1897

Annual Report of the Clemson Board of Trustees, 1897

Clemson University, Board of Trustees

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TRUSTEES' REPORT.

To the Honorable the Senate and the House of
Representatives of the State of South Carolina:

The eighth annual report of the Board of Trustees of the Clemson Agricultural and Mechanical College is herewith submitted to your honorable bodies.

R. W. SIMPSON,
President Board Trustees.

The report of President Hartzog, which is hereto appended, is so full and explanatory of all matters of general interest we do not deem it necessary to make any extended report. We ask a careful consideration of the reports of the President, and of the heads of the departments, the Secretary and Treasurer, and of J. P. Smith, Secretary of the Fertilizer Department, all of which reports are hereto attached.

At the annual meeting of the Board of Trustees in 1896 a plan for the organization of the college was adopted. This plan divides the college into five departments, with necessary subdivisions. It was not practicable at the time to change the system of bookkeeping so as to show the cost of the departments and each division separately, but only the cost of the different departments. Hereafter a system of books will be kept so as to show an itemized statement of the expenditures of each division and the total cost of each department, as well as an itemized statement of every other amount of money expended during the year. The itemized statement accompanying the Treasurer's report, necessarily for this year, is not so divided.

The Treasurer's report shows the total amount expended by each department. Much of this was for plant and permanent improvement.

The health of the college is good. The outbreak of sickness last June was much regretted, but everything has been done to obviate, if possible, any recurrence of the trouble.
The college and all of its departments are now, with a few minor exceptions, practically equipped, at least for the present, but additions will have to be made from time to time as the knowledge of the sciences and their application to practical uses increase.

The cost of maintaining an agricultural and mechanical college must not be compared with the cost of a literary college. The expense of such an institution is necessarily large, and the only way to determine whether the amount expended at Clemson is too large or too small is to compare it with the cost of other similar institutions. Such a comparison will show that that the appropriation to Clemson is below that of almost any other institution of like character.

The amounts heretofore appropriated we confidently believe have been wisely and profitably expended. This belief on our part has been endorsed by every one who has taken the trouble to visit the college and inspect its workings, and we respectfully request your honorable bodies in person to visit the college and judge for yourselves of its benefits and necessities.

It was claimed by some that there was a mistake in the amount appropriated to the college in 1894 of ten thousand dollars. This amount has been refunded to the State Treasury during the year.

By resolution, the Board of Trustees was required to pay from the college appropriation the annual instalments due for the purchase of the Lee land. One instalment was paid last January, and the next will be paid next January, which will be the last payment.

The Fertilizer Department is economically and satisfactorily managed by J. P. Smith, the efficient secretary of this department. See his report.

Farmers' institutes were held in as many places during the year as practicable. We are pleased to report that they are growing in popularity. The change in the vacation from winter to summer will enable the college force to do more work in this direction in the future, at a time that will best suit the people generally, and that will not interfere with the college work.

Respectfully submitted,

R. W. SIMPSON,
President Board Trustees.
Sir: I respectfully submit the following statement of the work of the Fertilizer Department for the year ending December 31, 1897; also, for comparison, the corresponding figures for last year are given:

<table>
<thead>
<tr>
<th></th>
<th>1897</th>
<th>1896</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amt. of privilege tax collected to Nov. 1.</td>
<td>$60,836 83</td>
<td>$49,874 37</td>
</tr>
<tr>
<td>Amt. of fertilizers sold in the State (tons)</td>
<td>243,347</td>
<td>199,497</td>
</tr>
<tr>
<td>Number samples collected by inspectors</td>
<td>400</td>
<td>354</td>
</tr>
<tr>
<td>Number of samples analyzed</td>
<td>272</td>
<td>237</td>
</tr>
<tr>
<td>Number of samples below guarantee</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Number of samples deficient</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Per. cent. of samples below guarantee</td>
<td>1.1 p. c.</td>
<td>2.5 p. c.</td>
</tr>
<tr>
<td>Number of farmers' samples analyzed</td>
<td>44</td>
<td>42</td>
</tr>
</tbody>
</table>

The following statement shows the expenses of this department for the year:

<table>
<thead>
<tr>
<th>Expense Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries of chemists and secretary</td>
<td>$3,237 44</td>
</tr>
<tr>
<td>Printing and delivering tax tags</td>
<td>1,148 80</td>
</tr>
<tr>
<td>Stationery, books and postage</td>
<td>90 77</td>
</tr>
<tr>
<td>Inspectors' salaries and travel</td>
<td>993 46</td>
</tr>
<tr>
<td>Freight, express and telegrams</td>
<td>112 85</td>
</tr>
<tr>
<td>Chemical supplies and fuel for laboratory</td>
<td>750 79</td>
</tr>
<tr>
<td>Expenses of Veterinary Surgeon</td>
<td>77 60</td>
</tr>
<tr>
<td>Janitor's salary</td>
<td>135 00</td>
</tr>
<tr>
<td>Total</td>
<td>$6,546 71</td>
</tr>
</tbody>
</table>

Respectfully,

J. P. SMITH,
Secretary Board Fertilizer Control.

REPORT OF PRESIDENT H. S. HARTZOG TO BOARD OF TRUSTEES.

To the Board of Trustees Clemson Agricultural College.

Gentlemen: I have the honor herewith to submit the fifth annual report as President of the Clemson Agricultural College. I assumed
charge of my office October 3, 1897, and therefore I am not in a position to report from personal acquaintance the workings of the departments prior to that time.

Owing to the change from winter to summer vacation the present report embraces parts of two terms. This unusual condition is further complicated by the requirement of the United States Government to close the fiscal year of the Experiment Station on June 30th.

This condition could be remedied and the reports of the Treasurer made with much less labor if the fiscal year of the three funds (Hatch, Morrill and State) were made to correspond.

The total number of students enrolled at the beginning of the year was 337. It was feared that the unfortunate epidemic of fever last June, and the many extravagant reports concerning the sanitary condition of the college, would materially reduce the attendance this session. On the contrary it is gratifying to report that we have already enrolled 303 students and a very large increase is confidently expected after January.

This shows that Clemson College still holds a firm place in the affections and confidence of the public.

Counting no student twice this gives a total enrollment for the year 1897 of 387 students, twelve of whom are from other States.

DIVISION INTO DEPARTMENTS.

By reference to the resolution of the Board of Trustees it will be seen that on last January the college was divided for purposes of instruction into five different departments: Agricultural, Mechanical, Chemical, Literary, and Military. We have found that this system works admirably. Each department is presided over by an efficient head or chief, who, in addition to teaching, exercises a general supervision over the work and workers in his department. Each department is subdivided into divisions under the immediate control of competent instructors.

The instructors of divisions make annual reports to the head of their department. The head consolidates these reports and submits a general report to the President. It is from these five departmental reports that the President prepares his annual report for the Board of Trustees, supplementing it with the result of his own observation.
These five departments are so correlated that they work harmoniously for the grand end in view.

**SCOPE OF WORK AT CLEMSON.**

The Agricultural Department is subdivided into six divisions, with courses and equipments for the study of Pure Agriculture, Horticulture, Botany, Dairying, Veterinary Science, Poultry Raising and Entomology.

In this as in other departments the students are taught to do by doing. Greenhouses, vineyards, orchards and laboratories enable the students in horticulture to study the book of nature as well as the book of the class-room. The botanical room is equipped with microscopes and other necessary apparatus for instruction and investigation. The dairying division has a building supplied with modern apparatus for its important work. A suitable structure is used by the veterinary division for clinical practice. Equipments for the poultry division and the division of entomology have not yet been supplied.

The Mechanical Department comprises work in Applied Mechanics, Physics, Drawing, Forge and Foundry Work, Wood Work, Machine Shops, Electricity, Mechanical Engineering and Electrical Engineering. This department has a separate building containing a larger floor space than any other building of a similar kind in the United States. In the forge and foundry shops the students receive instruction in moulding and venting, in the use of core making, mixing of iron, managing of coupola, etc. In the wood-working division there are graded exercises in carpentry, joinery and turning, in the use of planer, moulding machines, etc.

