Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico.....$3 00
One copy, six months, for the U. S., Canada or Mexico..... 1 50
One copy, one year, to any foreign country belonging to Postal Union. 4 00
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for the U. S., Canada or Mexico. $6.00 a year to foreign countries belonging to the Postal Union. Single copies 10 cents. Sold by all newsdealers throughout the country. See prospectus, last page.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to one address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries within Postal Union *eight dollars and fifty cents a year.*

Building Edition of Scientific American.

THE BUILDING EDITION OF THE SCIENTIFIC AMERICAN is a large and splendid illustrated periodical, issued monthly, containing floor plans and perspective views pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To builders and all who contemplate building this work is invaluable. Has the largest circulation of any architectural publication in the world.

Single copies 25 cents. By mail, to any part of the United States, Canada or Mexico, $2.50 a year. To foreign Postal Union countries, $3.00 a year. Combined rate for BUILDING EDITION with SCIENTIFIC AMERICAN, to one address, $5.00 a year. To foreign Postal Union countries, $6.50 a year. Combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN and SUPPLEMENT, $9.00 a year. To foreign Postal Union countries, $11.00 a year.

Export Edition of the Scientific American,

with which is incorporated "LA AMERICA CIENTIFICA E INDUSTRIAL," or Spanish edition of the SCIENTIFIC AMERICAN, published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number contains about 50 pages, profusely illustrated. It is the finest scientific, industrial export paper published. It circulates throughout Cuba, the West Indies, Mexico, Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. THE SCIENTIFIC AMERICAN EXPORT EDITION has a large guaranteed circulation in all commercial places throughout the world. $3.00 a year, post paid to any part of the world. Single copies 25 cents.

☞ Manufacturers and others who desire to secure foreign trade, may have large and handsomely displayed announcements published in this edition at a very moderate cost. MUNN & CO., Publishers,
361 Broadway, New York.

☞ The safest way to remit is by postal order, express money order, draft or bank check. Make all remittances payable to order of MUNN & CO.

☞ Readers are specially requested to notify the publishers in case of any failure, delay, or irregularity in receipt of papers.

NEW YORK, SATURDAY, SEPTEMBER 21, 1895.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF SCIENTIFIC AMERICAN SUPPLEMENT No. 1029.

For the Week Ending September 21, 1895.

Price 10 cents. For sale by all newsdealers.

THE AMERICA CUP RACES OF 1895.

With the withdrawal of Valkyrie III from the contest of September 12, the third race of the series was placed to the credit of the American cutter, and the safe keeping of the cup was intrusted for another indefinite period to its guardians, the New York Yacht Club.

Never in the history of these contests for the blue ribbon of the seas has the racing flag been hoisted under more auspicious and promising circumstances; and never has a contest realized a more unsatisfactory and altogether disappointing close.

The terms of agreement called for five races; three of them to be dead to windward and leeward and two on a triangular course.

The first race was sailed on September 7. The course was laid 15 miles out to sea, against the wind, and return. The wind was light and shifting. There was an enormous fleet of yachts and excursion steamers in attendance, and the maneuvering for the start, and the start itself, were made amid a confused crowd of attendant sightseers; the spectators vaguely speculating as to where the starting boats were anchored, and the yachts themselves having difficulty in finding the same. In the first 11 miles of windward work, the performance of the two yachts was very even. Four miles from the mark the breeze hauled to the southward and freshened considerably; and, when the yachts laid for the mark, Defender was seen to be over three minutes in the lead. What was intended to be a run home before the wind, with spinnakers, was changed by the shift of wind into a reach, and Defender gained rapidly, coming home in handsome style, a winner by eight minutes and forty-nine seconds.

The second race was sailed on Tuesday, September 10, over a triangular course of 10 miles to the leg, of which the first leg was laid to windward. In the maneuvering for the start, and just as Valkyrie, who was half a length ahead of Defender and to windward, was straightening for the line, her main boom fouled the Defender, carrying away the latter's starboard spreader. The Defender put about, so as to relieve the strain on the topmast, speedily repaired the damage, and then set off on a stern chase for the English boat. Valkyrie gained in the windward work, but her lead was cut down on the two remaining legs of the course, so that she eventually came in a winner by the small margin of 47s. That Defender should have done so well in her disabled condition makes this second race a moral victory for the home boat. The protest by Defender was taken under advisement by the Cup Committee, and after hearing all the evidence, they gave judgment against the visitor.

