	45.86	71.70
Remunerative testing	651.38	103.45
Sanitary investigation	333.80	101.61
Drainage investigation		209.84
Mechanical investigation	39.94	
Electrical investigation	174.15	58.80
Miscellaneous investigations	33.49	
	$4,697.40	$3,472.72
Deduct sales of department	147.00	498.45
Total expenditures of state appropriations	$4,550.40	$2,974.27

SUMMARY.

Cash on hand, July 1, 1906		$1,288.14
Annual appropriation for 1906-7	$3,500.00	
Annual appropriation for 1907-8	3,500.00	7,000.00
Total		$8,288.14
Expenditures 1906-7, as per exhibit	4,550.40	
Expenditures 1907-8, as per exhibit	2,974.27	$7,524.67
Cash balance July 1, 1908		763.47
Total		$8,288.14

The fund available for the coming year will consist of the balance of $763.47 given above, together with the annual appropriation of $3,500, making a total of $4,263.47.

The following is the expense budget for the year:

ENGINEERING EXPERIMENT STATION BUDGET.

1908-09.

Salaries as shown in the salary exhibits	$1,818.16
Equipment, research work, compiling data, fitting up laboratories, installing apparatus, office expenses, printing, etc	2,445.31
Total	$4,263.47

The fund is insufficient to carry on the work asked of the station by the various industries of the state. The board of trustees recommend that the annual appropriation be increased to $15,000.00.

GOOD ROADS EXPERIMENTATION.

Chapter 105 of the Laws of 1904 provides that the college shall act as a highway commission for the state. The duties of the commission are specified as follows:

1. To devise and adopt plans and systems of highway construction and maintenance, suited to the needs of the different counties of the state, and conduct demonstrations in such highway construction, at least one each year, at some suitable place, for the instruction of county supervisors, township trustees, superintendents, students of the college, and others.

2. To disseminate information and instruction to county supervisors, and other highway officers who make request; answer inquiries and advise such supervisors and officers on questions pertaining to highway improvements, construction and maintenance, and whenever the board of supervisors of a county adjudge that the public necessity requires a public demonstration of improved highway construction or maintenance in said county, and so request and agree to furnish necessary tools, help and motor power for same, the commission shall furnish as soon as practicable thereafter a trained and competent highway builder for such demonstration free to the county.

3. To formulate reasonable conditions and regulations for public demonstration; and to promulgate advisory rules and regulations for the repair and maintenance of highways.

The general assembly which established the commission appropriated to the college $7,000 for the conduct of the work for the biennial period. The next general assembly included in the college appropriation act a permanent annual appropriation of $5,000 for this good roads experimentation. Under the orders of the board of trustees, the dean of engineering and the dean of agriculture have general direction of the work, which is under the more immediate

supervision of Mr. T. H. McDonald. The expenditures for the last two years are set forth in the following exhibit:

GOOD ROADS EXPERIMENTATION.

EXPENDITURES.

	1906-7	1907-8
Salaries:		
T. H. McDonald	$ 1,400.00	$ 1,800.00
A. E. Miller (part salary)	200.00	.....
E. W. Hamilton (part salary)	.....	200.00
J. T. Hoover (part salary)	120.00	120.00
Equipment, including a 100,000-lb. Riehle Bros. testing machine, $1,140.34	1,356.26	26.10
Plans and publications, including as the principal items in the first year 3,000 copies 1906 revision of Manual, $245.20, and drafting plans at 25c per hour, $138.88; and in the second year 10,000 16-page bulletins, $100.00, and drafting plans, $294.35	520.09	469.54
Gathering and tabulating data	177.57	156.00
Experimental and demonstration work	47.96	122.90
Field work	103.99	366.46
Road schools, including advertising, salaries of instructors, traveling expenses of speakers; freight on material, expenses of operating road machinery, building culverts and roads for demonstration purposes and minor miscellaneous expenses	657.33	983.50
Office equipment and expenses, including typewriter, stenographic help, postage, stationery and other office supplies, freight, express, drayage, telephone and telegrams	727.50	741.05
Totals	$ 5,310.70	$ 4,985.55

SUMMARY.

Cash balance, July 1, 1906		$ 460.34
Annual appropriation, 1906-7	$ 5,000.00	
Annual appropriation, 1907-8	5,000.00	10,000.00
Total		$ 10,460.34
Expenditures, 1906-7	$ 5,310.70	
Expenditures, 1907-8	4,985.55	10,296.25
Balance, July 1, 1908		164.09
Total		$ 10,460.34

The above balance and the annual appropriation will give an

available fund for the coming year of $5,164.09. The annual budget for 1908-1909 will stand as follows:

GOOD ROADS EXPERIMENTATION BUDGET.

1908-9.

Salaries as shown in general salary exhibit	$ 2,420.00	
Equipment, investigation, collection of data, tabulating road census cards, preparing plans, expenses of Good Roads School and demonstrations for instruction of county supervisors and township trustees, printing, etc	2,744.09	
Total		$ 5,164.09

BUILDING AND EQUIPMENT FUND EXPENDITURES.

A distinct line lies between expenditures for support and expenditures for buildings and special equipment. Only the latter are considered under this heading. The total expenditures for the biennial period for this purpose are shown in the following exhibit:

SUMMARY OF BUILDING AND EQUIPMENT FUND EXPENDITURES.

	1906-7	1907-8
Repairs and contingencies	$ 20,555.94	$ 30,524.54
Special building tax:		
Hall of agriculture	48,995.38	129,538.62
Central building	28,485.99	182.53
Central heating plant	10,000.00	5,610.25
Dairy building	6,104.71	43.13
Dairy farm buildings	1,184.75	8,051.31
Forge shop	4,535.52	983.25
Machine shop	.....	1,000.00
Central building additional	28,371.79	.....
Central heating plant ($54,500.00)	33,782.47	.....
Central heating plant ($60,000.00)	2,244.23	30,755.77
Dairy farm buildings and farm equipment	1,924.62	2,338.93
Equipment for dairy farm and poultry buildings	6,600.95	3,399.05
Land additional	5,500.00	.....
Water system improvement	.....	5,000.00
Walks and grading	.....	4,640.91
Remodeling old engineering hall	140.00	6,860.00
Machine shop	254.60	14,237.12
Special equipment for college departments	2,535.49	6,000.63
Pure bred stock purchase	.....	4,342.15
Room rent fund	2,106.35	2,708.69
Totals	$203,322.79	$256,216.88

The above totals show that nearly two-fifths of the entire expenditures of the college for the biennial period were in the line of additional buildings and equipment. In general, these buildings and improvements are constructed under the constract system. The limit of cost having been fixed by the board of trustees, plans and specifications are prepared by the architect in consultation with the heads of departments interested. Bids are then secured, carefully considered and compared by the architects and building committee, and contracts let by the board to the lowest responsible bidder. An approved bond is required in each case.

The college engineer acts in general as local superintendent. Inspectors are appointed for the larger buildings. The architect visits the work frequently. The building committee has general oversight of all construction work. Under his former contract the architect received three per cent of the cost of construction; under the one now in force he receives two and one-half per cent for plans, specifications and superintendence.

Much of the repair and minor improvement work cannot be handled under the contract system. Where it can be the system is used. In other cases the college employs labor and buys the matrial through its purchasing committee. The need of the repairs asked for is passed upon by the building committee and appropriations made from the repair fund. The custodian of buildings and the superintendent of the fires and lights department are made responsible for the prompt execution of the repairs ordered and coming in their line of work. The wages and prices paid are set forth fully in the secretary's report to the Executive Council.

A most careful accounting is made of the expenditures under each of the state appropriations. An abstract of these expenditures is given in the exhibits which follow, together with such explanations as are considered necessary to an understanding of these expenditures and the present condition of the different funds.

The appropriations are considered in the order given in the summary.

1. REPAIR AND CONTINGENT FUND.

EXPENDITURES.

Remodeling west cottage for use as hospital	$ 2,694.30
Furniture for public rooms	1,247.29
Repairs on heating, lighting and water plants	10,022.38
Repairs on college residences occupied by president and professors	3,731.16
Agricultural hall repairs	2,074.31

Central building repair	685.57
Chemical building repairs	997.19
Dairy building repairs, including agricultural extension rooms	655.36
Margaret hall repairs	645.15
Morrill hall repairs	328.35
Fitting up grain judging rooms in judging pavilion	3,307.54
Remodeling old engineering hall and installing heating plant in same	2,867.79
Fitting up engineering library room in engineering hall	615.77
Installing machinery in new machine shop	1,858.32
Engineering buildings, miscellaneous repairs	543.95
Farm buildings repairs	1,284.79
Horticultural buildings, repairs	635.53
Veterinary buildings repairs	499.10
Shop for college carpenter	259.17
College hospital repairs	275.06
Music hall repairs	290.49
Bookstore and postoffice building, moving and repairing	94.73
Repairs on other college buildings	244.82
Labor and supplies for general repairs on buildings	932.64
Sewer disposal maintenance	579.63
Sewer extension	2,794.61
Sewer repairs	422.63
Extending water system	776.82
Fire extinguisher and hose	500.11
Campus lights	288.05
Extending lights to alumni hall	220.57
Repairs and minor improvements on campus	366.78
Farm improvements, tiling, fencing, etc	2,153.69
Building committee expenses	121.53
Land department expenses	127.78
Part of custodian's salary	620.80
Part of carpenter's salary	1,039.96
Part of second carpenter's salary	797.26
Painter's salary	1,246.21
Part of college treasurer's salary	200.00
Part of college engineer's salary	400.00
Part of salary of chairman of faculty comiitee on public grounds	83.33
Part of salary of superintendent of heating, lighting and plumbing	400.00
Part of salary of superintendent of sewage disposal plant	220.00
Salary of secretary of building committee and accountant	929.96
Total	$ 51,080.48

The demands upon this fund during the biennial period were so heavy that the trustees decided to increase it by the transfer of a portion of the receipts from tuition collected of students from outside the state. The amount is shown in the following summary of receipts:

REPAIR AND CONTINGENT FUND SUMMARY.