The electrical laboratory is supplied with the latest fruits of scientific research and gives practical work in the setting up and management of primary and storage batteries, electrical measurements, etc. The machine shops begin the course of instruction with exercises in chipping, drilling, boring, threading, etc. The senior year is devoted to advanced work in the construction of apparatus and machinery; the application of principles learned in lower classes.

The Chemical Department has a building admirably suited to its purposes. This department gives instruction in industrial, general,
and agricultural chemistry, with abundant laboratory practice. The work in geology and mineralogy is also comprised in this department.

The Literary Department comprises the usual courses in English, mathematics and history. The classes of this department recite in the main college building.

An Act of Congress makes it a condition absolute that military science be taught in those colleges receiving the Hatch and Morrill funds. An officer detailed from the United States Army is the head of this department at Clemson. He looks immediately after the discipline of the corps, the management of the barracks and mess-hall, and gives practical and theoretical instruction in military science.

These five departments are under the supervision of the President, who is held responsible by the Trustees for the general management.

There are two main courses of study—agricultural and mechanical. When a student has finished the Freshman class he is allowed to elect either course, and upon its completion is given the degree of Bachelor of Science.

The reports handed in by the heads of departments are so complete that I deem it unnecessary to make more than passing comments on each.

DISTINCTIVE FEATURES OF THE WORK.

An examination of the scope of work at Clemson shows that it is a special field of labor of great importance to the State. The object of the course at Clemson is to develop the mechanic arts and the science of agriculture. A profound thinker has said: "Not 'arms and man,' but 'tools and the man' is now and henceforth to be the great epic of the world." We need trained mechanics to develop the wasted resources of South Carolina. We need skilled agriculturists to put farming on a profitable basis.

All industrial revolutions are painfully slow. Although our college has been running but five years we can see already in many sections a growing appreciation of scientific and agricultural subjects as a result of the instruction given at Clemson. Among many other things may be mentioned the dairy which has stimulated an interest throughout the State in commercial dairying. The demand for students trained in this division exceeds the supply and the hundreds of
inquiring every year evinces an unabated interest. Clemson therefore fills a long felt want. It offers a course of study that cannot be pursued elsewhere in the State. The enthusiastic support given to agricultural and mechanical colleges in other States shows that the country is thoroughly aroused to the importance of industrial education. The commercial supremacy of Germany is owing largely to her far sighted statesmen who established technical schools.

As President it is my duty to supervise the expenditure of appropriations ordered by the Board of Trustees. Some have wondered why it takes more money to run Clemson than the other colleges in the State. A simple illustration will show the reason. Suppose two graded schools are in a town. Suppose one should install a steam engine properly geared to operate machinery. Would not the equipment and running expenses of the second school be greater than the first? It costs more to conduct a technical school than a literary college. A careful examination of the cost of similar schools in other States will show that Clemson College is not extravagant.

In order to keep up with the times it will be necessary to add the latest inventions in mechanic arts. This is particularly true in the department of electricity.

AGRICULTURAL DEPARTMENT.

The Agricultural Department is fortunate in having for its head Prof. J. S. Newman, a thoroughly progressive and competent chief, assisted by a strong corps of specialists.

The accompanying report shows in detail the operations of the year. The work in this department has been interrupted in the past by the tragic death of Prof. McGee and the retirement of Dr. Quick. Under the present management, however, the work is thoroughly organized, and, with a few improvements in equipments, will rank first in the United States.

The report of the Treasurer does not show the income of the farm because the Treasurer records only those transactions in which there is an actual exchange of money. For this reason I would call your attention to the fact that the value of the farm produce for the year is $3,038.50, and, in addition to this, the farm division has done work on the grounds and has furnished supplies to the value of $1,130.
Prof. Ernest Walker has been elected assistant horticulturist and entomologist. In order to carry on the work in entomology it will be necessary to have a collection of insects in their various stages of growth, and a suitable laboratory equipped with instruments, cases, etc.

The barns destroyed by fire last August have been replaced by modern structures designed with a special view to cleanliness and convenience.

The general interest aroused throughout the State by the work in the dairying division is very gratifying. From all sections of the State there has been a steady stream of applications for students trained in this work.

Some income has been derived by the dairy from the sale of milk and butter. The object of the dairy, however, is not to make money, but to teach the students how to test the acidity of milk, how to sterilize, how to separate and churn, how to make butter and cheese. Any income derived is purely incidental.

MECHANICAL DEPARTMENT.

The annexed report prepared with great care by Prof. Walter F. Worthington shows the present condition of the Mechanical Department. All the instructors in this department are doing earnest, faithful work. Competent critics who have visited other schools assure us that our mechanical equipment is one of the best in the country.

It may be well for the citizens of the State to know that standard instruments of the greatest delicacy have been installed in the division of electricity, and the college is now in a position to standardize and calibrate any electrical instrument that may be sent here for that purpose.

There has been a phenomenal and gratifying demand for instruction in the division of mechanical drawing. In order to do the best work it will be necessary to add to the equipments of this division. Mechanical drawing lays the foundation for efficiency in mechanical work, and, therefore, earnest consideration should be given to the needs of this division.

Your attention is respectfully called to the condition of the pump at the water works. The pump is worn in many places and is liable
to break down at any moment. Prof. Worthington recommends that an electric pump be installed and that the old engine be laid aside for repairs. I approve the suggestion.

DEPARTMENT OF CHEMISTRY.

The annexed report prepared by Prof. M. B. Hardin is an interesting and valuable paper. This report is an illustration of the intelligent exactitude and painstaking care displayed by Prof. Hardin in his class and laboratory work.

The change from winter to summer vacation has given the Sophomore and Junior classes exceptional opportunities for instruction.

Prof. Hardin’s report contains so much valuable information of general interest that I suggest its publication in full.

THE LITERARY DEPARTMENT.

In the division of mathematics solid, lasting work has been done by Prof. J. G. Clinckscases and P. T. Brodie.

The science of highway construction is one of deep and widespread interest. I am glad to note that this subject is receiving some attention at Clemson in the civil engineering division.

In the division of English the students have had practical exercises from the day of entrance. The Clemson College Chronicle, a magazine published by the students, will no doubt help in the cultivation of a literary taste, and valuable training in public speaking is gained in the three literary societies.

MILITARY DEPARTMENT.

The object of the military system at Clemson is not to produce soldiers, but soldier citizens—men prepared for the duties of peace and the emergencies of war.

Under Capt. E. B. Fuller’s enthusiastic instruction the cadets have made admirable progress when we consider the unsatisfactory drill ground and the limited number of drills.

The corps is divided into six companies and practical instruction is given in the school of the company, battalion and regiment; besides target practice, light artillery drill, signaling with flag, torch and heliograph. The theoretical course includes the usual subjects: Logistics, castrametation, military history, etc.
All the students in the barracks are subject to military discipline. The rooms are inspected frequently and every effort is made to preserve the health and comfort of the students. By special order of the Trustees a broad cement wall has been placed around the barracks, all wood-work in the rooms has been oiled or painted, the walls kalsomined, the water closets increased in number, and the canal in the bottoms filled.

The soldierly deportment and gentlemanly bearing of the students is highly commendable.

THE STATE FAIR.

The magnificent exhibit made at the State Fair was a source of gratification to all interested in the welfare of Clemson. This exhibit was a bona fide exhibition of regular class work. From the numerous letters received since the fair it is believed that many students will come here in the future, as a direct result of this public advertisement.

THE LIBRARY.

The library has 2,860 volumes on its shelves, consisting of 800 volumes of fiction, 425 volumes of general literature, 770 volumes of history, 280 volumes of poetry, 175 volumes of religious works, 180 of general science, and 80 volumes of reference works. In addition there are 600 volumes of government reports.

Since September 1,600 volumes have been taken out by students, making an average of five volumes per student. This is conclusive evidence that the students appreciate the privileges of the library, and I therefore recommend that the usual appropriation be given.