The third race was sailed on Thursday, September 12. Both boats were at the starting point and crossed the line with the wind dead aft. Immediately after the start Valkyrie drew out of the race, alleging, as excuse for her withdrawal, that the Cup Committee would not guarantee a free course, clear of obstruction from excursion steamers.

The Defender stuck to her contract and sailed the course in gallant style.

The two marine pictures herewith given present a timely and interesting comparison. The historical schooner yacht America is shown on page 185 as she appeared at the time she was winning the cup in a race round the Isle of Wight in August of 1851. It was an easy victory for the schooner, and the many novel features embodied in her design and construction were quickly recognized and favorably commented on by the English yachting world.

The Defender of forty-four years later—page 187—shows the enormous increase in power that has taken place in the interval. Of much the same displacement, she carries nigh upon double the amount of canvas that was spread by her predecessor.

HIGH SPEED RAILWAY RECORDS.

During the closing days of last month the two great competing railways that run from London to the north of Scotland, known respectively as the East Coast and West Coast routes, commenced an acceleration of service on their through trains. In the active competition that followed, the West Coast companies covered the total distance of 540 miles in the unprecedented time of 512 minutes, or at the rate of 63·25 miles per hour.

The sustained speed was remarkable in any case, and especially so when it is considered that it was made by a regular daily train starting on schedule time, and that the latter half of the journey was made through a mountainous country, in which, for a distance of 60 miles, the grades are very severe, varying from 1 per cent to 1·33 per cent. The engines, moreover, that hauled the train were not the largest on the road, but in some cases were of a type known as the President class, that is now some 25 years old, but which, on account of its excellent performance, is still in active service.

On Thursday, September 12, the New York Central Railroad made up a special train that was a counterpart of the Empire State Express, drawn by their latest and most powerful engines, and set out with the express purpose of "breaking the record" of their transatlantic breathren. Over a course that is 100 miles shorter and over a line that is remarkably level and free from gradients, this special train, which was considerably heavier than the English train, made an average speed that was one mile per hour faster than that of the West Coast train, being 64·348 miles per hour, as against 63·25 miles per hour for the English train. These are both very remarkable performances. For purposes of comparison, however, they are useless, until we are in possession of all the conditions that prevailed. The bare question of speed is in itself no test of locomotive performance. This is a fact little understood by the public at large; but well understood by engineers themselves. To judge of two performances it is necessary to know:

1. The ratio of the weight of engine to the weight of the train hauled.

2. The ratio of the amount of coal burned, water evaporated, and oil used per mile to the weight of train hauled.

3. The state of the weather, whether wet or dry, and the force and direction of the wind.

4. Most important of all, the amount and extent of the grades and curvature on the two roads on which the record is made.

With all these data to hand a very close estimate could be made in each case of the actual units of work performed in a given unit of time. Only after such a comparison, based on accurate data, as above, could it be even approximately stated which performance was the most satisfactory.

FIRING OF BOILERS WITH MIXED COAL.

A very interesting experiment, and one that ought to revolutionize the firing of steam boilers, has been in progress at the flour mill of Urban & Company in this city for several months and has now proceeded so far that positive advantages can be claimed with confidence.

The mill has made 1,200 barrels of flour in 24 hours, though the ordinary output is much less. The engine is a Corliss pattern of about 400 horse power, driven by steam generated in two upright tubular boilers with twin furnaces and covered with a composition to retain the heat.

The fuel formerly used was run-of-mine soft coal, but last March Mr. Urban, having long been dissatisfied with the fuel, began to use in connection with it various proportions of screenings of hard coal. The improvement was marked from the first. The amount used was much less, the cost was reduced, and the smoke and soot practically disappeared.

When the experiment began, the furnaces required fully 1,200 pounds of soft coal per hour to develop on the average 380 horse power. The amount now required for the same service is 890 pounds on the average. The coal used is one part soft coal culm, or any of the cheapest product of the mines, and four parts hard coal screenings, such as is not considered valuable in the general trade and is sold to whoever will buy it at a mere nominal price.

All possible proportions were tried and hard coal was used entire, but the present proportion of four to one is found to be the best. This affords soft coal enough to cement the fuel into small masses, but is not enough to harden it into large masses, as was the case if a greater proportion of soft coal was used. As the soft coal ignites first, it in a measure cokes the whole, and the slow-burning anthracite assists in producing a very lasting fire, not needing replenishing for a much longer time than is the case with clear soft coal. Anthracite used alone fills the grates with ashes, but the accepted mixture burns very free.

