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Contents.

(Illustrated articles are marked with an asterisk.)

Acid proof vessels (10)..... 155
American industries*..... 149
American minerals, native..... 148
Army worm, further notes on the 152
Astronomical notes..... 154
Aurora borealis 153
Bathing apparatus, portable*.... 148
Boilers, steam, inspection of..... 144
Boy, small, nature of the..... 148
Butterflies, evolution of species. 151
Calendar stone, Mexican, the. .. 150
Corn, to can (9)..... 155
Cotton crop, the, to tie..... 148
Cotton factories, Petersburg, Va. 145
Drying a specific gravity bottle.. 151
Electrical machinery, some new* 150
Engineering inventions..... 150
Engines, pumping, manufacture* 149
Evolution, species in butterflies. 151
Exhibition of gas and elec. app.. 149
Fast, great, Dr. Tanner's..... .. 144
Fence post and sill, concrete*.... 147
Fires, harbor, appliance for..... 145
Folding stand, novel* 147
Gas and elec. app., exhibition of. 149
Glass, composition of (6)..... 155
Grimmer's prophecy 149
Gulf Stream, table land across.. 154
Harbor fires, appliance for... . . 145
Hop growing in the United States 149
Horses, Percheron, importation. 151
Hydraulic works, Worthington*. 143
Industries, American* 149
Inventions, engineering..... 150
Inventions, miscellaneous..... 146
Inventions, new..... 147
Jumping, rope.. 148
Kettle, tea, improved*..... 146
Lawn mowing made a pleasure* 146
Locomotive, road, light, wanted 148
Meters, water, manufacture of*.. 149
Minerals, American, native 148
Nickel plating*..... 153
Paper—how it is made..... 153
Patent laws, English..... 150
Patents, decisions relating to.... 152
Petroleum as fuel..... 154
Platinum and iridium in Maine.. 150
Pork making in brief..... 154
Prophecy, Grimmer's 149
Pumping engines, manufacture.. 149
Rain theories..... 145
Rope jumping..... 148
Silver plating, natural..... 145
Spirits, to purify (8)..... 155
Spotted triton, the*..... 147
Stand, folding, novel*..... 147
Table land across Gulf Stream... 154
Tanner's (Dr.) great fast..... 144
Tea kettle, improved*.... 146
Telescope, folding* 148
Tunnel accident, Hudson River. 148
Type writer ribbons (12) 155
Water meters, manuf. of* 149
Weakness, human, profits of.... 145
Well, a, that needed cleaning. .. 147
Worm, army, further notes on... 152

TABLE OF CONTENTS OF
THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 244,
For the Week ending September 4, 1880.

Price 10 cents. For sale by all newsdealers.

PAGE

I. ENGINEERING AND MECHANICS.—Locomotive Steam Crane. 3 figures. Locomotive Steam Crane at the Barrow Shipbuilding Works. Perspective and sectional views.... 3879
Changing a Railway Gauge. By AUG. MORDECAI 3880
Automatic Feeding Apparatus for Steam Boilers. 3 figures. Fromentin's Apparatus 3880
A Remarkable Gas Explosion in the Streets of London 3880
Chain Fire Bars. 1 figure..... 3881
Sir Henry Bessemer. Story of Sir Henry Bessemer's life and inventions.—Early struggles.—Canceling stamp.—Defrauded by Government.—Bronze powder.—Bessemer steel.—Making steel from cast iron without fuel.—Trouble from phosphorus.—National honors.—One hundred patents.—A new furnace.—Recent labors.—The greatest and most powerful telescope in the world 3881
Shearing Strength of some Timbers 3881

II. TECHNOLOGY.—The Fabrication of Aino Cloth. By Prof. D. P. PENHALLOW A remarkable primitive industry. Plate I. 7 figures. Instruments used in weaving Aino cloth. Plate II. 8 figures. Method of stretching and tying warp threads. Plate III. 7 figures. Patterns and position of parts 3883
The Tanning Process. By Dr. CARL BOTTINGER..... 3887

