Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 0d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, AUGUST 18, 1900.

ECONOMIES OF SUPERHEATED STEAM IN THE STEAM TURBINE.

The excellent results obtained with the best types of steam turbines are due in no small measure to the fact that they are not subjected to the cylinder condensation which is a fruitful source of loss in the ordinary reciprocating engine and the forms of rotary engines not of the turbine type. When the steam turbine is steadily at work the interior surfaces are at virtually constant temperature, and, for this reason, it might be supposed that the only gain which would result from the use of superheated steam would be that due to the increase of thermodynamic efficiency, corresponding to the wider range of temperature. It seems, however, that in the course of investigations carried out at Sibley College, it has been found that there is an actual gain of about 1 per cent for every 3° Fahrenheit of superheat, which is accompanied by an increase in the capacity of the turbine of about 100 per cent for 37° Fahrenheit of superheat. It is considered that the causes of each of these gains from superheating are identical, and are due to the removal of the friction which is present when saturated steam is passing through the turbine. In the latter case there is a retardation of the flow of the steam due to moisture in the form of drops and mist, the moisture clinging to the walls of the steam passages within the turbine. This explanation is corroborated by the fact that the gain, as far as the experiments have gone, is about proportional to the amount of superheating. Sibley College is to be congratulated on this the latest of many valuable truths which have been disclosed as the result of the careful investigations carried on under Prof. Thurston by this famous engineering school.

TOOL STEEL AT THE BETHLEHEM STEEL WORKS.

What is probably one of the most extensive tests of tool steel ever carried out has recently been made in the shops of the Bethlehem Steel Company. A special lathe was set aside for the purpose of experimenting with tool steel of different makes, with a view to the selection of a standard for use, and several picked men were set to work testing the relative merits, not only of the different tool steels then in the shop, but of all brands of established reputation. We are informed by the company that over 200 tons of steel forgings have been cut up into turnings on this lathe, and that over $100,000 has been expended in labor and material alone in developing a new process for hardening tool steel. The results of the investigation are of a very surprising kind, as may be judged from the fact that the introduction of this process has enabled the company to speed up the main lines of shafting from 90 to one of 250 revolutions per minute. As the result of careful records, made from time to time of the average amount of metal cut per hour, per tool, throughout the shop, it was found that the cutting speed had risen from 8 feet 11 inches in October, 1898, to 25 feet 3 inches in January 15 of this year, a gain of 183 per cent; and that the pounds of metal removed per hour had risen from 31 in 1898 to 137 in 1900, a gain of 340 per cent.

The virtue of the new process lies in the fact that it gives to the steel the valuable property of retaining a high degree of hardness even when heated to a visible red heat, "it being possible with one of these tools to cut steel at a speed so great as to heat up the point of the tube to redness, and have it continue to cut for several minutes at this speed, leaving an unusually smooth finish on the work as well as cutting accurately as to size." We are informed that the effect of the new hardening process, which is applied after the tool has been dressed on the machine to shape, penetrates to the center of the steel, even in the case of tools used in the Bethlehem shops which are 4 inches square in section. While the standard brands of self-hardening steel are improved more or less by this treatment, it is preferred to use a steel of special composition in order to get the maximum results. We are free to confess that the facts as given above would be sufficiently startling to raise a doubt as to their accuracy, had they come from any authority less qualified to speak on the subject than the company in whose shop the tests were made.

CHINESE ARTILLERY AND THE PRESENT CRISIS.

