

reckoned, in horse power hours, equal to about one horse power hour. Taking this as a basis, it will require 6 cells for one horse power for 6 hours, or 30 cells for 5 horse power for the same length of time.

To obtain the length of wire on an electro-magnet, add the thickness of the coils to the diameter of the core outside of the insulation, multiply by 3.14, again by the length, and again by the thickness of the coils, and divide by the diameter of the wire squared.

Blotting paper, saturated with a solution of iodide potassium to which a little starch paste has been added, forms a chemical test paper for testing weak currents. When the paper (slightly damp) is placed between the terminals of a battery, a blue stain appears at the anode, or wire connected with the carbon or positive pole of the battery.

THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR, LONG ISLAND, N. Y.

The visitors who find their way into the bright, airy laboratory at Cold Spring Harbor, and are shown about by Dr. Conn, the director, can hardly fail of getting a pleasant impression of the place. But the full charm and value of the work done here and the esprit de corps of instructors and students can only be realized by one who has studied here for a summer. And most fortunate of all the students who have ever attended the sessions of the school are those who have come this year, for the comforts of living have never before been so ample.

The foundation of the school was due primarily to the energy of Professor Franklin W. Hooper, secretary of the Brooklyn Institute, under the auspices of which it was established and is still maintained. Prominent on its board of managers from the first have been the Hon. Eugene G. Blackford, Mr. John D. Jones and Dr. O. L. Jones, and their generous gifts contributed largely to its original equipment.

For the first three summers the work was carried on at the Hatchery of the New York Fish Commission, but under much inconvenience; the necessarily limited number of students found lodgings where they could in the vicinity. But with a director so able and enthusiastic as Dr. H. W. Conn, of Wesleyan University, who took charge of the work the second summer, the school was bound to grow. In 1892, Mr. John D. Jones, already mentioned as among the first benefactors, was instrumental in the incorporation of an association called the Wawepax Society, and it is to this organization that the school owes its present ample quarters.

The laboratory which they built, after Dr. Conn's plans, was occupied last summer. This year they have put at the disposal of the students two comfortable buildings for dormitories. The one for ladies, which contains a dining room and reading room for the whole party, is especially pleasant. The buildings have been comfortably furnished by the Brooklyn Institute. Together with the lecture hall and Professor Conn's home, also given by the Wawepax Society, they form a picturesque group most conveniently situated with reference to each other.

Their location is delightful, for they stand on the hillside sloping to the head of Cold Spring Harbor, with wooded hills behind them and across the inlet, while in the distance stretches the Sound. New York is only thirty miles away, but the quiet of the place could hardly be more if we were in the heart of a desert.

Not only do we hear no market wagons, fog horns, trolley gongs or locomotive whistles, but not even a town clock disturbs us. The rest to tired nerves is almost equal in value to the benefit to be derived from the work; to some people it may mean quite as much.

The laboratory deserves fuller description. It is a pretty building, 72 feet long by 36 feet wide, finished exteriorly with shingles and interiorly with polished Georgia pine; a large brownstone fireplace partly fills one side of the main room. There are wide and high windows close together on every side, so that light and air are as abundant as possible.

Through the warm July days it has not been uncomfortable. Broad working tables fitted with drawers stand in range of the windows along the sides of the room in sufficient number to accommodate about forty students. There are six rooms fitted up for private laboratories for the professors and investigators.

Along the center of the main room aquaria are placed, through which fresh or sea water may be made to pass at will by turning a stopcock in the pipes above. Nothing in the life here is more entertaining than to watch that of the forms which for the time inhabit these aquaria. To-day we may find the sides of one beset by star fishes, little and big, their ambulatory feet clinging so fast that they will lose some rather than let go, if you attempt to move them. Below them hermit crabs are looking out from snail shells of varying sizes; a spider crab is dining off her own eggs, which she picks out with her long claws, while another is feasting upon a dead brother.

Scallops are popping up and down in jolly fashion, and great clumsy whelks have their broad yellow feet

spread firmly upon the side of the aquarium where they are companions in exile.