III. CHEMISTRY.—The Value of Chemical Investigations of Food.. 3888
A Bromated Derivative of Nicotine By A. CAHOURS and ETARD. 3888
A New Aluminum Sulphate (Sesquibasic). By P. MARGUERITE. 3888
On the Critical Point of Mixed Vapors. Liquefaction of carbonic acid in the presence of other bodies.—Liquefaction of carbonic acid with trichloride of phosphorus.—Liquefaction of carbonic acid with tetrachloride of carbon.—Liquefaction of carbonic acid and chloride of methyl.—Carbonic acid and hydrochloric acid gases.—Carbonic acid and bromine.—Carbonic acid and camphor... 3888
Manufacture of Citric Acid. By J. CARTER BELL..... 3889

IV. PHYSIOLOGY AND HYGIENE.—Respiration at Various Altitudes on the Island and Peak of Teneriffe. By W. MARCET..... 3885
Hearing by the Aid of Tissue Conduction.—The mouth trumpet and the audiphone 3887
Dr. Tanner's Fast..... 3890
Salicylic Acid for the Cure and Prevention of Diseases in Cattle and Live Stock..... 3891

V. PHYSICS.—Contributions to Molecular Physics in High Vacua. Recent investigations by Prof. CROOKES.—Magnetic deflection of molecular trajectory.—Laws of magnetic rotation in high and low vacua.—Phosphorogenic properties of molecular discharge.—5 figures..... 3886
Stored up light 3887

VI. NATURAL HISTORY, ETC.—The Climbing Perch. 1 figure... . 3892
The International Bench Show at Berlin. 14 figures. The prize dogs at the Berlin Bench Show..... 3892
Aztec Ruins, Colorado. 1 figure. Ground plans of ruins at Aztec Springs, Southwest Colorado..... 3894

VII. MICROSCOPY.—An Evening with Fasoldt's 1,000,000 Test Plate. F. S BURREL 3885
The Microscope in Writing. What the microscope reveals in the examination of handwriting. By Dr. R. H. WARD..... 3885

VIII. ARCHITECTURE.—Carlisle Cathedral. Full page illustration. Drawn by S. READ 3882
Description of Carlisle Cathedral.... 3883

THE INSPECTION OF STEAM BOILERS.

There is no doubt that a steam boiler is in many respects a much more dangerous neighbor than a powder magazine. In order to be safe a steam boiler needs continual attention and care, while neglect or ignorance may have the most fatal results. In regard to a powder magazine, all it needs to be perfectly safe is to be left alone. Neither neglect in the watch nor absence of attendants can involve any danger; in fact, when the doors are securely fastened, no attendance whatever is needed. The only dangers are downright imprudence with fire, and lightning; both are easily guarded against by very simple precautions and well constructed lightning rods. Age will not deteriorate a powder magazine; on the contrary it will prove the reliability of its construction and management and the safety of its location; but, on the contrary, age is, in a steam boiler, an element of the most imminent danger, and, as experience shows almost daily, it is the main cause of the disasters which of late have become alarmingly frequent.

It is a peculiarity of human nature that familiarity with danger begets contempt of the same; hence that owners and managers of steam boilers have proved themselves so neglectful that all civilized governments have enacted laws to secure more safety against steam boiler calamities (we will not say accidents, as every thing has a cause) than are afforded by the care of the owners themselves and their engineers.

We have such laws, but unfortunately they are not sufficiently effective, and this for several causes: first, they are not framed according to the full light which science and experience has shed upon the subject; they only require a test of hydraulic pressure of the boiler, a test which will not reveal weak spots which may be the result of faultive design, imperfect construction, or wear by age—weak spots which, being worn down so far that they could just stand the pressure of the test, soon after, by continued wear, give out at a lower pressure. The Sewanhaka disaster appears to be due to a cause of this kind: namely, in the supposition that the boiler had actually been tested at the pressure required; but there are doubts in this regard, as it is well known that inspectors appointed by the government have often been neglectful in their duties, and, trusting to good luck, gave the certificates without making the test to the full extent as required by law. This is a second cause that the laws passed by the United States Government for the public safety in regard to steam boilers have not been as effective as intended and expected.

