per ends of these racks are attached suspender rods 1¾ inches in diameter; and to those are secured steel ropes ¾ of an inch in diameter, which pass over pulleys placed on the top chords. These pulleys are 42 inches in diameter, and are mounted on 3 inch shafts. To the inner ends of the ropes are attached long buckets which carry weights nearly sufficient to balance the floor, which is a plate girder system. The valve is an ordinary D valve, and the valve rod is so connected that it can be shifted from the ground. The inlet is connected with the city water mains, and although the pipe is throttled—the authorities being fearful of an excessive use of water to lift the bridge—the bridge can be raised in 15 seconds. A shoulder on the suspender rod rests on the lower chord of the overhead truss; this rod carries the dead load, the rope running over the sheaves carrying the live load. When the floor is down, its ends rest upon stone abutments.

Water being admitted to the cylinder, the piston is moved, the water pressure being amply sufficient to lift the unbalanced weight of the floor. The racks upon the ends of the piston rod, engaging with the upper side of one pinion, and the lower side of the other, move the pinions in opposite directions. The pinions upon the longitudinal shafts move all the vertical racks up, since the racks are so placed that the teeth of those in one row face those in the other. The arrangement of these parts is plainly shown in the sectional view. Thus the bridge is raised, the motion being regular and easy, the counter weights descending at the same time. To lower the bridge the water is turned off, and the valve shifted so as to allow the water in the cylinder to gradually escape, the extra weight of the floor being just enough to easily accomplish the descent. Each raising only requires a quantity of water equal to the capacity of the cylinder.

The machinery has been in operation for some time and has been found reliable in every instance, showing no wear and costing but little for attendance. It was manufactured at the Delamater Iron Works, this city.

New Oil Works on the Pacific.

To supply the western markets, the Pacific Steam Whaling Company has erected the Arctic Oil Works at Potrero, California, on a scale which renders them the finest works of the kind in the United States. *Engineering* says: The structure is of Ransome artificial stone. The main building is 150 ft. long, 40 feet wide, and three stories in height, with three wings, two 26 ft. by 26 ft., and two stories high, and the third 26 ft. by 16 ft. The great size of the building and the massive style of arcitecture give it an imposing although somewhat gloomy appearance. Besides the structure already mentioned there is a coopers' shop 24 ft. by 30 ft., two stories high, and sheds 155 ft. by 60 ft. for storing full casks. On the premises there are six enormous tanks, each with a capacity of 64,000 gallons, into which the crude oil will be discharged from the whalers. The process of refining is an elaborate one, and requires considerable time and skill. From the storage tanks the oil is carried through pipes to the main building, where it is run into tanks of 100 barrels capacity, and boiled; from there it is drawn so into pits—of which there are eight—each of 100 barrels capacity, where it is frozen by ice. When sperm oil is being treated, after freezing it is placed in bags and put under hydraulic presses, where it is subjected to great pressure. The first running from the press is called winter oil. The stearine or spermaceti remaining in the bags is again pressed, but the temperature is raised to 50 deg. The oil from this second pressing is called spring oil. The residue still remaining in the bags goes through a refining process, and is then taken to a hot room, at 85 deg., where it is again pressed. After this it is again refined and produces the spermaceti of commerce, or is ready to be manufactured into candles. The oil, as it comes from the presses, is put into vats under the roof, which is of glass, where it receives a sun bath, and is ready for the barrel and the market, under the name of natural winter and spring oil, as the case may be. Or else it is run into large bleaching tanks before being sunned, and then is marketed as winter or spring bleached oil. The manipulation of whale and fish oil differs in some respect from the treatment of sperm, but the process is in the main similar. The capacity of the new works is 150 barrels of refined oil per day, and this output can, with little expense, be increased to 250 barrels per day. The contractor for the building was Mr. Ernest L. Ransome, who furnished all the stonework, foundations, wall, etc.; Mr. S. H. Kent was the contractor for the woodwork; the Union Iron Works built the machinery, and Mr. D. E. Melliss was the constructing engineer; the whole being under the superintendence of the future manager, Mr. F. A. Booth, of New Bedford.

A Wild Cat Cannon Shot.

