The exposed sheets, as they are cut off, can be developed several at a time in one tray, with the usual pyro developer; Cooper's developer, described on page 197, No. 13, vol. 53, of the SCIENTIFIC AMERICAN, being preferred. Fig. 9 shows the tray, the developed negative being held up for examination to the red light. The developer is sold ready mixed, thereby insuring to the novice success at the outset.

After the negative is fixed and dried, positive silver prints may be made from it in the usual way; but to quicken the process, oiling the paper with castor oil and a hot iron, as shown in Fig. 10, is recommended, which renders it translucent. Paraffine wax may be used in place of oil.

The primary advantage of paper over glass is its extreme lightness. An 8 x 10 apparatus complete, with camera, lens, roll holder for 24 exposures, tripod, and case, weighs 28½ pounds less than a glass equipped outfit.

Such a saving makes the taking of large photographs attractive, and enablest he amateur to obtain panoramic or other views of inaccessible regions with considerable comfort. The danger of breakage is avoided, thereby making rough transportation of the negatives perfectly safe.

The compact way in which the negatives can be packed should not be overlooked; they can be kept in books, thereby affording as easy a means of reference as if they were in a photographic album—a point of much value in any large concern. They can be used in photographic ink printing processes without the need of transfer, so common with glass plates. They are splendidly adapted for large work, and, as an instance of their success in this respect, we have but to refer to the very fine exhibition of life-sized direct portraits which was given at the Buffalo Photographers' Convention, in Buffalo, N. Y., last July.

The softness and delicacy of the shadows and the brilliancy of the high lights were specially noticeable.

The retouching of paper negatives is more easily done than on glass, for the back of the negative is worked upon by a pencil; any mistake can be readily erased. With crayon stubs very pretty cloud effects can be worked into the sky of landscape negatives. Perfect freedom from halation is one of the special characteristics of the paper, making it valuable in the photographing of interiors. All portions of the holder are made interchangeable.

The enterprise of the Eastman Company in introducing so noteworthy an invention as their roll holder, and the excellent sensitive paper film used with it, is illustrative of the characteristic push and energy so often displayed by American inventors; we bespeak for their improvement an important future, and consider it an advance in the art of photography which will be welcomed both by the amateur and professional. A silver medal was awarded the company at the London International Inventions Exhibition for the novelty of the invention and the fine workmanship displayed.

Particulars as to the sizes and prices of the paper may be found in our advertising columns. Further information may be had from the Eastman Dry Plate and Film Company, 1347 State Street, Rochester, N. Y.

### Bread Mixtures.

Even in the most ancient times different foreign matters were mixed with bread.

In Thracia, bread was mixed with powdered dried roots, in Syria with dried mulberries, in Egypt with whole grains.

In modern times, in Sweden they add to the bread powdered dried fish; in Ireland and in Iceland, moss, which besides being nutritious keeps the bread from drying; in Prussia, white clay, which contains alkali salts and makes bread very light; in Russia, powdered bark or finely chopped straw. On western shore of England certain kind of sea weed (*Porphyra laciniata*) is gathered, washed, boiled, and then baked with oat meal flour.

In Africa, powdered dried locusts are mixed with bread, in India potatoes and pea flour, and during the famine even stones ground to fine powder were used in the latter country.

## SIBLEY COLLEGE, CORNELL UNIVERSITY.

THE NEW SCHOOLS OF MECHANICAL ENGINEERING AND THE MECHANIC ARTS.

Cornell University, notwithstanding its youth, has already, just twenty years after the date of its incorporation, become one of the distinctively great collegiate institutions of the United States. Whether considered with reference to the number and magnitude of its buildings, the extent and beauty of its grounds, the largeness of its endowments, the munificence of its founders and benefactors, the number and completeness of its courses of instruction, the practical usefulness of its outfit of apparatus and machinery, the number of its students, or, most important of all, the number and character and fame of its little army of professors and teachers, it stands well among the three or four admittedly pre-eminent colleges and universities of our country. Cornell enjoys the proud distinction of being the first of all universities, whether in this country or in Europe, founded explicitly as a university, designed to give a real and broad university training, in which the needs of the people are fully recognized by the provisions of its charter, and in which the "leading objects" are asserted to be the instruction of students, "without excluding other scientific and classical studies, and including military tactics," in "such branches of learning as are related to agriculture and the mechanic arts." Thus, while giving opportunity for securing an education of the broadest and most liberal character, its founders intended to make sure that the special needs of a nation of workers should be recognized, and that schools of agriculture and the mechanic arts, of the several branches of construction and of the highest departments of engineering, should take their place beside the schools of classical and of scientific learning. From the first, it was intended to become a real university, of such scope as should give to the citizens of this country the means of educating their sons and their daughters in such manner as should best fit them for the work of meeting the difficulties of life. It has been thus organized, and is now a great institution of learning, exhibiting the novel feature of schools of engineering and of the useful arts side by side with those departments which usually constitute, alone, the older colleges.