In the next one, perhaps, there is a mass of squids' eggs in long, airy looking sacs, from which, one by one, minute independent squids now begin to swim into sight. Farther on we may see botanical specimens: delicate green or red algae, and beside them in the next aquarium is a pond lily plant, root, leaves and fruit all in sight. Yesterday one aquarium was full of beautiful sponges, of which several varieties are found in the Sound. To-morrow some of these forms that we have watched with so much interest will give place to others perhaps even more curious.

These specimens are, for the most part, brought in by dredging parties who go out in the naphtha launch belonging to the laboratory. It is run by a man who knows just where to "let down the net" for everything these waters yield. The boat is swift and fairly comfortable, and the excursions upon it are among the most delightful and profitable features of the life here.

The working day begins at nine o'clock in the morning, when Prof. Fernald, of the State College, Pennsylvania, gives a lecture in the course in zoology and Prof. Conn gives one to advanced students in his course in embryology. These last an hour, and then all pass to their places at the tables in the laboratory. Each student is provided with the instruments he needs for dissection, and with a microscope, if he has not brought his own. The morning is all too short for the work that is to be done—the verification of the lectures or the study of some forms kindred to those presented by the instructors.

Let us go about the room during one of these experimental hours. We may find some students watching the development of newly fertilized eggs of oysters or squids. Here a young man is working out the nervous system of a species of worm—no easy task. We notice that a group is studying the lobster. They are at various stages of progress; one lady is making careful drawings of each of the appendages, while another is already tracing the digestive tract, and a third is finding the chain of nerve ganglia and their connections. The instructors are going about from place to place, adjusting a lens for one student, directing a cross section here, advising a better mode of procedure, helping or suggesting, as the case may be, but always attentive and unflagging in interest.

Many students are taking two courses, and in the afternoon two more lectures are given; one in the course in botany, by Prof. Johnson, of Michigan University, the other by Prof. Conn, on bacteriology. The afternoon laboratory work is largely botanical. Here is an enthusiast who has scarcely been seen since the day of his arrival without a quantity of mushrooms about him; he draws them, makes water color sketches of them, dries them, labels them, calls your attention to their beauties and peculiarities—does everything but eat them. Across the room we find several students are making slides. Their skill and success is evident if they invite you to look through their microscopes, for you find they have captured sea anemones and hydroids with tentacles spread, and the delicate forms have all the interest of a living specimen, save that they are motionless.

The students may be divided into three general classes: First, investigators who are working toward Ph.D. degrees in some college or university; second, teachers of science who have come to learn better methods, to get laboratory practice and to find out the latest opinions on unsettled questions in science; for example, whether both botanists and zoologists are still claiming volvox. The third class is composed of the youngest students, who are still undergraduates in college, or are supplementing the work which they have just completed there, preparatory to teaching or other practical science work. Most of these are from Wesleyan University.

But whatever the attainments or objects of all these students, there is no discounting the zeal and enthusiasm with which they study. The generous willingness to show what they find out so characteristic of the great scientists prevails here. Not a day passes but we see as interesting objects through other microscopes as our own.

The later parts of the day are devoted more or less to bathing, boating on the harbor or one of the ponds close by, or to rambles in the tempting woods. The wheelmen are among us, of course, and come into breakfast or dinner with cyclometer records that fill us with amazement, but which they assure us are quite within the bounds of moderation. Sometimes we have an evening of college songs, jolly, rollicking and care-dispelling as nothing else can be.

Once a week an evening lecture, semi-popular in its character, is given, and to this residents and summer dwellers or visitors at Cold Spring Harbor are invited. Prof. Conn opened the course with a suggestive lecture on "Evolution." Prof. Fernald followed with a charming account of "Three Months in the Bahamas."

This week we have had an illustrated lecture on our common wild flowers by Mr. Van Brunt, of New York. The beautiful colored photographs which he shows are his own and his wife's work, and very difficult to

make, he says, "because the flowers are so full of life and move so much." But they have succeeded in getting pictures as poetic as they are true.

