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Strains on Material.

There are infinite varieties of strains, but all are reducible to, or compounded of, five classes :—

First, The tensile strain, or fair pull, that to which ropes are commonly exposed. This is that to which most material can oppose the greatest resistance.

Second, The shearing strain, that to which pins in machinery, or constructions of any kind, are generally exposed. Although very much affected by the kind of shearing edge, and the manner in which the object is held, the resistance of most materials at common temperatures is, in round numbers, generally assumed to be equal to the tensile strain.—Thus, for example, if a pin in a joint must be sheared off in three places to allow the joint to separate, we assume the resistance of said pin to be equal to three times that which would rend it asunder, by a fair pull in the direction of its axis.

Third, The crushing strain, or that to which stone or brick are generally subjected in buildings. The same strain, much modified by the length, however, is that which is resisted by piles, pillars, struts, stanchions, and the like. The strength of most materials to resist a crushing strain is greater than its tensile strain when the object is of little length, but far less when it becomes much lengthened, as in the long and slender connecting rods of steam engines.

Fourth, May be ranked the twisting or torsional strain. It is that to which, more than any other, the shafts of mills and geared work are exposed.

The fifth, and last in our series, is the transverse or cross strain—that to which we always subject material when we intend to break it, this fact of itself being sufficiently indicative that the material opposes less resistance thereto. This is the strain on girders generally, on levers of all kinds, on the arms of wheels and pulleys in machinery, on the axles of carriages and cars, on the brest-summers or girders of bridges, and on the rafters and floor timbers of buildings, etc.

The ability to resist the tensile strain depends entirely on the area of the cross-section, whatever may be its form. A square, flat, or round bar of wrought iron one square inch in section, will bear a strain of from 50,000 to 90,000 pounds, and in that proportion for any other size, without regard to form. But it must be remembered that this calculation refers to sound iron alone, and that very large rods are liable—in fact are almost certain, to be imperfectly welded. Cast steel bears more; in some cases as high as 125,000 lbs. per square inch. Cast iron bears less, ranging from 8,000 to 40,000 lbs.

In resisting crushing strains, the form is important. A hollow pipe is far stronger to resist this strain than a solid pillar of the same weight, partly on account of the superior soundness of the metal, but partly also on account of the advantage this distribution of the metal affords in resisting the tendency to bend. Pillars or props of any considerable length almost invariably bend to one side before crushing or splitting; and in such cases the material, in fact, becomes exposed to a transverse strain—the fifth in our series. The torsional strain is best resisted by a tubular form; but, for convenience in manufacturing, shafts of all kinds, except large cast iron ones, are usually made round and solid. Nothing is gained by squaring, or adopting any other form except the hollow.

The transverse strain has been very carefully experimented on by ancient and modern philosophers, both on a small and a large scale. Gallileo first established the grand and fundamental theorem—the only point of importance which can be noticed here—that the strength of a beam, or other mass of material exposed to this strain, is as the square of the depth. A timber, for example, will resist a load in proportion to its width multiplied by the square of its depth, and divided by its length. It is, on this account, advisable to make every part exposed to this strain as deep as possible in the direction of the strain. For this purpose floor timbers, the beams of steam engines, the girders of bridges, and generally all large pieces exposed to this strain alone, are made comparatively narrow and deep. But there is a limit beyond which this form cannot be carried to advantage. Thus, for example, timbers may be made so very deep and thin as to bend to one side, or twist, when exposed to a load; and, in fact, generally large warehouses and the like, are made with the floor timbers somewhat too thin and deep to stand well alone; but by stiffening with light strips extending diagonally across from one to another, they are compelled each to support the other, and thus they resist this tendency very efficiently, and the floor as a whole is an example of the greatest strength practically obtainable with the quantity of material employed.

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Strength and Temperature.