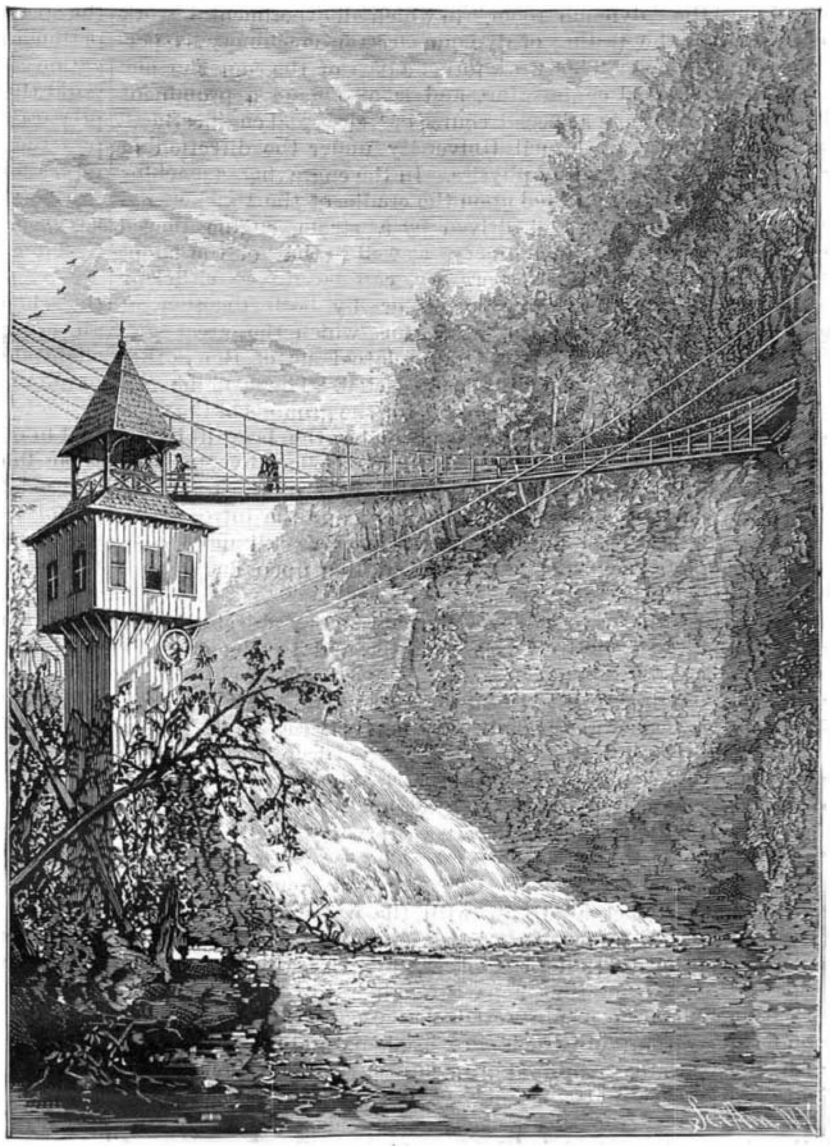

Fig. 9.—SIBLEY COLLEGE WATER WHEEL HOUSE.