Cash balance July 1, 1906	$ 323.19
Annual appropriation, 1906-7	23,000.00
Annual appropriation, 1907-8	23,000.00
Tuition fund transferred	4,757.29
Total receipts	$51,080.48

This entire amount was expended as shown in the exhibit of expenditures. The building committee has gone over the askings from this fund for the coming year, and approved those that are the most urgent. Adding these to the fixed charges, we have the following budget:

REPAIR AND CONTINGENT FUND BUDGET.

1908-9.

Fixed charges—		
One-fourth salary of custodian	$ 325.00	
Two-thirds salary of first carpenter	520.00	
Two-thirds salary of second carpenter	400.00	
Two-thirds salary for third carpenter	400.00	
Part salary of treasurer for handling funds	250.00	
Part salary of Prof. Meeker, superintendent of heating, lighting and plumbing plant repairs	366.67	
Part salary of college engineer, Marston	200.00	
Part salary of secretary and accountant of building committee	560.00	
Part salary of Mr. Okey, superintendent of sewage disposal system	118.36	
Salary of painter	660.00	
Painter's supplies	300.00	
Fires and lights repairs	5,500.00	
Maintenance of sewage disposal system	350.00	
Sewer maintenance	150.00	
Building committee office expenses	100.00	
Emergency fund for minor repairs	850.00	
Endowment fund expenses	25.00	11,075.03
Unexpended balances reappropriated—		
Agricultural engineering, general repairs	25.00	
Soils department, general repairs	34.00	
Gutters and conductors	33.73	

Painter's supplies	57.45	
Hospital furnishings	25.60	
Remodeling west cottage for hospital	20.10	
Remodeling book store and postoffice building	1,415.00	
Crematories for waste paper	23.54	
Sewage disposal system repairs	111.35	
Sewer repairs	91.03	
Repairs on botany gas machine	28.96	
Dairy building repairs	36.43	
Mechanical engineering improvement	112.68	
Mining engineering kiln for burning clay	71.17	
Mining engineering lantern screens	27.00	
Old engineering hall gutters	125.00	
Balance on remodeling old engineering hall	599.57	
Track for blue print frames	10.00	
Dairy farm house screens	18.03	
Heating upper rooms in barn	10.36	
Repairing horse barn floor	38.70	
Silo	92.68	
Lengthening driveway at station barn	30.75	
Botanical woods for cases	30.62	
Horticultural department repairs	29.12	
Chapel floors	290.45	
Repairs on residence occupied by Prof. Summers	160.37	
Extending heating plant to residence occupied by Prof. Curtiss	88.24	
Repairs on residence occupied by Prof. McKay	52.15	
Music hall repairs	20.00	
Repairing farm buildings	105.43	
Other minor repairs	136.45	3,950.97
New appropriations—		
Painting farm buildings and fences	150.00	
Building and repairing fences	100.00	
Dairy building, transom chains	10.00	
Miscellaneous repairs on farm buildings	60.00	
Additional for silo	57.32	
Animal husbandry cottage, screens	15.00	
Poultry farm fencing	150.00	
Animal husbandry, repairs on station barn	40.00	
Farm crops, tin linings for bins	30.00	
Farm crops, general repairs	50.00	
Corn laboratory dormer window	75.00	
Repairing greenhouse wall	75.00	
Soils gas machine	25.00	
Veterinary department improvements	1,200.00	
Engineering hall, painting and repairing	125.00	
Repairing walls of foundry, pattern shop and old power plant	100.00	
Installing machinery in machine shop	600.00	

Installing machinery in engineering laboratory	300.00	
Fitting up foundry room	200.00	
Cutters and conductors	85.00	
Roof painting, including new engineering hall	200.00	
Chemical department, general repairs as directed by Prof. Bennett	200.00	
Domestic economy, zinc tables	26.00	
Domestic economy, repairing gas stove	15.00	
Economic science, electric wiring	15.00	
Economic science, hanging maps	15.00	
Painting new hospital	150.00	
Hospital, new roof	150.00	
Bull stocks	25.00	
Grading and sidewalks	600.00	
Electric motor for chapel organ	390.00	
Dairy farm cottage, plumbing, heating and repairing	450.00	
Reflooring stalls in horticultural barn	25.00	
Doors in music hall	20.00	
Frescoing walls in veterinary department	16.50	
Screens for zoological department, Morrill Hall	10.00	
Rope for flag pole	10.00	
Repair of workman's club house	15.00	
Bins and shelving in greenhouse store-room	50.00	
Repairs in college creamery	25.00	
Repairs in college hospital	81.00	
Connecting bookstore and postoffice building with central heating plant	175.00	
Furniture for departments	500.00	
Painting floors in residence occupied by Prof. Mortensen	55.00	
Wiring residence occupied by Prof. Mortensen	64.25	
Doors for music hall	20.00	
Repairs on residence occupied by Prof. Meeker, including heater	100.00	
Shades in engineering hall	100.00	
Water connections at president's barn	45.00	
Blackboards in new recitation room in engineering hall	75.00	
Repairs on elevator at Dairy Building, including walls	300.00	
Furnace in residence occupied by Prof. Marston	150.00	
Repairs in physical laboratory	18.70	
Lights in college library	50.00	
Repairing farm cottage	75.00	
Minor repairs	29.81	7,693.58
Total		$22,719.58

The foregoing appropriations will practically exhaust the annual fund of $23,000.00. Many of the repairs laid over because of want

of funds are urgent. Many others will come up as emergency items during the year. The board ask that the legislature increase this annual fund to $45,000.00.

SPECIAL BUILDING TAX.

From the standpoint of the books of the treasurer of the college this account for the biennial period shows as follows:

RECEIPTS.

Cash on hand at the beginning of the biennial period		$ .56
Amount drawn from state treasurer 1906-7	103,876.49	
Amount drawn from state treasurer 1907-8	140,838.39	244,714.88
Total		$244,715.44

EXPENDITURES.

Hall of agriculture	$178,534.00
Central building	28,668.52
Central heating plant	15,610.25
Dairying building	6,147.84
Dairy farm buildings	9,236.06
Forge shop	5,518.77
Machine shop	1,000.00
Total	$244,715.44

The above does not, however, make a full showing of the condition of the fund, since it does not take into account the balance in the hands of the state treasurer. A joint statement from the books of the state and college treasuries shows:

RECEIPTS.

Cash in state treasury at the beginning of the biennial period	$ 38,038.55	
Cash in college treasury	.56	$ 38,039.11
Receipts from one-fifth mill tax during the two years		255,113.02
Total		$293,152.13

EXPENDITURES.

Expended in the erection of buildings as shown by books of college treasurer	$244,715.44
Cash in hands of state treasurer at close of biennial period	48,436.69
Total	$293,152.13

The first levy under the new tax law was made in 1907. Counting that all the receipts for the present year belong to that levy, the funds of the biennial period would be divided between the two laws as follows:

Old fund, to be expended under Chapter 172, Laws of 1902	$218,042.55
New fund, to be expended under Chapter 184, Laws of 1906	75,109.58
Total	$293,152.13

The new law runs for five years. The following shows the probable future receipts under its operation, and the purposes for which it is designed by the board that the fund shall be used:

SPECIAL BUILDING TAX.

ESTIMATED RECEIPTS AND PROPOSED EXPENDITURES.

RECEIPTS.

Cash on hand July 1, 1908		$ 48,436.69
Receipts for last half of 1908, estimated		56,000.00
Receipts for 1909, 1910, 1911 and 1912, estimated at $130,000 per annum		520,000.00
Total		$624,436.69

PROPOSED EXPENDITURES.

Hall of agriculture		
Balance of amount authorized by the Legislature and Executive Council, unexpended	$144,432.36	
Additional amount necessary to complete the building, estimated	17,000.00	$161,432.36
Central Building—		
Amount authorized from old fund by board of trustees for lighting front portico	$ 711.03	
Amount reserved on Schlueter's contract because of litigation between contractor and sub-contractors, regarding fire-proofing	3,000.00	3,711.03
General engineering laboratory		30,000.00
Domestic technology building		75,000.00
Veterinary science building		150,000.00
Library building		200,000.00
Unassigned		4,293.30
Total		$624,436.69

The estimated annual income of $130,000 is based upon an assessed valuation of the property of the state of $667,668,233. A one-fifth mill tax on this amount will yield annually $133,533.65, if the entire amount is collected. An estimate of $130,000 would, under these circumstances, seem conservative. Past experience would indicate that this annual income will become available in the first and second half of each calendar year in about the proportion of $74,000 and $56,000. The hall of agriculture will be completed in the spring of 1909. It will take about $61,000 of the $74,000 available in the first half of that year to meet the final payments on account of this building. This will leave $13,000 for the general engineering laboratory. The completion of this building in the late summer will call for $17,000 of the receipts of the second half of the year, leaving $39,000 available for the domestic economy building. This will permit the beginning of this building in the fall of 1909, and its completion in the spring of 1910. The $36,000 needed to complete it will leave $94,000 available in 1910 for the veterinary building. The completion of this building in 1911, involving the expenditure of $56,000 of the receipts of that year, will leave $74,000 for the new library. This amount, together with the receipts of 1912, will give a fund of $200,000 for this building and leave $4,000 for contingencies.

Reverting to the expenditures of this fund for the last biennial period and considering the different improvements separately, it has been deemed best to add, in each case, the expenditures charged to other funds, so as to show the entire cost to date of each such building or other improvement.

HALL OF AGRICULTURE.