There would have been less astonishment expressed at the strength of the resistance developed by the Chinese troops if the public, and, indeed, in some cases the military authorities themselves, had borne in mind the fact that for over thirty years China has been making rifles and heavy cannon in her own arsenals and under the supervision of European officials. The Engineer, of London, has recently republished an article which was written in 1898 by a correspondent who had recently paid a visit to the Kian-Nan Arsenal, near Shanghai. These works have been under foreign control since 1870, and they employ 2,500 men. They are equipped for making magazine rifles, rapid-fire guns of small caliber, and heavy ordnance up to 12-inch bore. A number of fifty-ton 12-inch guns of the Armstrong pattern have been manufactured there during the past ten years. The correspondent states that all of the product, whether it was in the shape of rifles, machine guns, heavy ordnance or complicated gun carriages, had the appearance of being of excellent quality. "Annually for many years past large quantities of war material have been turned out here, and what becomes of it nobody knows. It is somehow absorbed, I am told, without the defenses of China appearing to be strengthened by the process." The allied forces know by bitter experience what has become of much of this Chinese-made war material, and there is no question that those thirty years of work in the Kian-Nan Arsenal will prove to be a most potent factor on the Chinese side in determining the course of the portentous events which are now transpiring in northern China. There is no question that the small-bore rifle and the machine gun are great levelers of the vaunted superiority of the so-called civilized over uncivilized races. Great Britain has found this to her cost in South Africa, and the allied forces are learning the same lesson in the valley of the Peiho.

A SUGGESTION AS TO STREET SIGNS.

The question of the size, style and position of street signs, particularly in the larger cities, touches very closely the daily life and comfort of the citizens; while to the visiting stranger the provision of conspicuous street signs is a positive necessity whether his stay in the city be for business or pleasure. We sincerely hope that there are no large cities in this country that are worse supplied in this respect than New York. During the Strong administration a serious, and, as far as it went, very successful attempt was made to supply New York city with suitable street signs, and many of the principal thoroughfares were equipped throughout with special sign-lampposts containing the name of the street and the number of the nearest house or building. For reasons best known to the members thereof, the present government of the city has seen fit studiously to ignore this admirable provision, and the sign-lampposts have been allowed to fall into disuse or decay, until probably one-half of them are now missing from the street corners. If the present city administration is anxious to obliterate these street signs, the least they can do is to offer some decent substitute in their place; and they surely would not have to seek far for a suitable sign. We notice in a recent issue of Municipal Engineering a letter from Mr. C. H. Topp, City Engineer of Victoria, B. C., stating that that city is making use of large letters, countersunk into the concrete walks within the stone curb, the name of the thoroughfare being inserted parallel with the street, and within a few feet of the corner. The device has obvious advantages, and if it were used in conjunction with elevated signs, it would afford all the direction that could be desired. Although sidewalk signs would scarcely be sufficient to meet the necessities of street-car travelers, they would form a very effective sign for pedestrians.

THE LEADING RAILWAY SYSTEMS OF THE UNITED STATES.

The process of absorption of smaller concerns by large corporations is fully as marked among the railroads as it is among the great manufacturing industries. The growth in mileage of the largest roads is truly phenomenal, and it will surprise our readers to learn that upon this continent there are three separate systems, each of which has a total mileage which is almost half as great as the total mileage of Great Britain. The largest aggregation controlled by any one company is that of the New York Central Railroad, which totals 10,410 miles; making a very close second is the Pennsylvania system with 10,392 square miles, while the great Canadian Pacific Overland route and connections total 10,018 miles. Another trans-continental line of almost equal size is the Southern Pacific, which owns and controls 9,362 miles. There are four companies controlling from 7,000 to 9,000 miles; seven companies controlling from 5,000 to 7,000 miles; three companies from 3,000 to 5,000 miles, and nine companies controlling from 2,000 to 3,000 miles of track, the total mileage controlled by twenty-eight companies being nearly 150,000 miles. Of the five great trans-continental companies, the Canadian Pacific and the Southern Pacific with over 10,000 and 9,000 miles respectively are by far the largest. The Atchison, Topeka and Santa Fe comes next with 7,880 miles, followed by the Union Pacific with 5,584, the Northern Pacific with 5,449, and the Great Northern with 5,201 miles of track.

THE ENTRANCE TO THE MISSISSIPPI RIVER.