Cornell University was incorporated in the year 1865, endowed by the State of New York with its land scrip, representing nine hundred and ninety thousand acres, and by Ezra Cornell with a half million of dollars in money and two hundred acres of land, adjacent to the city of Ithaca. Since that date this endowment has been amplified by the generosity of Henry W. Sage, John McGraw, the late Mrs. J. McGraw Fiske, Hiram Sibley, Andrew D. White, and others. The university is beautifully located, above the city of Ithaca and overlooking the forty miles length of Cayuga Lake; is conveniently accessible, from every direction, by the six lines of railroad intersecting each other at Ithaca. Fig. 2 gives a striking view of the grounds of the university, as seen from the top of the tower of Sage College, the college endowed by Mr. Sage for the benefit of the young women among the students. Sage Chapel, in which the most distinguished clergymen of the country are invited from Sunday to Sunday to preach non-sectarian discourses, is in the foreground; the library building, known as the McGraw Building, flanked by Morrill Hall and White Hall, beyond, while in the distance may be seen the great laboratory building and a corner of Sibley College. Away beyond, apparently not far from the lake, but, in fact, nearly a mile from it, is the house of Mrs. Jennie McGraw Fiske, the magnificent mansion of a lady whose philanthropy left nearly a million of dollars for the erection and endowment of a hospital and a great university library.

Cayuga Lake, with its picturesque banks and gorges, fills the distance. The grounds themselves are among the most beautiful in the country, if not in the world, and are bounded at the right and left by wonderfully picturesque canyons, through which the rushing waters fall some four hundred feet to the lake below.

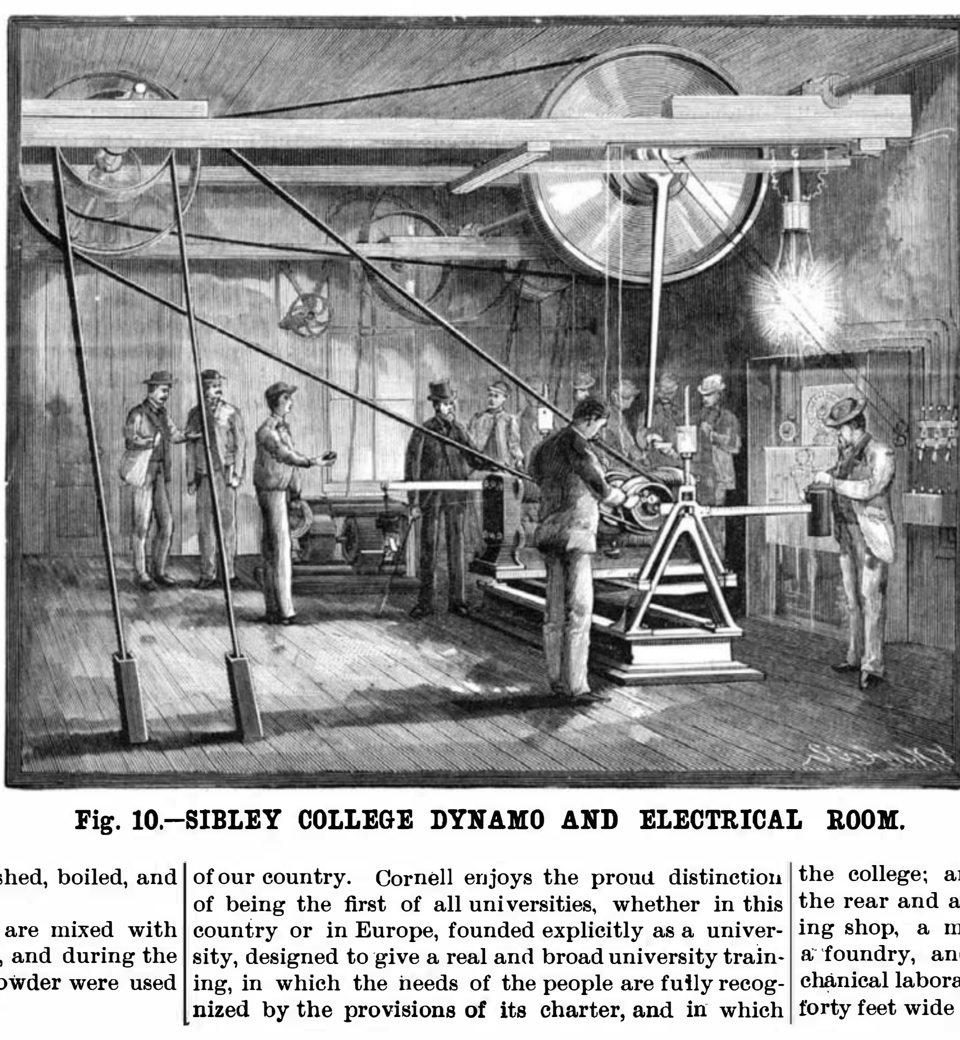

Fig. 10.—SIBLEY COLLEGE DYNAMO AND ELECTRICAL ROOM.