This building was begun in 1906. The bids for its erection are given on page 82 of the last biennial report. The contract was let, in August of that year, to H. W. Schlueter, of Chicago, for $210,905. It contained an optional clause giving the trustees the right to afterwards include an annex to the building at an agreed price of $60,000. The last general assembly authorized the board to use this additional amount of the special building tax for this purpose. The option was thereupon accepted and a new contract including the annex was executed. No provision having been made for the heating, lighting and plumbing of the annex, the Executive Council, acting under the authority granted them in the building tax law, gave the board permission to use $8,000 of the tax fund to meet these necessary expenses. It was found necessary, in the progress of the work, to lower the grade line to the annex, much additional room in the basement being thus made available. The Executive

Council voted $5,000 from the tax fund to cover this change in plans. Summarizing the action of the legislature and the Executive Council we have the following as the amount of the tax fund set aside for this building:

Chapter 184, laws of 1906	$250,000.00
Senate joint resolution, laws of 1907	60,000.00
State executive council, May 7, 1907, heating, lighting, plumbing and incidentals for annex	8,000.00
State executive council, July 10, 1907, change in plans for annex	5,000.00
Total	$323,000.00

A receiver was appointed in August, 1907, to take charge of Mr. Schlueter's affairs. The Empire State Surety Company, of New York City, was his bondsman in the sum of $50,000. After much deliberation this company decided to take over the work and complete the building. A contract to this effect was entered into between the Company and the board of trustees. The contract bears date of September 27, 1907. After citing the contract with Mr. Schlueter, the obligations of the surety company, the default of the contractor and the desire of the bond company for its own protection to carry out and perform all the provisions of the Schlueter contract, the contract of the Company with the board makes provision for the completion of the work as follows:

"Now Therefore, In consideration of the premises, the Empire State Surety Company is admitted, in the stead of said Schlueter, to the possession of the plant and materials on, adjacent to, or intended to be used upon said work, and it agrees to fully and completely perform and carry out all the provisions thereof which by the terms thereof are to be performed and carried out by the said Schlueter; the said Board to have all the rights and privileges, as against said surety, that are reserved to it as against said Schlueter. Said board of trustees of the Iowa State College of Agriculture and Mechanic Arts agree to make payments to said surety as they would have been made to said Schlueter under the said contracts, had he not made the aforesaid defaults and failures. Provided, however, that if, when said buildings are fully completed and all just claims for material furnished and labor performed are paid, the cost of the buildings is less than the contract price therefor, the remainder of the contract price shall be disposed of according to the rights of parties."

Under this agreement the Company has gone forward with the work, applying to the payment of laborers and material men all moneys received from the college, and in addition advancing a considerable amount from its own funds. Delays have occurred in the work which will probably prevent the completion of the building by January 1, 1909, the date mentioned in the contract. Its ultimate completion within a reasonable time thereafter, without loss

to the college, is however assured. In the end the institution will obtain a splendid building at a price much below cost. The following are the expenditures on its account during the biennial period:

HALL OF AGRICULTURE.

EXPENDITURES.

Henry W. Schlueter, contractor, estimates	$ 59,356.24	
Empire State Surety Co.' estimates	101,650.47	
Proudfoot & Bird, architects, part payment 3 per cent. of cost	7,600.00	
Metal Construction Co., heating and plumbing, part payment on contract of $28,000	5,958.27	
Ames Engineering Co., wiring, part payment on contract of $3,170.72	955.65	
Inspector	2,115.99	
Stenographer and other office expenses	538.34	
Reducing valves	126.00	
Advertising for bids	55.29	
Staking out location	14.97	
Traveling expenses of trustees and college officers, preparing plans and transferring contract from Schlueter to State Surety Co.	119.34	
Express, telephones and telegrams	19.19	
Miscellaneous expense items	24.25	$178,534.00

A carefully prepared estimate of the entire cost of the building, when fully completed, has been made and is given below:

ESTIMATED COST OF HALL OF AGRICULTURE COMPLETED.

Empire State Surety Co.—		
Contract for erection of building and annex	$270,905.00	
Additional for lowering grade line of annex, and furnishing granite for same	4,120.00	
Book shelves, option in contract	250.00	
Extras on contract approved by board and paid	923.84	
Additional extras on contract estimated by engineer as necessary	600.00	
Metal Construction Co.—		
Contract for heating, plumbing and ventilating	28,000.00	
Extras estimated by Professor Meeker, superintendent	200.00	
Ames Engineering Co.—		
Contract for wiring building	3,170.72	
Extras for telephone and power circuits	283.22	
Electrical equipment, including transformers, paid	425.41	
Water connections	186.20	
Reducing valves	126.00	
Superintendent Meeker's estimate of cost of installing air compressor, vacuum pump, elec-		

tric motor and switchboard and making connections		600.00	
Architect's fees, 3 per cent. of cost		9,250.00	
Inspector to November 1, 1908		2,475.99	
Inspector from Nov. 1 to completion of building		450.00	
Stenographic and other office expenses of superintendent		827.24	
Advertising for bids		55.29	
Traveling expenses of trustees and college officers, preparing plans and transferring contract to Empire State Surety Company		119.34	
Express, telephone, telegrams and other miscellaneous expense		58.41	
Laboratory plumbing	$ 4,000.00		
Elevator and enclosure	5,500.00		
Painting walls and decorating walls	3,500.00		
Electric light fixtures	3,000.00		
Fitting up room in basement	780.00		
Contingencies	193.34	16,973.34	$340,000.00

The above estimate exceeds the sum set aside for this building by $17,000. This excess represents, largely, items omitted from the original plans in an endeavor to bring the cost of the building within the limits fixed by the legislature. The necessary character of these omitted items becomes, however, more and more apparent as the building nears completion. A freight elevator, for instance, would seem to be a necessity. Any other method of handling the mass of material used by the different departments will be expensive and liable to cause serious injury to the building. The interior walls should be painted and considerable additional laboratory plumbing has been found necessary. Certain extras have been unavoidable. Considering the size of the building and the many laboratories involved, the amount needed in excess of the original estimate in order to insure a completed building does not appear to be unreasonable. The board ask the legislature for authority to thus fully complete the building, using the additional sum of $17,000 of the tax fund, needed for this purpose.

CENTRAL BUILDING.

The disbursements on account of this building prior to July 1, 1906, have been set forth in detail in previous biennial reports. They are summarized on page 76 of the last report. The building was occupied early in 1906 but much of the furniture and some of the fixtures were installed later. Settlements on a number of these contracts were not made until in the summer. For this reason

expenditures aggregating a considerable sum appear in this report though the building was completed in the preceding biennial period. Under the law a part of these expenditures were charged to the special building tax and a part to the special appropriation for completing the building. In the exhibit which follows, the expenditures charged to each of these are given:

CENTRAL BUILDING EXPENDITURES.

Charged to Special Building Tax—		
Henry W. Schlueter, contractor—		
Estimates	$13,605.31	
Extras on contract	3,199.90	16,805.21
Mitchell, Vance & Co., balance on contract of $3,000 for electric fixtures		500.00
Buffalo Forge Co., balance due on contract for sheet iron work		158.62
Des Moines Cabinet Co., balance due on contract of $10,729.75 for special furniture	36.27	
Extras on contract	785.54	821.81
L. Harbach Sons. & Co., balance due on contract of $3,295.08 for filing cabinets, book cases and office fixtures	87.36	
Extras, change in tables	232.00	
Additional tables	58.90	378.26
Holbrook Mantel & Tile Co., balance due on contract of $4,050 for toilet rooms	585.00	
Extras	31.20	616.20
Proudfoot & Bird, architects, balance due 3 per cent of cost		580.33
Younker Bros., contract for shades		358.00
Stoner Wall Paper Co., contract for tinting and decorating	3,300.00	
Extras	284.66	3,584.66
L. H. Kurtz & Co., balance due on contract of $26,800 for heating, ventilating and plumbing	1,732.73	
Additional plumbing, principally in botanical laboratories	2,827.48	4,560.21
Additional heating, lighting and plumbing by College Construction Department		228.31

Stenographic work		75.00	
Freight and telephone		1.91	$28,668.52
Charged to Central Building Additional—			
H. W. Schlueter's contract for granite base		$12,000.00	
Balance of Schlueter's contract for dome		4,000.00	
Des Moines Cabinet Co., amount paid on contract of $10,729.75 for special furniture	$ 4,860.97		
Extras on contract	46.36		
Additional cases	106.00	5,013.33	
L. Harbach Sons Co., amount paid on contract of $3,295.08 for filing cabinets, book cases and office furniture	407.20		
Balance of contract of $6,781.35 for stock furniture	792.80	1,200.00	
L. H. Kurtz Co., amount paid on contract of $26,800 for heating, ventilating and plumbing		6,140.48	
Basin		15.55	
Postage and express		2.43	$28,371.79
Total			$57,040.31

The sum of $3,000, due on the Schlueter contract, is yet unpaid. This has been reserved because of litigation between the contractor and the sub-contractor regarding the fire-proofing work. The electric light standards for the front porch were not installed until last summer. Bills for installing and wiring them, amounting to $711.03, are unpaid.

The summary of all expenditures connected with the erection of this building shows:

Expenditures prior to July 1, 1906, as shown on page 76 of the Twenty-second biennial report	$354,751.50
Expenditures during the last biennial period as shown in this report	57,040.31
Amount reserved as explained	3,000.00
Bills for installing electric light standards on front portico and wiring same, unpaid	711.03
Total cost of building, fixtures and furnishings	$415,502.84

CENTRAL HEATING PLANT.

An appropriation of $54,500 was made by the Thirtieth General Assembly for the erection and equipment of a central heating plant.

The appropriation was utterly inadequate and the trustees were forced to make provision, more or less temporary in its nature, for heating the new buildings, while they waited upon the further action of the legislature. In carrying out this provisional plan $20,717.33 was used in constructing a tunnel from the old power station to Morrill Hall and the new central building; installing two additional boilers in connection with the old plant, erecting a temporary shed for their protection and for the storage of coal; and installing pipe system and such additional power station equipment as the temporary plant necessitated. About $16,000 of the foregoing improvements were such as will form a part of the permanent plant when completed. The balance of the state appropriation, $33,782.47, was not expended, but held, awaiting further appropriation by the legislature.

