THE CASSEUIL DRAWBRIDGE.

Drawbridges were in common use in the middle ages, and even the smallest castle was provided with one. The use of them was seemingly falling into desuetude, but for some little time past the exigences of modern communications have been leading engineers to bring them to the front again. In order to render the maneuver easy, an endeavor has been made to balance the flooring in all its positions. In the bridges of the middle ages that we have just alluded to, this condition was rarely fulfilled, and, more correctly speaking, never was so absolutely.

Poncelet, the celebrated bridge builder, occupied himself with this question. In 1810, Derche, another investigator, devised a counterpoise winding around a grooved wheel in spiral form. We may mention, further, a system due to Belidor. All these bridges were of wood. Since iron has entered into the construction of bridges, the system has become developed. In 1856, a drawbridge with a compensating balance frame was established upon the Haute Marne Canal in order to allow passage to a railway. This work is known as the Marneval drawbridge. More recently, analogous drawbridges have been constructed over the Charleroi Canal, at Brussels.

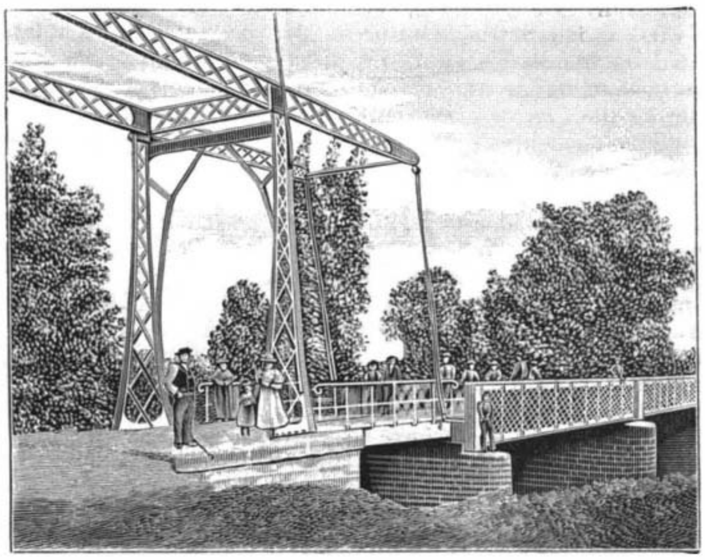


Fig. 1.—THE CASSEUIL DRAWBRIDGE CLOSED.

The drawbridge that we are about to describe is constructed over the lower arm of the Drop, a tributary of the Garonne, near Caudrot (Gironde). The Drop, through its division into two arms, forms a very fertile island, whose various portions belong to persons who do not inhabit it on account of its low position, which renders it very easily inundated. The upper arm of the river, which alone is navigable in ordinary times, flows into the Garonne through a lock that no longer operates when the water reaches a height of 15 feet above low water mark. The boats then take the lower arm, where they consequently navigate only very accidentally and at high water. Under such circumstances the bridge to be constructed would have had to be very high and would have required inclined approaches, whose cost would have taxed the fund disposable out of all proportion.

Mr. Clavel, government engineer, who has been at the head of the vicinal service of the Gironde for some years, and who, during his administration, has endowed the department with several remarkable works, thought that the economical and practical solution of the problem resided in the use of a drawbridge.

A project was drawn up in this direction which met with approval on every side. The work is now constructed and is operating to the entire satisfaction of all interested.

After this expose, and with a reproduction of two photographs that show the bridge open and closed (Figs. 1 and 2), a technical description does not appear to us to be necessary. Let us merely add that the bridge has three spans, and that it is the one of the right bank that is movable.

The boatmen themselves do the maneuvering when they wish to give passage to their vessel. Such maneuvering, however, is exceedingly easy, it being possible for one man to lift the flooring by acting upon a chain attached to the free extremity of the balance frame.

In this way the expenses of surveillance have been saved. Let us repeat that in many cases similar bridges will find a practical and economical application.—La Nature.

The Draught of Chimneys.

