SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XVI. No. 397.

NEW YORK, SEPTEMBER 12, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

CORNELL UNIVERSITY AND HER TECHNICAL DEPARTMENTS.

SOME years ago we gave some account of the organization of Cornell University, the "land grant college" of the State of New York, and the seat of those colleges of agriculture and the mechanic arts the support of which is the prescribed "leading object" of its foundation and maintenance, while it is still permitted and expected to offer suitable courses of liberal and academic education. Since the date of that article (*Science*, x. 158, Sept. 30, 1887), great progress has been made in all its departments, and especially in those in which we are particularly interested; and we take advantage of an opportunity which presents itself at the moment to exhibit something of this progress and the present condition of the technical school having most interest to our readers.

Five years ago there were about six hundred students in the University, of whom perhaps a third were engaged in technical studies, while the schools of useful arts were very slowly growing into form. With the increase of the income of the University due to the final harvesting of those financial returns coming of the earlier seeding and care of Cornell and his eminent successors on the board of trustees, and the generosity of Cornell, McGraw, H. W. Sage, Hiram Sibley, A. D. White, and other equally zealous if less able friends, an extraordinary growth began, and has continued uninterruptedly up to the present time; and we now propose to show what has thus far been effected. The reputation of the University is to-day so far assured that the requirements and the charges for tuition have been purposely made a bar to further growth, except at a moderate rate, the trustees evidently desiring quality rather than quantity; while their funds are now taxed to the utmost to afford those new buildings, and to secure those additions to the equipment, which are necessitated by such rapid progress. The University registered, in 1889-90, 1300 students, of whom about one half were engaged in technical studies; and of the others, the largest body were taking the course in arts, the most thoroughly classical of the many courses offered. Of these, also, some go, later, into technical work; and it is becoming very common, and more and more so, for young men proposing to go into the engineering professions especially, to first secure a liberal education. They find the advantage, both in college and later, to more than compensate the time thus demanded in addition to that required for the technical course alone. Such students often take their electives, in the senior and junior years, largely in mathematics and the sciences, and thus practically lose often but two years in attempting the double course.

The changes with which we are now concerned affect mainly the technical end of the campus; for the growth, though large in other departments, has been so much more in these lines of work that the construction marking material changes has mainly occurred there. It is now, however, expected that the law-school and the academic departments must soon illustrate in turn this extension of the growth of Cornell. The agricultural department is waiting for a patron to give it a new building and enlarged equipment, but it is not yet ready to fill much more space with its students.

A bird's-eye view of the campus from the north-west, over Cayuga Lake, would show the sixty acres of beautiful lawn besprinkled with buildings, including the dozen or fifteen great buildings of the University proper, and the twenty-five or thirty houses of the professors residing on the grounds. The main buildings are principally at the north extremity of the campus, and the technical departments are housed at the extreme north, on the edge of the Fall Creek gorge, from which are derived water-supply and water-power. Here a great brown-stone building, Lincoln Hall, is appropriated to the College of Civil Engineering and its allied School of Architecture. The three main buildings, Morrill, McGraw, and White Halls, are opposite, forming the main front of the University, toward the city of Ithaca lying in the beautiful valley, at the head of the lake four hundred feet below, and less than a mile away. The great library building given by Mr. Sage to the University as a memorial to Jennie McGraw Fiske, "whose purpose shall not fail," terminates this grand line of great edifices. It will be one of the most convenient, as well as largest and most beautiful, buildings for the purpose yet built in any land. Its capacity is for nearly half a million volumes, with ready extension to a million. Between $15,000 and $18,000 will be annually appropriated for additions to the catalogue, and it is expected that it will not only comprise the best of general literature, but will offer the grandest facilities for technical study to be found outside the Patent Office library, if not even superior, in time, to that.

The principal changes of the year have been the completion of a very large chemical laboratory (with accommodations for what have been of late years the largest entering and undergraduate classes in the United States, introductory laboratories, lecture-rooms, analytical laboratories, assay-rooms, and special laboratories for advanced work, both in instruction and research); the reconstruction and re-arrangement of the physical laboratories, now filling the great brown-stone building called Franklin Hall; and the extensions of Sibley College. We hope at some future time to be able to give full descriptions of these special laboratories, and will now only remark that they are working the largest classes in their several departments ever yet collected in engineering courses, and probably better illustrate what can be done by system and skill in administration, with crowded classes, than any thing else in the University. We must confine ourselves at the moment to the last of this series of changes.

The outline-plans seen in the illustrations represent the working parts of the College of Mechanical Engineering and the Mechanic Arts as now arranged for a maximum of six hundred students; the number working during the last year being about four hundred, of whom a very considerable number were graduates of the academic courses of this and other universities, or of technical courses in this and other colleges and technical schools, and including a number of professors of distinction engaged in departments of mechanical engineering elsewhere, who were engaged in the study and practice of laboratory methods as applied in engineering.