The strength of different materials differs very greatly, not only in regard to absolute cohesion, but also in ability to resist different *kinds* of strains. When quite juvenile, we were once thrown upon quite intimate terms with a very distinguished civil engineer, and were much struck with his answer to an inquiry as to what was "the most important point to be attained in preparing for the profession?" The answer was simply "a knowledge of materials." The strength of some materials is affected very greatly by temperature. Copper, for example, grows weaker with every elevation of temperature above the coldest ever yet tried, while iron grows stronger by warming up to a certain point, a change which, by the way, as is much to be regretted, has never been attended to in the long and careful experiments on this material made at the expense of our government a few years since. Common consent, based on imperfect experiments made many years ago, has assumed the maximum strength of most varieties of iron at about 500° Fah. but some recent experiments by Fairbairn—Wm. Fairbairn, Manchester, Eng.,—indicate a point much lower, or somewhere between 200° and 300° Fah. At all events, it is well established that this metal loses much of its strength—probably at least one-third—by intense cold. In almost every material a low temperature adds to its rigidity and liability to break by sudden impact, if it does not detract from its cohesive strength.

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Galvanized Iron.

Last week we described Morehead's process of coating iron with zinc, and it is generally allowed to be an excellent method. Iron, however, may also be covered with zinc by other modes of treatment; but it is necessary, in every case, to clean its surface first by acids and scrubbing with sand, to remove all scale and oxyd, or the zinc will not adhere to it. A very common zincing process is to dip the cleaned iron first into a solution of sal-ammoniac, then into the bath of molten zinc, the surface of which is covered with a thin stratum of powdered sal-ammoniac. The plate or sheet of iron may be held by each end with a pair of tongs, dipped vertically and slowly into the molten zinc, held in it for a few moments, and then lifted out. If held in the molten zinc too long, the iron becomes very brittle. This is the method in most common use for zincing iron chains and small articles; these may be kept in the molten zinc bath much longer than thin sheet iron. This process is public property.

The strength of the dilute sulphuric acid for removing the oxyd and scale must be proportioned to the articles to be treated. Sheet iron requires a weak liquor; chains for pumps and other strong iron articles, may be immersed in a strong liquor, made with a gill of the acid added to five gallons of water. The articles when taken out of the acid are always scrubbed in warm water with sand or emery.

In France, a bath of hydrochloride of zinc is frequently employed as a substitute for the sal-ammoniac preparatory pickle. It is made by dissolving zinc in muriatic acid, and is used at a strength of 17°. We do not believe it is superior to sal-ammoniac; one pound of which, dissolved in five gallons of water, makes a good liquor, which must be frequently renewed while being used.

Pure zinc must be used in these operations or the process will prove very troublesome and often fail. The zinc of commerce is often adulterated with arsenic and lead.

It has been frequently proposed to zinc or galvanize iron by the electrotype method in some form; but this—the real galvanizing process—although it is the best for the iron, is too tedious and expensive to be employed for coating common or large articles. It is, therefore, not in use anywhere, so far as we know. The zincing of iron by the two hot processes we have described, is now pretty generally practiced in Europe and in our own country; in fact, it is fast becoming a great business among us. In this city, we have been told, that 2,000 tuns of iron are zinced per annum; in Philadelphia, 800 tuns, and in Boston and some other cities in the same proportions.

We might describe some other methods of galvanizing iron, but we have given those believed to be the best and most simple. The information imparted will enable any person to coat iron articles with zinc, if he has only an iron kettle for melting the metal, and a wooden tub for scouring his articles and containing the preparatory solution.

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Artesian Well Water.

We have spent the most of a day among the deep-tubed wells of this city, and now wish to give our readers the benefit of the results for application in other localities. The water is not uniformly good, as we were led to suppose, when after a visit to one alone we wrote the article of March 7.

To aid those of our readers who are not conversant with the position of New York city, we may remark that it stands on an island called Manhattan, a moderately elevated strip of land twelve miles long and two miles wide. It is situated at the mouth of the Hudson, called here the North river, and separated from Long Island by a narrow strait termed the East river. In the channels of both the North and East rivers, the tides rush in and out with considerable force, and the fresh water of the Hudson is so extensively commingled with that from the sea, that except in great freshets, when the torrent from the country temporarily drives out the sea, the water on both sides of the island may be considered ordinary salt water. Wells sunk to a little depth yield plenty of hard, unpalatable water, which is little used since the completion of a magnificent aqueduct forty miles long, which, by a gradual descent, brings in the water of the Croton river, and distributes it to all portions of the city.