Some chimneys are made smaller at the top than at the base of the flue; others are larger at the top; and still others are of uniform size throughout, according to the fancy of those who designed them, writes W. H. Wakeman in Power and Transmission. Those who advocate the first, claim that it is the most natural way to build a chimney, and as the products of combustion ascend they become cooler, consequently contract, and do not need as much space as when they commenced their ascent. Advocates of the second, while they admit that the gases contract on cooling, call attention to the fact that as the chimney is higher, the friction of the contents increases rapidly, and so deem it advisable to enlarge area of the chimney or stack, as the draught is materially increased thereby. Those who are in favor of the third tell us that the contraction of the gases and other products of combustion counterbalances the friction, and so a flue of uniform size is correct. Each can show chimneys built according to their ideas which are doing good work, but it is a hard matter to show that the same draught could not be obtained with a chimney built according to another design, and until this is done the matter of which is the best must remain an open question.

THE ANNEALING OF ARMOR PLATES BY ELECTRICITY.

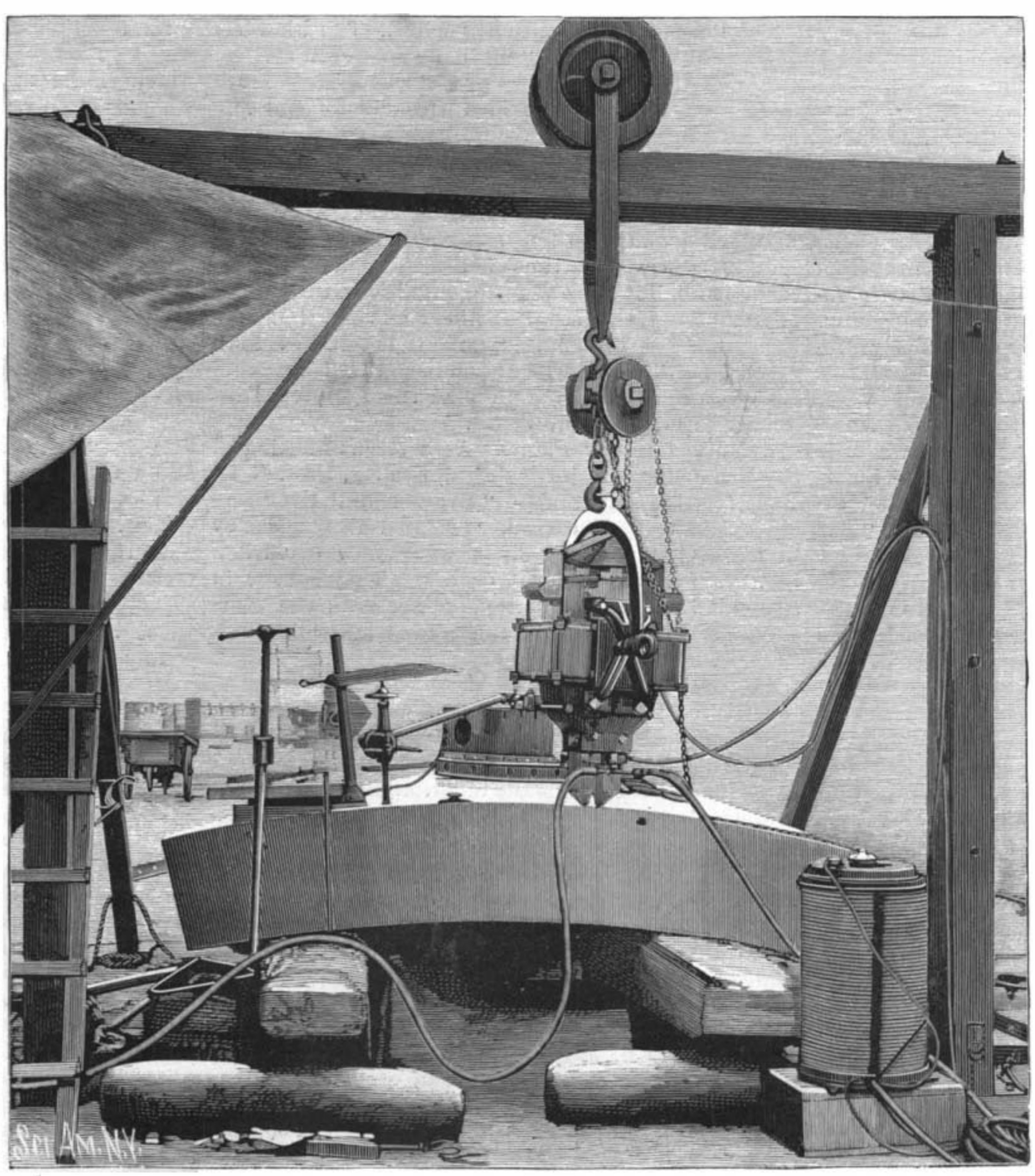
BY W. W. HANSCOM, CHIEF ELECTRICIAN, UNION IRON WORKS.