The library is particularly deficient in books bearing upon South Carolina history and literature. I suggest that the library be strengthened along this line.

PERMANENT EXHIBIT.

Inasmuch as quite a number of interesting specimens of student handicraft have been preserved in the mechanical department it is suggested that these be collected into a permanent exhibit. They could be displayed in the room adjoining the library. The only ex-
pense would be suitable glass cases for the specimens. Such an exhibit would be exceedingly interesting to visitors and stimulating to students.

IMPROVEMENT OF GROUNDS.

Nature has been very lavish in her gifts to Clemson College. The romantic situation and beautiful natural surroundings invariably elicit complimentary remarks from visitors. The extensive area of the grounds and the primary necessity of buildings have prevented the expenditure of suitable appropriations for the permanent ornamentation of the grounds. If a specific sum should be designated for this work would it not be wise to begin at the main college building and work outwards? With the splendid endowment of nature for a basis, art in five years could make the Clemson grounds the most beautiful place in South Carolina.

I would suggest that all work authorized in this line be done thoroughly after the fullest investigation, so that the shrubbery, walks, fountains and roads will stand as object lessons in road-making and landscape gardening.

FARMERS' INSTITUTES.

During the past year Farmers' Institutes have been held at the following points: St. Matthews, Mt. Carmel, Hartsville, Marion, Chester, Liberty Hill, Fort Mill, Yorkville, Cave's Church, St. Georges, Saluda, Sumter, Honea Path, Newberry, Lexington, Santuc, Conway, Greers, Gaffney, McCall, Winnsboro, Seneca, Fairview and Johnston.

The Institutes were attended by large crowds and the dissemination of scientific knowledge will no doubt accomplish much good.

YOUNG MEN'S CHRISTIAN ASSOCIATION.

Symmetrical education concerns itself not only with mental and physical development but with moral interests as well. The Y. M. C. A. organization is the most positive and aggressive religious force in the college. The leaders of this enterprise have worked against many discouragements, but their fidelity has been rewarded with success.
The membership at present is 117 and they exert a most wholesome influence upon the corps. The Y. M. C. A. is anxious for a hall as they feel that they can do better work with a room devoted exclusively to their needs. I heartily approve their request.

In conclusion I desire to express my appreciation of the cordial cooperation given me by the members of the faculty. The most perfect harmony prevails among the teachers.

Clemson must stand upon its merits and does not ask for any other test. I am aware of the fact that criticisms have been directed against Clemson in the past. This was to be expected. Every new college must go through a settling process. It requires time to fix the grooves of work, and to establish rules of government. When we consider the many difficulties that had to be encountered from the beginning, Clemson College stands to-day as a monument to the business judgment and scholarly thoughtfulness of the Board of Trustees.

Respectfully submitted,
HENRY S. HARTZOG,
President.

MILITARY DEPARTMENT.

Clemson College, S. C., December 11th, 1897.

President H. S. Hartzog, Clemson College, S. C.

Dear Sir: I have the honor to respectfully submit the following report regarding the operations of the Military Department of this college for the period from January 1st to December 1st, 1897.

Theoretical instruction in military science and tactics has been given, as heretofore, to the Senior and Junior classes, one hour each week, this being the minimum time prescribed by law.

Practical instruction in drill, guard duty, etc., etc., has been given to all students, so that the average has been two hours per week, this also being the minimum time prescribed by law for practical instruction. By authority of the Board of Trustees these practical exercises have been had at the most favorable seasons of the year for out-door instruction—the college having no armory or gymnasium—until the prescribed minimum number had been had each term.

A gymnasium is sadly needed at this college. The students need and should be required to take a certain amount of exercise to main-
tain their health, to say nothing about their physical development, and a large percentage of them take no exercise whatever outside of what they get at drill, and when these cease, as they do during the winter and inclement weather, they have little or none. I have been informed by cadets that there are many students who never stir outside of barracks, except when necessary to go to recitations, to work at the shops or on other duty.

While a few get out to work on the farm-educational work, of which there is very little during the winter, and a few have employment, a large number, all in the fitting school and the mechanical students, have not outside work and therefore get no exercise after drills cease for the term.

I desire to again call attention to the utter lack of facilities for drill and parade, as well as for athletic sports, on account of the condition of the grounds in the vicinity of the barracks. The old parade ground, although rough and too small, was better than none, which is what we have now, practically.

While I do not now and never have believed that the condition or location of the barracks was in the remotest degree the cause of the epidemic of fever that broke out here last June, yet it had the excellent effect of having the building renovated, fumigated and put in better shape than ever before. All the woodwork was oiled or painted, the walls kalsomined and general repairs made in the main building, in addition to the increase of conveniences in the water closets, so that now, with the exception of the ventilation of the dormitories and an insufficient number of bath tubs, I believe that nothing can be done, considering the plan and location of the barracks, to improve its sanitary condition.

The fare at the mess hall has been good, and the complaints made in regard to it have been so few that I might say there have been practically none. I can now remember but two that have been made since I have been Commandant. One was that the soup, on one occasion only, was cold and the other that one of the waiters had carelessly put a jug of syrup on the table with flies in it.

A report of the expenditures under the head of the cadet fund payments made for mess hall supplies and labor, for uniforms, etc., etc., out of the receipts from amount paid by the cadets for board, wash-
ing, uniforms, etc., has been made separately and I believe has been audited.

I submit herewith a report of all expenditures that have been made under my direction, from appropriations made for this department.

In conclusion, I wish to express my appreciation of the manner in which your predecessor and yourself have sustained me in my efforts to maintain good order and discipline in the corps, a task that at times has been difficult and one that has not been lessened by the students, or at least some of them, having the impression that military discipline is not favored by the people generally, especially by the patrons of the college.

Very respectfully, your obedient servant,
EZRA B. FULLER, Capt. 7th Cavalry, Commandant of Cadets.

DEPARTMENT OF AGRICULTURE.

Clemson College, S. C., Dec. 14th, 1897.

President H. S. Hartzog, Clemson College, S. C.

Dear Sir: I have the honor of presenting the following report of the work of this department of the college for the year ending December 31st, 1897. My connection with the department began on the 15th of last July and consequently I am personally familiar only with the work done since that time. Owing to the present organization of the department into divisions, each of which is in charge of an efficient chief, I can give a general account of the work of the year through their reports of the transactions of their respective divisions.

The Dairy Division, presided over by Prof. J. W. Hart, is now practically complete in equipment and constitutes a most important factor in our scheme of industrial education. Its work has been instrumental in stimulating an interest, before unknown, in both home and commercial dairying in this State. The correspondence of the division clearly demonstrates an active awakening in this direction. The demand for the cadets who have been especially trained in this division more than equals the supply.
It serves the triple purpose of education, experimentation and daily supply of milk and butter.

The loss of the barn and its machinery by fire on the 4th of August subjected this division to serious inconvenience. This will result, however, in greater comfort to the cattle, convenience to the workers and cleanliness in the products in the new barn than were possible in the old structure. The new cow barn, which will accommodate fifty-two head of cows, has been constructed with especially reference to cleanliness and freedom from all possible sources of contamination of the milk. During the year Professor Hart attended six farmers' institutes and lectured on subjects pertaining to the dairy industry. During the State Fair he conducted, on the grounds, an instructive working dairy.

The Horticultural Division, presided over by the veteran horticulturist, Prof. J. F. C. DuPre, is one of the most conspicuous features of the institution. Like the dairy division it combines many useful features. Besides the lecture room instruction afforded the students it presents a field of varied and attractive laboratory practice in everything pertaining to vegetable, fruit and floriculture. The truck farm subdivision furnishes a most valuable object-lesson in the methods of commercial vegetable growing and supplies the table at mess hall with the most wholesome food. Material improvements have been made in the method of heating the green house and the policy of its conduct changed from amateur to commercial plant-growing—an industry much neglected in this State.

Professor Ernest Walker, a graduate of Cornell University, and an experienced nurseryman, has been appointed assistant horticulturist and chief of the Division of Entomology.