The Thirty-first General Assembly failing to make such additional appropriation the trustees decided to use this balance, together with such sum as could be spared for the purpose, from the tax fund, in building and equipping in a permanent way such portion of the plant as was most needed. In pursuance of this policy a contract was entered into with Bartlett & Kling, of Cedar Rapids, to erect a portion of the power plant which should contain the engine room, the auxiliary and shop room and a boiler room so planned as to admit of ready addition. Contracts were also let for installing an engine, a boiler, a mechanical stoker and a generator and switchboard, the purpose being to provide such equipment as would enable the central plant to furnish light and motor power, leaving the heating problem proper to be taken up when additional funds were secured. This work cost $49,392.72, exhausting the balance of the direct appropriation and necessitating the use of $15,610.25 of the tax fund.

The Thirty-second General Assembly appropriated $60,000 for constructing heating tunnel system and purchased additional boilers and other equipment. Of this amount $33,000 was expended in the last biennial period. The purposes to which the balance of $27,000 will be devoted are given in a statement attached to the following exhibit, showing the total expeditures on account of the central heating plant during the last biennial period.

CENTRAL HEATING PLANT EXPENDITURES.

Charged to the Special Building Tax—		
Bartlett & Kling, part payment on contract on power station	$ 5,113.34	
Extras on contract	916.03	6,029.37

Proudfoot & Bird, architects, 2½ per cent. on contract cost of power station	740.80		
Balance due on tunnel completed, 3 per cent. of cost	90.25	831.05	
Stirling Consolidated Boiler Co., one-half contract price for 250 H. P. horizontal boiler delivered		1,320.00	
Westinghouse Machine Co., one Roney mechanical stoker	1,066.00		
Erecting same	61.75	1,127.75	
Buffalo Forge Co., engine and fan		566.00	
American Steam Pump Co., pump		215.60	
Globe Machine & Supply Co., one fan discharge stack		148.00	
Feed water heater		425.00	
Foundation for engine W. B. fans		719.23	
Steel frame for floor for draft fan		30.50	
Moving and setting boilers, including boiler foundation		1,092.56	
New power house equipment, including induced draft apparatus, piping and labor of installation		2,879.10	
Freight on boilers and other material		180.13	
Drayage		45.96	$15,610.25
Charged to Appropriation of Thirtieth General Assembly—			
Bartlett & Kling, amount paid on contract for erection of power station	23,800.00		
Constructing concrete floor in engine room	419.00	24,219.00	
Allis-Chalmers Co., contract for generator and switchboard in place and connection made		4,225.00	
Murray Iron Works, contract for 250 H. P. Corliss engine in place and connections made		2,985.00	
Balance on James Horribin's contract on tunnel		58.75	
Extra expenses installing generator and switchboard		87.86	
Labor and material equipping tunnel		1,949.00	
Testing tunnel		91.61	
Setting boiler		48.06	
Inspection		7.60	
Advertising for bids		8.40	

Drayage		88.14	
Freight, express and telegrams		14.05	33,782.47
Charged to Appropriation of Thirty-second General Assembly—			
Bartlett & Kling, contract for construction of tunnel at $4.45 per lineal foot		11,825.85	
Piping for tunnel		4,426.91	
Tunnel equipment, including installing pipe and lighting system in the main tunnel and the branches running to forge shop, farm house and experiment barn		4,965.54	
Paid on Central Insulation Supply Co.'s contract for covering pipes in tunnel and power house		3,500.00	
Superintendent and inspector		161.21	
Paid Stirling Consolidated Boiler Co., one-half contract price for 250 H. P. horizontal boiler delivered		1,320.00	
Power house piping and installing same		981.06	
Motor generator set		2,236.45	
Moving and setting Aultman-Taylor boilers, and setting new 250 H. P. boiler		743.25	
Balance on engine generator set		157.15	
Paid on installing Roney stoker		104.11	
Sewage disposal plant for power station		56.21	
Power house equipment, including lighting, plumbing, cement floor, conduits and everything not otherwise set forth in this report		2,368.18	
Balance of architect's fee		154.08	33,000.00
Total			$82,392.72

The following is Superintendent Meeker's statement of the purposes for which the balance of $27,000 of the appropriation of the last legislature will need to be expended:

Two 500 H. P. Sterling boilers	$ 7,705.00	
Setting Sterling boilers	3,000.00	
Pipe covering	1,500.00	
Tunnel piping	2,500.00	
Power house piping and equipment	4,600.00	
Two Green chain grate stokers	2,550.00	
One Roney stoker	1,156.00	
Boiler feed pump	220.00	
Setting old boiler, including fire brick	900.00	
Induced draft apparatus	1,500.00	
Miscellaneous items	1,369.00	$27,000.00

The following summary shows the total expenditures on account of the central heating plant since the inception of the work, together with the funds against which they are charged:

CENTRAL HEATING PLANT SUMMARY.

Expenditures charged appropriation of Thirtieth General Assembly—		
Biennial period 1903-5	$ 76.42	
Biennial period 1905-6	20,641.11	
Biennial period 1906-7	33,782.47	$ 54,500.00
Expenditures charged special building tax		15,610.25
Expenditures charged appropriation of Thirty-second General Assembly		33,000.00
Total expenditures to July 1, 1908		$103,110.25
Superintendent Meeker's estimate for unexpended appropriation		27,000.00
Total appropriations		$130,110.25

Superintendent Meeker estimates the amount needed to complete the system at $50,000. The following is his estimate in detail:

Boiler room extension of 70 feet	$15,000.00	
200 K. W. engine generator set	7,500.00	
Engine foundation	1,200.00	
Engine room piping and connections	500.00	
Coal and ash handling machinery	12,500.00	
High tension electric lines in main tunnel	4,500.00	
Extension of equipped tunnel to existing buildings	4,800.00	
Moving 500 H. P. of Sterling boilers from old plant and installing at central station	2,000.00	
Feed pump and heater	1,200.00	
Miscellaneous	800.00	$50,000.00

The board asks an appropriation of the above amount.

DAIRY BUILDING.

The expenditures on account of this building during the biennial period are as follows:

L. H. Kurtz Co., balance of contract for plumbing	$ 487.00	
Extras on contract	408.42	
Additional plumbing	571.74	$1,467.16
Vilter Mfg. Co., contract for refrigeratory plant		3,220.00
Harris-Emery Co., contract for shades		274.00
Installing switchboard		346.93
Finishing laboratory tables		50.00

Fitting up room for agricultural extension work	589.00	
Rugs for five offices	128.70	
Plumbing, A. L. Potter	72.05	$6,147.84

The above is charged to the tax fund collected under the old law.

The following shows the entire cost of the building:

Expended during the biennial period ending June 30, 1905, as shown on pages 124 and 125 of twenty-first biennial report	$49,918.31
Expended during year ending June 30, 1906, as shown on page 80 of the twenty-second biennial report	15,855.66
Expended during the biennial period ending June 30, 1906, as shown in this report	6,147.84
Total cost of building, fixtures and furnishings	$71,921.81

Of the above amount $55,000 came from direct appropriation by the legislature and the balance, $16,291.81, from the tax fund accruing under the old law.

DAIRY AND POULTRY FARM BUILDINGS AND EQUIPMENT.

The college purchased the dairy and poultry farm in 1905. It contains 200 acres and cost $22,000. The Thirtieth General Assembly appropriated:

For herd, equipment of dairy farm.....$7,000
For poultry and equipment of dairy farm. 500

At the beginning of the last biennial period the unexpended balance to the credit of the first of these appropriations was $4,199.69. No portion of the second appropriation had been used. Adding to these balances the amounts devoted to the development of the dairy and poultry departments by the last legislature and the board of trustees, we have as the total amount available for the biennial period the following:

Appropriations of the Thirtieth General Assembly—		
Balance on dairy herd and equipment	$ 4,199.69	
Balance on poultry and equipment	500.00	$ 4,699.69
Authorized from building tax fund by Thirty-second General Assembly, Senate joint resolution No. 7—		
Dairy and poultry farm buildings	8,000.00	
Amount added to above by board of trustees from building tax (old)	1,236.06	9,236.06

Appropriation of the Thirty-second General Assembly for buildings and equipment of dairy farm and poultry plant	10,000.00
Total	$23,935.75

The following are the expenditures during the two years:

POULTRY AND DAIRY FARM IMPROVEMENTS.

EXPENDITURES.

Dairy and poultry equipment and dairy herd—			
M. Hullibarger paid on contract of $1,825 for erection of dairy cottage	$ 783.90		
Extra items on cottage	7.64	$ 791.54	
C. F. Waltmire, contract for erection of feed shed		231.03	
Material furnished by college on barn		256.69	
Manger partitions		13.50	
Constructing two silos		478.14	
Erection of wind mill		34.50	
Grading around buildings		61.58	
Other minor improvements		19.59	
Equipment		54.46	
Advertising, surveying, express and telephone		14.44	
Additions to dairy herd		2,308.17	4,263.55
Dairy and poultry farm buildings—			
Proudfoot & Bird, 3 per cent. of $1,825, cost of cottage	54.75		
Part payment for barn plans	130.00	184.75	
M. Hullibarger, part payment on contract for erection of cottage		1,000.00	
Contract for completing barn		3,805.73	
Contract for building poultry feed barn		3,100.00	
Contract for poultry houses		1,100.00	
Ames Engineering Co., wiring poultry feed barn		45.58	9,236.06
Buildings and equipment of dairy farm and poultry plant—			
M. Hullibarger, contract for erection of dairy farm	6,500.00		
Extras on contract	11.59	6,511.59	
Lumber furnished by college		150.00	
Metal Construction Co.'s contract for heating and plumbing		3,000.00	
Barn equipment, stanchions, hay carriers, track, etc.		134.31	
Material used in constructing silo		89.34	
Well on dairy farm		42.14	
Surveying and grading around poultry buildings		43.60	
Extras on Hullibarger's contract on poultry buildings		13.85	
Extras on Ames Engineering Co.'s contract for wiring poultry buildings		7.88	
Advertising, freight, express and telephone		7.29	10,000.00
Total expenditures			$23,499.61

This leaves an unexpended balance of $436.14, which belongs to the appropriation of the Thirtieth General Assembly, divided as follows:

Dairy herd and equipment	$352.30
Poultry and equipment	83.84
Total	$436.14

The above is the only amount available at present for further work on the dairy and poultry plant. The need of additional buildings, in the poultry department especially, is very urgent. The trustees ask an appropriation of $10,000 to provide the same.