The New York, West Shore, and Buffalo Railway is equipped for eleven miles near West Point with electric block signals. Great precautions and large expense were incurred in order to pass West Point without interfering with the facilities for artillery practice, which was so far accomplished that nothing but a wild shot can touch the track or a train upon the track. A wild shot was fired, however, a few days since, and a 400 pound shot struck one of the 67 pound rails. The long angle fish plates broke, and the rail was forced out in the middle into a U form. Danger signals were immediately set in both directions by electric apparatus, which, if a train had been approaching within a little distance, would doubtless have prevented a serious accident.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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NEW YORK, SATURDAY, JULY 12, 1884.

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 445,

For the Week ending July 12, 1884.

Price 10 cents. For sale by all newsdealers.

CONTRACTION OF STEEL.

The hardening of cast steel, of the usual grades employed for tool purposes, generally contracts it. This quality in cast steel is frequently employed to reduce to exact size articles that must be hardened for their purpose. A machinist recently stated a rather unusual experience, that of rehardening six times a plug gauge in order to reduce it to size. At each hardening the steel was subjected to a close measurement test, and the successive contractions could be measured until the oversized gauge had been reduced to a size that required only the ordinary after-polishing. This quality of cast steel (contraction in hardening) is one that is generally accepted as belonging to the metal; but there are instances where expansion rather than contraction is to be expected from repeated heatings, hardenings, and annealings. So much difference, which is almost diametrical, is due largely, if not mainly, to the difference in the steel itself rather than to uneven heating and hardening.

Half of the published notices of the management of steel, whether common or unique, are given without the proper elements on which to form an opinion as to the behavior of steel under heat and in the bath. If workers of steel—cast steel, tool steel—would record their failure experiments as well as their successful experiments, we should sooner arrive at some reasonable way of treating steel, and the manufacturers would believe that the casting of steel was different from the casting of iron, and that its after-working required care enough to insure even and general results. But as it is, the steel market, as to quality of material, is about as unlucky and unreliable a test of the value of goods received as is the stock market. Not only every brand of steel must be judged by its own test, but almost every separate bar must be worked without reference to other bars from the same lot. Instances are not wanting in which steel from the same invoice behaved in ways exactly opposite in this matter of contraction by hardening. A recent case showed a plug tap and a reamer made from the same bar, both of which expanded in hardening. It was supposed that the interior of the bar might have been porous, but on breaking the tap and reamer, the steel appeared to be sound clear through. In this instance even heating and uniform hardening was to be presumed, as the specimens of this queer behavior were from a large lot of similar tools passing through the various processes in the same batch.

CUTTING LEADING SCREWS.

Under the head "Curiosities of Screw Cutting," in THE SCIENTIFIC AMERICAN of June 21, 1884, were two examples of defective leading screws for lathes, showing how they varied in aggregate number of threads in the total length, sufficiently, by cumulative errors in reproduction, to change the radical pitch of the thread. Errors of this nature are so common that a fractional thread has been reproduced from a leading screw that came from one believed to be of a regular pitch, and this in only three removes. But there was no allusion in that article to another serious error in the leading lathe screws and the elevating planer head screws, as they are usually produced on the lathe. This error is that of a defective thread, known to machinists, when largely developed, as a "drunken thread." A thread of this character is not a true spiral or helix, but twines about its core on a varying incline, sometimes—for a part of its revolution—moving at right angles to the core of the screw instead of on the incline demanded by the determined pitch of the thread.

On such a drunken thread a nut will not present a face perpendicular to the screw in all parts of its revolution, but at one point its face, if extended by a line across it, would show a dip below the horizontal, and at another point would show a projection above the horizontal. A "set-up" nut on such a screw must spring the bolt into line with its face, or strip the thread. Of course, such work is unmechanical and imperfect.

This sort of variation from truth in leading screws is probably very common, although not frequently noticed; recent exact tests have shown it to be a fault more general than that of unequal total length of thread to accord with the pitch. Its cause is largely the result of lack of homogeneousness in the material of the screw, while that of the defective length of thread, or number of threads, may be due, to a considerable extent, to varying temperature of the screw in the process of cutting.

