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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 944.

For the Week Ending February 3, 1894.

Price 10 cents. For sale by all newsdealers.

FOREIGNERS ARE LEARNING OUR INDUSTRIAL METHODS.

It has long been our boast that America was able to produce better results in the technical field than those due to any other nation; even where hand work is concerned, this is believed to hold true in many respects. If it is simply a question of adhering to tradition and of reproducing the products originated by past generations, the foreign workman may equal or surpass the American. But it has long been remarked that where originality and an ability of thinking and working on independent lines is involved, the foreign highly specialized workman yields to the more independent American mechanic, as to one less hampered by tradition. Thus we find our country abounding in self-made men who began at the lathe and bench, and now own and conduct great factories. Their independent habits of thought have opened for them their careers.

Inventiveness, the great American characteristic, has had much to do with this state of affairs. The constant striving after invention, the introduction of ingenious machines and labor-saving processes, has relegated the old-country machine-like workman to the past. His work is done here by machinery, and those who attend the machines may be destined to be the inventors of others designed to surpass them. While hand-made goods, from their very imperfections, have a charm for the artist, the every-day user appreciates rather the constant good quality of machine-made articles. Our superior methods have given us the power of competing under primarily unfavorable conditions with the cheaper labor of foreign countries.

It is a question how long the supremacy of our methods will last. Foreign competitors in the industrial world have for some time past realized the fact that certain American-made articles sell better than their own; indeed, they find a similar state of things obtaining in many lines of manufactures. One way of meeting the case is resorted to in the production of counterfeit American goods. Discreditable as it is, there is no question that extensive operations of this character have been carried on.

But a more honorable way of meeting what seems to be a true emergency has been adopted. English manufacturers now send over students of our manufacturing processes, in the persons of intelligent young men, who enter our shops as workmen and labor there, studying meanwhile and learning all the details of our shop management and manufacturing processes. The United States is, in fact, treated as a technical school. The men sent pass from one factory to another, so as to get a good view of different processes. Then they return and use their knowledge to advance their own home industries.

In almost every field of technical work America has won renown. It is now evident that our neighbors are determined to find out why this is, and the placing of students in our shops is a tribute of the highest value to our methods of work.

THE ORIGINAL EDISON ELECTRIC RAILROAD.

We reproduce elsewhere an interesting illustration from the SCIENTIFIC AMERICAN of June 5, 1880. The cut represents Edison's electric railroad as operated at that time in Menlo Park, N. J., a station on the Pennsylvania Railroad, in those days celebrated as the abode of Edison and the site of his laboratory. The Wizard of Menlo Park, as he was then called, made the place illustrious by his work on the incandescent electric light and the first or "tin-foil" phonograph. As he left the train a short flight of steps or steep path led the visitor up a bank by the side of the track, and a few minutes walk on the more level ground brought him to the laboratory. Here Edison with his corps of assistants was at work on a variety of operations in the many branches of science which have always been carried on in his laboratories.

The inventions then being developed were from time to time described by us, the original phonograph making one of its earliest appearances in public in the office of the SCIENTIFIC AMERICAN, and being first described in our columns.

The year 1880 is an ancient period in electric engineering. To-day we see the horse-drawn street car disappearing from our streets, the local traffic of steam railroads transferred in great part to a new system of travel, and areas of country brought within frequent and rapid communication by a new agency. This element in transportation is the electric road. Starting from humble beginnings, deriving its energy originally from primary batteries in the days of Page, then using the rails or an insufficiently insulated conductor laid between the tracks for the transfer of mechanically generated electric energy; next using the overhead wire with trolley running upon it, and finally reaching its present efficient, if objectionable, form of trolley pole pushing up against the under surface of a conductor, the electric road has reached a position of first importance in local traffic, and may yet displace the steam locomotive on long distance work. In ten years a new element has entered our life and a new profession has been created.

The cut which we reproduce has a special interest for us at this day. It shows the electric railroad of 1880. If the next ten years witness as great progress in electric railroads as the last decade has sufficed for, the face of the country will be revolutionized.