FORGE SHOP.

The trustees, in the summer of 1906, set aside $5,525 from the tax fund receipts, under the old law, for the erection of a forge shop. The following exhibit shows the cost of the building:

EXPENDITURES.

Western Steel Construction Co., contract tract for erection of building	$ 4,444.44		
Extras on contract	51.34	$ 4,495.78	
Equipment, forge exhauster and blower		502.75	
Piping and labor of installing		303.52	
Advertising for bids		5.20	
Freight, drayage, express and telephones		61.36	
Labor		150.16	$ 5,518.77

In this, as in the case of all other improvements of any considerable cost, bids were received and contract let to the lowest bidder.

The college has been enabled under this system to erect its buildings at a minimum cost. The bids on this building are inserted as an illustrative case.

C. E. Atkinson, Webster City, Iowa	$5,099.00
H. W. Schlueter, Chicago, Ill.	5,297.00
Western Steel Construction Co., Des Moines, Ia.	4,444.44
Bartlett & Kling, Cedar Rapids, Iowa	5,900.00
Jacobson & Chrystie, Perry, Iowa	5,206.00

MACHINE SHOP.

The last legislature appropriated $16,000 for the erection of a machine shop. The bids on this building ranged from $13,400 to $17,430. The contract was let to H. W. Schlueter, of Chicago, he being the lowest bidder. Comparatively little progress had been made in the work when the receiver for Mr. Schlueter was appointed. His bondsman, The Empire State Surety Company, of New York, assumed all the obligations of the Schlueter contract. In adjusting matters with the Surety Company the contract relating to the building and the one for the erection of the Hall of Agriculture were joined and though the machine shop is now completed and in use the ten per cent reserved on monthly estimates will be held until the Hall of Agriculture is completed and accepted.

During the construction of this building the board became convinced that much additional room could be obtained at small additional cost by building a gallery around the main floor. This could not be done, however, without obtaining additional funds. The sum of $1,000 was needed. Since the shop itself was not erected by the new tax fund this extra amount could not be secured from that source. The attorney general held, however, that the board of trustees could use for this purpose any balance remaining of the fund collected under the old tax law. The books of the state auditor showed the necessary balance on hand and the board ordered the gallery added to the contract as an extra. While this change in plan increased the cost of the building by $1,000 it increased its capacity in a much greater proportion.

The following shows the expenditures on account of the building.

MACHINE SHOP EXPENDITURES.

Charged to Machine Shop appropriation—		
Paid on Schlueter's contract of $13,400 for erection of building	$12,059.79	
Extras on Schlueter's contract on foundation	837.79	
Proudfoot & Bird, architects, 2½ per cent. of cost	400.00	
B. F. Sturtevant Co.'s contract for heating apparatus	856.00	
Installing heating apparatus and connecting with central heating tunnel	176.58	
Toilet room plumbing	58.01	
Drayage	14.05	
Grading	62.99	
Advertising for bids	18.66	
Surveying, freight and express	7.85	
Total from state appropriation		$14,491.72
Charged Special Building Tax—		
Extra on contract, for change of plans so as to include gallery		1,000.00
Total expended		$15,491.72

The unexpended balance will not more than cover the ten per cent reserved on the building contract and certain small bills for completing the heating and wiring, which are still unpaid.

ADDITIONAL LAND.

In order that the college might purchase additional land adjoining the farm the Thirty-first General Assembly provided a fund of $11,000. One hundred and thirty-seven acres in all were bought. Payments to the amount of $5,500 were made on the contracts of purchase, prior to July 1, 1906. These are reported on page 86 of the last biennial report. The balances due on these contracts were paid in the last biennial period. The following is the list of such payments:

E. E. Little and A. P. Whitmore, 20 acres at $64.00 per acre, second one-half payment	$ 650.00	
Ellen Gilchrist, 27 acres, second one-half payment	1,250.00	
John L. Stevens, 80 acres, at $75.00 per acre, second one-half payment	3,000.00	
Interest on above deferred payments	144.26	
Improvements in the line of fencing made by parties before delivery of land under agreement with the college	455.74	$5,500.00

WATER SYSTEM IMPROVEMENT.

The appropriation of the last legislature for the improvement of the college water system was $10,000. Only one-half of this amount was available in the last biennial period. It was expended as follows:

Paid on contract of Cook Construction Co., for new pump house and pipe system	$2,190.22	
E. C. Archibald, contract for drilling new well	$ 364.00	

Strainer, piping and fittings	552.10	916.10	
Byron-Jackson, for pump	808.00		
Freight on same	81.13	889.13	
Electric motor, and installing same		542.22	
Reservoir and pipe connections to power house		405.82	
Inspection		11.13	
Advertising, surveying, drafting, telegrams, express, drayage, testing and office expense		45.38	$5,000.00

The greater portion of the work connected with this improvement has been finished. The unpaid bills show that the balance of the appropriation will be expended as follows:

Balance of Cook Construction Co.'s contract for reservoir, pump house and pipe line	$3,031.47
Buffalo Steam Pump Co.'s contract	941.75
Pump house equipment	39.74
Pipe connections to fire pump	617.35
Electric connections to centrifugal pump	239.69
Inspector	130.00
Total	$5,000.00

Professor Meeker, superintendent, in charge of the expenditure of this fund, says in his report upon the work:

"In connection with the closing up of this appropriation I would say that the reservoir, well and centrifugal pump, with its direct connected motor drive, have been given a thorough trial. The results have been most satisfactory. The pump delivered water for five continuous hours at the rate of 24,000 gallons per hour. The builders' guarantee was 15,000 gallons per hour. At the end of the run there was no indication of any decrease in the supply of water. It would seem that we have a first class well. The underwriters' fire pump that has been installed has a capacity of 1,000 gallons per minute, or enough to supply four fire streams. When this is connected to our new boiler installation the college water supply will be on a most satisfactory basis.

The new apparatus and construction is first class in every respect, and looking back over the expenditure of the fund I do not know how any part could have been better expended or how we could have lessened any item of cost without impairing the value of the installation."

WALKS AND GRADING.

The Thirty-second General Assembly appropriated the sum of $5,000 for grading around the new buildings and beginning the work of constructing a system of walks on the college grounds. The following statement shows how the appropriation has been expended:

WALK AND GRADING EXPENDITURES.

Grading around Central Building, Association Building, Engineering Hall and Engineering Shops at $4.25 per day for man, team and use of tools		$2,933.73	
Grading and filling pond near creamery		75.98	
Cement walks, use of machine at 50c per hour, superintendent at 40c per hour and workmen 25c to 30c per hour		406.50	
Cement for walks at 57½c per cwt		276.12	
Gravel for walks at 75c per yard delivered		76.90	
Grading for cinder path to Ames		271.71	
Surveying, drafting and setting grade stakes at 15c to 25c per hour		138.87	
Lumber for bridges across Squaw Creek	$ 179.20		
Driving piling at 25c per hour	155.50		
Other work on bridges, 15c to 30c per hour	114.88		
Hardware for bridge and repairing tools	11.52	461.10	$4,640.91

The unexpended balance of $359.09 is not more than sufficient to cover the unpaid bills. The greater portion of the appropriation, as the statement shows, was expended in grading around the new buildings on the west campus. Only a small amount was expended in building walks. With the completion of the Hall of Agriculture considerable grading will need to be done on the east campus. The college grounds are extensive, the buildings scattered, and the number of students large. Only a beginning has been made upon an adequate system of walks. The board ask the legislature to provide an additional fund for sidewalks and grading of $11,000.

REMODELING OLD ENGINEERING HALL.

The legislative appropriation for this purpose was $7,000. The bids when opened by the board ranged from $9,153 to $11,162. All bids were rejected. Mr. R. G. Coutts, of Grinnell, then submitted a proposition to do the work for actual cost plus seven per cent additional for management and supervision. His proposition was accepted upon the following conditions:

1. That he should guarantee that the total cost of the work should not exceed the lowest bid, $9,153.

2. That the building committee should have the right to stop the work when the sum of $7,000 had been expended.

Contract was entered into upon this basis. After careful investigation the committee decided to recommend to the board the completion of the work on the basis of the original plans. The board adopted this recommendation and appropriated the additional amount needed from the repair fund.

The following are the expenditures during the biennial period, divided between the state appropriation and the repair fund as noted:

REMODELING ENGINEERING HALL.

EXPENDITURES.

Charged to State Appropriation—		
Labor and material bills included in Mr. Coutts' contract	$6,786.31	
Architect's fee, part payment	175.00	
Advertising for bids	7.20	
Repairing measuring tank	16.35	
Heating plant	15.14	$7,000.00
Charged to Repair Fund—		
Labor and material under Coutts' contract	$1,735.59	
Paid Coutts for repairs on tank	325.00	
Paid other bills for repairing tank	92.84	
Paid Proudfoot & Bird, balance of architect's fee	53.83	
Heating plant	660.53	2,867.79
Total expenditures		$9,867.79

The following bills chargeable against this improvement are unpaid:

Citizen's Lumber Co.	$ 65.00	
R. G. Coutts per cent for supervision	621.95	$ 686.95
Total cost		$10,554.74

Not dividing the expense between funds, the items making up the final cost can be condensed and better stated, thus:

Labor and material under Mr. Coutts' contract	$8,586.90	
Amount added for work on measuring tank	325.00	$ 8,911.90
Seven per cent. allowed Mr. Coutts for management and supervision		621.95
Bills for repairing tank paid direct by college		109.19

Installing heating plant	675.67
Adertising for bids	7.20
Architect's fee, 2½ per cent. of $9,153.00	228.83
Total	$10,554.74

Dean Marston says of this improvement that it has made a practically worthless building into a modern fire-proof hydraulic and structural laboratory worth at least $25,000 as a part of the college plant.