A portion of "the reason why" is probably the yielding character of the lathe on which the work is performed. The tool carriage of the ordinary screw cutting lathe is anything but firm and solid. It is composed of two large pieces, one to slide on the ways of the lathe bed, and the other to slide transversely on it, while the tool post is another element of unstableness. Added to this rattletrap construction is the fact that the propelling force of the tool carriage, the screw, is situated usually at one end of the carriage and below it, compelling the overcoming of a vertical and a horizontal leverage combined. This improper construction is so unmechanical that it has been rejected in the building of so crude a machine as the steam engine (crude in its results as compared with those demanded from the lathe), and engines now must have the piston rod, the pitman, and center of crank shaft in line. Such simple principles should govern the construction of the screw cutting lathe; the propelling screw should be as nearly in a line, horizontally and vertically, with the tool carriage as is possible in construction, so that there shall be no invitation to "give" at a hard place in the work, and no possibility of "winking" of the tool. As the screw cutting lathe is made now, it is a lathe of convenience, and is as well adapted to turning, drilling, and boring as to screw cutting. This should be abandoned for the method of building screw cutting lathes for that purpose alone. As they are now generally built, they are scarcely more accurate in the reproduction of threads than the old-fashioned hand lathe and the hand chaser.

A move has been made in the right direction for improvement in this department of mechanics in the construction of a lathe that avoids the faults of the ordinary screw cutting lathe and combines the requirements for an exact tool. The principle appears to be correct, and future improvements will probably be confined to those of details.

Instruction of Deaf Mutes.

A convention for considering methods of teaching articulation to the deaf was held in New York, June 25 to 28. More than 200 delegates were present, representing 38 schools. There were in the United States at the last census about 35,000 deaf mutes; there are 58 schools for their instruction, and 7,000 are being educated at public expense. The leading systems of instruction are the French method of signs and the German one of teaching speech and lip reading. The York institution was the first here to introduce the oral method as practiced in Germany, and thirteen schools have been recently established in which this method prevails, while nearly all the old schools now have special classes in articulation and lip reading.

Prof. A. Graham Bell presided at the convention, and Principal Greenberger of the New York Institution, gave an exhibition of reading spoken words from the lips with a class of a dozen boys and girls. The pupils were able to understand all words spoken to them, and even to repeat them. Dr. Gallaudet, President of the National Deaf Mute College in Washington, D. C., said oral instruction had been carried on there for five or six years. One pupil, who came to that institution six years ago, had no speech whatever, and they were obliged to teach him the simplest elements. At the end of four years and a half he spoke very well, and read from the lips of his friends, and even of strangers. One and a half years ago it was ascertained that he possessed a degree of hearing that it was decided to experiment with. He then heard loud noises, but knew nothing of articulate sounds. His teacher made use of the speaking tube and very little use of the audiphone. Through their means the boy began to recognize articulate sounds, and his hearing developed until, within the last few months, he had been able to undersand conversation through a tube such as is used by persons who are not considered very deaf.

Such cases give encouragement to the belief that many who have heretofore been considered incurably deaf may yet have the dormant power, under proper treatment, of recovering sufficient hearing faculty to be practically useful. Prof. Clark of the Washington Heights Institution, N. Y., said that experiments made there showed that less than 25 per cent of the pupils were totally deaf, and of these a large majority were those who had lost their hearing by disease.

The convention was one of the most interesting in its proceedings as well as one of the largest ever held, and it is hoped that it will have good results in promoting the establishment of a training school for teachers of the deaf, with a curriculum to include the anatomy and physiology of the organs of speech and hearing; vocal gymnastics, speech reading, the elementary laws of sound, the methods of testing and developing latent hearing, English orthography and orthoepy in their special relations to the deaf, and the art of imparting a knowledge of articulate speech to the deaf and semi-deaf.

A Flame of Gas Eighty Feet High.

A measurement of the flame from the new gas well on the Westinghouse property has been made, and it is found to be eighty feet in height. It varies, however, with the condition of the atmosphere. The gas escapes from a six inch pipe seventy-five feet high, so that the top of the jet when the engineer brought his instrument to bear on it was 155 feet from the surface. A still, clear night makes every difference in the volume of the blaze.

The successful finding of gas at Pittsburg has stimulated other establishments to try and supply themselves with this valuable fuel. Two firms have already begun the drilling of wells, and four others will begin operations in a day or two.

At the Pennsylvania Tube Works the use of coal has been discontinued altogether. The workmen find the new fuel superior in its application to the manufacture of wrought iron tubes, and the cost is about half the old expense for coal and coke.

The Thermometer as a Pressure Gauge.

In view of the occasional unreliability of steam pressure gauges for boilers, Sig. G. Clodig proposes to use thermometers to replace or accompany them, in order that the record of temperature may serve as a check upon the record of pressure. The thermometer for this purpose would have a reservoir of iron for the mercury, which would be conveniently inserted through the boiler shell, so as to be in contact with the water. The tube, so far as it is contained in the boiler, would also be of iron, while its indicating prolongation outside would be of glass. The temperature of the water, by the usual law, would indicate the pressure of the vapor.