Sibley College is the school of mechanical engineering and of the mechanic arts of Cornell University. It was built and endowed, and supplied with a splendid outfit of machinery, workshops, models, and apparatus by the Hon. Hiram Sibley, of Rochester, himself a mechanic by original occupation and training, and later one of those princely men who built up the existing great systems of telegraphy in this country. Like Cornell himself, he turned a good proportion of his profits into the hands of the Trustees of the University, for the benefit of the youth of the present generation, in remembrance of those earlier days when he would have given so much for such opportunities, then not to be found anywhere in the land.

The Sibley buildings were designed by Prof. Morris; as shown in Fig. 4, they consist of a main building 160 feet long by 40 feet wide and three stories high, in which are the lecture rooms, the drawing rooms, and the museums of the college; and of a series of workshops seen in the rear and at the side, consisting of a wood working shop, a machine shop, a blacksmith shop, and a foundry, and also including a very extensive "mechanical laboratory." These shops are usually about forty feet wide by forty to sixty long, are well equipped, and are still receiving new machinery and tools of all the forms familiar to the engineer as used in the trades. Before the close of the present college year, they will be practically complete, and are already sufficiently so to permit the instruction of sections of twenty-five students at one time. They will be extended and new tools added as the growing classes may make it necessary. Fig. 1 shows one of the museums, that of mechanism, containing the Reauleaux collection of models illustrating the course in "kinematics," of "pure mechanism," or of the motions of machines. The second, the museum of machines, is similarly fitted up with cases containing models of machines, and also with book cases and tables, thus serving as a reading room as well as a museum and room in which to sketch machinery. These models are used in the lecture rooms in the illustration of the courses of instruction in mechanism and in machine design. One of the drawing rooms is seen in Fig. 7, the freehand or fine art room. Four large rooms are devoted the department of drawing and machine design.

The lecture rooms are also fitted up with cases for apparatus especially intended for illustration in special subjects. For example, that of the professor of mechanical engineering contains principally models and apparatus used in the course of lectures upon the steam engine and other motors. Some of the workshops are shown in Figs. 3, 5, and 8. At the left is seen the blacksmith shop, with its ten forges and its tools; at the right is the foundry, with its stock of flasks and accessories, and its cupola in which the iron is melted as required. Both of these departments greatly interest the young mechanics, who, under the careful and systematic instruction of their skilled teachers, often do wonderfully good work, and learn with singular rapidity.

The machine shop is seen at the lower part of our multiple illustration; and here, as well as in the carpenter's and pattern maker's shop, many a young successor to the great mechanics of to-day is finding his way into the mysteries of fine work and construction, to gauge size with a facility and ease that makes his elders regret that this epoch of true technical education had not come a generation earlier. It is here that the real mechanic at once separates himself from the youth who has mistaken his vocation, and shows that marvelous sleight and that wonderful accuracy of hand and eye that distinguish him from his less fortunate fellows. Such a student often acquires more knowledge and more skill in handling tools and in doing good work in a week than his classmate of the other type can attain in months. Nevertheless, here, as in every other department, it is not certain that the race is to be won by the swift; for steady, patient, earnest work does wonders for many who, at the first, give little promise of success.

The machine shop of Sibley College is fitted up with lathes and planers, milling machine and slotter, and with all the needed hand tools. The engine seen in the foreground of Fig. 8 is not intended to drive the machinery of the shop, although it may be so used, as the shop is ordinarily driven by water power; but is placed here for the purpose of serving as an experimental engine, with which the students may be made familiar with the methods of taking indicator cards, of using the Prony brake, and of testing engines to determine their power and efficiency, the position of their valves, and of solving all questions that arise in the operation of the steam engine. This was made by the students, under the direction of Professor Sweet, and was exhibited at the Centennial Exhibition of 1876.

