SCIENTIFIC AMERICAN

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NEW YORK, JANUARY 11, 1890.

[$3.00 A YEAR. WEEKLY.

THE FORTH BRIDGE.

We give on our first page this week a general view of this most remarkable structure, which has lately been completed, and is now receiving the finishing touches, preparatory for opening for travel.

The Forth Bridge is the most important link in the direct railway communication which the North British Railway and their allies, the Midland Railway Company and the East Coast Companies—the Great Northern and the Northeastern Railway Companies—are seeking to complete between Edinburgh on the one hand and Perth and Dundee on the other, which will enable them to compete with the West Coast Companies for the North of Scotland traffic on equal if not more favorable terms.

It was in 1882 the plans were adopted. The total length of the viaduct is 8,296 feet, or nearly 1⅝ miles, and there are two spans 1,710 feet, two of 680 feet, fifteen of 168 feet girders, four of 57 feet, and three of 25 feet being masonry arches.

The clear headway for navigation is 150 feet for 500 feet in the center of the 1,710 feet spans. The extreme height of the structure is 361 feet above and the extreme depth of foundations 91 feet below the level of high water.

There are about 53,000 tons of steel in the superstructure of the viaduct, and about 140,000 cubic yards of masonry and concrete in the foundation and piers.

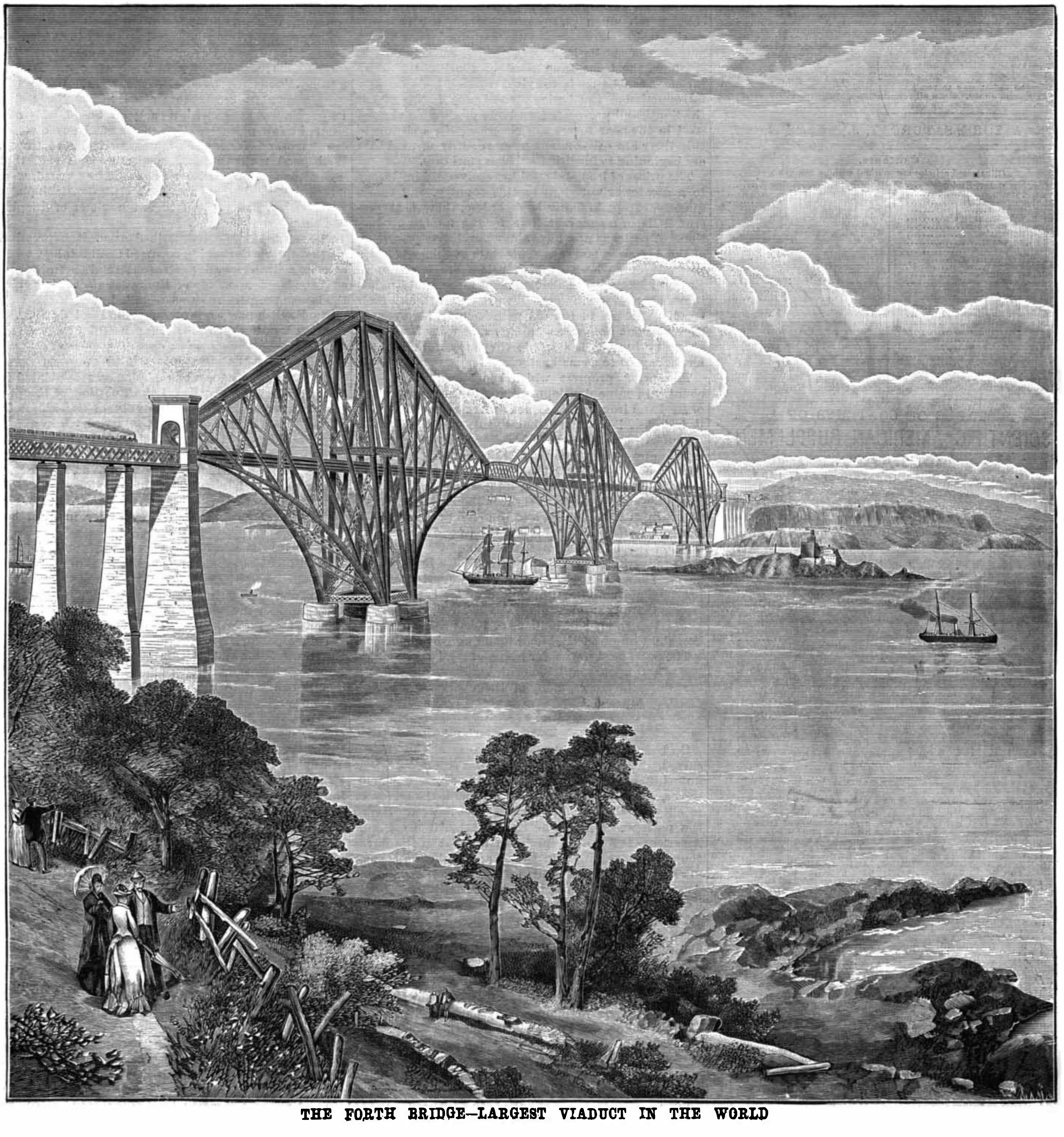
The main piers, three in number, consist each of a group of four masonry columns, faced with granite, 49 feet in diameter at the top, and 36 feet high, which rest either on the solid rock or on concrete, carried down in most cases by means of caissons, of a maximum diameter of 70 feet, to the rock or bowlder clay, which is of almost equal solidity.