The cost of hard coal screenings is $1.45 per ton and of soft coal slack $1.50. The difference is so small that either price may be taken, and reckoning the consumption at 900 pounds an hour, which is slightly more than the reported amount, a 24 hour run would consume 21,360 pounds at a cost of $16.02, reckoning $1.50 to the ton. The cost of run-of-mine soft coal is $2.20 per ton. At an expenditure of 1,200 pounds an hour, which is considered below the average requirement, a 24 hour run on soft coal would cost $31.68.

The saving appears to be largely in the entire combustion of the coal. If the test has proved anything, it is that a much greater amount of carbon is blown out of the chimney than any one has supposed. With soft coal there was not only a constant waste in the dense smoke that ruined so many things about the city, but a blower was needed to keep up the draught, and that carried the particles of carbon up the flue in a constant stream.

With soft coal the chimney had to be blown out every twelve hours, but with the present mixture no blower is used. The flue is scraped once a week, just as it was with soft coal. It is not difficult to see by this that the forcing of draught costs money.

The mixed coal is kept very wet; in fact, fairly saturated. In this condition it does not escape from the chimney at all, either in smoke or in fine particles independent of the smoke. For the most part there is no perceptible smoke and it is never more than a

© 1895 SCIENTIFIC AMERICAN, INC.

thin jet that does not become darker than a light gray. One requirement is that the boiler capacity shall be ample. It is from having to crowd the boilers quite as much as anything else that so much coal is thrown out of the tops of chimneys unburned. The above results cannot be obtained if the steam-generating apparatus is scant.

A further result is the small cost of repairs, which is due both to the style of fuel and the generous boiler capacity. Last year, with insufficient boiler capacity, the repairs to the boilers cost over $2,200. So far this year, with sufficient capacity, the repairs have cost next to nothing.

With the fuel in the above proportion it is found that the expenditure of 2·6 pounds of coal an hour is, under the most favorable conditions, sufficient for developing one horse power at the Urban mill.

It is believed that the advantages in cost of money and labor and in the ridding of manufacturing centers of smoke and carbon deposits independent of smoke, which are shown by this experiment, ought to lead to the development of a new system of firing steam boilers. With such a system in general use coal now considered practically worthless could be made of prime value and a nuisance would be abated.

JOHN CHAMBERLIN.

90 Johnson Park, Buffalo, August 17.

Gold in Photography.

It is not our purpose to write a treatise on bimetallism, though the erratic changes in the price of silver of late years have added to the difficulties of the plate maker; gold being the standard metal in this country, the pound's worth of gold which a sovereign originally contained is still the measure of its value. It is the physical qualities of gold and its salts that we now discuss. It is not a little remarkable that in the present day we never hear of this metal as a light-sensitive agent. Yet, in the early days of the science, there was considerable promise in the experiments made in this direction. So long ago as 1840, Sir John Herschel investigated its properties at length, and these were still further examined by Hunt. Washing the surface of paper lightly with chloride of barium followed by a wash of chloride of gold, then exposing a few minutes to the sun's rays the portions of the paper acted on by light—first whitened by the light—became a full purple brown when held in the vapor of boiling water or even dipped in cold water. If for the barium salt oxalate of ammonia be substituted, the paper passes rapidly to violet purple; but as the same effect is produced, though more slowly, in the dark, it would be difficult to utilize this property. Again, using acetate of lead instead of barium, we get a paper sensitive to light, the faint image so produced being capable of "development" by steam or cold water. Bichromate of potassium and gold chloride solution give a light-sensitive paper. When the print is placed in cold water, the yellow tint disappears entirely in the whites, while the image, which has passed in printing through deep brown to bluish black, becomes, according to the extent of the solar action, crimson, blue, brown, or deep black. It is evident that here we have a fertile mine of experiment if any one care to work it; but, in modern photography, the chief interest of gold lies in the toning powers of its salts—mainly its chlorides.

It might be thought that little remained to be said upon this well-thrashed-out subject; but so far is this from being the case, that we may draw attention to two very interesting papers on the qualities of this salt which have recently been read before the Chemical Society, a brief reference to one of them having already been given. When treating of "chloride of gold," most writers have in view the acid chloride. Very few people have ever seen the pure gold trichloride, free from acid. Indeed, Watts says, "the only method of procuring auric chloride perfectly free from acid salt is to decompose aurous chloride with water." This aurous salt is made by evaporating a solution of the acid chloride to dryness, heating the residue to about the melting point of tin, and constantly stirring it as long as chlorine is evolved. An almost neutral solution of chloride of gold is obtained by evaporating a solution of the acid chloride till the liquid is dark ruby in color and begins to emit chlorine. When cool, the result is a dark red crystalline mass, very different from the usual yellow crystals. We may say that we have often pointed out, in instructions upon making toning baths, this fact. Ordinary solution of commercial crystals of gold chloride, or the double salt, is a pale yellow color, but the neutral salt solution is entirely different, it is a rich brown. If a useful toning solution, uniform in character, is to be made, it is this brown, not the yellow, solution that should be employed.