It is a fact, perhaps not generally known, that one of the principal objects which led to the purchase of Louisiana in 1803, was to obtain control of the outlet to the great central basin of the Mississippi River with its 15,000 miles of navigable waterways. Commencing in 1837, the government of the United States made at different times more or less serious efforts to increase the depth of the channels at the delta mouths, which ranged from 8 to 15 feet. The results obtained, however, were not permanent. It was in May, 1875, that Congress awarded a contract for the deepening of the Southern Pass to the late Captain James B. Eads, for a sum of $5,250,000, payments on which were to be made only as results were secured. In the face of natural difficulties and political opposition, which would have staggered a less resourceful and resolute man, Captain Eads verified the correctness of his theories by securing a channel 26 feet deep and of 100 feet surface width. This channel has been maintained and is still available for navigation; but the twenty-five years' contract having now expired by limitation, and the draught and size of vessels having greatly increased in the interim, the country is confronted with the problem of immediately providing additional channel facilities.

On June 7 of last year, the Board of Engineers reported a project for securing a channel of 35 feet depth and adequate width through the Southwestern Pass of the Mississippi River. The plan consisted of two parallel, straight jetties, placed 2,400 feet apart, which were to commence on the seaward slope of the bar and in about 30 feet of water, and to extend for about seven miles up the pass, the total estimated cost of this improvement being $13,000,000, while the estimate for the extension of the jetties and for maintenance is equal to an interest of three per cent on $13,000,000 more. The plan being purely a tentative one, a second board was appointed, which on January 11 of this year advised that the main reliance should be placed upon dredging, assisted by a bottle or coffin-shaped plan of jetties which would aid in maintaining the channel. These jetties were to be about three or four miles in length; were to extend out to the 20-foot depth of water on the outer slope of the bar; and their distance apart was to vary from 7,000 feet at their greatest diameter to about 3,000 feet at the seaward entrance. It is evident that a national work of improvement of this magnitude, costing, according to the first estimate, $26,000,000 for construction and maintenance, should receive, as regards its engineering features, the fullest investigation before a pile is driven or a yard of sand removed.

The problem of maintaining a channel at the entrance to a river like the Mississippi, which brings down annually and deposits at its mouth enormous volumes of sand, has been the subject of a vast amount of study and careful experiment by engineers who, like Captain Eads, have made a specialty of this class of work; and the elements of the problem are fairly well understood by the public at large. As long as the effluent waters maintain a certain velocity, the silt is carried along in suspension; but as soon as the outflowing waters spread out at the river mouth, the current becomes slack and the silt is deposited, choking the channel and reducing its navigable depth. The contour of a natural channel, such as the Southwestern Pass of the Mississippi, shows a decreasing depth until a minimum is reached at the crest of the bar, which will usually be found extending approximately at right angles to the course of the channel, and parallel with the seacoast. After passing the crest of the bar, the depths decrease somewhat rapidly to deep water. The object of parallel jetties is to confine the effluent water and cause it to flow with sufficient rapidity to keep the silt in suspension until it is carried past the mouths of the jetties and out to deep water beyond the bar. Unfortunately, a parallel jetty system fails in two particulars. In the first place, it merely pushes back the bar further seaward, necessitating the constant extension of the jetties to cut through the fresh bar thus formed; and, in the second place, it not infrequently occurs that an inner bar is formed within the jetties themselves.

We have recently received from Professor Haupt, whose work in connection with rivers and harbors is well known, a pamphlet in which he suggests an alternative scheme for the Mississippi River improvement which is well worthy of consideration; particularly as its principles are based upon the laws which govern the conformation of the natural bars and channel ways of rivers. The whole paper, which is accompanied with illustrations and diagrams, is published in the

current issue of the SUPPLEMENT, and only a brief description of the principles advocated is possible here.