The nickel steel armor plates, as furnished the later vessels of the United States navy, are by the Harvey process hardened on the face to a depth varying from one-half inch to three-fourths inch. This face is such that it successfully resists the hardest steel drill that can be made, and as it is required in the final location of the plate to drill and tap numerous holes in it, it was necessary during the hardening process to protect the desired places by preventing the carbonizing material from coming in contact with them. The operation was not entirely successful, however, as it was found upon trial that although a number of the places were sufficiently soft to be worked, others immediately alongside were as hard as the unprotected portions. A number of attempts were made to locally anneal these hard spots by means of the oxyhydrogen blowpipe and other apparatus, the most successful being


Fig. 2.—THE DRAWBRIDGE OPEN.

that offered by the Thomson Welding Company, of Lynn, Mass. It was found impossible by all other means than electricity to apply sufficient heat in a concentrated form to attain the desired results, as the large mass of metal surrounding conveyed the heat away as fast as it was supplied. One of the electric welding company's annealing equipments has recently been installed at the Union Iron Works, San Francisco, for annealing the armor plates of the battle ship Oregon, and the following is a description of the plant and its operation:

The apparatus in general consists of an alternator, with its exciter, a regulating rheostat, a transformer annealer, and the engine for driving the same. The engine develops at 450 revolutions per minute 55 horse power. The alternator and exciter are of the well known commercial type; the former, of 40 k. w. capacity, has six coils on as many pole pieces, the windings being in two series of three in multiple. The armature is of the toothed type, with six coils, connected in a multiple of three series of two. It is wound for an output of 135 amperes at 300 volts, when making 1,000 revolutions per minute. A pulley on the end of the armature shaft drives the exciter, a D type shunt wound generator of 100 volts, at 2,000 revolutions per minute. Its terminals are connected to alternator fields through the regulating rheostat, a cylindrical frame, having German silver coils cut into or out of circuit by a contact arm on top. The coils are protected from mechanical injury by the wire gauze covering, which arrangement permits of a constant circulation of air.



THE ANNEALING OF ARMOR PLATES BY ELECTRICITY.

The transformer annealer is of the shell type, and consists of an outer core of laminated iron surrounding both primary and secondary coils, the former being wound on a form, and incased inside the latter, which is a hollow copper casting made in halves to receive it, and then bolted together, after which the remaining space is filled with oil for insulation and as an assistance in conducting away the heat generated in the primary. The secondary coil has but a single turn, U-shaped, to the ends of which are bolted various shaped copper contact pieces, which are hollowed and connected to a water circulation, thus preventing the heat of annealing from reaching the coils. The yoke from which the transformer is suspended by two trunnions, as well as the afore-mentioned contact pieces, permit of the transformer being swung into any desired angle, and brought against any part of plates already located.