The stresses to be provided for are those arising from the weight of the structure itself, the rolling load, and wind, as well as from change of temperature.

The rolling load had been taken as 1 ton per foot run on each line of rails over the whole structure, or a train on each line consisting of sixty short coal trucks of 15 tons each, headed by two locomotives and tenders, weighing in the aggregate 142 tons.

The wind pressure provided for is a pressure of 56

(*Continued on page* 24.)



THE FORTH BRIDGE—LARGEST VIADUCT IN THE WORLD

Scientific American.

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IN IRON AND STEEL OUR COUNTRY NOW LEADS THE WORLD.

The United States may now be said to be independent of other countries both in the mining of its ores for steel and iron and also in the manufacture of the finished product. Heretofore it has been asserted and believed that this country could not furnish the required ores for steel, and resort has been had to imported ores; but the great demand for this important mineral has stimulated new researches and efforts, which have been crowned with success.

The Lake Superior region, for example, has been so greatly developed that the larger proportion of the supply now comes from that source.

The output of Superior ore for 1889 is stated to have been seven millions of tons, and the estimate for 1890 is nine millions of tons, of which three millions have already been sold at an advance of 75 cents to $1.25 per ton above last year's rates. It is understood the entire product will be taken by Western iron men. This may make almost an ore famine here in the East; it is not believed the Cuban ores can be supplied in sufficient quantity to meet the steel demand of this region. There is hope of steel ores in the Southern States. As for Spain, its whole product of seven and a half millions of tons is required for England, France, Belgium, and Germany. All these countries depend largely upon foreign importation for the best steel ores. This country alone occupies the satisfactory position of possessing its own steel ore beds. Many of the Southern mines now worked, although yielding excellent ores for iron, contain too much phosphorus for making the best steel. It has however been ascertained that by the adoption of the basic process, now extensively used in England, the irons from most of the Southern coke furnaces can be made to yield excellent steel. The introduction of the basic process is now in progress at the South and prospects for a large production of good steel in the near future are cheering. In addition to this there are other mines more recently opened that are beginning to furnish first-class steel ores.

The prices of iron and steel have advanced in Europe to a greater extent than in this country, and consequently, except in filling back orders, there is at present little or no market here for the foreign production. Americans now have almost exclusive possession of the American market. This state of things is likely to continue so long as high prices are kept up in Europe; but when a decline takes place, and English iron makers are willing to sell without profit, and their steamers return to the old practice bringing over pig-iron without charge as ballast, and rails for a trifle above nothing, it is possible they may work into the market again to a small extent.