SPECIAL EQUIPMENT FOR COLLEGE DEPARTMENTS.

The funds available for this purpose under the special state appropriations, during the biennial period, were as follows:

Appropriation of Thirty-first General Assembly	$ 5,000.00
Appropriation of Thirty-second General Assembly	5,000.00
Total	$10,000.00

Equipment for the several departments was purchased from this fund as follows:

Agricultural department	$ 300.00
Agricultural engineering	482.80
Animal husbandry	191.15
Botany	1,150.00
Chemistry	357.78
Dairy	187.60
Electrical engineering	2,015.00
Horticulture	99.80
Farm Department stock	75.00
Mechanical engineering	1,700.00
Mining engineering and geology	655.38
Soils	471.61
Veterinary department	200.00
Zoology	650.00
Total	$8,536.12

This leaves a balance of $1,463.88, which added to the second half of the appropriation of the last general assembly, gives an available fund for the coming year of $6,463.88. This has been apportioned by the board of trustees to the different departments as follows:

Agricultural engineering	$ 252.20
Animal husbandry	658.85
Botany	400.00
Chemistry	442.22
Civil engineering	1,100.00
Dairy	162.40

Economic science	25.00
Farm crops	400.00
Horticulture	205.20
Mechanical engineering	545.00
Mining engineering	944.62
Physics and electrical engineering	400.00
Soils	328.39
Zoology	400.00
Veterinary	200.00
Total	$6,463.88

These figures are in themselves a forcible argument in favor of a material increase in the equipment fund. An institution with thirty-four departments, more than a hundred laboratories and 1,834 students in its four year technical courses needs a much larger fund than it has now at its command, in order to maintain and increase its department equipment and thus meet the demands of a reasonable development. The trustees ask that the equipment appropriation be increased to $20,000 and made annual.

PURE BRED STOCK PURCHASE.

The following shows the expenditures on account of the appropriation of $5,000 made by the last legislature for the purchase of pure bred stock:

EXPENDITURES.

One gray shire stallion	$ 750.00
One gray shire mare	1,250.00
Two Clydesdale mare	1,010.00
Airdrie Duchess "F"	200.00
Rival's Nellie	200.00
Romford Premier	50.00
Insurance on shire stallion and mare	65.00
Transportation charges on eight horses, from England	775.00
Commission on letter of credit	40.00
Traveling expenses purchasing	2.15
Total expended	$4,342.15

This leaves an unexpended balance of $657.85.

ROOM RENT.

This is one of the minor sources of college revenue. Its receipts include rental from rooms, and all other income from college buildings. Its expenditures are largely along the line of keeping in repair the buildings and rooms from which the rental is derived. The following shows the receipts and expenditures during the last biennial period:

RECEIPTS.

Cash on hand July 1, 1906	$ 60.28
Rental collected	4,183.35
Sale of wreckage material largely from Emergency Hall	1,188.73
Net receipts from custodian's store-room	126.68
Amount received from Interurban Railway Co. on improvement account	75.00
Total	$5,634.04

EXPENDITURES.

Salaries:—		
Part salary of custodian, two years	$ 619.20	
Part salary of first carpenter, two years	658.70	
Part salary of second carpenter, two years	200.00	$1,477.90
Margaret Hall:—		
Murescoing	$ 362.42	
Painting	53.05	
Furniture and repairing same	413.68	
Disinfecting and cleaning	251.31	
Kitchen range and utensils	158.75	
General repairs	174.29	$1,413.50
Labor wrecking old cottage and Emergency Hall		1,138.05
Repairs and furnishings for club house rented student girls		139.76
Repairs and furniture, office building		85.87
Expenses of custodian office		224.10
Net increase in inventory of custodian's store-room		265.64
Railroad improvements, re-charged to railroad company		40.40
Supplies for carpenter shop and other minor items		29.82
Total expended		$4,815.04

The foregoing exhibits cover in detail the entire expenditures of the college. The summary of these expenditures is given on page — of this report.

FUNDS AVAILABLE FOR 1908-1909.

The following exhibit shows:

1. The balances in the hands of the state and college treasurers to the credit of the various college funds at the close of the fiscal year 1907-1908.

2. The estimated income for the year from all sources.

1. BALANCES.

Building and Equipment Funds:—

Special building tax	$48,436.69	
Appropriation of Twenty-ninth General Assembly for pure bred stock	.44	
Appropriation of Thirtieth General Assembly for dairy farm and equipment	436.14	
Appropriation of Thirty-first General Assembly for equipment of departments	492.32	
Special appropriations of Thirty-second General Assembly, (portion of $75,000 authorized, not expended)	2,496.78	
Room rent balance, and tuition balance transfered to repair account	1,782.28	$53,644.65
Support Funds:—		
Educational funds	$22,288.25	
Agricultural extension	5,682.51	
Experiment funds	3,349.47	$31,320.23
Trust Funds:—		
Railroad damages	88.00	
Hospital fund	1,870.93	1,958.93
Total balances		$86,923.81

2. ESTIMATED RECEIPTS.

Buildings and Equipment Funds:—		
Building tax fund	$130,000.00	
Annual repair and contingent fund	23,000.00	
Tuition from students outside of the State ordered transfered to repair account	5,000.00	
Rental of rooms	1,500.00	
Balance of appropriations of the Thirty-second General Assembly available under the law in 1908-9	48,000.00	$207,500.00
Educational Support Funds:—		
From National government	$ 70,000.00	
From State	158,000.00	
From student fees	51,000.00	$279,000.00
Agricultural extension		27,000.00
Experiment Funds:—		
Agriculture:—		
From National government	$26,000.00	
From State	25,000.00	$ 51,000.00
Horse breeding (special)	5,000.00	
Engineering	3,500.00	
Good roads	5,000.00	64,500.00

Total estimated receipts for the year, for all purposes, and from all sources	$578,000.00

The funds available for the coming year are already devoted by the orders of the board to specific purposes:

1. *Special Building Tax.*—The amount available will be as follows:

Balance from last year	$ 48,436.69	
Estimated income for fiscal year	130,000.00	
Total		$178,436.69

It is designed to use this as follows:

In payment of claimes against central building	$ 3,711.03	
In completing hall of agriculture	161,432.36	
In beginning work on general engineering laboratory	13,293.30	
Total		$178,436.69

2. *Annual Repair and Contingent Fund.*—The following are the items that will make up the amount available:

Tuition from students outside the State transferred, balance	$ 963.28	
Estimated tuition for the year	5,000.00	
Annual appropriation by the State	23,000.00	
Total		$ 28,963.28
The board has already appropriated from this fund, as stated in detail in the report upon the expenditure of the fund	$ 22,719.58	
Leaving as a balance with which to meet a large number of demands already urgent, and new needs which may come up during the year	6,243.70	
Total		28,963.28

3. *Room Rent Fund.*—With its balance now on hand of $819 and its estimated income of $1,500 there will be available $2,319. Under a standing rule of the board this will be used in keeping in order the rooms and buildings from which the rent is derived.

4. *Special Legislative Appropriations.*—These total as follows:

Balances on hand	$ 3,425.68	
Part of appropriations not available until this year	48,000.00	
Total		$51,425.68

These appropriations are devoted by legislative act to the following purposes:

Equipment of college departments	$ 6,463.88	
Constructing heating, tunnel, new boilers, etc	27,000.00	
Improvement of water system	5,000.00	
Purchase of pure bred stock	657.85	
Dairy farm and equipment	436.14	
Pure bred stock (old appropriation)	.44	
Walks and Grading	359.09	
Machine shop	1,508.28	
Total		$51,425.68

The details of these proposed expenditures have already been discussed under their special heads.

5. The budgets of the agricultural extension department and the various lines of experiment work have also been given in full under their respective heads.

6. The statement of balances and estimated receipts show the following as the total support fund available for all purposes:

Balance July, 1908	$ 22,288.25	
Estimated receipts for the year including student fees	279,300.00	
Total		$301,588.25

In determining, however, the fund available for definite appropriation by the board the above is subject to the following deductions:

1. Since student fees cover simply the material used by the students in the laboratories and each department is therefore allowed its fees to purchase such material, these fees are omitted from both the income and expense side of the budget. Hence, there is deducted, estimated fees	$ 51,000.00	
2. Since the state support funds are payable at the end of each quarter it is necessary to reserve a considerable balance at the close of each year to meet the expenses of the first quarter of the following year. The balance thus reserved is	12,000.00	$ 63,000.00
The available balance for the budget is then.		$238,588.25

It is the policy of the board to reappropriate to the different department balances on hand at the close of the preceding year.

The fund available for appropriation is therefore divided as follows:

Balances reappropriated	$ 10,942.48	
Amount available for additional appropriations	227,645.77	
Total		$238,588.25

The budget shows these two classes of appropriations in separate columns:

EDUCATIONAL SUPPORT FUND BUDGET.

1908-9.