A third cause is the incapacity of many of the inspectors, who used to be appointed after an examination so ridiculously easy that any schoolboy who has learned his lessons in natural philosophy can pass it. We are glad to say that recently great improvements have taken place in this regard, so that when the old, ignorant inspectors are weeded out, and more capable ones are appointed in their stead, public safety will become greater in this regard, provided, however, that also the inspectors are men of integrity, who will not hesitate to condemn boilers even when the owner offers a bribe to save himself from the great expense involved by the purchase of new ones.

The thorough investigation to which the Sewanhaka disaster referred to above has given rise shows that a small weak spot in a tube in the rear of the furnace, by suddenly giving out, threw a jet of steam forward, which, like a back draught, threw the fire out of the furnace doors and ash pit, and set the dry woodwork around at once in a blaze. This escape of steam was so small as not to interfere perceptibly with the boiler pressure, as the engine could be kept running until the boat was run ashore, which was done so successfully that all lives might have been saved if the passengers had not lost their presence of mind in the panic which ensued after the discovery of the fire.

There is one consolation after such calamities, not for the poor victims and their relatives, but for the survivors and the public in general. It is that every such incident teaches a lesson which makes the future more safe in this regard. The disaster in question promises to be especially useful in this respect. It will result in a revision of the laws on steam boiler inspection, on the choice of the men to be appointed as inspectors, and on their behavior after being appointed, convincing them that they are not irresponsible for the consequences of their carelessness in giving certificates for old and worn out boilers, as was the case with the Sewanhaka. They have, as well as the owners of the boat, been arrested for manslaughter.

In regard to the revision of the law, the best which can be done is to adopt the mode of inspection practiced by the steam boiler inspection and insurance companies in London, England, and in Hartford, Connecticut. These companies, who make themselves responsible for damages to boilers under their charge, are not satisfied with the mode of inspection prescribed by the United States law, but add to this a thorough test of all parts of the boiler by means of the hammer handled by a practical expert, who in this way can detect any weak and dangerous spot. If such a spot is found the owner has to have it properly repaired, or the company will not insure it, which is only done after approval by their own inspectors.

Statistics are there to prove the results. While boilers approved by the United States inspectors have been continually exploding, sending death and destruction around, the explosion of boilers in charge of the insurance companies has very rarely caused any disasters, and if one gave out, it was always proved to be caused by the most gross carelessness or recklessness of those in charge. Many boiler owners, therefore, have grown disgusted with the United States inspection, calling it a farce and an imposition, and the flourishing condition of the inspection and insurance companies has been the necessary result.

DR. TANNER'S GREAT FAST.

We call the attention of our readers to the full account of Dr. Tanner's world celebrated great forty days' fast to be found in the SCIENTIFIC AMERICAN SUPPLEMENT of this week, No. 244. It is from the pen of Dr. Vander Weyde, who, in his position as one of the watchers, and in his capacity as Professor of Chemistry of the U. S. Medical College, when the fast took place, had charge of the chemical and microscopic investigations, and therefore ample opportunity to collect the data required to give the complete account of this remarkable physiological experiment.

It should not be lost sight of that this case is very different from cases where a fast is held by necessity, such as being compelled by disease, by shipwreck, by being lost in a wilderness or forest, being buried in a mine, or lost in a cave. Dr. Tanner had enormous advantages over all these cases, and hence that he could indulge at once in hearty meals, as his digestive apparatus was not impaired by disease, nor his nervous system shattered by anxiety; in such cases it would be very dangerous, if not fatal, at once to indulge immediately in such abundance of food. In the case of shipwreck, the exposure of the survivors, resulting in a total want of any comfort, but to the enduring a suffering from other distressing discomforts, and exposure to the elements, contributes as much if not more to the fatal results than the need of nourishment. To this must be added the anxiety and uncertainty which keeps the nervous system upon an exhausting strain. It is the same with those being lost in a wilderness or forest, Of these the forest gives the best chances of survival; but in case of burial in a mine, the utter want of light and the gloom surrounding the victim, combined with the extreme anxiety, make a fast under such circumstances the most destructive to the nervous system. Persons who, for instance, were lost in caves, such as frequently happened in the Mammoth Cave, were, after only a few days' search, found to be nearly insane, so much so that they hid themselves from the searchers.