The great progress which has been made in this country in mine development and in the manufacture of steel and iron will be evident when we consider that it is but a little more than twenty years since the manufacture of steel rails was begun in this country. In 1867 our production of steel rails was only 2,550 tons. In 1887 it was 2,355,000 tons, or double the quantity made in England. As to pig iron, we are now producing in the aggregate about eight millions of tons a year, all of which we consume, and England produces about the same, of which she exports much. In steel production the United States is ahead of Great Britain, our production being about three and a half millions of tons per annum against three and a quarter millions for England. As for iron, our product is also much larger than that of the royal kingdom, ours being about two and a half millions of tons against one million eight hundred thousand tons English production.

The advanced prices for iron and steel are having a bad effect upon the British shipbuilders, and unless a lowering soon comes, many of them will suffer loss on existing contracts.

The Total Eclipse of the Sun.

On December 23, 1889, a total eclipse of the sun occurred. The path of the total eclipse pursued a rather unfortunate course for observation. As our map shows, Africa was the favored continent, the region of totality crossing it obliquely from east to west. Hence the path was across the South Atlantic to South America. It formed a species of tangent to the latter continent, touching it in Brazil and Guiana. It took in some of the islands, notably Trinidad. In South America the eclipse was total in the early part of the day, in Africa it was visible in the afternoon.

The physicist and astronomer have of late become more closely related in their work. In old times the observations of eclipses were principally for the determination of data of time. Recently the constitution of the sun and the corona surrounding it have been one of the principal objects of eclipse observation. Recent progress in photography lends itself admirably to this line, and the work done during the present eclipse has been largely accomplished by photographic methods. The corona is the circle of rays that is seen emanating from behind and all around the moon when the sun is totally eclipsed. Its exact nature is unknown. Various theories have been advanced. It has even been attributed to a lunar atmosphere. It is, however, tolerably certain that it has a real and objective existence. It cannot well be regarded as a reproach to modern science that we know so little of it. We are on the average granted but a few hours in a century in which to see it.

Two American parties were in the field. The government party, for which $5,000 had been appropriated by Congress, under charge of Prof. David T. Todd, of Amherst College, established itself about 100 miles south of St. Paul de Loando. This place is near the mouth of the Congo River. The other party, under the auspices of the Lick Observatory, and directed by Profs. Burnham and Schoeberle, went to Cayenne, French Guiana, on the northeast coast of South America. Unfortunately, the oceanic path of totality made the establishment of satisfactory intermediate stations impossible. Moreover, there is no telegraphic communication possible between the extreme points of observation.

The English expeditions selected a point near St. Paul de Loando as one station, and established another one upon the island of Trinidad.

At Cayenne the period of totality was only one minute and forty-seven seconds. At the African station it lasted three minutes and fifteen seconds. Between the two stations a period of difference of time of eclipse of two hours and forty minutes intervened. This would have been of special value as a factor in determining the invariability of the corona's aspect were it not that the phenomenon was witnessed under such different conditions as regards the earth's atmosphere as to deprive this feature of much of its value.

The accounts from the American party in Africa indicate fair success. Seventy pictures were secured before totality, and a lesser number after it. During totality clouds interfered with the work. While this work was in progress, the United States Navy ship Pensacola was at sea with a party on board, who also secured a few pictures. The great efficiency of modern "methods of attack" was well demonstrated. With good meteorological conditions it is said that many hundred successive views could be secured, were it an object to obtain so many. Twenty-two inch plates were used, and on each of them ten views of the phenomenon were obtained.

The scenic effects are described as most impressive. No perceptible darkening occurred until totality, when at once a strange and portentous semi-obscurity covered the landscape. Several minutes after this period the lowest temperature was recorded.

The English party report from St. Paul de Loando that the weather prevented any useful observations.

The New Industrial Era.

Eighteen years ago, a commission was appointed in Great Britain, to investigate the question of the probable duration of the coal supply of the kingdom. Some of the results of this official inquiry, given in a paper read before the Statistical Society, suggest some startling probabilities. At the average rate of increase and consumption which has been going on for the past twenty years it is computed that the Newcastle coal district will be exhausted in 94 years, the South Wales district in 79 years, and the remainder in even less time.