Adjacent to the machine shop is the boiler room, containing the steam boilers used for heating and experimental purposes. One of the boilers is fitted up with all the apparatus required for boiler trials, where students are taught its management, the determination of its power and economical efficiency, and to ascertain the character of the steam made, by the best known methods. It is expected that, as the old boilers wear out, the new boilers introduced in their place, and to supply steam for the new buildings to be erected, will illustrate all the forms made by the best builders, including the so-called "safety boilers," as well as the older "shell" boilers. The work of the closing term of the regular course brings in this and a large amount of other experimental work.

A "mechanical laboratory," a large room, some sixty by forty feet, is fitted up adjacent to the workshops, also, in which are placed a variety of testing machines, including the Fairbanks, Riehle, and Olsen forms, for determining the strength, elasticity, ductility, and "resilience," or shock resisting power, of iron, steel, or other materials of construction, Thurston's "autographic" and lubricant testing machines, meters, indicators, scales, dynamometers, and all forms of apparatus for determining the quality of the materials used by the engineer and the power given or demanded by machines of all kinds, and their efficiency. This department forms a very prominent part of the establishment, and the course of instruction includes a considerable amount of work of this kind. The laboratory is one of the most interesting of all the interesting apartments in this great college, and is deserving of separate and independent illustration and description; it is therefore reserved for a later occasion.

In the main building is still another exceedingly important department, illustrated in Fig. 10. This is the "dynamo room," in which all experimental work in the testing of dynamo-electric machinery is performed. This work forms a part of the course in mechanical engineering, and is also made a prominent feature in a special course of "electrical engineering," taught at Cornell University under the direction of the professor of physics. In the engraving, a machine is seen supported upon the cradle of the Brackett dynamometer, and driven by a steam engine placed below. This machinery, as well as that of the shops and mechanical laboratory, can be driven either by steam or by water power, or by both together, as has been done in work for which the great galvanometer illustrated in a late issue of the SCIENTIFIC AMERICAN was constructed. The machine furnishing the electric lights for the grounds of the university is placed here, as will be the beautiful machinery lately presented Sibley College by Mr. Edison. A reconstruction of this part of the establishment, about to be undertaken, and the introduction of a new engine, are expected to give still more complete facilities for experimentation upon engine and machinery.

Exterior to Sibley College are many objects of great interest both to the engineer and to the ordinary unprofessional visitor. Immediately behind the buildings, and within a stone's throw, is Fall Creek, a beautiful stream, rushing between high banks, precipitating itself through the deep gorge over a dozen high ledges, and furnishing such picturesque views as delight the heart of the artist, while supplying the utilitarian necessities of the college. Here, as seen in Fig. 6, is placed the water supply machinery furnishing the reservoir, one or two hundred feet above it, with the water needed by the whole university. A few hundred feet below this beautiful fall is another, Fig. 9, which furnishes power for the shops through a turbine wheel, inclosed in a substantial house, as shown in the illustration; in which, also, are kept and used all the apparatus required to make determination of the power and efficiency of the wheel. The trial and test of the turbine is thus capable of being made a matter of class instruction and illustration. Such exercises will be made a part of the regular course when the plans now in hand are fully carried out. The Director is now engaged in improving the channels of supply, putting in a larger and more powerful wheel to drive the considerable amount of machinery to be introduced, and inclosing the wheel in a new house of sufficient size to permit the instruction of classes to be carried on within it. Our artist has given a very excellent view of this beautiful lower fall, and lack of space only prevents our introduction of other views from this interesting locality, which is but a sample of many in the neighborhood of the university. The wheel house and suspension bridge represent our artist's plans rather than those of the Director, who will adopt architecture of a simpler character and a suspension bridge of less imposing design.

Thus much for the material part of this great and growing school of mechanical engineering. But bricks and mortar and fine machinery and beautiful apparatus do not make a school. Brains, not buildings and museums of apparatus and machines, give real success, if worked into an organization of proper form. The organization and *personnel* of the establishment are of more importance than the buildings and plant, however elaborate. The trustees of Cornell University, recognizing this fact, have effected an organization upon which they rely for the successful conduct of this mighty educational machine. They place at its head a "Director," whose title indicates his office and his unusual powers. He organizes the college, determines the work and the limits of its several departments, arranges the courses of instruction, prescribes the methods, selects the right men, and assigns them their lines of work. The college, with the approval of the Trustees, has been divided by the Director into three principal departments: a department of drawing, a department of mechanic arts or of shop work, and a department of mechanical engineering; each of which is conducted by a professor versed in the art taught in his part of the establishment. Each of these departments forms a part of the school of engineering, in which the regular course of instruction is given, and each contributes its part in the organization of the several advanced schools of special branches of mechanical engineering, conducted under the general supervision of the Director or by members of the college faculty especially fitted for such lines of work.