Ten acres of creek bottom are to be underdrained and prepared for irrigation during the winter, preparatory to growing vegetables under an intensively intensive system. This is to be conducted as a model truck farm to illustrate the capabilities and the advantages of a combination of drainage and irrigation.

Special attention will be given to the protection of trees, vines, plants and their fruit from injury by frost, insects and fungi. The Horticultural Division will, by early spring, be thoroughly equipped
for most thorough work in education, theoretical and practical, extending into every detail of the production, utilization and preservation of fruits and vegetables, and the propagation, management and marketing of commercial nursery and green house stock. The chief of this division, having no assistant in whose charge the exacting duties of the division could be placed, was prevented from participating in farmers' institute work to the extent that the importance of the division demanded.

The Botanical Division, Dr. A. P. Anderson, Chief, though less than one year old, has accomplished much, besides teaching in three college classes, in equipping the lecture room and laboratory and making collections of the flora of the State, to be used as a college herbarium for future use in class instruction.

Botany or vegetable bacteriology is taught in each of the four years of the course in agriculture. Beginning in the freshman year, in early spring, the student is introduced to the mysteries of plant life, from the germination of the seed to the fulfillment of the destiny of the plant in reproduction. He collects, classifies and names our common flowering plants until he learns to introduce himself to the class and name of any strangers he may meet in his pathway.

In the sophomore year he continues this course in general botany and when he becomes a junior the more intricate mysteries of plant life are studied by the aid of compound microscopes. This is followed in the same year by a course of lectures upon the physiology of plants. In the senior year the botanist becomes bacteriologist and the student, now prepared for more thorough scientific research, is introduced to the bacteria of soil, air and water, and studies those which are injurious as well as those which are beneficial to economic plants. The fungous diseases of plants are now studied, together with the means of combating them. All of these subjects bear directly upon the work of the farmer, horticulturist, fruit-grower and florist. A collection of the plants of the State has been begun by the botanist. Already about 500 species of flowering plants and fungi have been collected.

The herbarium now contains 2,200 species, besides those collected during the present year. Besides the regular college classes instruc-
tion has been given to two special students in the botanical laboratory. Dr. Anderson lectured at five farmers’ institutes during vacation last summer.

The questions asked at these institutes and the number of inquiries received from all parts of the State indicate a decided interest on the part of the farmers in plant diseases and the means of combating them.

The Veterinary Division, W. E. A. Wyman, V. S., Chief, has been the agency through which the farmers of the State have profited in amounts far exceeding the cost of the division. So deeply interested in the study of veterinary science were the cadets that they petitioned the head of the department to be allowed to receive extra instruction from Dr. Wyman. The students of the senior class enjoyed nothing more than three hours every Monday afternoon devoted to free clinics. These were so thoroughly appreciated by the farmers that afflicted animals were brought great distances to receive relief from this master of his science.

The work of this division has been wonderfully successful and serviceable to both students and stock owners. At farmers’ institutes no one was more enjoyed than Dr. Wyman and no one more missed if absent. His correspondence was voluminous. He will no doubt return from his furlough of special study more thoroughly equipped, but not possibly more earnest nor more enthusiastic in his work.

Division of Animal Industry, Prof. C. M. Connor, Assistant Agriculturist, Chief. From and after January 1st, 1898, there will be an entire separation of the cattle being milked for supplying the college with milk, butter and cheese. These will be classed as belonging to the dairy division. All other stock will be in charge of the chief of the division of animal industry and available for experiment purposes. Under this arrangement the chief of the dairy division will have such control of the college herd of cows as will enable him to use them and their products at will for class instruction or investigative or illustrative experiment. He teaches the breeding, rearing, management and feeding of dairy cows as such. Everything else pertaining to the breeding and management of stock is taught by the chief of the division of animal industry. Besides the instruction given in the lecture room, the classes are taught to judge the merits of stock
of different species and breeds of the same species, according to the recognized standard of excellence in each class. Each student is thus made familiar with the characteristics of the different breeds, as well as with the desirable qualities which should be found in individuals intended for usefulness in the lines of milk production, flesh and fat production or in capacity for labor.

The veterinarian inspects all stock at short intervals and reports to the head of the department any defects discovered in health or hygiene.

For the purposes of more thorough and varied instruction, as well as for experiment purposes, additional breeds of cattle, sheep and swine are needed. Professor Connor lectured at six farmers' institutes during the last summer vacation.

The Division of Entomology, Prof. Ernest Walker, Chief, has just been established. Systematic work in the class room will be commenced in January next. The student will be taught the life history of insects both friendly and injurious to vegetation, their classification, modes of propagating, transforming, hybernating, the means of destroying those injurious to vegetation and of protecting those which are beneficial. Collections will be made and classified into families and these as friends and foes. These exposed in a museum or class room will serve as an object lesson from which much can be learned in a very short time. The chief of this division will have specially in charge the study of the habits of destructive insects and the means of destroying them. When we consider the vast values annually destroyed by insect ravages and how little is known of their habits by the tillers of the soil we realize the importance of instructing our youth in the science of entomology.

The Poultry Division, authorized at the last meeting of the Board, is being put into readiness for work as rapidly as possible. The value of the poultry products of the United States are said to exceed that of the cotton crop by $30,000,000. There is no other interest so universally practiced and yet millions of dollars worth are destroyed annually by disease. In view of these facts it is wise to add this division to an industrial scheme of education.

A limited number of breeds of those most promising of profit will be kept pure for the purpose of comparing their productiveness and
profit and to familiarize the students with standard specimens of each class. A large number of common stock of hens will be used for mating with thoroughbred cockerels with a view to ascertaining the most profitable grades to be grown. By means of the use of incubators and brooders the profit of growing early broilers for market will be tested. While this division will be constantly occupied in experiment work, it will also be used for laboratory instruction in the classes in agriculture.

The Agricultural Division, in charge of the Professor of Agriculture, with Prof. C. M. Connor as assistant, embraces everything pertaining to field culture of every description. It grows the crops on which all stock are fed, keeps in repair farm buildings, does the hauling for all the departments of the college and has general charge of the farm property. It conducts all field experiments, builds dykes, roads and fences and keeps them in repair. It has charge of the campus and all buildings occupied by employees, and, indeed, is the general servant of the institution.

The class room instruction commences with the freshman class and continues through the four years of the student's college life. Its duties are the teachings of the application of the teachings of the chairs of chemistry, geology and physics and the various scientific divisions of the department to the art of agriculture.

Geology delivers the soil formed from the solid rock.

Physics prepares the way for the study of these soils by teaching the properties and the relations of matter as such.

Chemistry dissects this matter into its ultimate atoms and explains where the plants derive their food.

Botany teaches the secrets of the life of the plant—how they grow, how they feed and how they reproduce.

Bacteriology, by the aid of the microscope, reveals the unseen agents in soil, air, water and plants, which are the most fruitful sources of disease in both vegetable and animal life.

Entomology introduces the student to the many forms of insect life, which creep by day and fly by night.

Veterinary Science explains the anatomy and physiology of the animals on the farm, and explains the causes of disease and the conditions of health.
The Professor of Agriculture collects the rays of light radiating from these sciences and focalizes them through the lens of practical thought and experience upon the great central agricultural industry, which, though the oldest of the arts, is the least studied and the least understood.

The head of the department, besides lecturing eight hours per week, exercises a general supervision over the sequence of study in the lecture room work of the divisions, directs the farm improvements and crop growing, plans each day the work to be executed by the active and efficient farm foreman, supervises the expenditures of the various divisions, and, through the aid of the accomplished clerk and librarian, keeps on record all vouchers corresponding to accounts kept in detail with not only the divisions in college and station work, but with all departments of the college for which the farm labor is employed. An average of about two hours per day are occupied in answering inquiries not covered by any available bulletins. These inquiries are increasing in number and variety. Many of them originate in a desire to put into practice recommendations made in lectures before farmers' institutes or suggestions made in recent bulletins.