Nothing in the future appears more probable than that within the lifetime of persons now living the industrial supremacy of Great Britain will pass away with the exhaustion of her coal fields. Switzerland, Italy, and the Scandinavian peninsula are destined to become the great manufacturing districts of Europe. This extraordinary industrial revolution will be brought about by the transmission and distribution, by electrical means, of the inexhaustible and permanent water power which is now running to waste in those countries. Indeed, this power is already beginning to be successfully utilized by the skill of the electrical engineer. More than a year ago we visited in Switzerland a woolen manufactory of 36,000 spindles, with the usual complement of auxiliary machinery, which was operated wholly by electric power conveyed from a distant stream, deriving its never-failing supply of water from the melting of Alpine snows. To an electrician, the sight was an inspiring one and full of significance. In the new era which is advancing with such rapid strides, the Swiss republic may not improbably become the foremost industrial nation of Europe. Nothing is more certain than that the next quarter century will witness amazing changes in the commercial relations of the nations of the earth, in consequence of the development of the conception of the electrical distribution of energy.—*The Electrical Engineer.*

THE Malvern Hill Marl and Phosphate Company is a new organization which has an unusually rich deposit of marl at the historic farm of "Malvern Hill," in Henrico County, and have already commenced operations on a large scale. The marl beds abound in bones, petrified, fossilized, and also decayed, of all shapes and sizes. The beds are situated on Turkey Island Creek, a tributary of the James, and are at the head of a bluff 170 feet above the water level.—*Richmond (Va.) Dispatch.*

SECOND ANNUAL MEETING OF THE AMERICAN GEOLOGICAL SOCIETY.

The sessions of the above society began, according to previous announcement, on Thursday, December 26, at 10 A. M., and occupied six hours a day, besides an extra session on Friday evening. About one hundred members were in attendance. The meetings were held in the new lecture room of the American Museum of Natural History, this city. The hall seats 1,000 people, in which the small company seemed almost lost, and its acoustic properties are such that little could be heard, except by those quite near the speaker. To this may be added the fact that, for some inscrutable reason, most scientists spurn the graces of elocution, seeming quite willing that the best results of their investigations should be marred by defective enunciation. On the other hand, it should be said that the Museum placed every facility at the disposal of the geologists, including the use of two pairs of fine stereopticons.

An address of welcome was made by Morris K. Jesup, director of the Museum, in which he predicted that New York City was destined to become the center of science as well as of art and literature. This was responded to by the retiring president, Prof. James Hall, of Albany. Official reports followed, presenting highly encouraging facts. Prof. J. D. Dana was elected president, Profs. J. S. Newberry and Alexander Winchell were chosen vice-presidents, and Profs. Stevenson and Williams were re-elected secretary and treasurer. Profs. J. W. Powell, G. M. Dawson, and C. H. Hitchcock were made the executive council. Fifteen new fellows were admitted, making the entire number enrolled 188. Three fellows have died during the year, namely: G. H. Cook, State geologist of New Jersey, Rev. D. H. Honeyman, of Halifax, N. S., and C. A. Ashburner, the celebrated mining expert, of Pittsburg. Biographical notices of them were read, and suitable resolutions passed.

The titles of forty-three papers were entered with the secretary for reading, of which less than half were read in full; partly because the fellows who got the floor almost invariably exceeded the time which they themselves had set for their communications, thus crowding out their less fortunate brethren. Another, and better, reason was that nearly every paper was vigorously discussed, and in the most friendly temper, which greatly augmented the interest of the meeting. Stenographic notes were taken of these discussions, which will appear in the published proceedings.

Among the eminent geologists present were: Dana, Marsh, Chamberlain, Gilbert, Lesley, Orton, Proctor, Shaler, Cope, besides those whose names have already been mentioned, and others.

The sum of $1,000 was appropriated as a nucleus for a $10,000 publication fund. It was decided that the proceedings should appear in an annual volume, to be called "The Bulletin of the Geological Society of America." This is to contain abstracts and discussions of papers presented, the edition being limited to 500 copies. The memoirs are to be issued separately as occasion offers and funds permit. The first year's bulletin is almost ready for distribution, and the first part of the second bulletin, to cover the New York meeting, will appear as soon as practicable.