The main building, Fig. 1, is shown in heavier line than the shops and laboratories which are adjacent. The work in chemistry and in physics is given in the great laboratories of the University, as is all work in pure mathematics and in languages, thus leaving the professional work only to be done in the Colleges of Engineering. The ground-floor sketch shows the main building, 165 feet by 45, with its museums, library, and reading-room, in

which the working library is kept and all its technical periodicals — a hundred of them — filed. In the court is the boiler-house with its 600 horse-power of water-tube boilers, selected for safety and compactness; at the left, the dynamo-room with its driving engines; beyond, the machine-shop, 165 feet by 40, and its office, toilet-rooms, and lockers (of the latter some 500, including those at the foundry and forge across the road). The latter building is 150 feet by 40, and, though a frame building, one of the neatest buildings on the campus. Between this building and the main building of Sibley College, and east of the latter, is the large building, 150 by 40, devoted to the work of the Department of Experimental Engineering,—the mechanical laboratory,—in which

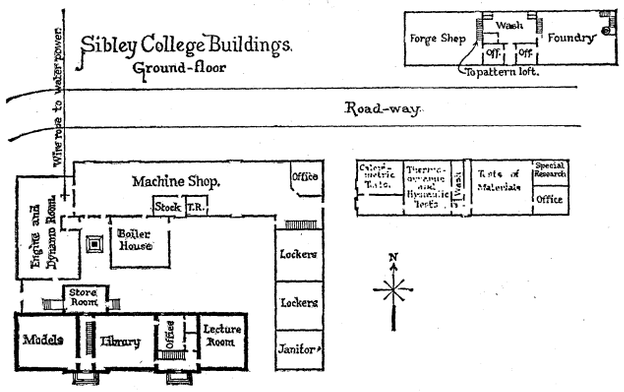
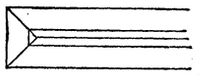


FIG. 1.

are placed all the testing-machines for metal and materials of all sorts, from 10,000 to 100,000 pounds capacity; a number of lubricant testing-machines; and also a considerable amount of miscellaneous apparatus of research in engineering. The boiler-test department is fitted up in the main boiler-house; and the several engines are placed adjacent, both the half-dozen devoted to experimental use and those employed for driving the dynamos used for electric lighting. The plans of the second floor, Fig. 2, exhibit the extent of the wood-working shops, 165 by 40; the upper part of the laboratory building, in which the problems of design and of the laboratory are worked out; and the arrangement of the main building; in the latter the offices and lecture-room of the



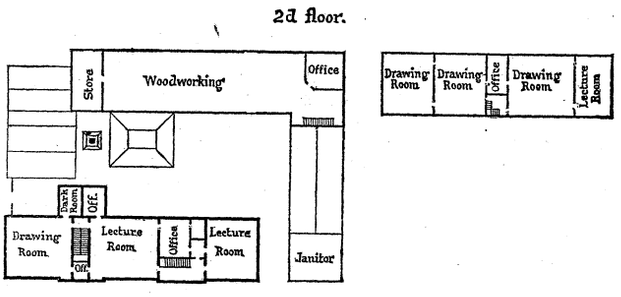


FIG. 2.

director, and the lecture-room of the professor of electrical engineering. The professor of mechanic arts, the professor of machine construction, and the professor of experimental engineering share the other lecture-rooms shown in this and the other plans; while the officer detailed from the United States Naval Engineer Corps to give instruction especially in steam and naval engineering finds accommodations in the laboratory building.

These plans are not, however, precisely accurate in their apportionment of apparatus. The Department of Electrical Engineering and that of physics have become so large, and their stock of apparatus so extensive, that it is probable that the coming college year may see all their larger machinery transferred to the dynamo-room, and even overflow into the west end of the machine-shop floor, which is, however, only a provisional arrangement of the professors of physics and of electrical engineering, and subject to amendment as the exigencies of the case may require. The crowd of small dynamos for individual instruction, of which there are a half-dozen each, for example, of the Edison and the Westinghouse, and a number of others of the better known types, will be used in the physical building. Other dynamos and other engines are continually coming in, and it is thought to be but a matter of very short time before it will be found imperatively necessary to put up a great engineering laboratory, in which to group every thing demanding power and steady speed, as well as all the apparatus of the Sibley College proper. It is presumed that, when built, it will bear the name of the "coming unknown," who will thus at once do a great work and build himself a permanent monument.

Space will not permit the description of the improved and numerous courses of instruction open to technical students at Cornell to-day. They include purely professional courses in agriculture and in engineering, courses in chemistry and physics, in all the natural sciences, and in mathematics, pure and applied, and undergraduate and advanced, in every line in which the ambitious student may desire to excel. For those entering the professions, the courses in patent law and in political and social economy, in ethics and in history, are well adapted, and are found fittingly to supplement the work in the engineering and other technical courses. Many students are taking advanced work in technical departments, and at the same time such outside work as their plans may seem best to warrant. All students in regular mechanical engineering are given instruction in electricity; and, for those who desire it, work is specialized, in the senior and post-graduate years, for students in electrical engineering, as in steam, marine, and other lines of engineering, and in professional work having relation thereto. Of all this, the interested student may learn by applying to the President of the University; to the Director of Sibley College, and to the heads of the other great departments, in either of which he may desire to work.

THE TIME-RELATIONS OF MENTAL PHENOMENA.

[Continued from p. 117.]

HAVING thus considered the time-relations of a simple re-action, we may proceed, on the line of analysis there laid down, to the consideration of the more complex forms of re-action.

Adaptive Re-actions.

It has been noted that the prominent characteristic of a useful re-action is the adaptation of the response to the excitation by which it was called out. This adaptation involves a recognition of the stimulus, and its association with the movement in question. In this recognition we found it convenient to distinguish between the recognition of the presence and that of the nature of the stimulus; but it may be questioned whether we can recognize the presence except by noting some point of the nature of the stimulus, and whether the noting of this point does not involve its distinction from others. If, in re-acting to a sound, I recognize that it is the stimulus to which I am to re-act, and press the key, does this mean that I know that the stimulus is not a visual or a tactile one, that it is not a higher or a lower, a louder or a feebler, sound? Here, as still more in the analysis to follow, our experimental basis is defective. Experiment has naturally followed the lines of convenience and ready analysis; and as there has been little harmony in these analyses, and as the one here adopted differs somewhat from those adopted by other writers, it will be difficult to maintain the parallelism between theoretical