width, and the cost of the single lines would be much less, even if labor and material were at the same price in each case. Practically, the United States traffic is moderate, and spread over a large area of line, while ours is enormous, and spread over a very limited area. Hence, with us solidity and durability are of absolute importance, qualities which, as a rule, do not distinguish American railway construction.

Sleepers are an item of serious cost also with us; and the geological structure of our islands is such that cuttings, embankments, and tunnels are of constant occurrence, a level piece of line, except in the east of England, being of very rare occurrence. In the United States, on the contrary, the contracted contour of our country becomes expanded. Level plains are of enormous extent; and if there are obstacles, such as hills and mountains, the cheapness of land and construction permits a *détour* which would be simply ruinous, if not impossible, with us.

An interesting question, and one of great importance, as affecting railway enterprise, is that involving area, population, and commerce; and in this the comparisons between the United States and ourselves is remarkable. In 1861 our population was 29,321,288; in 1860, that of the United States was 31,443,321. In 1871, ours was 31,817,108, and that of the States in 1870 was 38,555,983. The latter, therefore, increased by seven millions, while our increase in the same period was about two and a half millions; the American increase was thus nearly three times that of ours. Comparing the respective areas, ours is 121,115 square miles against 3,034,459 of the States (exclusive of Alaska), of which about one fourth only is under civilization; but this area is six times that of ours, say 750,000 square miles. Our ratio per square mile is 250 persons against about 51 on the limited area just estimated. It results that, while both goods and passenger traffic is carried on in a compact area with us, the reverse occurs in the States. If precisely the same traffic took place for an equal population, at the same cost of material, wear and tear, etc., in both countries, it is evident that the States lines would be ruinously expensive. But fortunately for them the general cost of management and repairs is much less.

The management of the United States railways has been a subject of much complaint, and blame has been cast alike on engineers, directors, and other officers of the companies. We are not disposed to dip our hands into dirty water, of which abundance has been scattered about lately.

On the other hand, however, the resources of the country are enormous. Generally the soil is of inexhaustible fertility for the growth of corn, cotton, tobacco, etc. The forest districts afford endless supplies of almost every kind of useful and ornamental woods. In the mineral kingdom few valuable products are absent; coal, iron, copper, lead and most metals being found in abundance and frequently of the richest ores. All these natural products will tend to foster railway enterprise; and if this, in future, be restricted in its extension to the actual wants of the country, instead of its supposed distant necessities, it is impossible but that railway enterprise in the States can be other than of the most profitable and prosperous character at no distant period.—*Engineering.*

Gas Purifier and Mixer.

M. D. Colladon says: Gas requires to be freed from particles of solid matter, naphthalin, coal tar, ammoniacal salts, etc., as well as from gases such as carbonic and sulphurous acids. For washing it, vessels have been employed similar to Woolf's bottle, in which the gas traverses water or a suitable solution through a metallic network, in the form of bubbles or continuous currents. This arrangement is insufficient for working on a large scale; because the bubbles of gas take a spherical form, and consequently present a minimum of surface for a maximum volume.

Further, this method requires a decided increase of pressure, which is inconvenient. The chemical cascades, in which the gas passes upwards through a fine rain of the washing liquid, act much better, but they require too large a quantity of liquid. Coke towers (scrubbers) produce a more complete effect, but the action is very irregular. The new mechanical washing apparatus has the advantage of producing very powerful action without requiring large dimensions. At Geneva it yields coal gas, superior both in illuminating power and in a sanitary point of view. Less purifying matter is also required than on the old system. The same apparatus will doubtless prove useful when it is required to saturate a gas with the vapors of a liquid, for example, hydrogen with the vapor of petroleum. The system rests on the principle that the best arrangement either for washing a gas or saturating it consists in making it strike, in the form of currents as thin as possible, against solid walls kept perpetually moist. The currents are broken against these surfaces, and are prevented from moving on in a straight line. The gaseous particles are thus always kept in a rotatory movement, and are pressed against the moist walls, so that they either absorb the substance diffused over these walls or may deposit there a part of their own substances, according as it is required to saturate the gas or to wash it.—*Chemical News.—Comptes Rendus.*

New Method of Tempering Steel and Regenerating Burnt Iron.

M. H. Caron says: A piece of steel is generally tempered, and then reheated more or less according to the hardness nd the elasticity which it requires to receive. The dry temper, as commonly practiced, that is to say, plunging the red hot metal into cold water, has the drawback of developing cracks and crevices injurious to its tenacity. Reheating does not remove these flaws; and subsequently, on use, these fissures, though invisible at first, increase and terminate in fractures. It has already been discovered that, in order to escape danger, it is preferable to temper the steel a little softer and afterwards to reheat more slightly. The author has succeeded in producing the combined effects of temper and reheating in one operation, and of removing as far as possible the chances of flaws. This is done by heating the water, into which the red hot metal is plunged, to 55°. Tempering in hot, or even boiling, water modifies soft steel containing from two to four thousandths of carbon. This process augments its tenacity and elasticity without sensibly altering its softness. The texture is changed and becomes fiberous, even if previously crystaline. The author's method for restoring burnt metal is likewise to plunge it at a red heat into a hot liquid.—*Ibid.*

New Dyeing Recipes.