Foundations in Quicksand.

Mr. T. P. Hosegood, of the College of Practical Engineering, London, writes as follows to *Engineering:* Mr. MacAlpine, the eminent American civil engineer, when last in this country addressed the pupils of this college in explanation of some of the expedients adopted by him in his prolonged and extensive practice. One of these was a mode employed at Albany in the preparation of the foundation for the capitol. The ground on which the structure is built consists of a rather soft blue clay, which suffers considerable compression from any heavy weight placed upon it; to obviate any disturbance from this cause, Mr. MacAlpine first proposed to bore holes at equal distances in the clay, and to fill them up with sand, forming thereby sand piles, which were practically incompressible; but on further consideration it appeared to him that these piles might be dispensed with by taking the precaution to make the area of the foundation for every wall in the structure strictly proportionate to the weight which such foundations would have to sustain, so that the pressure per square inch of the foundations would be equal in every part; in such a case it was clear that though the building would sink somewhat, it would all sink equally, and so no damage would be done by the unequal settlement of the parts. This was the plan that was practically carried out, and it has been found to be in all respects successful.

A still more difficult problem than this, however, is how to place a heavy structure on a quicksand which swallows up everything. It is well known that the beds of Ganges and various other rivers in India are composed of quicksand, and the question arose in the construction of the East India Railway in what way a bridge could be carried across such a river, the bed of which is three miles wide.

The principal of this college, who was at the time one of the engineers of the railway, proposed a plan for the accomplishment of this object, which it may be useful to describe as a guide to others in similar cases.

The river, though 40 feet deep during the periodical floods, dwindles to a small and shallow stream at other times of the year. The greater part of the bed is at such times dry, and the small stream of water which remains in the dry season can easily be diverted. It was proposed to run a row of sheet piling of small depth and thickness across the river during the dry season, and another similar row 40 feet to 50 feet higher up the river, forming a belt, say 50 feet wide from side to side, on which belt the bridge was to be built. Perforated pipes were to be forced at short intervals into the quicksand, say to a depth of 30 feet or 40 feet, and through these pipes a solution of green vitriol was to be forced, which would convert the whole mass of quicksand to this depth into rock. There was a hill of green vitriol or iron barytes near at hand which could have been easily utilized for this purpose.

It appears to be a valuable suggestion, though so far little acted upon, to turn intractable soils into rock by the injection of an agglutination fluid, when the difficulty cannot otherwise be dealt with without great expense. Natural sandstones are thus formed by the infiltration of fluids containing either iron or lime, and probably a union of these substances would be preferable (as in Payne's process for preserving timber) to the use of either ingredients separately. The different fluids, however, in such case should be introduced through separate pipes, as if sent through the same pipes the opening would be promptly closed by the formation of sulphate of lime or gypsum.

The Lalande Primary Battery.

A considerable amount of attention has recently been directed to the Lalande-Chaperon-Spence primary battery, by means of which it is claimed that a current of electricity can be generated and used either for lighting or for driving machinery, and that certain of the elements which produce the current become converted during the time they are doing their work into a substance of greater value than before the battery was started. In other words, we have a battery which not only produces a good electric light, but puts money in our purses after it has done so. We have heard of such batteries before, and we have seen some, but the truth of the remarkable statements made respecting them has never before been so nearly and so clearly demonstrated as in the present instance. It of course remains for time to show whether the battery will prove commercially as well as scientifically successful; but as far as we have seen and heard, we cannot refuse to accept the favorable statements made respecting it. The battery is at present somewhat large, but this, we are told, can and will be remedied in future examples. That which we recently inspected at the office of Mr. Hugh A. Fergusson, of 31 Lombard Street, London, is composed of forty-eight cells, each 1 foot square, and giving a current of from 15 to 20 ampères, with the somewhat low electromotive force of 0·94 volt. The battery itself is capable of maintaining fifteen glow lamps of 10 candle-power each, or of driving a small motor. Each cell of this battery consists of an iron tray, on the bottom of which is placed the depolarizing agent, which is oxide of copper. Just above this and supported at each corner is a plate of zinc, the cell being filled with a solution of caustic soda. Under ordinary circumstances, and when the circuit is open, no action takes place between these elements; but on the circuit being completed the work of decomposition commences. The oxygen of the oxide of copper combines with the zinc, and forms oxide of zinc, metallic copper being left behind. When the battery is exhausted the zinc is recovered from the liquor in the form of an oxide, and this is stated to be 56¼ per cent more valuable than the metallic zinc, and is used for making paint and for other industrial purposes. This remarkable increase in value is said to be obtained by reason of the metal having gained 25 per cent in weight by its absorption of oxygen, and the oxide being also 25 per cent more valuable than the metal, weight for weight, thus giving a total increase in value of 56¼ per cent as stated. The oxide of copper is revivified, and can be used over and over again. The claims mainly advanced for this battery are, that it is absolutely constant so long as the elements in it are kept in a state of efficiency; that the action upon the zinc is very gradual; that while the light is not being used there is no waste going on; and that no noxious smell is given off, as is the case when acids are used. This latter point was clearly demonstrated upon the occasion of our visit, as was also the ability of the battery to give an excellent and steady light. A series of nine Woodhouse & Rawson glow lamps, each of 10 candle-power, were used in circuit. An Ayrton & Perry's motor was driven by the current, and showed the battery to be capable of doing good work in this respect.—*Iron.*