According to Mr. Haupt, there are other agencies at work in a stream besides the mere volume and velocity, which tend to create and maintain deep channels, as may be seen by a study of the bed of the Mississippi River at the delta. It is found that wherever the course of the river passes from a tangent to a curve, there is an immediate increase in the depth of the channel, which will be found to follow closely the concave bank. Not only is a deep channel formed close to the concave bank of the river, but the silt is thrown over to the convex shore, which shallows gradually from the point of greatest depth to the opposite bank. The sand is continually being washed out from one side of the river, and thrown up on the other. It is claimed by Mr. Haupt that if these natural conditions were reproduced at the Southwest Pass by building a single jetty with a curve of normal radius, the same results would be obtained. The outflowing and inflowing water impinging upon the jetty would maintain a constant depth of water in its proximity, and the surplus water would flow at reduced velocity over the collateral bank, depositing the silt and forming a shoal which would answer the purpose of an artificial jetty. "A single, concave, curved jetty so placed as to encroach gradually upon the path of the stream, produces a compression which causes deflection of the water and deep erosion of the sand, thereby creating a channel parallel to the axis of the jetty, and also building a natural levee by the lateral transportation of displaced material."

The proposed jetty would start from the eastern point of the Southwestern Pass; and would extend nearly two miles in a practically straight line, parallel with the axis of the flow of the river, and at a proper distance from it; thence it would curve to the northwest, with a radius of 4½ miles, for a distance of about 2 miles and end at the 30-foot depth of water on the outside of the bar.

It is estimated that the depth of water which would be attained by a reaction jetty of this type would be 40 feet. Having in view the enormous cost of either of the plans suggested by the Boards which have reported upon this project, there can be no question of the superior economy of Mr. Haupt's single-jetty system. If, after the jetty was completed, it was found that, owing to unexpected conditions outside the river mouth that did not exist in the river itself, the reaction theory did not hold, it would still be possible to obtain all the advantages of the other system by building another jetty parallel, and concentric to the first. It is not likely that if it were found necessary to complete it as a double jetty, the slight curvature would produce any harmful effect upon the structure.

IRRIGATING THE SUGAR PLANTATIONS OF HAWAII.

Sugar is the paramount staple of the Hawaiian Islands. In 1898 the amount produced equaled 2,224,825 short tons, and with the opening of projected new plantations the production will be doubled. With the absorption of the country by the United States, and continuance of the present commercial conditions, the industry is favorably affected. There are now forty-nine incorporated companies, with a paid-up capital of $68,812,000.

The Hawaiian Islands are peculiarly adapted to the cultivation of the cane. The climate is semi-tropical. The soil, volcanic, of exuberant fertility, and the rainfall—an essential feature—copious and fully adequate to the enormous requirements of the plant; the quantity necessary for the cultivation of the sugar cane is prodigious. Upon the Oahu plantation, near Honolulu, there are thirty-six artesian wells, 12 inches in diameter, varying in daily capacity from 1,000,000 to 2,000,000 gallons, all required to supply the plantation of 10,000 acres. Every day 10,000,000 gallons are necessary for each 1,000 acres. Twelve vertical inches of water each month have to be pumped on these thirsty fields, which have to be flooded every ten days. The present yield of this plantation yearly is 18,000 tons, which ultimately will be increased to 40,000 tons.

Though the annual rainfall of the island of Oahu is 70 inches, dependence is placed upon the wells alone. The soil of all the islands has a foundation of porous, volcanic rock, over which has been deposited seven or eight feet of loam, the product of ages of decaying vegetation. It is consequently easily drained and quickly absorbs the heaviest rainfall. A few hundred feet below the surface are inexhaustible supplies of water, and at no time have the wells failed to pour forth their wonted streams or to become reduced in their normal level. Even when the surface rainfall has been less, the wells have never yet been affected in the least.

Taking three of the best known plantations of the island of Oahu—Oahu Sugar Company, Ewa Plantation, and Waialua Agricultural Company, aggregating 50,000 acres—the total number of pumping plants are 24; wells, 108; and the daily amount of water required, 196,000,000 gallons, pumped to a height of 550 feet in some instances, and from that down to levels as low as 60 feet. In the island of Oahu there are altogether 209 artesian wells, supplying yearly 44,000,000,000 gallons, and scientific calculations prove that, deducting the natural loss from surface drainage and evaporation from the 600 square miles of the island, at least four-fifths of the yearly surface rainfall passes away without rendering any service to agriculture whatever.