It is evident that Dr. Tanner had an easy time, if his fast is compared with that of any of the fasters for causes mentioned above. If he had been locked up under the threat that no food would be given him for forty days, he surely would not have stood it so well, as the mere consciousness of the constrained situation would have affected his mind, and all ease and comfort would have been at an end. To the contrary, his mind was kept at peace because he had plenty of air and water, the comforts of good shelter, and all the conveniences of civilized life; he could read his papers and keep up his usual correspondence, walk, ride, or stay at home, converse with congenial friends, and, best of all, he knew that if he wanted food it would cost him only a word to obtain what he desired at once. Fasting under such circumstances can, of course, be much longer prolonged than if it is done by necessity.

These facts were overlooked by those who from the first declared a forty days' fast an impossibility, and staked money on it. They were not well informed about actual fasts for so long a period, of which there are instances on record, or they did not believe the truth of such records. They judged only from the results of many well known constrained fasts which ended fatally within thirty, twenty, and even ten days, and were kept under unfavorable conditions, often by delicate girls of comparatively tender age and of a feeble constitution, perhaps of consumptive tendency to begin with; therefore they declared all claims of those who pretended to be able to fast as long as forty or even only thirty days as fraudulent and impossible without the deception of secretly taking food. Having this as a fixed idea in their minds, they expected that a careful watch would surely cause the death of any man who pretended to be able to fast for so long a period, and hence the clamor of defective surveillance.

It must be a satisfaction to Dr. Tanner that his uprightness and honesty in regard to keeping strictly to the conditions of his self-imposed trial are now generally granted even by his former most violent opponents, who acknowledge freely that his behavior as a gentleman has proved him to be far above surreptitiously taking food while he was pretending to fast.

They have had their eyes opened to the fact that Dr. Tanner's case was very different from most other real or pretended fastings; that in him we have a man of a strong, tough, and wiry constitution, at an age between forty and fifty, which, for such a constitution, is that of the greatest resistance, a man provided with a copious layer of adipose tissue or fat around his body, and of a weight of one hundred and fifty-seven and a half pounds, which is far above the average for his height, which is rather below the medium, so that he must be classed among the small men. A tall man of that weight surely would not stand it as well. Even a tall man of greater weight would possess no advantages, as army statistics prove that large men, who may be stronger in regard to muscular power, are less strong in regard to their powers of endurance than smaller men, who, as is well proved by long experience, stand various sorts of privation and fatigue better than large men, who usually are the first to break down under each circumstances.

Dr. Tanner may not have proved that everybody can fast forty days, but if he has only proved that man can fast

longer than has generally been supposed, that we are all eating too much, and that for a family remedy, fasting affords a better, safer, and more economical cure than the taking of all sorts of patent medicine, to which many people are so much addicted, he has done a really good work.

We recommend to our readers the perusal of the full account of the fast.

EFFECT OF STARVATION ON THE BLOOD.

Further observations upon the gradual improvements of Dr. Tanner's blood have made it necessary to modify the statements made at the close of the article on this subject in the last number of the SCIENTIFIC AMERICAN (see page 128). It was noticed that the quality of the blood varied greatly in different specimens obtained from day to day, and even in specimens drawn the same evening. It was at last found that if the blood was drawn from a very small puncture, from which it had to be pressed out forcibly, it was found to be in a much worse condition than if drawn from a deeper puncture from which it flowed freely. It is evident that in the first case it was drawn only from the capillaries, and in the second case from the larger vessels, in which a regular circulation takes place. This appears to prove that the abnormal corpuscles linger in the capillaries, and that it takes time to remove them therefrom, while in the larger vessels, in which free circulation takes place, restoration may already have been accomplished to a considerable extent. Close observation appeared to show that this restoration was taking place in two ways, by a cleaning and healing process of the affected corpuscles, and by the formation of new ones. The first was proved by the observation of corpuscles in all stages of the healing process from the most abnormal to the perfect smooth ones. Some of those which had become free of fungoid spores appeared, however, to have suffered considerably, some were partially destroyed, some were only half or parts of perfect corpuscles, and no doubt such will be either eliminated from the system or the defective parts healed up. Which of these takes place is a question. The second process of restoration was proved by the appearance of fresh and small corpuscles, looking very smooth and perfect, and bearing the stamp of youthfulness upon their appearance—we would almost say countenance—a freshness which became more striking the higher the magnifying powers were by which they were observed, in comparison with the affected corpuscles, in which the higher powers showed the imperfections more strongly.