Reference has already been made to Prof. Conn's course of lectures on bacteriology. His investigations in this field, which have put him among the foremost bacteriologists, are carried on at the laboratory during the summer. Some ninety colonies of bacteria are under examination, the preparation of their culture media, their sterilization and that of the utensils used about them, the daily record of growth, multiplication, etc.—all this work is carried on under Prof. Conn's direction by his students and assistants. In time these ninety colonies will be differentiated and their value or deleterious effects will be tested.

Besides this work, the cultivation of Prof. Conn's famous "Bacillus Number 41" is carried on here, and from here it is mailed to creameries far and near where it has been adopted. The fact is that the application of this bacillus to butter making is revolutionizing the business, for not only does its introduction into the cream give a superior flavor to the butter, but it also makes it keep better. Already, some Iowa creameries have made between \$20,000 and \$30,000 by its use, for the reason that whereas they were formerly not able to get their butter into the seaboard markets soon enough to command the highest price, now they do, for they can sell their product for fresh butter.

This practical outcome of investigation with the bacteria which thrive in milk can hardly fail to act as a stimulus to some students at the laboratory to persevere in their patience-taxing study, and it is not unlikely that the world may some day see important results from their work. To the students least ambitious for renown or reward of any sort there is a stimulus in the thought of Mr. Benjamin Kidd that "in our time biology has been raised from a mere record of isolated facts to a majestic story of orderly progress."

Cold Spring Harbor, L. I., July 27, 1895. A. D.

A Great Gas Holder.

The recent completion of the largest gas holder in America, in connection with the largest metal tank ever constructed, is an event in the history of the gas industry worthy of notice.

The holder in question was built by Messrs. R. D. Wood & Company, of Philadelphia, for the New York and East River Gas Company, at their works in Ravenswood, Long Island City, nearly opposite Sixty-fourth Street, New York City. It has a capacity of five million cubic feet. It is the first holder of importance built in this country with the inner lift rising above the top of the guide frame when fully inflated.

The general dimensions of the holder are as follows:

First or inner lift.....	179 ft. 0 in.	diameter by 48 ft. 6 in. deep.
Second lift.....	182 ft. 0 in.	" " 49 ft. 0 in. "
Third lift.....	184 ft. 6 in.	" " 48 ft. 6 in. "
Fourth or outer lift.....	187 ft. 0 in.	" " 49 ft. 2 in. "
Steel tank.....	190 ft. 0 in.	" " 49 ft. 6 in. "
Guide frame; 24 standards, 148 feet high;		5 tiers of latticed girders.

The tank rests upon a concrete foundation, the space under the bottom plates being filled with a cement grouting run through holes in the plates after the bottom was lowered upon the foundation.

The top of the tank shell is stiffened by a horizontal plate girder, 48 inches wide, which serves as a walk around the tank, extension plates being placed back of each standard to permit passage.

When the holder is fully inflated, the crown is over 40 feet above the top girder and is reached by means of a chain ladder kept taut by a weight on its lower end, working in guides. When the holder is filled with gas, the crown is 240 feet above the level of the ground.

The largest holder of the world is that built by Messrs. Clayton & Sons for the South Metropolitan Company, at East Greenwich, London, and which possesses the enormous capacity of 12,200,000 cubic feet. It consists of six lifts, of the following dimensions:

Inner lift.....	287 ft. 6 in.	by 31 ft. deep.
Second lift.....	290 "	" " 32 "
Third lift.....	292 " 6 "	" " 32 "
Fourth lift.....	295 "	" " 31 " 6 in. deep.
Fifth lift.....	297 " 6 "	" " 31 " 3 "
Bottom lift.....	300 "	" " 31 "

The depth of the masonry tank is 34 feet, 13 feet of which is below ground and 21 feet above.

Curves of Least Resistance.

A novel method of determining the curves of least resistance in water and air was recently employed at Newport News, and was described in the American Engineer of July by M. Moulton, S. B. The idea was to make the water and air themselves shape the model, and accordingly rectangular blocks of ice were towed in the water, and the alterations in their shape and in the pull necessary to keep them moving at a certain speed carefully noted. The method proved quite successful, and the experiments will be continued until complete data are obtained. Wax was the material used for the models moving in air, and the air currents were heated sufficiently to gradually melt the wax.