The peculiar features of the primitive installation will be noticed. The use of frictional gear for throwing the motor on and off, the small traction car distinct from the passenger car, and the use of the rails as conductors are characteristic. It is curious that fourteen years have sufficed to produce relics in this engine and car which are as antiquated in regard to modern work as is the De Witt Clinton when compared with modern locomotives.

We feel that we cannot do better in the way of contributing to ancient history than to reproduce the text of the article describing this affair. The last paragraph is interesting, showing how hazardous it seemed to prophesy what the future has actually brought forth.

FIGHTING MAN'S MOST DEADLY FOES.

For two or three years past there have been indications, increasing in number, that chemists in many lands (one or more even in far-off Japan) are at last giving their minds and their labors to the study of the chemistry of the bacteria.

Already we have a probable working hypothesis, which furnishes a valuable guide to the chemist in this field. This is the view, which must at least involve much truth, that all bacterian diseases are the results of blood poisoning by certain products or educts of the growth of the bacteria, after these have effected a lodgment in the tissues of the body.

On this hypothesis have been based several methods of experiment, which we have not space for now. Our present object is to sustain assertions made above, by citing, as an example, results announced during the last year, on the authority of two German chemists, Wernicke and Behring. They found that the poisons of both the diphtheria and the tetanus (lockjaw) microbes were neutralized, after being introduced into the circulation of animals, by introducing also iodine trichloride. It appeared also that this compound acted as an actual antidote to the blood poison, inasmuch as it did not kill the bacteria themselves, while preventing them from killing the animal. To say the least, this is a most encouraging result, and justifies the hope expressed in the previous article referred to, that if these enemies cannot yet be actually destroyed, their baneful and debilitating agencies may be neutralized, so that the vital energies may have a chance to combat and overcome them. Experiments on men in this direction have been promised, and will be awaited with interest.

Test of Holtzer Projectiles.

The reception test of the second lot of 100 ten-inch armor-piercing Holtzer shells took place January 18 at the Sandy Hook proving grounds. The shells were made by the Midvale Steel Company, of Pennsylvania, after the celebrated French process. The gun used was a ten-inch breech-loading rifle, mounted on a barbette carriage. The steel armor plate was one which had been used before, having been made by the Bethlehem Company. It weighed 10 tons and was 11½ inches thick. Two shots were fired, each weighing 575 pounds. The charge was 183 pounds of powder. The test was highly successful, the plate and its oak backing three feet thick was pierced with ease, and the projectile was lost in the sand bank, but was afterward recovered and calipered. The gauges and calipers were passed along the shot and failed to reveal the slightest variation in length or thickness. The velocity was 1,625 feet per second. A crack in the plate almost imperceptible before firing was widely opened by the shot. The edges of the hole were turned out like rose leaves and the steel surrounding the hole was blued by the heat generated by impact of the shell.

Artificial Sunlight.

In a dark room with alternating currents of 800,000 voltage, Nikola Tesla, by means of atmospheric vibrations, caused a faint glow of light to appear. Explaining the phenomenon, he said: "If I can increase the atmospheric vibrations, say 1,000,000 or ten thousand millions, I can produce sunlight in this room. Of course, I can increase the vibrations by increasing the voltage. I can make the voltage 8,000,000 as easily as 800,000; but I am not ready to handle 8,000,000 volts of electricity. Currents of such strength would kill everybody in the room. I expect, however, to learn how to control a large voltage. When I have increased the atmospheric vibrations perhaps a thousand times, the phenomenon will be no longer electricity. It will be light. I am satisfied that sunlight can be made from electricity without doing harm to anybody, and I expect to discover how it is done. It is a grand idea, and whether the voice through which it came be hushed and still or yet resounds in the proclamations of new truths, the idea itself will be carried to fruitage, and the world will be wiser, whatever may be the issue."

The Niagara Hydraulic Works in Operation.