The International Hotel (Taylor's) stands nearly midway between the North and East rivers, and the tight tube (some twenty inches in diameter, driven down some seventy-five feet below the surface springs.) brings up water which, judging from a fairer sample than before, would, in the absence of the Croton, be tolerable water for the table, but it is a little salt and limy, and is consequently not used at all for any purpose. The well is a complete failure for hotel purposes, as it is deemed inexpedient to attempt to lay and keep in order two sets of pipes for conveying water over such a structure. We should have distinctly stated in our former notice that the well water is not used.

Tatham & Brother, in Beekman street, near the East river, sunk a tube 120 feet, found an inadequate supply of brackish water, and abandoned the tube, allowing it to fill up, and dug another well three feet in diameter around the first to a depth of only 45 feet, which gives them plenty of common well water. They use it only for condensing steam.

Ockerhausen & Co., sugar refiners, sunk a tube 100 feet, with a large well around it 45 feet deep, and draw the water from both mixed together. This mixture is no criterion, of course, but we may remark that it is decidedly bad.

Kattenhorn, Brunjes & Co., sugar refiners, near North river, sunk a twenty inch tube 99 feet, and obtained fresh muddy water first day, but did not taste it very carefully, and could get nothing but almost pure salt water from it since. Have filled it up, and dug a large well around it 25 feet deep, which yields ordinary well water in liberal quantities.

Havemeyer & Moller, sugar refiners in Vandam street, who have been announced as pumping 350 gallons per minute from an artesian well, never had such, but pump all their water for condensing from a large surface well.

John Harrison, brewer, Sullivan street, has a very successful example, about 120 feet deep. Yields from 75 to 150 gallons per minute of good water, which is used for beer and for all purposes. Used in the boilers, it produces no sensible incrustation, and deposits less mud than even the pure Croton.

Whether, as we have heretofore supposed, the surface water becomes in this case greatly purified by filtering down through an increased depth of earth, or whether this tube chances to penetrate a channel connecting with a distant and superior spring we are unwilling to decide; but the fact that the sugar refinery of R. L. & A. Stuart, (another place we visited,) is supplied with an extremely liberal quantity of equally good water from two large surface wells, argues in favor of the latter supposition. Mr. A. Stuart, who very courteously showed us about the premises, feels assured that the good water of both is due to a chance communication with springs in the upper portion of the island.

The well on Duane street, (late Howell & Co.'s sugar refinery,) has exemplified two evils which it may be important to avoid in other localities. The well was successful until by pumping too fast—before the water had washed out suitable minute channels for its conduction—the influx started up the earth and excavated a cavity. On driving the tube down farther to avoid this, it is supposed to have been planted so tightly on the ledge of rock which underlies the whole city, and which chanced to be flat and dense at that point, that the supply has since been too feeble to be of importance.

In nearly all the cases referred to, the wells are dug in the cellar of the building, and the surface of the water when at rest rises nearly to the level of the cellar floor—in one case within about fifteen inches. In another instance, where the engineer, backed up by a plumber of experience, insisted that the water surface was forty feet below the pump, and that in opposition to all theory the water was successfully raised that hight by the vacuum; we sounded with a tape, and found the actual depth of the surface to be nine feet.

It appears from all these examples that the chances of obtaining good water from such wells in quicksands below the level of neighboring salt water, although sufficient to induce the attempt in cases where success would be a very great desideratum, are not by any means as certain as we had before intimated. We give these facts as they stand. This is the best answer we can make to numerous inquiries and suggestions in relation to the subject. We have neither the data nor the leisure to make up an elaborate article on the subject. We believe that *generally* the earth, however near the sea, may be assumed to be saturated with fresh water to an indefinite depth, and that the accessions of rain on the surface, by filtering down and displacing it, creates a slight current, flowing through the interstices from the land into the sea. When a deep well penetrates below the sea level, it attracts to itself this insterticial current, and if the sand is tolerably uniform, like that of a great part of Long Island, the drainage thus effected may be estimated with some certainty as extending to a certain measurable distance, and with given effect in all directions. But, on the contrary, if the earth is partially composed of firm layers, which can retain and guide the water, it may be conducted from an immense distance entirely independent of any filtration from the surface. This is the case at Grenelle, near Paris, where the water spontaneously rising through a tube sunk to a depth of eighteen hundred feet below the surface, is by every indication identical with that of lakes situated two hundred miles distant. On this island the source of the water obtainable from wells