The organization of this department is now complete, but the equipment of some of the divisions is not. It is composed of a corps of earnest, competent and efficient workers, whose best efforts are given to the promotion of the interests of the college. The co-ordination of the work of the divisions is very satisfactory and the cooperation of the chiefs of divisions, inter se, and with the head of the departments presents a solid front to the great work before us and there seems no reason why Clemson College should not, in the near future, stand without a rival in the arena of industrial education in the Southern States.

(1) Accompanying find reports of work done and crops gathered in 1897 in the farm division, together with outline of plans for work contemplated in 1898.

(2) Another showing expenditures in all the divisions during 1897 on college account, with estimates of appropriations necessary to carry on the work in each during the fiscal year 1898.
To Henry S. Hartzog, President.

Sir: I have the honor to submit the following report of the progress, condition and future needs of the Department of Mechanic Arts, together with reports on the more important machinery under my supervision, statement of expenditure for 1897.

There has been a steady improvement in all the divisions of the Mechanical Department, and a number of changes have been made with a view of systematizing instruction, redistributing the time according to the relative importance of the subjects, and for the purpose of adding new studies to perfect the course.

The theory of mechanics which was formerly taught in the two divisions is now all taught in one. The time thus gained in the division of physics is spent on a more extended course in that important branch. Drawing, which was formerly taught in three divisions, is now taught in one. The time thus gained in the woodwork division enables the class to get over the same course as last year in one-half the time. The time thus gained in the forge shop has rendered it practicable to reduce the number of hours devoted to that work from eight per week to five per week. Steps are being taken to extend the benefits of instruction in drawing to the high preparatory students, and to instruct the whole Sophomore class in elementary electricity. Two most important additions have been made to the equipment, viz.: the dynamo laboratory, where practical instruction is given in the use of typical electrical machines of the best design; and the mechanical laboratory, recommended by my predecessor in his report for 1896. The equipment in both cases is nearly complete, and when the advantages offered here for thorough, practical instruction in electrical, steam, air, water motors and machines become generally...
known, it may be confidently expected that many students, both post-graduate and others, will be attracted from this and adjacent Southern States.

The text book in the Mechanics of Materials by Merriman, introduced last year by my predecessor and given to the present Senior Class for the first time, has proved to be well adapted to its purpose.

A detailed statement of the work of the various divisions is on file in this department for reference, and also complete records of expenditures in the form of duplicate bills. In this report only an outline can be given. In addition to the work outlined, instruction is given in all divisions to students who desire to take a special course, and in some of the divisions to post-graduate students; the number of the latter increasing from year to year.

PHYSICS.

I strongly endorse the recommendation made by the head of this division, Captain Fuller, as well as by his predecessor, Professor Welch, in November, 1895, that this subject be taught by the modern method of practical exercises in a physical laboratory. As, however, this will involve an expenditure of about $1,000 for apparatus and radical changes in the curriculum, I recommend that action be postponed for another year, when I hope the equipment of the other divisions will be so far advanced that there will be a material decrease in the amount required for them.

WOODWORK.

In this division is installed about $4,000 worth of machinery, one-half of which is devoted exclusively to the instruction of the students, and the remainder, consisting of a variety of woodworking machines, which are used primarily for construction purposes, but are also available for the instruction of advanced and post-graduate students.

MECHANICAL LABORATORY.

The apparatus represents the best forms in use in modern schools and has been selected with great care, with a view of teaching such practical engineering as the students from the South will be most likely to require. Instruction is given to all students of the Junior
and Senior Classes of the Mechanical Branch; three hours per week in each case. The Junior Class is taught the use of engineering instruments, their construction and calibration. The Senior Class is taught to handle steam and hot-air engines, compressed air and water motors, pumps, rams, and steam boilers; to measure their power and to determine their efficiency; also to test the quality of coal, oil and products of combustion.

All this instruction is in the actual handling of the instruments and apparatus, standard books being used for reference, and the instructors' notes being supplemented by verbal explanations.

ELECTRICITY.

The course in the class room is as follows: Junior Class, three hours per week in elementary electricity and magnetism. Senior Class, five hours per week in electrical engineering and designing. Post-graduates, five hours per week in advanced alternating currents and the study of leading types of machines, and the general systems of the leading manufacturers of electrical apparatus. In all three classes, especially in the two more advanced ones, the text books are supplemented by lectures and notes. In the Electrical Laboratory, four hours per week of practical instruction is given to the Junior, Senior and Post-Graduate students. The instruction consists in demonstrating the principles and verifying the laws taught in the class room, in familiarizing the student with the construction and management of the leading types of dynamos and motors, calibrating and standardizing electrical instruments.

The course is arranged to turn out men with a practical as well as theoretical knowledge of the subject, sufficient to enable them to take charge of electric light and power stations, or to enter the designing rooms of any electrical company.

During the past year valuable additions have been made to the instrument laboratory.

A good start has been made in the equipment of the dynamo laboratory; besides several other machines standard instruments of greatest accuracy have been installed, and the division is now in a position to calibrate or standardize any electrical instruments that may be sent
here for the purpose. In order, however, to render the course of instruction in the dynamo laboratory complete and full a number of additional instruments and machines will be required.

FORGE AND FOUNDRY.

Instruction is given to the Freshmen Class for five hours per week in forge work, beginning with simple graded exercises in iron and going on to steel, including hardening, tempering, etc. The Sophomore Class (Mechanical Branch) have five hours per week in foundry work. This work also begins with simple forms, and proceeds to making moulds and cores, preparing the cupola, charging it, and running off a heat.

Some time is also devoted to brass casting, mixing alloys, etc. Castings are made for machines to be built in the shops, and a variety of work is done for the college, affording good exercises for the more advanced students.

The practical instruction is supplemented by a course of lectures on which the students are required to take notes.

MACHINE SHOP.

The regular course of instruction takes four hours per week for the entire Junior and Senior years. The work begins with chipping and filing, proceeding through a series of selected and graded exercises, ending with the construction of complete machines. The equipment, as in the other divisions, is modern, well arranged, well adapted to its purpose. What is needed now is additional small tools and attachments to machines to permit of a greater variety of work being done, thus stimulating interest, giving the student a more extended knowledge and greater skill in execution.

There is every reason to expect this division to soon reach a state of high efficiency.

DIVISION DRAWING.

Instruction is given through the four years of the college course, and steps have been taken to extend this to the second half of the high preparatory department.
The Freshman Class has three hours per week, the Sophomores four, the Juniors three, the Seniors three. The work begins with free hand exercises and reading simple drawings, and extends to include making working drawings, tracing and blue prints of original designs of machines and structures.

The course also includes Descriptive Geometry, shades, shadows, perspective and isometric projection. For the civil engineer students map drawings, topography, etc.

A beginning has been made, and it is expected soon to add a short course in photography sufficient for the ordinary practical purposes of engineering. The number of students desiring instruction in drawing increases so rapidly that last year it was found necessary to have an assistant in this division. This year the space devoted to drawing had to be doubled, and now it will be necessary to provide instruments enough to admit of thirty students in a section instead of twenty-two. This is one of the principal items in the amount asked for equipment. In addition to the regular classes, there are sixteen students taking a special course and one post-graduate.

During the past year this division has done a great deal of work for the other departments of the college, such as furnishing drawings for silos, feed stables, corn barn and experimental station barn, giving the students excellent illustrations of practical work.

**STATE FAIR.**

The exhibit made at the State Fair in November last was commented on most favorably by numerous visitors and also by the daily papers.

It undoubtedly served to show clearly the variety, character and quality of the work done at the college and to attract the attention of the people of the State. Next to providing facilities for instruction comes the importance of having it generally known what the college is able to do, and I believe it would be well to make a similar exhibit every year. The total cost was $434.61, which includes the printing of 5,000 folders for distribution. About $40 worth of these remain, and are available for distribution to persons likely to be interested in the college.
An equally complete exhibit can be made next year for $400.
Respectfully submitted,
WALTER F. WORTHINGTON.

CHEMICAL DEPARTMENT.