The first practical test of the hydraulic tunnel which has been under construction at Niagara Falls for the past three years, was made on the 25th of January.

The test afforded a practical demonstration of the new works, which have already cost nearly $4,000,000. The Niagara Falls Paper Mill, which is the first to get the benefit of the power, is the largest of its kind in the world. Its contract calls for 6,600 horse power, one-half of which is being used now, and the cost, including the lease of the land occupied by the mill, is $8 per horse power per year, for twenty-four hours per day, the cheapest, it is said, ever obtained. The mill is now in full operation.

The hydraulic tunnel has a capacity of 120,000 horse power. The formal opening of the general power house, where 5,000 horse power turbines will operate 5,000 horse power electric generators for the transmission of power, will take place on June 1, and it is intended to give the event a celebration at which distinguished scientists, engineers, and state officials will be present.

Harvard Observatory in Peru—the Highest Meteorological Station in the World.

We are indebted to Dr. S. I. Bailey, of the Harvard Observatory, Arequipa, Peru, for a copy of *La Bolsa*, of that city, containing an account by him of the establishment of the Harvard Meteorological Station on the summit of Misti, not far from Arequipa.

We translate the following abstract: "Well knowing the interest which Peruvians take in scientific progress, and especially in all observations made in connection with the famous volcano of Arequipa, I have the pleasure of giving you the following particulars concerning the meteorological station recently established on the summit of Misti. In order to equip and put this station into operation, a road for mules was very much desired; for, although one might be able to go on foot to the summit once or twice, it would be very difficult, without such a road, for an intelligent person to visit the station regularly and make the necessary observations. The experience of persons who have ascended to great heights has been, in general, that the fatigue due to the extraordinary exertions has disabled them from making exact observations. We have never heard it said that mules have ascended to so great a height as the summit of Misti; but previous experience with these animals at heights of 17,000 feet convinced me that, with proper care, mules might ascend to a height of 19,000 or even 20,000 feet.

Of all the mountains in the neighborhood of Arequipa, Misti, by its splendid isolation and symmetry, is the most adequate for a prominent meteorological station.

In August last an expedition was sent out to make the complete circuit of this volcano, with the object of studying the possibility of making a mule road to the top. Minute observations were made with good telescopes of all sides of the mountain, and we took some photographs. Seen from whatever direction, Misti presents a surprising symmetry, always showing a cone more or less truncated, but almost perfect. This examination convinced me the mountain was accessible from the northeast. In August a stone cabin was erected on the northeast side of the volcano as a station, and here I stayed several days watching the construction of the road to the summit. Without leaving the great slopes of volcanic sand and avoiding the sharp rocks, it did not prove to be an impossible enterprise, as many have feared.

On the 27th of September I had the pleasure of reaching the summit with my assistant, several Indians and two mules. Going on foot and on mule back alternately, we arrived in good condition to make scientific observations, and the mules were not seriously injured. The altitude, however, produced a great effect upon the mules, and when near the top they refused to go more than twenty steps at a time without taking a good rest. Without such extreme care, it is probable they would have succumbed.

On the 12th of October I returned to visit the summit with two members of the observatory, twelve Indians, and thirty mules, transporting a portable house of wood, with double walls. We also carried a small house for instruments, together with the instruments necessary for the station work. Provisions were sent to our stone cabin, where we pass the night at an altitude of 16,000 feet, more or less; without this precaution the ascension would have been impossible. Some of the members of the committee suffered seriously from breath exhaustion (*soroche*), and only by great exertions did the men and mules succeed in reaching the summit. In many places it was necessary that two men should assist each of the mules that bore the heavy parts of the house. On this expedition one of the mules stumbled and went down a rocky declivity and was considerably hurt; happily its burden consisted of clothing and other articles which were not damaged by the fall.

The station consists at present of two little houses, one for the observers and the other for the instruments. They have been located at a short distance from the iron cross, which, for more than a century, has formed so fitting a crown for the mountain. The station is provided with an automatic barometer, indicator, thermograph, hygrometer and anemometer, together with various mercurial thermometers. The first named automatic instruments run ten days, and a member of the observatory will visit the station three times a month.