The historical address by Prof. Hall was given in a familiar way, reviewing the important labors of pioneer geologists, running back for a hundred years. Special tributes were paid to Prof. Eaton, who was wonderful for inspiring his pupils and auditors with a love for science, and who started the idea of summer schools of philosophy, by taking classes on excursions of a scientific nature. Prof. W. B. Rogers, one of the earliest geologists of Pennsylvania; Dr. Samuel L. Mitchell, a man of wide attainments, who made the first mineralogical survey of New York; Louis Agassiz, ranked among geologists, though a zoologist, whose very presence was a source of strength and courage to the scientists of this country; Logan, Emmons, Silliman, Hitchcock, Gibbs, Vanuxem, and many others were sketched in a masterly way, and the address closed with a graceful recognition of the labors of Prof. J. D. Dana, who sat by his side.

The intervals between the leading Glacial epochs were treated by Prof. Chamberlain, who held that the continent was low during the first epoch, rose during the interval, and was high in the second. The "orange sands" of Mississippi were really of pre-glacial origin. Erosion along the Allegheny, Ohio, and Mississippi Rivers, varying in depth from 200 feet along the Allegheny to 300 feet south of Cairo, and reaching a breadth of sixty miles along the Mississippi, indicates the length of time between the two epochs. The second glacial epoch did not reach as far south as the Ohio. In the discussion, Prof. W. J. McGee, of the U. S. G. S., supplemented the paper by remarks on phenomena supporting the same conclusions from regions farther south.

The paper by Prof. Shaler showed that in Eastern Massachusetts there has been a large amount of true mountain building since the Miocene age. This was mainly visible along the sea coast, especially at Gay Head. A cloud burst over Martha's Vineyard, a year ago, let fall five and a half inches of rain in two hours, and washed the cliffs away so as to facilitate investigation. The basal formation is Cretaceous; the main portion Eocene and Miocene, while the upper portion is Pliocene. The same evidence of mountain building can be seen at Block Island. The foldings of these clays surpass in degree those of the Appalachians, though far less in magnitude.

In a valuable contribution on Cretaceous plants from Martha's Vineyard, C. D. White, of Washington, D. C., describes fossils, a few of which had been known for a hundred years, but had never been systematically studied till last summer. His conclusion, in which he was sustained by Newberry and Ward, was that at least the lower clays of the Vineyard series are Middle Cretaceous, improved methods of collecting having revealed a rich flora of that age.

The Laramie group has been bandied about between the Cretaceous and Tertiary ages, by eminent authorities, on account of its floral remains. But the confusion has arisen by adding in the Fort Union group of the Upper Missouri region, which belongs in the middle Eocene period. Prof. Newberry, in his paper on this topic, showed that Clarence King, the original observer, was right in placing the Laramie with the Cretaceous, because none of the rocks described contain a species which has been found in the Tertiary rocks of Europe. The Fort Union group should be regarded as an entirely distinct formation from the Laramie. The latter contains the coal of Western Colorado. In the discussion following, the important concession was made by Prof. Ward, the eminent paleobotanist, that even the Fort Union might be included in the Cretaceous.

The gist of Prof. Emmons' paper on "Orographic Movements in the Rocky Mountains," was that, from observations made during the last ten years, previous opinions must be modified, and two highly important and widespread movements be added to the list, that had not hitherto been recognized. These occurred, the one during the Carboniferous, and the other in Jurassic times. The latter was of such vast dimensions as to have affected the greater part of the continent.

The serpentine of Syracuse occurs in a well-marked dike, cutting directly across the Onondaga limestone. The strata near the serpentine are much disturbed, and show the intrusive rock forced out laterally between them. Prof. G. H. Williams, of Johns Hopkins University, gave as further evidence of its eruptive origin the fact that the serpentine is full of inclusions of the country limestone, and of Utica shale, which occurs 1,000 feet below the surface there, and of granite, which must be still deeper down. The rock is of interest as being almost the only eruptive rock in the horizontal strata of New York, and is the third known occurrence in the world of the rock in which the Kimberly diamonds of South Africa are found. No diamonds have yet been found in it.