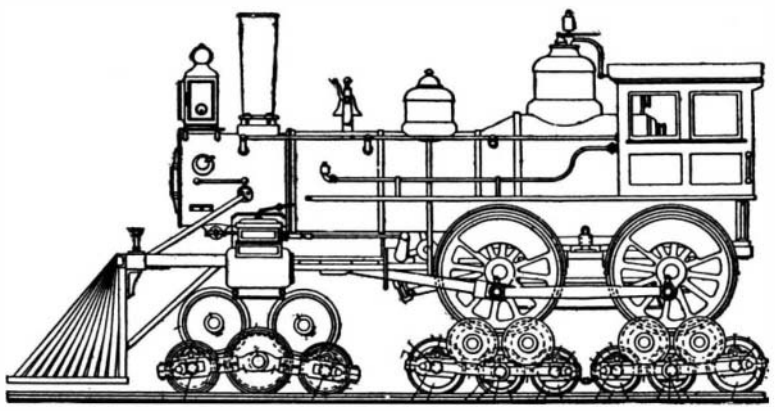
The question of the volatility of gold chloride or chlorine has often been before chemists, and most varied have been the opinions they have given. While one says it is entirely unvolatilizable, another says it can be driven off by heat at comparatively low temperature. A word of explanation of a table recently quoted by us may be given: The volatility referred to an atmosphere of chlorine, the words of Mr. T. K. Rose, whose paper was quoted from, being "it is certain that, when gold is heated in chlorine at atmospheric pressure, trichloride of gold is formed and volatilized at all temperatures above 180° C., up to and probably far beyond 1,100°."

Lest some of our readers who manufacture, and wisely, their own chloride of gold may be under the impression that, during the heating of the capsule in which it is prepared, some of the gold may be lost by volatilization, we will again quote from Mr. Rose: "It may be added that, when gold is heated in atmospheric air or coal gas, no gold is volatilized below 1,050°, and only about two per cent in thirty minutes at 1,100°. There need, therefore, be no trouble anticipated in heating the gold chloride to expel free acid in the usual manner."

Similarly free from danger of decomposition will the heating, if moderate, prove to be, for, again quoting Mr. Rose, we have: "The decomposition of gold trichloride in air might be expected to become perceptible at 70°, requiring, however, about twenty-five years for its complete conversion into monochloride, AuCl, at this temperature. The observed rate of decomposition at 100° shows that a similar change would require about 1,000 days at this temperature, while it results from calculation . . . that at 200°, thirty-six hours, and at the melting point, viz., 288°, less than one minute suffices for the complete decomposition of $AuCl_3$ in air." These interesting investigations, which have a practical value of their own, besides leading up to other practical aspects of our subject, do not leave us enough space to continue our survey at the present time, and we will therefore resume it at an early date. —Br. Jour.

SPEEDING TRUCK FOR LOCOMOTIVES.

Our engraving shows a device by William J. Holman, of Minneapolis, termed a speeding truck, which



A LOCOMOTIVE SPEEDING TRUCK.

consists of reversely flanged wheels having inwardly extended hubs running in contact with the treads of the locomotive drivers, and flanged traction wheels having outwardly extended hubs supporting the treads of said reversely flanged wheels, and with the axles of said traction wheels coupled by independent side rods adapted to oscillate about the central axles, whereby the speed of the locomotive may be increased without altering its running gear or increasing the speed of the moving parts and the requisite flexibility secured.

This machine might almost be termed the locomotive cycle. It appears to be intended to do for a locomotive what the bicycle does for a man—increase the velocity of travel over the surface of the ground without augmentation of exertion. By means of the bicycle a man can travel a given distance far more rapidly and with less expenditure of power than if he were to walk. It remains to be seen whether mounting a locomotive as here proposed will accomplish any such improved result. We understand an experimental truck is now in process of construction. The result of the trial will be duly noted.

Wood Pulp Pinions.