Rapid Assaying.

In the Assay Office it is a common thing to melt up foreign coin and assay it, preparatory to having it coined into United States money. The amount required to be assayed varies with the course of trade; when foreign gold flows in rapidly, the office is very busy. During the past four years the New York office has assayed about $300,000,000 of foreign coin.

Recently half a million dollars' worth of Spanish doubloons were treated in a day. The process is somewhat complicated. First the coins are weighed in the receiving room, and then they are sent to the melting room, where they are melted, cast into bars, and what are called slips are taken. These are small thin pieces of the metal, which are used to test the quality. The sample is rolled and hammered into a thin ribbon and stamped with the number of the deposit which it represents, when it is assayed to determine the proportion of gold, silver, and base metal. Having a portion of pure lead added to it, it is placed in the cupelling furnace, in which the lead quickly oxidizes by absorbing oxygen from the heated air that passes continually over the surface; this oxide carries away with it all the base metals which may be originally combined in the alloy, but leaves the precious metals. A beautiful "flash" is observed to take place on the surface of the metal at the moment when all the base metal is removed. Pure silver in the form of fine granules is added, and the alloy again cupelled. The resulting button is boiled in nitric acid, which dissolves the silver, leaving a small roll of pure gold. Weighings at the various stages in the operation determine the proportion of gold, silver, and base metals in the bullion.

The amount of pure gold varies in different coins. In United States coins the amount of pure gold must be nine-tenths. In doubloons the amount of pure gold is generally about 87 per cent. Of the remainder 9 per cent is silver and 4 per cent baser metals. The charge for assaying is about four cents an ounce.

Winding Wire Springs.

In winding an open spring of wire all that can be calculated on its reflex force after being "shut," or compressed, are the elements of material of the wire, temper of the wire, size of the wire, and diameter of the coil. These calculations are easily made, or so nearly that any error may be easily rectified, if the spring should not prove yielding enough, by stretching its coils apart. But a close spring is a different matter. In this there should be more than a closeness of coil; it is requisite that the closing-up inclination of the coil should be greater than the opening resistance, in order to get the greatest power from the spring. This condition may be obtained by holding the winding wire back toward the winding end, even if the leader is "off" from the open end; if the wire is strong enough to sustain the tension, as the result will be an apparently open-wound spring that is a closely coiled spring as soon as the end is released.

To increase the intensity of a spiral spring (close wound), the wire should be twisted in the winding, the direction of the twist being against the line of the pull on the wire.

Drying Oils.

A. LIVACHE.—The author finds that while an ordinary drying oil containing lead dries in 24 hours, a similar oil containing manganese dries under the same conditions in 5 to 6 hours. Copper, zinc, cobalt, nickel, iron, chrome, etc., prolong the time of drying to 36 to 48 hours. In practice he takes an ordinary lead oil, adds to it dry manganese sulphate in fine powder, and agitates for some time in the cold. The manganese is entirely substituted for the lead, and the oil obtained, freed from dregs by simple decantation, possesses an extreme drying power.—*Les Mondes.*

Rendering Paper Waterproof.

Labels may be fixed upon tin boxes, etc., exposed to damp by the following method: White of egg is diluted with one-half part water, and applied with a brush to the surfaces to be united. A hot iron is then passed over the paper, so as to coagulate the albumen. By means of successive layers of paper and albumen, waterproof boxes, etc., may be formed.—*Cosmos les Mondes.*