[Reimann's Färber Zeitung.]

This number contains a recipe for a safflower rose on glazed calico. The dressing consists of 50 lbs. of wheat starch, 20 lbs. of wheat flower, 4 lbs. of white wax, and 6 lbs. of cocoa nut oil, a little sulphuric acid being added to the water in which the starch is mixed.

There are also recipes for light and deep Prussian blues on glazed calico; for a green (extracts of indigo and of quercitron) on jaconnet; a peach wood crimson on glazed calico and jaconnet; a brown on calico with Bismark brown and magenta; a gray drab on wool, and a scarlet on woolen cloth and flannel; also a blue (soluble aniline blue) and a coffee brown on plush; a violet on woolen yarn. The mordant in this case consists of 1½ ozs. of tannic acid, dissolved in hot water in which ½ oz. of Marseilles soap is next dissolved; ½ oz. rape oil is next added, and stirred up till it forms an emulsion. The liquid is used at 167° Fah. The bleached yarn is worked in this mordant for fifteen minutes, and then withdrawn. The color bath, at the same temperature, is prepared with 5 ozs. of alum and the clear solution of 1 oz. of methyl violet.

There is also a prescription for a light green on cotton yarn, the color being methyl green fixed with tannic acid.

The editor gives a recipe for a brown on shoddy containing a mixture of cotton, called on the continent *velour*. To 100 lbs. of this material, make up a bath of 30 lbs. of fustic, 3 lbs. of alum, 2 lbs. of prepared tartar, and 1 lb. of blue vitriol, in which the shoddy is boiled for half an hour. To the same flot are then added 1 lb. of chromate of potash and ¾ lb. of aniline red, ruby, or aniline crimson, known on the continent as rosain. The dyeing is carried on at a gentle boil, and turmeric added to modify the shade. Logwood may be used, if needful, to darken. Aniline is refuse magenta; it is dissolved in hydrochloric acid and boiled in water previous to use.—*Chemical News.*

Alleged Presence of Iron Filings in Tea.

In several cases of prosecution under the adulteration act which have recently been reported, the analyst has been able to demonstrate that a magnet thrust into a specimen of tea would attract certain particles which were stated to be iron filings, and held to be indisputable proof of a fraudulent admixture. That this inference is necessarily correct has, however, been disputed in more than one quarter. Mr. Treffry, of Exeter, England, writing to the *Grocer*, asserts that the mineral matter found in tea is not iron filings but a native magnetic oxide of iron, and he states that "it is probably titaniferous iron sand, which is very abundant in China." Mr. Alfred Bird, F. C. S., of Birmingham, says that he has separated particles of mica and quartz from the magnetic oxide of iron found in tea, his inference being "that, as magnetic oxide of iron forms part of the soil of China, it would rise with the dust of the country, and coming in contact with the damp leaves would adhere to them when they are dried, and thus make the dried leaves stick to the magnet as if there were iron filings mixed up amongst them." Speculative, to say the least, as this may seem, it would appear to receive some support from an experiment made by Mr. Bird upon some French bean leaves grown in his own garden. One hundred grains were dried, and upon testing with a magnet were found to be attracted by it in a similar manner to that reported of some specimens of tea leaves. A closer examination of the matter adhering to the leaves showed that it was magnetic oxide of iron, and 0·02 of a grain was obtained from the 100 grains of bean leaves. An investigation of the black mold of the garden in which the plants were grown showed that it contained an abundance of magnetic oxide of iron.

If all that the opponents of the adulteration act say against it were true, it would be but little to be able to reply that it is not an unmitigated evil; but still it is a fact that the act has given a great impulse to the investigation of food substances, the benefit of which must appear in an acquisition to our store of knowledge respecting this important subject. For even should Mr. Bird's speculations prove correct, it would not be the only instance that has recently come under our notice where the presence of a gross adulterant has been alleged upon insufficient grounds.—*Pharmaceutical Journal.*

DENTIST'S SOLDERS.—I. H. P. says: For gold solder, use 8 grains American silver coin and 4 grains best copper wire (or copper from an old style cent) to each pennyweight of gold plate of the same fineness as that to be soldered. For silver solder, use 8 grains best brass wire to each pennyweight of silver coin. Melt with borax, cool, and roll into plate.

THE Hoosac tunnel alignment proves to have been very accurately made. The error in vertical alignment was only nine sixteenths of an inch, and that in the level was one inch and a half. This result is very creditable to the engineers.