In the operation of annealing, the contact pieces are brought up against the brightened surface of the plate and wedged into position, straddling the spot to be annealed, after the regular rheostat has been adjusted to a point reducing the primary current to a minimum. The distance between the contact pieces for a hole ⅞ of an inch in diameter is 1¾ inches. When the contact is established between contact pieces and the plate, a slight humming noise notifies the operator, and the primary current is gradually raised to its maximum. A bright red spot then appears under each contact piece. The intense local heat at these spots causes the plate to expand outwardly in the direction of least resistance, forming slight mounds, from which circles of a gradually changing color slowly approach the center. The primary is kept up till the plate has become sufficiently heated to char or even ignite a pine stick held against it, and is then gradually decreased, till it has again reached the minimum.

The first or heating period requires about three minutes, duing which the secondary current has reached from 3,500 to 6,000 amperes at four volts. The second or cooling period requires from ten to twelve minutes, in order to permit the sudden chilling of the spot due to the surrounding mass of metal, and to insure a perfect anneal. The plate at the spot of annealing presents a dark blue color, elliptical in shape, with a major axis of 4 inches and a minor axis of 2½ inches, and is very readily drilled and tapped.

The cut shows the annealer at work on a 17 inch plate for the Oregon's 13 inch barbette. A portable drill press driven by a direct current motor is shown in the background, ready to drill the holes as fast as the plate is annealed. The regulating rheostat is shown in the lower right hand corner. Four wires are led from alternator and exciter to a convenient spot, and connected to annealer and regulating rheostat through a flexible four-wire cable.

In conclusion, the writer wishes to tender his thanks to Mr. W. S. Garton, of the Thomson Welding Company, for information in regard to the apparatus, and also to Mr. Ratto, photographer of the Union Iron Works, for the photograph herewith presented.—Pacific Electrician.

Natural History Notes.

Singular Case of Commensalism.—A singular case of commensalism, says the Revue Encyclopedique, has just been made known by Mr. Gadeau de Kerville. It concerns the young of the marine fishes called false mackerel, which are almost always found in company with the large medusæ known as rhizostomes. These young fishes swim parallel with the long axis of the jelly fish and in the same direction as the latter. They remain above, beneath, and behind the animal, but never advance beyond its umbel. It frequently happens that some of them introduce themselves into the cavities of the jelly fish, and are then visible from the exterior, owing to the transparency of the host. Sometimes the school of fishes wanders a few yards away from the medusa, but, at the least alarm, immediately returns with great rapidity to occupy its former position. It is evident that the medusa very efficaciously protects the young fishes by means of its innumerable stinging capsules. This is demonstrated by the fact that when the fishes become larger they no longer protect themselves by accompanying the medusæ.

Preserving Sea Weeds.—The following recipe is recommended by Dr. J. P. Lotsy for preserving examples of Florideæ for microscopic examination: "The specimen is first laid in a 1 per cent solution of chrome alum in sea water and kept there for a period varying from one to twenty-four hours, according to the size and texture of the species. The chrome alum is then completely washed out and the specimen placed in a mixture of 5 ccm. of 96 per cent alcohol in 100 ccm. of water and vigorously stirred. The amount of alcohol is then increased by increments of 5 ccm. every quarter of an hour until it amounts to 50 ccm. The specimen is then removed and placed in a mixture of 25 per cent alcohol in distilled water, and the quantity of alcohol again increased in the same way, till it amounts to 50 ccm. alcohol to 100 ccm. of water. The same process is again repeated with 50, 60, 70, 80, and 90 per cent solutions of alcohol in distilled water; the specimen being finally preserved in the last."

Resistance of Vertebrates to Thirst.—The camel is the animal that is oftenest mentioned as an example of one in which thirst is the longest endured. But Mr. S. M. Gorman, of Cambridge, Mass., writes to Nature that more striking cases of prolonged endurance are found in a number of small rodents that inhabit the arid plains in the vicinity of the Rocky Mountains. These animals live for weeks and months without meeting with a single drop of water. The sand is torrid, the entire vegetation is burned up, and yet they resist. This is not the result of observation solely, for direct experiment has been made. Some common mice were put apart on the first of last October in cages in which they received nothing but perfectly dry food, such as Indian corn and grass seeds. On the seventeenth of January they were in perfect health and seemed as if they would continue thus for a long time, although they had not received a single drop of water or of any other liquid in the interim.