This corroborates what other microscopists have observed in regard to the formation of new young blood corpuscles. It has, however, been denied by others who failed to observe it; but this is merely negative testimony, of which there appears to be a great deal in the medical profession; it proceeds from a kind of conservatism, which lies at the basis of all the medical intolerance manifested by the so-called regular school against all supposed innovations, even among their own brotherhood.

A striking illustration was offered in this regard by the discovery of Prof. Cohnheim, of Kiel, who found that pus globules could originate from the white blood corpuscles, but whose observations were most strenuously opposed at first by the majority of the profession, who could not see it. It may be mentioned here, as it has some relation to Dr. Tanner's fast, by which fast the number of his white blood corpuscles was more than quadrupled. It is well known that persons subject to privation of food have a strong tendency to pus formation and running sores, and if starvation increases the number of white corpuscles, these combined facts appear to support Cohnheim's theory. The opposition against it was, however, set at rest by Dr. Bastian, in London, and Surgeon Woodward, U. S. Army in Washington, who verified Cohnheim's observation, and by Huxley, who adopted it in his great lecture on protoplasm.

The number of white corpuscles did rapidly diminish after the fast in Dr. Tanner's blood, and was soon reduced to the normal proportion; but the interesting change in the red corpuscles and their very gradual restoration during a length of time, is a contribution to science which Dr. Tanner has given after the end of his fast, and this should be acknowledged.

MAKING PROFITS OUT OF HUMAN WEAKNESS.

It is not only among lawyers that a certain class is found who induce quarrelsome or avaricious people to go into lawsuits by telling them they are right and must seek redress by law. They do this only for the purpose of obtaining their professional fees, in place of giving them the honest advice to settle amicably, by mutual agreement, as *in nine cases out of ten would be far better.*

We find the same class of men among doctors, who, when people mention some slight ailment, make them believe that they are sick, or soon will be very sick if they do not take a certain course of medical treatment which they will prescribe. They also do this for the purpose of obtaining a professional fee, in place of giving them the honest advice to fast for one or two days, to take rest, and to stop drinking and smoking, if they are addicted to these vices. *In nine cases out of ten this would be far better.*

The lawyer of this class makes the client believe that he has been wronged, and the doctor makes the patient believe that he is very sick. They all have their own profit in view, and play upon human weakness, which, in some individuals, consists in combativeness, in others in imaginary weakness of body, and again, in others, in conceit about their mental accomplishments.

There is no profession in which men can make money out of it by telling people about their weakness of mind. The only mental weakness of which people sometimes complain is defective memory, but they will never complain about defective judgment or defective common sense. This agrees perfectly with what a German physician has lately argued in an essay, that insanity is a blessing, as the insane live in an ideal sphere, which usually is far happier than the reality in the world of trouble through which they have passed and which made them insane. But the fools outside the asylums, which largely outnumber those in confinement, are happy also, while the sensible people have all the cares. How far it is right to attempt the cure of the insane is another question. The German physician referred to considers it an act of unkindness, if not cruelty, to restore the happy lunatics in asylums again to this world of troublesome realities, while we consider the cure of the lunatics out of the asylums an impossibility. Already Solomon had found this out when he said: "Though thou shouldst bray a fool in a mortar among wheat with a pestle, yet will not his foolishness depart from him."

NEW APPLIANCE FOR HARBOR FIRES.

The recent total loss of the steamer City of New York by fire in this harbor, as well as the extensive destruction of property at Hunter's Point caused by the going to pieces of the burning bark Nictaux, suggest the urgency of new appliances for our harbor fire service, which, had they been in use, would have greatly limited the damage.