Clemson College, S. C., December 1st, 1897.

President H. S. Hartzog, Director of S. C. Experiment Station.

Sir: I respectfully submit the following report of the Chemical Department of the Experiment Station for the year ending December 1st, 1897. The first division of the report gives an account of the work of the Experiment Station proper, the second division contains the analyses of fertilizers, waters, etc., made under the direction of the Board of Fertilizer Control.

I. EXPERIMENT STATION WORK.

The investigation of the sweet potato as a starch producer referred to in my last annual report has been completed and a bulletin has been issued on the subject. The analytical work was done by Mr. F. S. Shiver, whose bulletin on the different methods of determining starch has also been published.

The investigation of the composition of the sea island cotton plant, which was also mentioned in my last annual report, has been in progress and the work would have been completed by Mr. Shiver this year but for want of the requisite material. The crop was so badly damaged by storm that I was advised by two well known planters to have the remaining work deferred until next season. The analyses of the seed, bolls, leaves, stems and roots of two varieties have been completed. The analysis of the seed has been sent to Mr. W. G. Hinson, of Charleston, through whose kindness we received the specimens of the plants, and who particularly desired an analysis of the seed. Following is the analysis:
During the past summer some experiments were undertaken by Mr. Shiver in connection with the Dairy Department. This work included the analysis of sixty samples of whole milk, forty-six of skim milk, fifty-six of butter milk and fifty-three of butter. This work will be submitted for publication in a bulletin.

Mr. Shiver and Mr. John Thompson have determined the sugar in sixty samples of sugar beets, forty-one from the Horticultural Department, three from the Experiment Station farm, fifteen from different parts of the State sent by persons who had received the seed from the United States Department of Agriculture through the former vice director of this station, Prof. Walter J. Quick, and one sample sent separately from Dresden, Abbeville County, S. C. The results of the analyses will be submitted for publication with the report of the Agriculturist.

The rotation experiments referred to in my last annual report as having been undertaken by Mr. Thompson in conjunction with the Agriculturist of the station, Prof. McGee, were brought unfortunately to a close before any results were obtained. The bottom land on which the experiments were being conducted was flooded by the breaking of the dike or levee and the ground was subsequently plowed up by order of the vice director, Dr. Walter J. Quick.

Last spring a rotation experiment on upland soil was begun by Mr. Thompson in conjunction with the Agricultural Department. Analyses of the soil have been made and ash analyses of the crops are in progress. Mr. Thompson is also engaged in the analysis of twenty
samples of soil taken from ten fields of unequal fertility. Most of these samples are from the station farm and were selected by Col. J. S. Newman, Agriculturist and Vice Director. Prof. Lewis, our Geologist and Mineralogist, is making physical examinations of the same samples. If the results of these investigations in the laboratory are in harmony with the results obtained by field experiments I will recommend an extension of the work so as to include typical soils from other portions of the State.

Seven samples of soil sent from different parts of the State have been analyzed by Mr. Thompson. Six of these samples were sent to us in sets of two, each set containing representatives of what were considered by the farmers good and poor soils from the same locality. While, as a rule, nothing new or very striking was brought out by the results, yet in every case the analytical determinations were slightly in favor of the samples marked "good." In one instance the "good" sample had a neutral reaction while the "poor" one had a slight but distinctly acid reaction. In the soils from the farm of Mr. J. C. Stribling, near Pendleton, S. C., a very considerable proportion of titanium dioxide was found, Mr. Thompson reporting 2.83 per cent. in the "good" soil and 3.54 per cent. in the "poor" soil. These results are interesting when viewed in connection with the recent paper by Prof. Dunnington, of the University of Virginia, on the "Distribution of Titanic Oxide Upon the Surface of the Earth."

II. STATE ANALYTICAL WORK.

This part of the present report is respectfully submitted to the Hon. J. E. Tindal, chairman of the Board of Fertilizer Control, through the director of the station.

The following is a summary of this work compared with that of last year:

<table>
<thead>
<tr>
<th></th>
<th>1896</th>
<th>1897</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official fertilizer samples</td>
<td>237</td>
<td>272</td>
</tr>
<tr>
<td>Farmers' fertilizer samples</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Mineral and potash waters</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Phosphate rocks</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Ores and minerals</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Marl</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
A detailed statement of the analyses of 272 samples has been given in Bulletin No. 29 of this station. Following is a comparison of the general results with those of last year:

**CLASSIFICATION.**

<table>
<thead>
<tr>
<th>Classification</th>
<th>1896</th>
<th>1897</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogenous superphosphates and fertilizers</td>
<td>115</td>
<td>117</td>
</tr>
<tr>
<td>Acid phosphates</td>
<td>42</td>
<td>59</td>
</tr>
<tr>
<td>Acid phosphates with potash</td>
<td>26</td>
<td>34</td>
</tr>
<tr>
<td>Kanit</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Cotton seed meal</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4</td>
<td>...</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>237</strong></td>
<td><strong>272</strong></td>
</tr>
</tbody>
</table>

Of the number reported above for the season 1897 only one sample was deficient according to the present requirements of the law. This sample was an acid phosphate.
### AVERAGES OF ANALYSIS.

<table>
<thead>
<tr>
<th>ACID PHOSPHATES.</th>
<th>1896. PER CENT.</th>
<th>1897. PER CENT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble phosphoric acid</td>
<td>9.68</td>
<td></td>
</tr>
<tr>
<td>Reverted phosphoric acid</td>
<td>3.80</td>
<td></td>
</tr>
<tr>
<td>Available phosphoric acid</td>
<td>18.48</td>
<td>12.07</td>
</tr>
<tr>
<td>Insoluble phosphoric acid</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total phosphoric acid</strong></td>
<td>15.08</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACID PHOSPHATES WITH POTASH.</th>
<th>1897. PER CENT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble phosphoric acid</td>
<td>8.27</td>
</tr>
<tr>
<td>Reverted Phosphoric acid</td>
<td>8.72</td>
</tr>
<tr>
<td>Available phosphoric acid</td>
<td>11.99</td>
</tr>
<tr>
<td>Insoluble phosphoric acid</td>
<td>1.39</td>
</tr>
<tr>
<td><strong>Total phosphoric acid</strong></td>
<td>13.38</td>
</tr>
<tr>
<td>Potash soluble in water</td>
<td>1.39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ITROGENOUS SUPERPHOSPHATES.</th>
<th>1897. PER CENT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble phosphoric acid</td>
<td>6.77</td>
</tr>
<tr>
<td>Reverted Phosphoric acid</td>
<td>2.94</td>
</tr>
<tr>
<td>Available phosphoric acid</td>
<td>9.81</td>
</tr>
<tr>
<td>Insoluble phosphoric acid</td>
<td>1.90</td>
</tr>
<tr>
<td><strong>Total phosphoric acid</strong></td>
<td>11.21</td>
</tr>
<tr>
<td>Ammonia</td>
<td>2.64</td>
</tr>
<tr>
<td>Potash soluble in water</td>
<td>1.86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COTTON SEED MEAL.</th>
<th>1897. PER CENT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available phosphoric acid</td>
<td>2.57</td>
</tr>
<tr>
<td>Ammonia</td>
<td>8.45</td>
</tr>
<tr>
<td>Potash soluble in water</td>
<td>1.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KAINIT.</th>
<th>1897. PER CENT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potash soluble in water</td>
<td>12.45</td>
</tr>
</tbody>
</table>

The available phosphoric acid found in acid phosphates has for the last five years averaged 13.23 per cent. The available phosphoric acid in acid phosphates with potash has for the same period averaged 11.96 per cent., while in nitrogenous superphosphates it has averaged 9.31 per cent.

For the five years the ammonia in nitrogenous superphosphates has averaged 2.67 per cent., the potash 1.80 per cent. For the same period the soluble potash in kainit has averaged 12.32 per cent.