1. Salaries—		
Professors, Assistant Professors and Administrative Officers	$109,037.36	
Instructors and Assistants	43,125.00	$152,162.36

2. Department expenses and ordinary additions to equipment—

	Balances reverting, re-appropriated.	Additional appropriation for current expenses and ordinary equipment.	Total
Agricultural dean's office	$	$ 200.00	$ 200.00
Agricultural engineering	61.42	600.00	661.42
Agricultural journalism		100.00	100.00
Animal husbandry		1,000.00	1,000.00
Animal husbandry short course		300.00	300.00
Botany		1,000.00	1,000.00
Chemistry	772.00	800.00	1,572.00
Civics		75.00	75.00
Civil engineering	19.00	1,000.00	1,019.00
Dairy	1,543.00	2,000.00	3,543.00
Dairy farm	106.00	750.00	856.00
Dean of women	47.00	75.00	122.00
Domestic economy	275.00	425.00	700.00
Domestic economy short course		275.00	275.00
Economic science		200.00	200.00
Electrical engineering	226.00	1,850.00	2,076.00
Engineering dean's office		100.00	100.00
English	306.00	500.00	806.00
Farm		2,200.00	2,200.00
Farm crops		1,000.00	1,000.00
History	75.00	125.00	200.00
Horticulture	30.00	1,500.00	1,530.00
Junior college dean's office	110.78	1,075.00	1,185.78
Library general expenses	247.00	575.00	822.00

	Balances reverting, re-appropriated	Additional appropriation for current expenses and ordinary equipment	Total
Library books and periodicals	22.70	2,400.00	2,422.70
Mathematics	138.00	175.00	313.00
Mechanical engineering, including heating, lighting and water supply balance transferred	3,497.00	1,300.00	4,797.00
Military	82.00	250.00	332.00
Mining engineering	412.00	850.00	1,262.00
Modern languages	9.00	75.00	84.00
Music, (including piano rent)	161.31	125.00	286.31
Poultry		600.00	600.00
Public speaking	241.00	100.00	341.00
Scholarship	301.71		301.71
Soils	226.00	735.00	961.00
Veterinary	201.00	1,200.00	1,401.00
Zoology	46.00	500.00	546.00
	$ 9,155.92	$ 26,035.00	
Balances reappropriated	$ 9,155.92		
New appropriation	26,035.00		
Total	$35,190.92		
3.—Maintenance of public grounds and buildings—			
Heating, lighting and water supply	$	$ 16,000.00	$ 16,000.00
Janitor service and supplies		12,797.50	12,797.50
Care and improvement of public grounds	206.05	2,800.00	3,006.05
	$ 206.92	$ 31,597.50	
Balances reappropriated	$ 206.05		
New appropriations	31,597.50		
Total	$ 31,803.55		
4. Administrative and general expense—			
President's office	$ 117.00	2,850.00	2,967.00
Treasurer's office		1,913.00	1,913.00
Registrar and recorder's office	690.73	400.00	1,090.73
Secretary's office	130.00	1,325.00	1,455.00
Purchasing committee	7.00	1,630.00	1,637.00
Entrance requirement committee including inspection of high schools	151.00	725.00	876.00
Junior college dean's office	110.78	1,075.00	1,185.78
Agricultural dean's office		400.00	400.00

	Balances reverting, re-appropriated	Additional appropriation for current expenses and ordinary equipment	Total
Engineering dean's office		400.00	400.00
Advertising	54.00	400.00	454.00
Catalogs and compendiums	96.00	2,000.00	2,096.00
Class enrollment and assignment committee		275.00	275.00
State fair exhibit		200.00	200.00
Commencement week expenses	65.00	300.00	365.00
College day speaker		25.00	25.00
Telephone service	61.00	200.00	261.00
Ringing chimes	20.00	165.00	185.00
Proctors		457.00	457.00
Annual fee of agricultural college association		15.00	15.00
Graduate school of agriculture		25.00	25.00
Carrying campus mail		100.00	100.00
Reserved for contingencies subject to further orders of the board		500.00	500.00
Sabbath services	78.00	500.00	578.00
	$ 1,580.51	$ 15,880.00	
Balances reappropriated	$ 1,580.51		
New appropriations	15,880.00		
Total administrative expense	$ 17,460.51		
Total appropriations for 1908-9 from the educational support funds			$236,617.34

Summarizing the foregoing so as to show how the educational support funds of 1908-1909 are to be used and the expenditures along different lines, we have:

	Old Balances	New Appropriations	Totals
1. Salaries of educational and administrative officers	$	$152,162.36	$152,162.36
2 Current expenses of departments and ordinary additions to equipment	9,155.92	26,035.00	35,190.92
3. Maintenance of buildings and grounds (exclusive of repairs and improvements of buildings)	206.05	31,597.50	31,803.55

	Old Balances	New Appropriations	Totals
4. Administrative and general expenses	1,580.51	15,880.00	17,460.51
Total	$ 10,942.48	$225,674.86	$236,617.34

It will be noticed from the foregoing that the estimate of the available funds for the educational work is $238,588.25, while the appropriations aggregate $236,617.34.

The principal item in the educational budget is of course the salary list. This is given in full in the exhibits that follow. The funds to which these salaries are charged are also stated. The schedule covers the school year, beginning September 1, 1908. Its totals are somewhat in excess of those for the fiscal year beginning July 1, for the reason that changes in salary have then gone into full effect. It is chosen, however, since it gives the running expense basis for the future.

SALARIES OF PROFESSORS, ASSISTANT PROFESSORS AND ADMINISTRATIVE OFFICERS.

SEPTEMBER 1, 1908—SEPTEMBER 1, 1909.

	Support Fund	Agricultural Experiment Station	Other College Funds	Totals
A. B. Storms, president and dean of science division	$ 5,000.00	$	$	$ 5,000.00
E. W. Stanton, mathematics, dean of junior college, secretary of Board of Trustees	3,000.00			3,000.00
C. F. Curtiss, dean of agriculture, director of experiment station	2,000.00	2,000.00		4,000.00
J. R. Lincoln, military science	1,000.00			1,000.00
A. A. Bennett, chemistry	2,100.00			2,100.00
L. H. Pammel, botany	1,800.00	300.00		2,100.00
W. H. Meeker, mechanical engineering	2,100.00		$200.00 *400.00	2,500.00
College engineer	2,550.00		**250.00	3,000.00
Lizzie M. Allis, modern languages	1,400.00			1,400.00

	Support Fund	Agricultural Experiment Station	Other College Funds	Totals
L. B. Spinney, physics	2,250.00			2,250.00
W. J. Kennedy, animal husbandry	1,250.00	1,250.00	†250.00	2,750.00
S. W. Beyer, mining engineer	2,750.00			2,750.00
A. B. Noble, English	1,900.00			1,900.00
H. E. Summers, zoology	1,600.00	400.00		2,000.00
A. MacMurray, public speaking	1,800.00			1,800.00
M. Mortensen, dairy	2,000.00			2,000.00
O. H. Cessna, history and psychology	2,300.00			2,300.00
H. E. Bemis, veterinary	1,400.00			1,400.00
R. C. Barrett, civics	2,000.00			2,000.00
Alice Dynes Fueling, domestic economy	1,900.00			1,900.00
S. A. Beach, horticulture	1,500.00	1,500.00		3,000.00
C. E. Major, mechanical engineering	1,700.00			1,700.00
J. E. Kirkham, civil engineering	1,700.00		‡300.00	2,000.00
C. B. Stanton, civil engineering	1,700.00			1,700.00
F. A. Fish, electrical engineering	2,000.00			2,000.00
Marion H. Kilbourne, dean of women	900.00			900.00
C. G. Tilden, physician (Also receives $300.00 from Hospital.)	1,100.00			1,100.00
Maria M. Roberts, mathematics	1,500.00			1,500.00
Hermann Knapp, treasurer, recorder and registrar (Also receives $500.00 as superintendent of book department.)	1,550.00	250.00	*100.00	1,900.00
A. T. Erwin, horticulture	1,000.00	1,000.00		2,000.00
L. C. Hodson, mining engineering	1,800.00			1,800.00
W. H. Peters, animal husbandry	250.00			250.00
J. B. Davidson, agricultural engineering (Also receives $300 from United States Irrigation Bureau.)	1,125.00	825.00		1,950.00

	Support Fund	Agricultural Experiment Station	Other College Funds	Totals
W. H. Stevenson, soils...	1,250.00	1,250.00		2,500.00
C. H. Stange, veterinary.	1,350.00	250.00		1,600.00
R. H. Dystra, veterinary.	1,800.00			1,800.00
W. E. Madson, veterinary.	1,600.00			1,600.00
B. H. Hibbard, economic science	1,800.00			1,800.00
Lola Placeway, chemistry.	1,200.00			1,200.00
W. F. Coover, chemistry..	1,800.00			1,800.00
Wayne Dinsmore, animal husbandry	1,800.00			1,800.00
M. L. Bowman, farm crops	800.00	800.00		1,600.00
I. A. Williams, mining engineering	1,800.00			1,800.00
Helen Donovan, domestic science	1,200.00			1,200.00
H. C. VanPelt, dairy farm	850.00	850.00		1,700.00
C. A. Scott, horticultural and forestry	1,000.00	1,000.00		2,000.00
John Bower, dairy.....	700.00	700.00		1,400.00
H. C. Ford, civil engineering	1,500.00			1,500.00
Adolph Shane, electrical engineering	1,700.00			1,700.00
W. B. Anderson, physics..	1,300.00			1,300.00
A. H. Hoffman, physics...	1,050.00			1,050.00
M. P. Cleghorn, mechanical engineering	1,500.00			1,500.00
F. G. Allen mechanical engineering	1,400.00			1,400.00
R. A. Norman, mechanical engineering	1,200.00			1,200.00
Julia Colpitts, mathematics	1,000.00			1,000.00
J. E. Guthrie, zoology....	1,400.00			1,400.00
L. B. Schmidt, history....	1,200.00			1,200.00
H. C. Pierce, poultry..... (Also receives $200 from agricultural extension work.)	500.00	500.00		1,000.00
H. G. Bell, farm crops...	1,200.00			1,200.00
B. W. Crossley, farm crops	1,200.00			1,200.00
M. I. Evinger, civil engineering	1,200.00			1,200.00
R. H. Porter, civil engineering	1,200.00			1,200.00
T. H. MacDonald, good roads			††1,800.00	1,800.00

	Support Funnd	Agricultural Experiment Station	Other College Funds	Totals
R. E. Buchanan, botany.	1,400.00	100.00		1,500.00
Elizabeth Maclean, English	1,100.00			1,100.00
Dora Tompkins, English..	900.00			900.00
Julia Vaulx, English.....	900.00			900.00
Sybil Lentner, public speaking	1,000.00			1,000.00
J. E. Brindley, economic science	1,200.00			1,200.00
Ruth Morrison, domestic science	850.00			850.00
Vina E. Clark, librarian.	1,000.00	100.00		1,100.00
J. P. Watson, physical director	1,800.00			1,800.00
Carolyn Grimsby, library.	700.00	100.00		800.00
E. A. Pattengill, mathematics	1,300.00			1,300.00
E. E. Little, horticulture..		1,200.00		1,200.00
I. O. Schaub, soils.....		1,700.00		1,700.00
L. G. Michael, chemist...		2,000.00		2,000.00
F. E. Colburn, station photographer		1,700.00		1,700.00
Totals	$109,575.00	$ 19,775.00	$ 3,300.00	$132,650.00

*—Repairs and improvements.
**—Engineering experiment station.
†—Live Stock experimentation.
‡—Good roads.