The height of the station, according to determinations made by various barometric observations, is 19,300 feet above the level of the sea.

For the government and citizens of the country who have so generously lent their assistance and confidence to this observatory, it ought to be a matter of pride that Peru not only possesses some of the sublimest scenery, but also has given to science the highest meteorological station in the world.

New Pier of the American Line.

On the Hudson River, at the foot of Fulton St., New York, is situated the new pier of the American Line, which is one of the finest in America. It is situated in the immediate vicinity of the ferry termini of all the railway lines which center in Jersey City and Hoboken. It can also be easily reached by the elevated roads and the cable cars. The new pier is 720 feet long; the piers in use by other lines are about 600 feet long. The width of the American Line pier is 125 feet; that of other piers 70 feet. The pier was specially built to order by the city and the annual rental is $50,000, the lease running for ten years. On this superb pier the American Line Company has erected a huge superstructure at an expense of $300,000. Some of the features of this great shed are new. The building is divided into two stories. From the decks of the steamships the passengers will walk off on an almost horizontal gangway to the second floor, which resembles a large railway waiting room. To any one who has ever crossed the Atlantic or visited a pier either before sailing or on completion of a voyage, the advantage of landing the passengers away from the almost inextricable tangle of cabs, wagons and freight will be apparent. A commodious passenger elevator at the shore end of the pier will add greatly to the comfort of passengers. Special elevators are arranged for baggage. Comfortable waiting rooms are provided, as well as telegraph, cable, and telephone service. The pier is lighted throughout with arc and incandescent lamps. This new pier, in which the comfort of the passenger is carefully considered, will probably be the forerunner of many such piers, and will be in keeping with the five ocean racers which are now being built at the Cramps' shipyard in Philadelphia for this line.

Trial of the Montgomery.

The trial of the partially protected cruiser Montgomery, which took place off New London, January 18, showed a speed of 18·85 knots per hour, without tidal correction, which afterward increased it to 19 knots, so that the contractors (the Columbian Iron Works) will receive $200,000 premium over $612,500, which was the contract price. There were 166 pounds of steam in the boilers and the screws were revolving at a rate of 177 per minute when the first buoy was passed. The number of revolutions was increased to 180. The engines worked smoothly throughout the trial.

The Montgomery is 257 feet long; 37 feet wide; draught, 14½ feet; displacement, 2,000 tons. Two vertical, three-cylinder, triple expansion engines drive the two four-bladed propellers. The indicated horse power is 5,400. A protective deck varying from 0·43 to 0·3 inch thick is provided. The battery is composed of eight 5-inch guns and two 6-inch rapid fire guns. There are also three torpedo-launching outfits and a secondary battery composed of six 6-pounders, two 1-pounders and two machine guns.

George B. Prescott.

The well known electrician and author of electrical works, George B. Prescott, died in New York, January 19, of heart failure. Mr. Prescott was born at Kingston, N. H., in 1830. He became interested in electricity when only a boy and all his life he was actively connected with various telegraph and telephone companies. He made useful improvements both in telegraphy and telephony. He was the joint owner with Thomas A. Edison in all the quadruplex telegraphs. The quadruplex telegraph was introduced by Mr. Prescott. As an author Mr. Prescott was well known and his works served a useful purpose. He advanced the theory that the Aurora Borealis was of electrical origin and interesting accounts of his experiments connected with it were published.

EXCAVATIONS in Oisseau le Petit, Department of the Sarthe, France, have revealed a Gallo-Roman city, which appears to have been destroyed by an earthquake. The city probably contained some 30,000 inhabitants, but its name is not known in French history. The ruins include a great temple, part of which is still standing, also a theater and monuments.

Perpetual Motion of Atoms and Molecules.