In cotton seed meal, which is in itself a complete fertilizer, so far as containing all three of the essential ingredients is concerned, the
ammonia has averaged 8.47 per cent., the available phosphoric acid 2.55 per cent., the potash soluble in water 1.58 per cent. The meal contains in addition a few tenths of a per cent. of phosphoric acid and of potash not available or soluble according to the usual laboratory tests.

By comparing the foregoing figures it will be seen that the average percentages of the essential ingredients found in the fertilizers of this season are higher than the averages for the period of the last five years in every instance but one, viz., the cotton seed meals, in which the average of available phosphoric acid for the present season is five hundredths of a per cent. lower, a difference which is insignificant and scarcely worth mentioning.

(2) FARMERS' SAMPLES OF FERTILIZERS.

Forty-four samples of commercial fertilizers sent by farmers have been analyzed. Among these were several samples of a material designated as "Natural Plant Food."

Three brands of material bearing this name were received, marked respectively "No. 1," "No. 2," and "No. 3 Natural Plant Food." Numbers 1 and 2 consist mainly if not entirely of a ground rock phosphate, Florida soft phosphate or some similar material. The guaranteed analysis is full of errors in chemical nomenclature, and not one of the ingredients mentioned, whether correctly or incorrectly named, is recognized as an essential constituent of a commercial fertilizer by the law of South Carolina. Our State law recognizes only soluble and precipitated phosphoric acid (constituting together what is known as "available" phosphoric acid), potash soluble in water, and nitrogen or its equivalent as ammonia. The precipitated or reverted phosphates are soluble in a certain standard solution of citrate of ammonia, and it is now customary to include as "available" the phosphoric acid of all phosphates soluble in this solution, because such phosphoric acid has been proved by experiment to be readily assimilable by plants. Now neither water soluble nor citrate soluble phosphoric acid nor ammonia is claimed in the guaranteed analysis of these samples and only very small percentages of them were found by tests in this laboratory. Yet below the guaranteed analysis appears the claim
“All plant food available to plants in the soil.” This statement is liable to mislead, inasmuch as the term “available” is here evidently used in a different sense from that in which it is used by agriculturists and chemists, who, in speaking of the phosphoric acid and potash in manures apply the expression “available” to these substances only when they are soluble in water or in the standard citrate solution. Such material as “Natural Plant Food” can not be properly compared with the ordinary commercial fertilizers which contain the essential ingredients, phosphoric acid and potash in soluble and readily available forms as shown by laboratory tests.

Raw phosphatic material does, under certain conditions, have an undoubted agricultural value, its phosphoric acid, and potash if present, becoming gradually available in the presence of much decomposing vegetable matter, but if farmers wish to try experiments with such material they should understand its nature and know that it has a low commercial value. Chemically this “Natural Plant Food” is of the same general character as our ground phosphate rock or floats. The sample marked “No. 3 Natural Plant Food” has the same phosphatic basis, but contains some cotton seed meal and hulls. The guaranteed analysis claims 3.30 per cent. of nitrogen, equivalent to 4 per cent. of ammonia, but no available phosphoric acid nor soluble potash. Our analysis showed only 1.70 per cent. of nitrogen, equivalent to 2.07 per cent. of ammonia, and very small percentages of available phosphoric acid and soluble potash. It will be seen then that while No. 3 is a somewhat better fertilizer than Nos. 1 and 2, it has a much lower commercial value than the ordinary ammoniated superphosphates on our markets, and, worse than this, that it contains only about one-half the nitrogen, or ammonia, claimed for it.

RULES.

Farmers wishing samples of fertilizers analyzed should make application to the secretary of the Board of Fertilizer Control at this college for a copy of the rules concerning the analysis of farmers’ samples. Samples not collected, witnessed and forwarded in the prescribed manner can not be analyzed.
(3) WATERS.

Ninety-five samples of water from different parts of the State have been examined during the year. Except in cases of distinctly mineral waters and waters proposed for irrigation or boiler purposes we have been compelled, in order not to interfere with other work, to limit the analyses to partial and sanitary examinations. With regard to mineral waters it should be understood that chalybeate and sulphur waters undergo rapid changes on standing after collection, so that as a rule we can not determine in a sample sent from a distance the amount of iron or of sulphuretted hydrogen existing in solution at the well or spring. Such waters should be examined on the spot.

With regard to the ordinary spring and well waters it was found that quite a large number of those examined gave evidence of being more or less contaminated by sewerage or impure surface water. The proportion of the well waters which appeared bad or suspicious was greater than that of the spring waters, and the shallow well waters of the low country made the worst showing of all. The water supply of the Barracks at this college has been repeatedly tested and has always been found in good condition.

In the up country great care should be taken in locating wells to avoid all possible sources of contamination, and the surroundings should always be kept perfectly clean.

In the low country the use of shallow wells should, if possible, be abandoned, and the effort made to secure drinking water from deep or artesian wells.

DEEP AND ARTESIAN WELLS.

An artesian well is properly a flowing well, but the term is now commonly used to include all deep wells which furnish water coming from considerable depths and cut off from subsoil water by impermeable or difficulty permeable strata. We have examined this year deep well waters from the following counties:

(1) Darlington, Florence, Marion, Horry, Williamsburg and Georgetown. The waters examined are from depths ranging from 100 to 795 feet, and flow or rise nearly to the surface. Most of them are soft carbonated alkaline waters. One from a well 185 feet deep in
the city of Georgetown is strongly saline, and one from a well 190 feet deep in the western part of Williamsburg is a hard water having carbonate of lime as its chief constituent.

(2) Sumter and Clarendon. The waters examined from wells having a depth of from 130 to 300 feet and flowing furnish water containing only from five to eight grains of total solids per gallon. Three well in Clarendon, depth from 400 to 573 feet and flowing furnish soft and distinctly alkaline water.

(3) Orangeburg, Berkeley, Colleton, Hampton and Beaufort. The wells from 45 to 260 feet deep furnish rather hard water. One in Berkeley, Mt. Pleasant, 420 feet deep, supplies a strongly saline water, and one in Colleton, Pon Pon, 428 feet deep and flowing, furnishes a fine, soft, carbonated alkaline water.

Most of the samples examined, whether hard or soft, were good drinking waters. A few of them contained rather too much mineral matter for drinking waters in constant use, but in only two cases was anything found to suggest possible contamination by injurious organic matter. Replies to our inquiries concerning the deep well waters which we have analyzed during the last two years have been almost invariably to the effect that none but the best results have followed from their use, and that the prevalence of malarial fever has diminished wherever shallow well water has been abandoned and deep well water substituted. As there seems to be among many people in the State a strong prejudice against hard waters, it may not be amiss to say that there is no satisfactory evidence that water containing even fifteen or sixteen grains of carbonate of lime to the gallon is unsafe. Such waters may not be palatable to some persons and may produce temporary intestinal derangement when first used by those who have been accustomed to soft water, but a careful study of all the statistics on the subject shows that calculous affections are no more common in hard than in soft water districts, and that "the rate of mortality is practically uninfluenced by the softness or hardness of the water." Hard waters are objectionable for washing purposes and for boilers, and possibly in certain cooking operations, but for drinking purposes there should be no hesitation in preferring the hard water of a deep well to the soft water of a shallow one in a malarial region.
SANITARY EXAMINATION.

It should be distinctly understood that we do not make bacteriological examinations in this laboratory, but simply chemical tests with the view of determining if possible whether waters are contaminated by objectionable organic matter, sewage, etc. For isolating and identifying bacteria of any kind an expert bacteriologist should be called upon. But Dr. Cheesman, instructor in bacteriology, College of Physicians and Surgeons, Columbia University, New York, says in an article published in the "Albany Medical Annals," March and April, 1897, that there are many things which "render the search for pathogenic bacteria in water or in sewage almost a hopeless one in the beginning and usually a fruitless one in the end." Dr. Charles Smart, Deputy Surgeon General, U. S. Army, says in an article published in the last number of the National Medical Review, December, 1897, that "the bacteriologists have not as yet been able to detect the typhoid bacillus in water supplies, but we know that the bacillus is there, because people who drink infected water die of fever. But both bacteriologists and chemists can in many instances inform us when sewage leaks into a water supply, and when this is the case there is always danger of infection." Again in speaking of the propagation of malarial diseases, this authority on "drinking water and disease" says, in the article referred to above, "that the plasmodium of Laveran, the germ of malarial fever, has not been found in water supplies," but that this "does not militate against the belief that these fevers are susceptible of propagation by water supply, because this germ has not been found in air although few medical men doubt the aerial propagation of malarial diseases."

