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Experimental Engineering at the Iowa Agricultural College

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3. An adjustable attachment for a Bunsen burner, having three upright posts for the support of dishes, and a platinum triangle, made of wire, passing through holes near the tops of the posts, to support a crucible, watch-glass or small dish. The attachment permits the use of a "crown top" if it is desired to evaporate a liquid rapidly without boiling, and it is provided with supports for a cylindrical chimney which encircles the posts and protects the flame from drafts of air.

4. An apparatus for electrolysis, consisting of a dessicator containing a platinum triangle to support a platinum dish. A wire of the same metal is connected with the triangle and passes through the side of the dessicator. To prevent loss by spray, the dish is covered by a large watch-glass, in which is sealed a large platinum wire ending in a spiral below to serve as the positive electrode. The wire extends through a very small cork fitted in the top of the dessicator, and thus can be raised, lowered or supported in any position.

EXPERIMENTAL ENGINEERING AT THE IOWA AGRICULTURAL COLLEGE.

BY G. W. BISSELL, PROFESSOR OF MECHANICAL ENGINEERING.

Experimental engineering at the Iowa Agricultural College is of two kinds. The first kind has for its object the instruction of the student in the use of and calibration of the instruments employed, and in the performance by improved methods of a series of graded experiments whose variety and selection are such as experience has shown to be productive of the best results attainable with the facilities of the laboratory.

The experiments under this head which are conducted by the students in mechanical engineering are: Tension, transverse and compression tests of the materials of construction, properties of lubricants, measurements of power by absorption and transmission dynamometers, steam gauge and indicator spring calibration, cement testing, fan-blower tests, calorimetry, weir and water-meter calibration, efficiency tests of steam engines, boilers, injectors, air compressor and steam heating, electric lighting and pumping plants, and the thermal analysis of the steam engine.

Owing to the number of experiments and students and the lack of duplicate apparatus, it is necessary as well as advisable to maintain all apparatus in working order, so that the student is not obliged to lose time and patience and courage in looking for things. While the experience obtained in arranging apparatus might be useful as instruction, such preliminaries are apt to discourage the beginner. Moreover, the practice, if followed with large classes, would cause confusion and sacrifice discipline. System is necessary in this particular.

The actual performance of the above or any other set of experiments is secondary to another feature of the work, which consists in the writing of a satisfactory report of the experiments. This report includes several distinct things, and is generally arranged under heads as follows:

1. Object of the experiment.
2. Method to be employed in attaining it. Under this head is placed the derivation of the fundamental formulae for the experiment.
3. Description of apparatus. This includes all apparatus, principal or accessory. The description is often assisted by sketches.
4. Describe the experiment. Every operation having direct or indirect bearing on the results.
5. Give numerical data. These are usually taken on printed blanks and afterward copied on similar blanks for pasting in the note books.
6. Derive results.
7. Draw conclusions.

When the student has the results obtained from the above experiments upon the pages of his note book he has a valuable store of knowledge to draw upon in his future work. For the tests of the materials of construction he finds certain constants. Experimenting with lubricants shows him that the value of an oil for lubrication depends upon many properties. Testing the transmission of power by various devices opens his eyes to the extent of the friction losses, resistance of the air, etc. The calibration of instruments, calorimetry, flue-gas analysis are essential in establishing the value of the efficiency tests; and from these efficiency tests, he learns, above all, the value of accuracy in each and every step and the importance of perfect honesty in the recording of observations.

With the exceptions of the tests upon materials, the numerical results of much of this work are far from correct because of the inexperience of the experimenters and because also of the variability of conditions peculiar to engineering problems. The exactness of the physical and chemical laboratories are unusual in the engineering laboratory. But education and not figures is the result sought by the instructors. Professor Carpenter, in charge of experimental engineering at Sibley College, Cornell University, says "The undergraduate laboratory should be equipped so as to demonstrate in a practical and convincing way the principal laws or facts that the student must master in order to finish his course. Its course of instruction should be such as to require systematic work of the student, teach him how to observe, how to use apparatus, how to deduce conclusions from his mass of data and finally how to make a neat and systematic report of his work."*

Having completed, or nearly so, the above outlined work, the student takes up the second kind of experimental work which is offered to him chiefly in the form of thesis work. That "there's nothing new under the sun" cannot be said of man's knowledge. And in engineering there are countless problems still unsolved for the lack of evidence which those actively engaged in professional work have not the time to gather and the technical schools are expected to help by contributing facts. Hence the necessity for original work in the technical schools. This can almost always be accomplished by assigning it to students as thesis work and the results of so doing when the instructor can give personal supervision to the work are good. Educationally, the results are good because the student is thrown largely upon his own resources and because in opening the gates to the new

*Engineering Laboratories, R. C. Carpenter. *Science*, November 3, 1893.

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fields of knowledge thus brought to view he has new experiences and new thoughts and is taught the increased importance of application, reasoning and preliminary training. In short we aim to benefit first the student and next the profession by the second kind of experimental work.

The time spent on thesis investigation and writing ranges in amount from one hundred to two hundred hours of actual work.

The scope of the original work in experimental engineering for the past two years is indicated by the following subjects chosen from the whole number assigned:

The force exerted in cutting cast iron, wrought iron and steel in the lathe.—For cast iron the force is proportional to the amount of metal removed. For wrought iron and steel the force does not increase as rapidly as the amount ot metal removed.

Determination of the point pressure and twisting moment exerted by twist drills in cast iron, steel and brass.—A collection of data useful in the design of drill presses.

The resistance of swing check valves in the return pipes of steam heating systems.—Found to be very slight, indeed—not over one-quarter of a pound.

Some of those projected for the coming year are:

Friction of cylinder oils.

Variation of stress in the punching of metals.

Variation of economy of the steam engine with change of load.

Experiments with small venturi meters.

In the other departments of the engineering, electrical, civil and mining, the experimental work plays an important part and is prosecuted with vigor by the instructors and students.

Ames, Iowa, December 26, 1893.

ON THE GEOLOGICAL POSITION OF BENNETTITES DACOTENSIS MACBRIDE, WITH REMARKS ON THE STRATIGRAPHY OF THE REGION IN WHICH THE SPECIES WAS DISCOVERED.

BY SAMUEL CALVIN, IOWA CITY.

Since Professor Macbride's paper on *Bennettites dacotensis* was published in the *American Geologist* for October, 1893, there have been numerous inquiries respecting the exact geological horizon from which the cycads were derived. The close resemblance and the intimate relationship indicated between the Dakota fossil and *Tysonia marylandica* Fontaine, while not conclusive, would point toward a common horizon for the two species, and so make it possible to correlate the Potomac formation with a definite Mesozoic horizon in the northwest. Prosessor Macbride's paper left