If the fire boat Havemeyer had been provided with a ram, so as to be able to scuttle the burning ships as soon as it became evident that the engines were unable to subdue the fire, the ships as well as the cargoes would have been saved with comparatively little loss.

To furnish the Havemeyer with an orthodox ram now would scarcely be advisable, as she has not been built for that purpose, and therefore would have to undergo alterations which would necessitate her withdrawal from service for a considerable time. There is, however, a simple way of fitting her with a ramming apparatus without altering her at all. A long, heavy floating spar, lashed to her side, and protruding from twenty to thirty feet from her bow, might be carried on board, to be used when called for. Experiments alone can decide whether she will be able to bear the strain of the collision when this spar is fastened by strong ropes, which will not part by the contact, or whether the ropes ought to be so thin as to part by the shock. Perhaps it might be found most practicable to cut the lashings a second or two before the collision takes place, and leave it to the impetus of the spar alone to break the burning vessel's side, and enable the Havemeyer to steer clear of the wreck.

The shortest way to scuttle a ship, however, would be the application of *small torpedoes* loaded with some high explosive, for instance dynamite. The torpedoes could be constructed just powerful enough to knock a hole of certain dimensions in a ship's bottom, and might be applied either by a spar from the Havemeyer direct, or, when practicable, they could be fastened to the burning vessel by competent men in a rowboat, and then be exploded by electricity from a safe distance. In cases where the vessel's cargo consists of naphtha or other highly inflammable substances, the spar ram would have to be resorted to.

We have no doubt that General Abbot, commanding the United States Engineer Battalion at Willetts' Point, would be willing to instruct our fire commissioners about the proper charge of dynamite required for the operation, and the authorities of the Brooklyn Navy Yard would be able to give every facility and the best advice for rigging the necessary torpedo spar on board the Havemeyer.

RAIN THEORIES.

Some years ago, at the occasion of a long continued drought, several individuals published suggestions in the papers for means to produce rain. One which was brought prominently forward was that some big fire should be made. According to the theory suggested, the ascending hot air currents, aided by the water formed by the combustion of the hydrogen present in most all ordinary fuel, a copious rain would surely result. As an argument it was brought forward that rain storms have often succeeded large battles, when a great deal of gunpowder was burned. Unfortunately for this theory the amount of hydrogen present in the charcoal of gunpowder is so insignificant as practically to amount to nothing, while the chief products of its combustion are carbonic and sulphurous acids, with free nitrogen and some sulphide of potassium. Statistics also do not sustain the assertion that rains always follow great battles, as there are scores of instances that this was by no means the case. Unfortunately for the theory of the party who suggested the starting of fires for the promotion of rain, shortly afterward the woods took fire in several parts of the Northwest, and even also in New York State, as is frequently the case after long continued drought, but not the least impression was made, and rain did not fall for a long time afterward.

Mr. Bell's suggestion that a single timely rain would pay the cost of one of his rain-towers, described on page 113 of the SCIENTIFIC AMERICAN, may be very true, and that a nation who could control the rain would "prove her wealth and grandeur," but the questions are: Would such a tower have any influence on the rain at all? Are there not local and temporary circumstances which produce ascending and descending air currents much more powerful and extensive than can be produced by any number of such towers? What will the moisture amount to which can be conveyed by an ascending column of air of twenty feet diameter? How will we saturate this ascending air with moisture, or subtract the moisture from the descending clouds so as to diminish their enormous bulk before bottling them up? A mere superficial consideration of these and similar questions shows already the absurdity of the idea, and we would not think it worth while to answer them if the answers did not enable us to incorporate some useful practical ideas.