Every body is composed of a multitude of extremely, but not infinitely, small molecules, and it might be thought, says Sir R. Ball (according to a contributor in the Newcastle, England, *Chronicle*), that in a solid, at all events, the little particles must be clustered together in a compact mass. But the truth is far more wonderful. Were the sensibility of our eyes increased so as to make them a few million times more powerful, it would be seen that the diamond atoms, which form the perfect gem when aggregated in sufficient myriads, are each in a condition of rapid movement of the most complex description.

Each molecule would be seen swinging to and fro with the utmost violence among the neighboring molecules and quivering from the shocks it receives from the vehement encounters with other molecules, which occur millions of times in each second. The hardness and impenetrability so characteristic would at first sight seem to refute the supposition that it is no more than a cluster of rapidly moving particles; but the well known impenetrability of the gem arises from the fact that, when attempt is made to press a steel point into the stone, it fails because the rapidly moving molecules of the stone batter the metal with such extraordinary vehemence that they refuse to allow it to penetrate or even to mark the crystallized surface. When glass is cut with a diamond, the edge which seems so hard is really composed of rapidly moving atoms. The glass which is cut is also merely a mass of moving molecules, and what seems to happen is that, as the diamond is pressed forward, its several particles, by their superior vigor, drive the little particles of glass out of the way.

Trinidad Asphalt.

Col. F. V. Greene recently read a paper before the American Institute of Mining Engineers that gives some interesting facts about this product. He says:

"The asphalt of Trinidad is found in a so-called lake, situated about 100 feet above the sea and about three miles from the shore of the island, at the village of La Brea (the Spanish word for pitch). Its area is about 114 acres; its depth, as far as ascertained by certain rude borings, is reported to be about 18 feet at the sides and 78 feet in the center; and underlying it there is said to be a bed of blue clay. If these figures are correct, the lake contains about 6,000,000 tons of asphalt. Whether these borings are even approximately accurate is, however, very doubtful. It is even contended by some that the lake is still fed from underground sources. The only positive information on the subject is the fact that the excavations of the last ten years (about 180,000 tons) have not appreciably lowered its level."

The word "lake," applied to this deposit, is an entire misnomer. It is a level tract of brownish material having an earthy appearance. Cracks or fissures having a width and depth of a few feet appear here and there over the surface. Some of them are filled with rain water, while others have been filled with soil blown there by the wind and giving support to a scrubby vegetation. Some travelers have reported that the deposit is liquid in the middle, but such is not the fact. Carts and mules can be driven everywhere on its surface. The material is dug with a pick and shovel, loaded into carts, and hauled to the beach. Here it is placed in baskets, which are carried by coolies wading through the surf to lighters, and from these lighters it is loaded on vessels. During the voyage the material unites in a solid mass, and has to be removed again by the use of pick and shovel. On being unloaded it is placed for about five days in large tanks heated by a slow fire. The moisture is expelled, the roots of trees and other vegetable matters are skimmed off the surface, the earthy matter with which it is combined settles by gravity, and the refined product is run off into barrels. The refining is in reality a mere heating to a liquid condition, in order to allow the sediment to deposit; and great care is taken not to heat the material to a point which will in any way change its chemical condition or produce distillation.

A Top Heavy War Steamer.

Her Majesty's ship Resolution, one of the best war ships in the navy, as was supposed, recently left Plymouth for Gibraltar, was caught in a terrible gale in the Bay of Biscay, and had to put back to Queenstown. It is stated that during the height of the storm she rolled 40 degrees each way, and her deck rails were frequently under water. The ship had to keep her head to the wind for two days, owing to the extreme danger of her capsizing if any attempt were made before the gale abated to turn her head toward port. Two men were washed overboard together, but the captain of the torpedo catcher Gleaner, it is reported, jumped overboard, and, with the assistance of the Resolution's lifeboat, saved one of the men. The other disappeared. It is understood that at times the Resolution was in the gravest danger, being almost unmanageable and at the mercy of the seas which broke over her. Water in hundreds of tons got in the between decks and one of the boats was smashed.