With regard to the chemical examination of drinking waters much misunderstanding exists. Frequently samples of water are sent for analysis with no information as to the source, and when this is asked for it is either declined or given with evident reluctance. The idea is that the chemist should be able to make an analysis without knowing anything about the source and history of the water and that if this information is furnished him he could not well make an unprejudiced report. This indisposition to aid the chemist might be pardonable if he was expected to give only his analytical results. But he is expected to do more than this and to give also his opinion as to the
purity of the water and its fitness for drinking purposes. Now, analytical results which would in one instance condemn a water as unfit for use, would in another have no such significance. For instance, the quantities of chlorine and ammonia which we have found in some of the deep well waters of the low country, and which cast no suspicion upon the water, would almost certainly condemn a water from a shallow well located at some distance from the coast, especially if its surroundings were objectionable. Instances might be multiplied, but it is hoped that this one will be sufficient to show that the chemist needs the information not to aid him in his analysis but in the interpretation of his results. In order that a truly representative sample of water may be sent for analysis it is evident that the greatest care should be taken in collecting it, and hence all persons are requested not to send on samples for examination without having previously written to us for instructions.

(4) ORES, MINERALS AND OTHER SUBSTANCES.

A detailed description of these specimens is unnecessary as the results of the analyses are in most cases not of general interest. The total number of determinations falling under this head is twenty-four.

(5) DISTRIBUTION OF THE WORK.

The analyses of fertilizers have been made by Messrs. F. S. Shiver, John Thompson and C. C. McDonnell, the analyses of waters with a few exceptions by Mr. McDonnell; the assays of ores and determinations of minerals by Dr. R. N. Brackett, who has also done some work in the sanitary examination of waters.

Very respectfully,

M. B. HARDIN,

Chief Chemist.

MORRILL FUND.

Report of P. H. E. Sloan, Treasurer of Clemson Agricultural College, to the Secretary of the Interior and the Secretary of Agriculture, of amount received under the Act of Congress of August 30,
1890, in the aid of Colleges of Agriculture and the Mechanic Arts, and of the disbursements thereof to and including June 30, 1897:

Balance on hand July 1, 1896..........................$ 33 75
Annual cash installment from State Treasurer............ 11,000 00

Total available for year ending June 30, 1897.........$11,033 75
Disbursements thereof for the year ended June 30, 1897:
Agriculture, as per schedule A, on account salaries........ $ 616 72
Mechanic Arts, as per schedule B, on account of salaries.. 3,166 55
Mechanic Arts, as per schedule B, on account apparatus.. 6 50
Mechanic Arts, as per schedule B, on account stock and material ........................................ 106 58
English language, as per schedule C, on account salaries.. 1,391 62
Mathematics, as per schedule D, on account salaries...... 1,616 63
Natural or physical science, as per schedule E, salaries... 2,566 70
Natural or physical science, as per schedule E, apparatus.. 369 36
Natural or physical science, as per schedule E, text books. 8 75
Natural or physical science, as per schedule E, stock and material ........................................ 145 49
Economic science, as per schedule F, salaries............. 950 00

Total expended during year..............................$10,944 90
Balance remaining unexpended July 1, 1897..............$ 88 85

I hereby certify that the above account is correct and true, and, together with the schedules hereunto attached, truly represents the details of expenditures for the period and by the institution named, and that said expenditures were applied only to instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural and economical science, with special reference to their application in the industries of life and to the facilities for such instruction.

P. H. E. SLOAN, Treasurer.

(Itemized statement on file in my office.
W. D. MAYFIELD, State Superintendent Education.)
# REPORT OF THE TREASURER.

P. H. E. Sloan, Secretary and Treasurer, in Account with Clemson Agricultural College.

For the Year Ending December 31, 1897.

## SUMMARY

<table>
<thead>
<tr>
<th>RECEIPTS</th>
<th>DISBURSEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>To balance on hand as per last Annual Report.</td>
<td>$474.40 By paid on account salaries.</td>
</tr>
<tr>
<td>To interest on Clemson bequest.</td>
<td>$8,468.30</td>
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<tr>
<td>To Land Scrip Fund.</td>
<td>$5,754.00 By paid on account electric plant.</td>
</tr>
<tr>
<td>To cash from insurance on barn.</td>
<td>5,040.00</td>
</tr>
<tr>
<td>To cash from tuition fees.</td>
<td>By paid on account Agricultural Department.</td>
</tr>
<tr>
<td>To cash from rents.</td>
<td>$3,000.00</td>
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<tr>
<td>To cash from electric plant.</td>
<td>By paid on account Agricultural Department, Dairy Division.</td>
</tr>
<tr>
<td>To cash from chemical laboratory.</td>
<td>1,162.75</td>
</tr>
<tr>
<td>To cash from teams and teamsters.</td>
<td>140.68 By paid on account Agricultural Department, Veterinary Division.</td>
</tr>
<tr>
<td>To cash from dairy.</td>
<td>76.07</td>
</tr>
<tr>
<td>To cash from mechanical department.</td>
<td>By paid on account Agricultural Department, Botanical Division.</td>
</tr>
<tr>
<td>To cash from farm products.</td>
<td>1,385.16</td>
</tr>
<tr>
<td>To cash from Veterinary Division.</td>
<td>By paid on account Agricultural Department, Convicts.</td>
</tr>
<tr>
<td>To cash from Police Magistrate.</td>
<td>700.89</td>
</tr>
<tr>
<td>To cash from convict division Board Employees.</td>
<td>10.38 By paid on account office.</td>
</tr>
<tr>
<td>To cash from Experiment Station Library Books.</td>
<td>76.65 By paid on account construction and repairs.</td>
</tr>
<tr>
<td>To cash from miscellaneous items.</td>
<td>76.65 By paid on account construction and repairs.</td>
</tr>
<tr>
<td>To cash from clerical errors.</td>
<td>76.65 By paid on account construction and repairs.</td>
</tr>
<tr>
<td>To cash from privilege tax on fertilizers.</td>
<td>3,774.56</td>
</tr>
<tr>
<td>Less expenses of Fertilizer Department in collecting tax and analyzing fertilizers:</td>
<td>1,979.76 By paid on account geological Division.</td>
</tr>
<tr>
<td>$5,546.71</td>
<td>3,262.84 By paid on account Mathematical Department.</td>
</tr>
<tr>
<td>Less amount refunded State Treasurer on account of error in appropriation 1894:</td>
<td>3,740.91 By paid on account Geological Division.</td>
</tr>
<tr>
<td>$10,000.00</td>
<td>3,740.91 By paid on account Geological Division.</td>
</tr>
<tr>
<td>1,995.00</td>
<td>3,740.91 By paid on account Geological Division.</td>
</tr>
<tr>
<td>18,411.71</td>
<td>$58,067.62 By paid on account cadet labor.</td>
</tr>
<tr>
<td>42,058.29</td>
<td>$58,067.62 By paid on account cadet labor.</td>
</tr>
<tr>
<td>$89,417.62</td>
<td>$89,417.62 By paid on account cadet labor.</td>
</tr>
</tbody>
</table>

1898.

Jan. 1. To Balance | $3,774.56 |

(Itemized statement on file in my office—W. D. MAYFIELD, State Superintendent of Education.)
We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Treasurer of the South Carolina Experiment Station for the fiscal year ending June 30, 1897, that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the Act of Congress approved March 2, 1887.

Signed:
J. E. WANNAMAKER,
J. E. BRADLEY,
JESSE H. HARDIN,
Auditors.

Attest:
P. H. E. SLOAN,
Custodian.