The regular course in mechanical engineering begins with two years of preparatory work, in which the students, coming from the preparatory and high schools of the country, are taught the higher mathematics and such branches of science and literature as are best adapted to their needs. Thenceforth the instruction in this department is made very largely professional, and includes lecture room and experimental study of the materials of engineering, of kinematics or motions of mechanism, of machine design, and of the principles, the theory, and the structure of the steam engine and other machines and motors. Experimental work and appropriate laboratory investigations accompany every step in the progress of the pupil throughout the course, and the final work is the preparation of a graduating thesis, which mainly occupies the last term of the course. Accompanying the professional work, also, a large amount of laboratory work is done in the departments of physics and chemistry, such as the engineer finds continually useful in his later practice.

Advanced courses are also given, where desired, in the school of marine engineering, in that of steam engineering, or in the post-graduate course in the mechanical engineering of railroads. As the college grows in number of students and instructors, and such advance becomes practicable, new schools will be organized in other branches of mechanical engineering. It is possible that special courses may, in time, also be organized for the benefit of young men desirous of preparing themselves to become superintendents of shops and establishments, or, as is common in Europe, for the benefit of young proprietors. Possibly, also, trade schools, as of carpentry, pattern making, machine work, may be organized for the purpose of teaching the higher branches of the several arts, thus combining schools for the mechanic arts in the same system with the present schools of engineering.

The officers of Sibley College are: Dr. R. H. Thurston, M.A., Doc. Eng., Director, and Professor of Mechanical Engineering; J. L. Morris, M.A., C.E., Sibley Professor of Practical Mechanics, or of the Mechanic Arts; E. C. Cleaves, B.S., Professor of Drawing; F. H. Bailey, U.S.N., Assistant Professor of Mechanical Engineering and of Marine Engineering; F. Van Vleck, M.E., Assistant to the Director and Instructor in the Mechanical Laboratory; R. Anderson, B.M.E., in charge of the workshop; and various skilled mechanics in the several shops. For all information our readers may address either the Director, the President of the University, Dr. Chas. Kendall Adams, or the Treasurer, Mr. E. L. Williams.

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### Blacksmith's Hammer Signals.

There are few persons, either in the city or country, who have not at times watched a blacksmith at work in his shop with his assistant, or striker. They have noticed that the smith keeps up a constant succession of motions and taps with a small hand hammer, while with his left hand he turns and moves the hot iron which the assistant is striking with a sledge. The taps are not purposeless, but given entirely for the direction of the striker. According to a writer in the *Hardware Reporter*, the signals, as given by the blacksmith and wheelwright, are as follows:

When the blacksmith gives the anvil quick, light blows, it is a signal to the helper to use the sledge or to strike quicker.

The force of the blows given by the blacksmith's hammer indicates the force of blow it is required to give the sledge.

The blacksmith's helper is supposed to strike the work in the middle of the width of the anvil, and when this requires to be varied the blacksmith indicates where the sledge blows are to fall by touching the required spot with his hand hammer.

If the sledge is required to have a lateral motion while descending, the blacksmith indicates the same to the helper by delivering hand hammer blows in which the hand hammer moves in the direction required for the sledge to move.

If the blacksmith delivers a heavy blow upon the work and an intermediate light blow on the anvil, it denotes that heavy sledge blows are required.

If there are two or more helpers, the blacksmith strikes a blow between each helper's sledge hammer blow, the object being to merely denote where the sledge blows are to fall.

When the blacksmith desires the sledge blows to cease, he lets the hand hammer head fall upon the anvil and continue its rebound upon the same until it ceases.

Thus the movements of the hand hammer constitute signals to the helper, and what appear desultory blows to the common observer constitute the method of communication between the blacksmith and his helper.

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A RECENT compilation of fires caused by the explosions of petroleum lamps used for illuminating purposes in the city of Philadelphia during the last five years gives the following results: In 1880, 125 fires; in 1881, 79 fires; in 1882, 53 fires; in 1883, 72 fires; and in 1884, 66 fires; making a total of 395 fires. The numerous other fires caused by plumbers' and painters' pots, oil stoves, etc., are not contained in the above list.