Activity of Animals.—In a recent number of Science Mr. Stewart gives the results of some interesting experiments upon the activity of animals that were made upon rats, mice, and squirrels inclosed in circular cages so arranged that every motion of the occupant caused the cage to revolve. An automatic apparatus permitted of registering the motions of the cage and of consequently ascertaining the periods of rest and activity of the animals. Rats and mice divide their time into twelve hours of rest and twelve of intermittent work during the night. During the period of work, the intervals of activity rarely exceed one hour, and are separated by intervals of rest of a nearly equal duration. In winter the squirrel works almost continuously from twenty minutes to two hours in the morning, and sometimes a little in the evening also, but during the balance of the time it remains at rest.

The food has a marked influence upon the daily activity. As a general thing, the richer this is in protein, the greater is the activity. Fatty substances have a contrary effect. They reduce the activity of mice from six to eight hours to a few minutes of work a day. In order to ascertain the influence of alcohol there was given to four rats fed upon dry grain some of this liquid at proofs varying from 5 to 60 per cent, instead of water. This treatment, kept up for fifty days, showed no uniform effect of the alcohol.

All the animals experimented with did more work when the barometric pressure was high.

Animals in Sterilized Air.—By keeping animals in a specially devised apparatus designed to supply them with air in an absolutely sterilized condition and also feeding them with food as far as possible free from bacteria, Dr. J. Kijanozin, of the University of Kieff, has been able to ascertain that there was a remarkable decrease in their assimilation of nitrogenous matter. The reason suggested is that micro-organisms, when present, aid in the decomposition and peptonizing of the nitrogenous matter in the intestine, and it is thought that were the removal of all the micro-organisms from the intestine possible, the decrease in the assimilation of nitrogen would be still greater. The animals also lost weight more quickly than under normal conditions, and excreted more nitrogen and carbon dioxide. In a number of cases the animals died a few minutes, hours or days after the beginning of the experiment, and as yet it has not been possible to assign any cause for this result.

The Poison of the Ornithorhynchus.—The hind feet of the ornithorhynchus, "the mole with webbed feet and the bill of a duck" that puzzed zoologists so much for a long time, are provided with a solid spur connected with a gland. Have we here a poison gland? From some apparently trustworthy accounts that have reached him, Mr. Stewart thinks we have. This gland is at least venomous at a certain season. A dog was wounded by one of these spurs three times, and the symptoms the first time were those of pain and somnolence, but there were no convulsions, titubations or trembling. Upon the two other occasions, the symptoms were less pronounced, and even null, thus indicating habituation. The poison has proved mortal to the dog in four cases, but in man the symptoms disappear without causing death.

Evolution among Plants.—At a recent meeting of the Massachusetts Horticultural Society, Prof. L. H. Bailey read a paper upon "Experimental Evolution among Plants." The speaker prefaced his remarks by saying that all thoughtful persons are now evolutionists, whether they know it or not. They believe in some kind of a transformation of species in the same way that they believe in the gradual unfolding and growth of human institutions.

Prof. Bailey then proceeded to consider the question: Do new species originate now? The notion that a species, to be such, must have originated in Nature's garden and not in man's has been left over to us from the last generation—it is the inheritance of an acquired character. Ray appears to have been the first to use the word species in its technical natural history sense, and the matter of origin was an important factor in his conception of what a species is. Linnæus said: "We reckon as many species as there were forms created in the beginning." Darwin elaborated the new conception that a species is simply a congregation of individuals that are more like each other than they are like any other congregation, and declared that one new variety raised by man will be a more important and interesting subject for study than any more species added to the infinitude of already recorded ones. The old naturalists threw the origin of species back beyond known causes, while Darwin endeavored to discover their origin; and it is significant that he set out without giving any definition of what a species is. It is important, when we demand that a new species be created as a proof of evolution, that we are ourselves open to conviction that the thing can be done. The fact is that the practice of systematic or descriptive botany is at variance with the teachings of evolution. Every naturalist now knows that Nature does not set out to make species. She makes a multitude of forms which we, merely for purposes of existing methods of botanical description and nomenclature, call species.