Houses on the college grounds are occupied by President Storms, Professors Curtiess, Noble, Summers, Stanton, Marston, Meeker, Beach and Mortensen.

The following is the list of instructors and assistants for the coming year, with the salary of each and the fund to which it is chargeable:

SALARIES OF INSTRUCTORS AND ASSISTANTS.

	Support Fund	Agricultur'l Experiment Station	Other College Funds	Totals
George Mitchell, farm foreman.	$ 1,000.00	$	$	$ 1,000.00
E. N. Wentworth, animal husbandry ..... (Also receives $200.00 from Clay-Robinson fund.)	800.00			800.00
H. Kildee, animal husbandry.... 6 mo. at $1,000 per annum.	500.00			500.00

	Support Fund	Agricultural Experiment Station	Other College Funds	Totals
Laurenz Greene, horticulture	700.00			700.00
F. B. Meyer, gardener, 12 mo.	650.00			650.00
J. T. Barker, soils	1,000.00			1,000.00
E. W. Hamilton, agricultural engineering	700.00		†200.00	900.00
R. E. Carr, agricultural engineering	540.00		‡300.00	840.00
D. W. Sylvester, agricultural engineering	500.00		†120.00 ‡180.00	800.00
Estelle D. Fogel, botany	850.00			850.00
Harriet Kellog, botany	300.00	300.00		600.00
Ada Hayden, laboratory assistant	100.00			100.00
R. E. Jeffs, laboratory assistant.	250.00			250.00
Lola Stephens, chemistry	750.00			750.00
Laura Taggart, chemistry	650.00			650.00
Melissa Flynn, chemistry	650.00			650.00
R. W. Getchell, chemistry	650.00			650.00
Lillian Lister, chemistry	500.00			500.00
F. G. Churchill, chemistry	500.00			500.00
R. W. Crum, civil engineering	900.00			900.00
D. B. Wheeler, civil engineering	600.00			600.00
T. E. Culp, dairy	600.00			600.00
Emma Cunningham, matron	500.00			500.00
Mabel Campbell, domestic economy	700.00			700.00
Cecilia Odendahl, laboratory, assistant domestic economy	250.00			250.00
Wm. Kunerth, electrical engineering	800.00			800.00
H. A. McCune, electrical engineering one month	80.00			80.00
M. W. Pullen, electrical engineering, nine mos.	720.00			720.00
W. H. Raymond, english	1,100.00			1,100.00
Ruth B. Safford, english	650.00			650.00
W. D. Foster, english	800.00			800.00
Mary Morris, english	700.00			700.00
Mabel Rundall, english	350.00			350.00
Carrie Watters, history	540.00			540.00
Ethyl Cessna, history	750.00			750.00
Vera Dixson, library	600.00			600.00
Caroline Laird, library	540.00			540.00
Anna Fleming, mathematics	900.00			900.00
Ward M. Jones, mathematics	1,100.00			1,100.00
Helen M. Smith,	900.00			900.00
Agnes Mosher, mathematics	800.00			800.00

	Support Fund	Agricultural Experiment Station	Other College Funds	Totals
John Bates, mechanical engineer	700.00			700.00
J. W. Cameron, mechanical engineering	800.00			800.00
J. G. Hummel, mechanical engineering	1,000.00			1,000.00
†—Good roads.				
‡—Sales and repair.				
T. R. Minert, mechanical engineering	800.00			800.00
E. C. Potter, mechanical engineering	900.00			900.00
John Sawin, mechanical engineering	800.00			800.00
E. M. Spangler, mechanical engineering	480.00			480.00
J. B. Varela, mechanical engineering	800.00			800.00
Student assistants, mechanical engineering	155.00			155.00
C. Mundhenk, band instructor	300.00			300.00
C. E. Ellis, mining engineer	600.00		**600.00	1,200.00
Grace Norton, modern language.	900.00			900.00
Lisle McCollom Michael, modern languages, one mo.	90.00			90.00
Louise Peters, modern languages	1,000.00			1,000.00
Ingeborg Lommen, modern languages	850.00			850.00
Mary P. Fairfield, modern languages	750.00			750.00
Daisy A. Arville, modern languages	700.00			700.00
Emma Wenholtz, modern languages	100.00			100.00
Marie Zimmerman, modern languages, nine mos.	720.00			720.00
Mr. and Mrs. A. S. Thompson, music	500.00			500.00
Frederika Shattuck, public speaking	800.00			800.00
C. E. Bartholomew, zoology	1,100.00			1,100.00
Henry Ness, zoology	500.00			500.00
C. R. Shumway, zoology	150.00			150.00
Geo. Judisch, veterinary lecturer	50.00			50.00
F. M. Okey,			** 900.00 *120.00	1,020.00
Student assistants, mathematics	210.00			210.00

	Support Fund	Agricultural Experiment Station	Other College Funds	Totals
Margaret Forgeus, cataloger...	600.00			600.00
E. T. Robbins, animal husbandry		1,500.00		1,500.00
L. C. Burnett, farm crops..... Also receives $1,000 from U. S. Department of Agriculture,		500.00		500.00
R. L. Webster, assistant entomologist		1,200.00		1,200.00
M. L. King, experimentalist, agricultural engineering.....		1,500.00		1,500.00
J. H. Crisswell, superintendent field experiments, farm crops..		1,100.00		1,100.00
Charlotte M. King, botany.....		1,000.00		1,000.00
Stella Hartzell, assistant chemist		780.00		780.00
B. A. Madson, assistant chemist.		600.00		600.00
Student assistants, chemistry..		300.00		300.00
C. V. Gregory, bulletin, editor..	300.00	300.00		600.00
Dairy		400.00		400.00
Dairy bacteriologist		500.00		500.00
	$43,125.00	$9,980.00	$2,420.00	$55,525.00

**—Engineering experiment station.
*—Repairs and improvement.

The salaries chargeable to the several funds for the coming year differ slightly from the totals in these exhibits for reasons already stated. The following summary shows the sums actually payable during the year. These are the amounts which appear in the different expense budgets:

SALARIES.

	1908-09
Educational support funds, including administrative officers	$152,162.36
Agricultural extension work	15,948.94
Agricultural experiment station	29,834.14
Live stock experimentation	250.00
Engineering experiment station	1,818.16
Good roads experimentation	2,420.00
Repair fund	1,260.03
Total	$203,693.63

It will be noticed from the foregoing exhibits that the plan adopted by the board in the expenditure of the college income, involves the determining at the beginning of each year of a budget which places a limit upon the expenditures in every department of the work.

A comparison of institutions show that there are two general systems under which college finances are managed. Under one, each department expends during the year such an amount as the reasonable necessities of the work seem to require. Any deficit at the end of the period is met by an appeal to the legislature, in the case of state institutions, and to private generosity, by other colleges and universities. The budget is made at the end of the year, after the expenses in the different lines are fully known.

Under the other system, which is the one strictly adhered to by the trustees, there is practically no danger of a deficit. Each department knows at the beginning of the year the fund at its disposal and is compelled to adjust its plans to the amount thus set aside for its use.

LEGISLATIVE ASKINGS.

The needs of the college are many. The institution is earnestly striving to keep pace with the growing demand that our youth shall have instruction in the sciences underlying the industries, and training in their application. In order that it may do this with credit to itself and honor to the state it must have an increase in its instructing force, additional buildings and more equipment. These needs are fully discussed in the President's report. They are summarized here for ready reference. The trustees ask for them the careful consideration of the legislature.

SUMMARY OF LEGISLATIVE ASKINGS.

Additional Annual Funds—		
College support fund	$75,000	
Agricultural extension	8,000	
Agricultural experiment station support fund	50,000	
Engineering experiment station support fund	11,500	
Repair and contingent	22,000	
Department equipment	20,000	
Library book fund	2,500	$189,000
Direct appropriations—		
Furnishings for hall of agriculture	$35,000	
General engineering laboratory	5,000	$40,000
Central heating plant		50,000
Sidewalks and grading		11,000

Gymnasium, auditorium and armory	150,000
Abattoir laboratory and meat curing building	25,000
Ceramics building	15,000
Poultry farm buildings	10,000
	$301,000

The last general assembly approved plans and specifications for an addition to Margaret Hall to be erected from the special building tax at a cost not to exceed $45,000. The board ask that the authority to erect this Margaret Hall addition be revoked and that then plans and specifications be approved for the erection of the following buildings from the tax fund in the order given.

Completion of hall of agriculture	17,000
Completion of general engineering laboratory	5,750
Domestic technology building	$ 75,000
Veterinary department building	150,000
Library building	200,000

The above will exhaust the fund, the last receipts from which will be payable in 1912.

Respectfully submitted,

E. W. STANTON,
Secretary.

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