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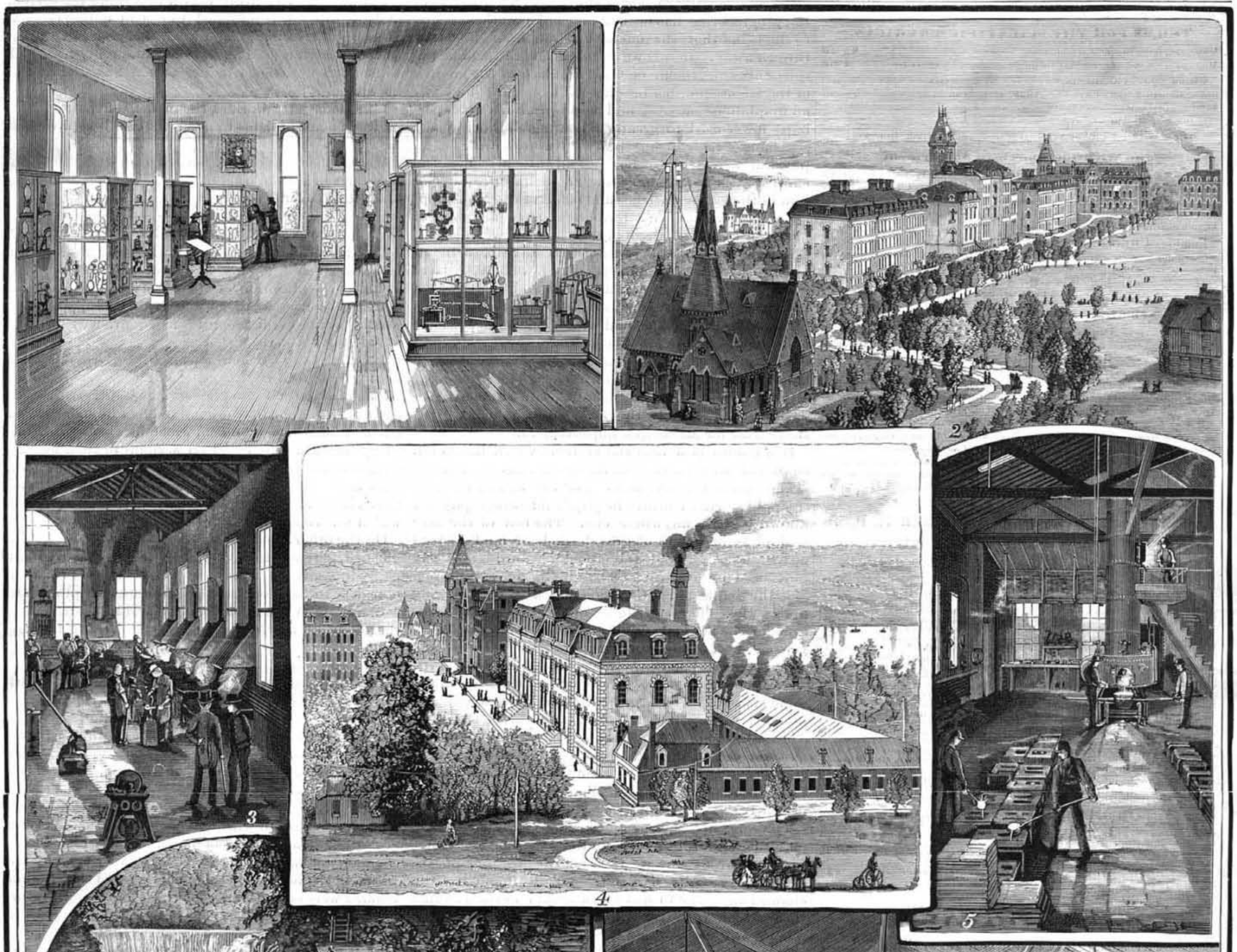

Buildings, Dr. R. H. Thurston, Director. 5. The Sibley College Foundry. 6. Fall Creek Reservoir and Water Supply. 7. The Sibley College Draughting Room. 8. The Sibley College Machine Shop.

**ILLUSTRATIONS OF SIBLEY COLLEGE, CORNELL UNIVERSITY, ITHACA, N. Y.**—[See page 247.]