The great development of electrical mechanism during the past few years has caused engineers and mechanics to give special attention to anything connected therewith. It has been found that an objection to nearly all electrical power apparatus is the extensive vibration of the gear wheels, which in almost every instance revolve at a higher rate of speed than in ordinary machinery. The effect of this vibration is detrimental in several ways. The jar tends to loosen bolts and nuts. Besides, the noise created is not pleasant. A number of methods for overcoming the trouble have been adopted, among which has been the use of gears constructed on the combination plan, the spokes and rims being iron and the cogs wood. But the temperature affects wood, causing it to contract and expand, resulting in needed repairs and alterations in order to keep the mechanism going.

Compressed rawhide pinions and cogs made from same material have been adopted with some success. Even this material, however, has its drawbacks, all of which are claimed to be done away with by combining wood pulp with the same. Compressed rawhide and wood pulp form the foundation of the new pinions and adjustable cogs.

The Emancipation of Labor by Machinery.

One of the interesting proofs of the lightening of toil by the aid of machinery is found in the constantly enlarging sphere of labor being opened to self-supporting women, and the prediction is here made that within the next quarter of a century the ranks of the mechanic will be largely augmented by women.

Statistics show that the number of women to whom the sewing machine gives occupation to-day is vastly greater than the number who formerly gained a precarious livelihood with the needle, or who could obtain similar work under old conditions.

Contrast the "work-a-day" clothes and simply made "Sunday-go-to-meetin'" garments of the people of a century ago with the wonderful variety and complexity of finery comprising the holiday attire, and, indeed, the everyday wearing apparel, of those of a similar class to-day. If it is true, as stated, that one sewing machine operated by one woman will do the work of ten hand sewers, it is no less true that the modern woman possesses ten times as many garments as her sister of a former age, and each garment displays ten times as much machine-sewed work upon it.

But the sewing machine is a mere suggestion. The mind is fairly staggered in contemplation of the wealth of opportunity for wage earners that has been created by the steam engine—especially in the form of the steamship and locomotive, which have literally opened new worlds to the old world's poor. And what is true of the steam engine is true only in lesser degree of the telegraph, the telephone, the electric motor, the turbine and the whole range of modern agricultural machinery.

The modern bicycle—a theoretically perfect invention, and in some respects an almost perfect mechanism—has already produced beneficial effects upon the physical development of the wage-earning class sufficiently marked to attract general notice, and its future influence is incalculable. It is destined, in my judgment, to emancipate woman from many of the conventional shackles which have bound her for ages, and from some physical disabilities which have hitherto limited her sphere of occupation. This is only one of the many striking instances in which invention is helping to benefit the masses.

I am convinced that modern mechanical inventions have in all cases proved to be distinctively beneficial to the wage earner. He is through their aid better housed, better fed, better clothed, better educated, has more numerous and better amusements, and is thus approaching more nearly the condition of life of the employer; indeed, the wage earner to-day enjoys many advantages of civilization which were unknown to the employer of a generation gone by.

The majority of employers in this country are men who have risen from the ranks, and many of our most important inventions have been made by wage earners, who have the best opportunity, through experience in their daily work, to learn the necessities of the age.—A. E. Outerbridge, Jr., Engineering Magazine.

Queer Crankism of Electricity.

The Boston Journal of Commerce says that North Adams continues to be puzzled over a queer crankism of electricity in its vicinity. Although when the great 4½ mile Hoosac Tunnel was built no ores, magnetic or otherwise, were encountered, there was general expectation that rich ore pockets would be found; yet, for an unexplained reason, not an electrician has been discovered who can send a telegraphic message on a wire running from portal to portal of that tunnel, be such wire run inside of an ocean cable through the huge cavern or out of it. Therefore such messages have to be sent on wires strung on poles over the top of the mountain, fully nine miles, and that is the way in-going and outgoing passenger and freight trains are heralded to the keepers of the two tunnel approaches.

Phosphorescence.

M. Raoul Pictet, the French chemist, who has long been experimenting with intense cold, finds that phosphorescence ceases at very low temperatures. Glass tubes filled with sulphides of calcium, strontium, and barium were exposed to the sun and then taken into a dark room where the intensity and duration of the phosphorescence was noted. After being again exposed to the sun the tubes were put into a mixture where by rapidly lowering the pressure their temperature was reduced to —140°; they then showed no sign of phosphorescence, but after a time the upper parts of the tubes which had been least cooled began to glow, and as the temperature rose the light extended, becoming at last as bright as in the first experiment.

© 1895 SCIENTIFIC AMERICAN, INC.