One of the most instructive papers of the meeting was by Prof. Orton, on "The Rock Pressure of Natural Gas in the Trenton Limestone of Ohio and Indiana." By the term rock pressure is meant the showing made by a gauge after a well has been shut in by pipes. This determines the size of pipe to be used and distance of market which can be reached. The highest recorded pressure in Ohio is 650, many being less than 300 pounds; while the range in Indiana is from 350 to 225. The depths of the wells vary from 1,500 in Tiffin, O., to 850 in Marion, Ind. A table was exhibited showing the close approximation of the estimated pressures to the pressures actually observed in a series of principal wells over a wide area. The basis of calculation was the hydrostatic pressure of a column of salt water standing 600 feet above tide, plus the distance of the gas-bearing Trenton limestone below tide. There is no danger of a cave-in in the gas region, for the gas will not go out of the rock until the salt water forces it out and takes its place. The supply is not unlimited, as so many seem to think. The present reckless waste of natural gas is simple vandalism. According to careful calculations, the supply can last but a few years longer, at most not more than nine. All the fuel and most of the light for 400,000 people in Ohio and Indiana come from this source. Forty glass works, besides scores of iron, steel, pottery, and brick works, depend on natural gas entirely. Prof. I. C. White confirmed the views of Prof. Orton's paper as absolutely true, from his own observations in Pennsylvania. The statements of these gentlemen have especial weight from the fact that we owe to them mainly the great progress made in our knowledge of the geology of the gas-bearing rock during the past few years.

The term "Appomattox formation" was applied in 1888 to a widespread deposit of orange-colored sands and clays in eastern Virginia and widening and thickening southward. This was described by Prof. McGee, of United States Geological Survey. He stated that the same formation had been recently traced through the Carolinas, Georgia, Alabama, and Mississippi, constituting the prevailing surface deposit in these States. Although its age has not been determined, it lies between the Miocene and Pleistocene deposits. By reason of its vast extent and uniform character, it forms a datum from which the stratigraphy of the coastal plain may be reckoned. It also shows a rather short age of continental depression.

Dr. J. S. Diller, of Washington, D. C., described, and illustrated by lantern slides, the distribution of remarkable sandstone dikes in Tehama and Shasta Counties, in California. They occur in joints of Cretaceous shales, and contain fragments of the same. They vary in width from a mere film to eight feet. The longest one is nine and a third miles in length. They are evidently filled from below. The geological structure of the country is especially favorable to the formation of such dikes, by the welling up of sand in fissures made by earthquakes. It will be remembered that sand spouts are common seismic phenomena.

Regions studied by Prof. G. H. Williams in Norway were described and illustrated in a paper by him. They show remarkably the effects of contact and of regional metamorphism. From rocks most diverse in origin the same kind of metamorphic rocks have been produced; so that it is not always safe to state that a certain metamorphic rock came from a particular crystalline rock. The regions visited were those in which are exposed the famous mica schists, containing corals, trilobites, and other fossils, as described by Rausch, Toernboehm, and other Swedish geologists. In the ensuing discussion, Prof. Emerson, of Amherst, called attention to the fact that Profs. Hitchcock and Dana described almost exactly similar rocks from Bernardston, Vt., previous to those described by European authorities as types of metamorphism.

Several lengthy papers of great value were presented by different members, on the Archæan rocks of Minnesota and Canada, presenting many facts new to science and having an important bearing on the question of the taxonomy of the rocks, and giving rise to varying opinions as to the correct correlation of the strata. The most noteworthy of these were offered by Profs. Winchell and A. C. Lawson, the latter of the Canadian Geological Survey.

Four papers were presented regarding Alaska and the Canadian Northwest. The first was by I. C. Russell, U. S. G. S., on the "Surface Geology of Alaska," from recent data. The observations of this expert in glacial geology failed to support John Muir's theory of a southward-moving glacier through Behring Straits. The northern part of the peninsula shows no evidence of ancient glaciation, but the ancient as well as the existing glaciers were confined to the mountains of the southern part of the territory and the Aleutian Islands. In Mr. McConnell's paper it was shown that east of the Rocky Mountains the ancient continental glacier extended as far north, at least, as the mouth of the Mackenzie River, the bowlders of the drift showing that the ice came from the east and southeast.