These questions are answered by the solution of the simple problem in physics, How much moisture such a tower can throw in the atmosphere? and this is easily found. Let us suppose that the inventor is able to saturate this air with moisture, which he cannot do, but for the sake of argument we will suppose the circumstances as favorable as possible, and grant that he succeeds to do this. Let this air have the medium temperature of 60°, then, as it has been demonstrated that such air when saturated can contain not more than seven grains of water per cubic foot, every cubic foot of air thrown upward through the tower will bring so much watery vapor in the atmosphere. As the interior shaft is 20 feet diameter, or nearly 300 square feet surface, and we suppose that he succeeds in moving this air upward at the rate of 15,000 feet per hour, he well get 15,000 × 300, or 4,500,000 cubic feet of air, which for 7 grains per cubic foot gives 7 × 4,500,000 = 31,500,000 grains, or nearly 4,100 pounds of watery vapor per hour. An ordinary locomotive evaporates more than twice this amount, and being high pressure without condensation, throws it all in the atmosphere, so that every working locomotive is, in regard to the cloud-making watery vapor it evolves, equivalent to two of Mr. Bell's rain towers, if not three, as an ordinary locomotive evaporates as much as 12,000 pounds of water per hour, consuming to do this 2,000 pounds of coal, producing from 6,000 to 7,000 pounds of carbonic acid gas and a variable amount of water, from the variable amount of hydrogen in the fuel.

Let us now consider that several hundred locomotives are at present daily running over the plains of Colorado, Utah, and adjacent almost rainless districts, where the air is exceedingly dry, where in many regions there are no lakes or rivers within more than a hundred miles distance, and where most of the rivers always dry up in summer, and are in any case insignificantly small, so small indeed that there exists no navigation even for a row boat. We meet people born there who had never seen even a small sailing vessel or steamboat. Consequently there is no evaporation, and all the moisture in the air and the clouds, seldom seen, must be wafted there by the winds from more favored regions. If, now, in such a region some hundreds of locomotives blow watery vapor in the dry atmosphere at the rate of 12,000 pounds per hour each, which as every pound of steam occupies a place of 25 cubic feet, every locomotive throws 300,000 cubic feet of steam per hour in the atmosphere, which for 100 locomotives, working 7 hours per day, is 100 × 7 × 300,000, or 210,000,000 cubic feet of steam, which mingled with ten times its amount of air may make a respectable little cloud.

This estimate will explain why the climate has changed in many regions of the West, and rains have become more frequent where formerly they were too scarce, and all this since railroads have been built and railroad trains travel daily through the formerly rainless districts.

Natural Silver Plating.

A curious instance of natural silver-plating is reported from the Lord of Lorne Mine, of the American Flat section, Nevada. The sides next to the veins and the hanging walls of the ledge are covered with a thin coating of natural plating of pure silver as smooth as glass. The vein itself is narrow, and is being prospected by means of a tunnel. The superintendent says this peculiar feature of the inclosing walls is observable so far as the tunnel has followed the ledge. The ore of the vein itself is of a soft, easily-worked nature, showing considerable chloride as well as sulphurets, yet not giving very high assays. The filmy deposit of silver on the walls was evidently condensed and forcibly deposited there under immense pressure, as it has a smooth, burnished appearance.

Cotton Factories at Petersburg, Virginia.

The following interesting particulars are given with regard to the cotton industry of Petersburg, Va.: The Ettrick Manufacturing Company have 6,060 spindles and 250 looms, and give employment to 215 operatives. The annual consumption of cotton is 3,000 bales, with a yearly manufacture of 2,900,000 yards of cloth. The Matoacoa Manufacturing Company have 9,600 spindles and 260 looms, and give employment to 225 operatives. The consumption of cotton yearly is 2,500 bales, and they turned out last year 3,605,000 yards of cloth. The Battersea Manufacturing Company has 3,600 spindles and 100 looms, and employs 90 operatives. The annual consumption of cotton is 1,500 bales, and the yearly manufacture of cloth 1,300,000 yards. The Petersburg cotton mill has 3,288 spindles, 110 looms, and turns out daily nearly 5,500 yards of goods, such as fine sheetings, shirtings, and drillings. It consumes annually 1,000 bales of raw cotton. The Blandford factory, owned by the same company, located in Blandford, is run by steam, and turns out about 3,000 yards of cloth daily. The Mechanics' cotton factory has 3,600 spindles and 100 looms, and consumes a thousand bales annually, and the manufacture of cloth is 5,500 yards per day, or about 1,650,000 yards per annum.