The opening up of the new Olaa plantation, on the island of Hawaii, has demonstrated the existence of huge reservoirs on the slopes of the volcanoes of Mauna Loa and Mauna Kea, from which an immense and inexhaustible flow of water is to be obtained. The plantation embraces 19,500 acres, located on the east side of the island, and encloses a strip 4 × 15 miles in dimensions, at an altitude ranging from sea level to a height of 2,000 feet. The average annual rainfall varies from 160 to 200 inches. Along the slopes are found swampy places, where the interior waters have appeared above the surface, and occasionally flowing springs, suggesting hidden sources of water supplies. Exploration revealed a promising site for tunneling into the side of the mountain, and soon a great increase in the flow was encountered.

The use of dynamite demolished the walls of the reservoirs, and great floods of water resulted. No. 1, tapped May 15 of the present year, has regularly supplied 5,750,000 gallons daily, and No. 2, 4,250,000 gallons. United, these streams will be conducted to the mill of the plantation by a flume and used in transporting cane from the highest portions of the plantation to the site where it is manipulated, a distance of 15 miles.

The enormous rainfall of the island of Hawaii, compared with others of the group, is easily explained. The evaporation is great, and the humid air, driven by the prevailing northeast trades against the lofty range of mountains, of which Mauna Loa, 13,675 feet, is the dominating summit, is condensed by the extreme cold of these high altitudes and falls to the ground. The reservoirs are great bubbles in the earth formed during volcanic eruptions.

The discovery of these water reservoirs has greatly stimulated sugar planting in Hawaii.

NEW FORM OF CELLULOSE.

A new form of cellulose has been recently discovered, which possesses many valuable properties. The chemical designation of this new body is the soda salt of cellulose—xanthogenic acid; it is often designated by the name xanthate of cellulose, or viscose. The discovery of the body is due to the researches of Messrs, Cross, Revan and Beadle, the fundamental action being that of the alkali upon cellulose; these have no action if they are sufficiently diluted with water, and have no other effect than that of bleaching the cellulose; when concentrated, however, they act energetically and give a well-defined compound of cellulose and alkali. In order to obtain the viscose from an alkali-cellulose, the latter must be submitted to the action of carbon disulphide. A combination is formed, and the body at first swells up, being converted by degrees to a gelatinous mass, which gives a homogenous solution in water. The process is thus very simple; the cellulose is triturated in a mortar, while still somewhat wet and in short fibers, with soda lye, which is poured in little by little. The matter is then placed in a closed vessel with a small quantity of carbon disulphide for three or four hours, to obtain the viscose. This body somewhat resembles glue in appearance, being more or less thick, according to the quantity of water it contains; it is remarkable for its viscosity, whence its name. It is strongly colored, but the coloration may be changed by the addition of pigments. The property of viscose which makes it of especial value, is that at the end of a certain time, often but a few hours, it forms an insoluble gelatinous mass, which becomes comparatively hard and washes perfectly. It may be moulded into different forms or spread in a thin layer upon wood, paper, fabrics, etc. The various uses of this product are apparent; the insolubility of the varnish may be increased by dipping it into a concentrated solution of salt, alum, etc. It is probable that viscose will render service in the fabrication of artificial leather or vegetable silk.

INTERNATIONAL MINING CONGRESS.