The speaker then proceeded to show that there has been as wide a variation in very many garden plants as there is between accepted botanical species of the same genus.

Species making forever enforces the idea of the distinctness and immutability of organic forms, but study of organisms themselves forever enforces an opposite conception. The intermediate and variable forms are perplexities to one who attempts to describe species as so many entities which have distinct and personal attributes. So the garden has always been the bugbear of the botanist. Even the lamented Asa Gray declared that the modern garden roses are "too much mixed by crossing and changed by variation to be subjects of botanical study." He meant to say that the roses are too much modified to allow of species making. The despair of systematic botanists is the proof of evolution.

If species are not original entities in nature, then it is useless to quarrel over the origination of them by experiment. All we want to know, as a proof of evolution, is whether plants and animals can become profoundly modified under different conditions, and if these modifications tend to persist. Everyone interested knows, as a matter of common observation and practice, that this is true of plants. He knows that varieties with the most marked features are passing before him like a moving panorama. He knows that nearly every plant which has been long cultivated has become so profoundly and irrevocably modified that people are disputing as to what wild species it came from. Consider that we cannot certainly identify the original species of the apple, peach, plum, cherry, orange, lemon, wine grape, sweet potato, Indian corn, melon, bean, pumpkin, wheat, chrysanthemum, and nearly or quite a hundred other common cultivated plants. It is immaterial whether they are called species or varieties. They are new forms. Here is the experiment to prove that evolution is true, worked out upon a scale and with a definiteness of detail which the boldest experimenter could not hope to attain were he to live a thousand years. The horticulturist is the only man in the world whose distinct business and profession is evolution. He of all other men has the experimental proof that species come and go.

Formation of Secretions in Plants.—Dr. A. Tschirch announces, in the Botanisches Centralblatt, the remarkable discovery that in all normal cases which he has been able to examine the formation of a secretion it is a function, not of the protoplasm, but of the cell wall. In schizogenous passages the secreting cells which clothe the canal contain a resinogenous layer, which is often vacuolar; in schizo-lysigenous cavities the secretion is formed in peculiar caps of cell wall belonging to the cells which inclose the space. In the oil glands of the Labiatæ, Compositæ, etc., it is produced entirely in a subcuticular layer of the cell wall, and this is the case also with the papillæ which project into the intercellular spaces of the rhizome and base of the leaves in Aspidium filix-mas, and in many, if not all, extra-floral nectaries, the secretion lifting the cuticle off from the palisade-like secreting tissue. In all stigmas examined by the author, the secretion is formed in the subcuticular mucilaginous layer of the papillæ, into which the pollen tube makes its way. Similar observations were made on the oil of oil glands and on the resin which is formed in the duramen of trunks. But, although the secretions are formed in the cell wall, they are never produced by metamorphosis of the substance of the cellulose itself. Dr. Tschirch ascribes to all resins a uniformity in chemical composition, regarding them as compounds of aromatic acids with a peculiar group of alcohols which he calls resinols.

Tests of the Maxim Gun.

The light weight, rapid fire Maxim gun, though not new, has been greatly improved of late and in its present form was given a comprehensive series of tests at Sandy Hook on June 8. The gun weighs, packed in its case together with all its extra parts and mechanism, only 45 pounds, and is easily carried on a soldier's back. When in use it stands upon a tripod. The cartridge contains 28 grains of smokeless powder and a ball of 0·302 caliber, and a rate of from 600 to 770 shots a minute is claimed at 3,200 yards effective range. A range of only 500 yards was selected for the test. The gun was taken from a man's back, assembled and fired in 58 seconds. About 500 shots a minute were fired and no attempt was made to greatly exceed this rate. In the breakdown test an essential part of the mechanism, supposed to have been broken by a shot, was taken out and replaced by a new one in 26⅗ seconds. The barrel was changed in 1 minute and 12⅖ seconds.