The next paper, by J. B. Tyrrell, of Ottawa, showed an immense amount of work concerning the "Post-Tertiary Deposits of Manitoba and the Adjoining Territory." It was quite technical, and confirmed the theory that the ice came from the east, and not from the mountains, the general movement being changed toward the south after fairly getting into the great valley. The evidence of two glacial epochs is not known in Canadian territory. The fourth Alaskan paper was by Prof. A. S. Bickmore, of the Museum, on the "Glaciers of the Selkirk Mountains and Alaska." It was profusely and magnificently illustrated by original and unique views prepared under his personal direction.

On Friday morning, before the regular session, a meeting of state and government geologists, including those of Canada, was held to devise some method for a more rapid and satisfactory interchange of ideas concerning their special department of work. No formal organization was effected, but it was decided to hold an annual meeting in connection with that of the G. S. A. Prof. E. Orton was selected to take measures for the next meeting.

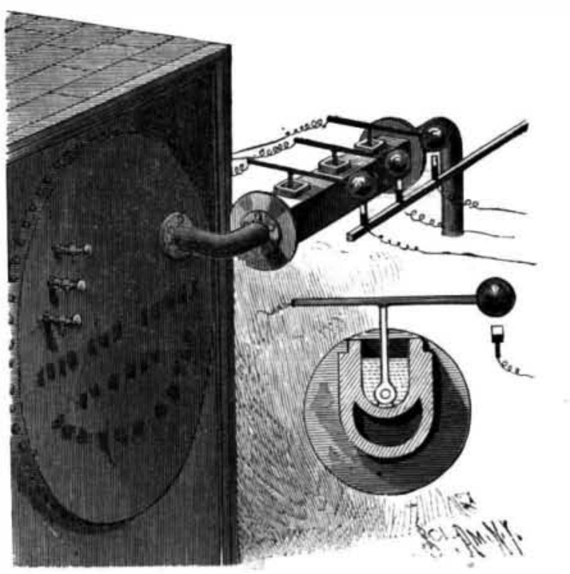
On motion of Prof. W. M. Davis, a committee of three was appointed to confer with similar committees from the naturalists and the physiologists as to the feasibility of holding the next annual meetings of the three societies at the same time and place for the purposes of mutual convenience. Late on Saturday afternoon, after a most successful series of meetings, the American Geological Society adjourned to meet again at Indianapolis during the sessions of the American Association for the Advancement of Science next August.

Communicating the Bouquet of a Wine of High Quality to a Common Wine by Changing the Ferment.

It appears that the flavor of a wine depends less on the nature of the soil in which the vines have been grown than on the ferment employed. The wine ferments which have been hitherto supposed identical and which have received the name *Saccharomyces ellipsoideus*, are various, and communicate different qualities to the must in which they set up fermentation. The juice of the "chasselas" grapes of the south of France can, by a change of ferment, be made to yield high class (*grands crus*) Burgundies.—*A. Rommier.*

A LOW WATER ALARM FOR STEAM BOILERS.

A simple device for indicating low water in a steam boiler is illustrated herewith, and forms the subject of an invention of Mr. E. Kildoyle, of the Yokohama Engine and Iron Works, Yokohama, Japan. A pipe adapted for connection with the boiler at the water line is furnished with pockets projecting downwardly into the pipe, and open at the top, there being at the bottom of each pocket an ear to which is pivoted a



KILDOYLE'S LOW WATER ALARM FOR STEAM BOILERS.

T-lever, as more plainly shown in the small view. One arm of the lever carries a weight and its other arm is connected with a wire, thus forming, with a contact point arranged below the weight, and a battery and alarm apparatus, an electric circuit, which remains normally open when the T-lever is in a vertical position, this lever being so held by fusible metal cast in the pocket. The several pockets contain fusible metal adapted to melt at different temperatures, so as to insure certainty in the action of the apparatus. When the water in the boiler drops below the mouth of the pipe, the steam, taking the place of the water, melts the fusible metal in the pockets, allowing the weighted levers to topple over and cause the weights to strike their contact points, thus completing the circuit and giving the alarm.