One of the most interesting of the international congresses held at Paris has been that relating to mines and metallurgy; its president was M. Haton de la Goupillière, Inspector-General of Mines. The opening and closing sessions were held in the Palais des Congrès of the Exposition, and the remainder at the rooms of the Société d'Encouragement de l'Industrie Nationale. A large number of delegates from the different nations were present, and from an industrial point of view the results of the congress have been considered of great importance. In the opening address the president referred to the great progress realized in the metallurgy of iron and steel, and co-operation of the different sciences in the final results, of which the expression was to be found in the numerous reports which had been prepared to serve as a base for the discussions. Among the papers of especial interest may be mentioned that of Prof. Weddind, of Berlin, who treated the magnetic separation of ores. M. Hubert, Chief Engineer of the Belgian railroads, gave the results of the progress accomplished in the direct use of blast furnace gases in the production of motive power. M. Babu, Professor at the Paris School of Mines, showed what had been realized in the manufacture of special steels with manganese, chromium, nickel, etc. A remarkable study was presented by M. Hartmann, Chief of the Artillery Works near Paris, relating to the phenomena which accompany the deformation of metals when worked. The different studies of coke furnaces are worthy of note, and those on the mechanical installation of metallurgical works, transportation of slag, methods of charging and discharging raw material and products, the use of electricity in mines, and others. M. Bousquet, a prominent engineer of the South African region, made a communication of great interest on the progress of the metallurgy of gold and the cyanuration of ores in the Transvaal. In order to handle the large amount of material which was presented, the congress was divided into special sub-sections for the study of the various mining and metallurgical questions; the reports on the different subjects were prepared in advance, in order to give an exact basis for the discussions and to limit them to the essential points. The resumé of the reports and discussions of the congress will give an exact account of the present state of these industries.

DEATH OF DE WITT CLINTON HASKIN.

DeWitt Clinton Haskin died July 17, 1900, at Buffalo, N. Y. He was born in 1824 and after varied adventures in his early career, he started to build the California Pacific Railroad line, connecting the city of Marysville with San Francisco; a short line connected Sacramento with the main line. He then built the California Pacific Railroad line, which was completed in 1869, after which he became engaged in mining in Utah. In 1872 he came to New York and while crossing the Hudson River during a fog he realized the advantages of a tunnel under the Hudson. He immediately began operations for the construction of such a tunnel, the nature of the material being a fine quicksand silt. He found that methods different from those adopted at that time would have to be used. He conceived the idea of utilizing compressed air to balance the weight of the water and silt until masonry could be put in. He then took out patents covering the pneumatic process. His idea at that time met with great opposition by those familiar with tunnel construction. After years of persistent effort Mr. Haskin demonstrated that his plan was practicable, although the work was never completed, owing to financial complications.

CAVIAR.

Two distinct varieties of caviar are manufactured in Russia, the granulated and pressed forms. The granulated form is obtained by passing under pressure through a fine-meshed sieve; the small eggs pass intact, but the envelops are retained in the sieve. To these pure salt is added in the proportion of $\frac{1}{20}$ or $\frac{1}{40}$; it is intimately mixed with the eggs by means of a kind of wooden spoon. The caviar is then ready for consumption; it is packed in round metallic boxes of 1½ to 5 pounds, enveloped in parchment for transportation. The pressed caviar keeps better than the granulated form. To obtain it the fresh caviar is treated with a solution of salt at 25° Baumé until the eggs have acquired a certain degree of hardness. This operation requires considerable skill and experience; if allowed to stay in the solution too long, the caviar will be too salty, and if not long enough, the eggs cannot be preserved. The caviar is then put into small sacks, which are pressed under a screw-press to drive out the excess of salt. It is packed in barrels containing up to 1,000 pounds, or left in the original sacks, which measure 8 by 20 inches. The average export of pressed caviar for the three years, 1896 to 1898, has been more than 3,000 tons, representing a value of $1,400,000.

TELEGRAPH LINE IN GERMANY.

In Germany the establishment of a new telegraph line between that country and England has been considered, and an addition of $500,000 to the budget has been demanded for this purpose. Since the laying of the fourth cable in 1896 the number of telegrams has continued to increase, this number being 1,867,868 in 1895 and 2,465,613 in 1899. As a result, the crowding of the lines has been prejudicial to the commercial interests, and accordingly the establishment of a fifth line was found necessary. The new cable, of four conductors, will start from Borkum and end at Bacton, Norfolk; it will be constructed and laid in concert with the British telegraph administration, and will unite all the most recent improvements in the technique of submarine cables. The expense will be supported in common, except for the junction lines proceeding from the terminal stations, which will be borne by the respective governments.