SCIENTIFIC AND PRACTICAL INFORMATION.

A NEW WEATHER VANE.

The old weathercock has three essential faults; it indicates a direction when there is a dead calm, it gives no means of learning the force of the wind, while it fails to show the true course of the same, by exhibiting merely its horizontal component. M. Tany proposes the arrangement to be attached to the ordinary lightning rod. Just above a suitable shoulder on the latter is placed a copper ring, grooved and made into a pulley easily rotated in a horizontal plane. Around this passes a knotted cord, the ends of which are secured to the extremities of a short stick or metal rod, to which is secured a simple streamer. Thus constructed, the vane indicates a calm by falling vertically, and besides shows the strength of the wind by being blown out more or less from the lightning rod. As is evident, it is capable of motion in every direction, so that if there exist in the wind an upward tending vertical component, the same will be shown.

NEW MODE OF SHOWING NODAL POINTS IN SOUNDING TUBES.

Bourbouze proposes, as an improvement upon the Kœnig capsule generally used for the above purpose, the employment of a simple membrane of rubber on which is attached a very light silvered mirror which oscillates with it. If rays from a luminous point be reflected upon the mirror, and the image passed through a lens, the image is lengthened, and often transforms itself into an ellipse. It reaches its maximum elongation when the mirror is placed at a node, but retains its immobility when reaching the points corresponding to ventral segments. The device, it is stated, can be placed at the extremities of Helmholtz's resonators, or of the rubber tube attached to these instruments, and the mirror vibrates when a mixed sound is produced, containing the note proper to the resonators, to which it is applied.

AQUEOUS EXHALATION OF PLANTS.

M. Barthélemy, after a series of experiments on the above subject, concludes that in plants there is an insensible exhalation throughout the entire cuticular surface, through the medium of a true gaseous dialysis; that there is an abrupt emission of saturated gases which escape by breathing apertures when the plant is submitted to a rapid elevation of temperature, especially when under a bell glass; and that there is finally an accidental exudation, the result of defects in equilibrium between the absorbent action of the roots and the work in the aerial portions for the fixing of the carbon added to the elements of the water, a labor which ceases when light disappears.

SIMPLE METHOD OF DETECTING ADULTERATION OF WINE.

Into a small quantity of the wine to be tested, says *Le Temps*, drop a piece of potash. If no deposit is formed, and the wine assumes a greenish tint, it has not been artificially colored. If, however, a violet deposit appears, elder or mulberries have been used. If the deposit be red, the adulteration is sugar beet; if violet red, campeachy wood; if violet blue, privet berries; if clear blue, coloring matter obtained from sun flowers.

IMPROVEMENT IN PHOTO-LITHOGRAPHY.

M. Paul proposes the substitution of albumen for gelatin in the bichromate process. The paper is covered with a thin layer of albumen, to which a concentrated solution of bichromate is added. After sufficient exposure under the negative, the sheet is covered with lithographic ink and then immersed in cold water in order to dissolve the unaltered albumen, which is removed by fine sponge. A very clear image, it is said, is thus obtained, ready to transfer to the stone.

PHYSIOLOGICAL PROPERTIES OF CAFFEIN.

The physiological action of coffee, according to MM. Aubert and Haase, should not be attributed to caffein, but to other principles. An injection of 0·6 cubic inch of coffee containing 0·6 grain of caffein killed a rabbit in a very short time, producing acceleration of the pulse and respiratory organs, uneasiness, and finally convulsions. An injection of 0·75 grain of pure caffein, however, did not produce death nor even any symptoms of sickness. An infusion of 770 grains of very hot coffee, corresponding to 6·3 grains of caffein, acts upon a man far more intensely than a stronger dose of pure caffein. Headache, vertigo, trembling, and similar symptoms are produced, which last upward of four hours. Coffee extract, deprived of caffein by chloroform and injected into the jugular vein of a rabbit, causes strong convulsions, but never tetanus, such as is produced by an overdose of caffein singly.

JAMES VICK, the Rochester (N. Y.) seedsman and florist, informs us that he manufactures and sells the tent roof garden chair illustrated in this journal some time ago. It will be remembered that we recommended its introduction in this country. We are glad that our suggestion has been anticipated.

MR. A. PELL desires such of our readers as have old numbers of the SCIENTIFIC AMERICAN which they do not want, to send them to No. 18 East 30th street, New York city. Any papers sent will be distributed in the Bellevue Hospital and other charitable institutions, where they are frequently asked for and eagerly read by the patients.

A STRONG colony of bees has been known to build one hundred square inches of comb in twenty-four hours; at that rate, over sixty sheets of comb a foot square could be constructed in three months. The *Annals of Bee Culture*, mentions a swarm that built nine sheets of comb, ten by thirteen inches, in ten days.