THE SULZER ENGINE AT THE PARIS EXHIBITION.

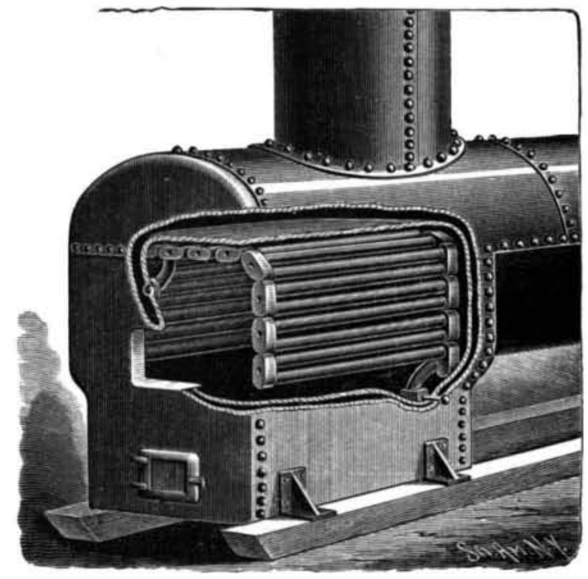
One of the engines which drove the line shafting in the Machine Hall of the Paris exhibition was supplied by MM. Sulzer Brothers, of Winterthur. It is, as seen in our perspective view, for which and the following particulars we are indebted to the *Engineer*.

The steam is admitted into the jacket of the small cylinder before it reaches the cylinder itself; and the exhaust passes directly to the jacket of the large cylinder, which thus acts as a reservoir, because the firm has found by experience that nothing is gained by a separate receiver. The diameters of the high and low pressure cylinders are respectively 500 mm. and 800 mm., or 19⅝ in. and 31½ in., while the stroke is 1·4 m., or 4 ft. 7 in. The normal speed is 75 revolutions; and, with an initial pressure of 7½ atmospheres, or 112·5 lb., per square inch, the engine will indicate 315 horse power at 10 per cent admission, 420 horse power at 20 per cent, 510 horse power at 30 per cent, and 585 horse power at 40 per cent. The engine at the exhibition was working at a disadvantage, as it was only making 70 revolutions; but some trials made this year with an identical engine erected at Narano, near Milan, show a consumption of only 6·35 kilos, or 14 lb., of steam at 6 atmospheres, or 90 lb. boiler pressure per indicated horse power per hour, the engine only indicating 267 instead of 400 horse power. The distinguishing feature of the engine is its high piston speed, 3½ m. or 11 ft. 5¾ in. per second, due to the long stroke, and giving the following advantages: Great reduction of the clearance spaces in proportion to the total content of the cylinder; reduction of piston area, and consequently of the effect of any leakage which may occur; reduction of area of cylinder, and consequently of abstraction of heat from the steam by radiation.

In the perspective view at the end of the valve-controlling shaft may be seen a small horizontal pump worked by a crank; this is for drawing a drop of oil as its falls from the sight feed lubricator, and forcing it into the cylinder. A small pipe admits steam into the lubricator in cold weather, for keeping the grease in a liquid condition. The oil falling from the main bearings is raised by a rotary pump for use over again. The pistons have Ramsbottom rings; and all rubbing surfaces are very large, so as to reduce the pressure per unit of area. The horizontal double-acting air pump is worked by a connecting rod and bell crank off the main crank at the large cylinder end of the lay shaft; and ample dimensions are given to the cellar containing it, so as to afford easy access. The castings are remarkably smooth, being only covered with a thin coat of dead black paint. The turned parts, such as cylinder covers, are so bright that it is difficult to believe they are not nickelized, even when near the brass parts so treated. Since the first Sulzer engine was started at the first Paris exhibition in 1867, no less than 1,223 engines of 104,060 horse power indicated collectively have been turned out at the Winterthur works, which now employ 2,000 men, while 70 engines of nearly 9,000 horse power on this system have been ordered since the opening of the present exhibition. Messrs. Sulzer Brothers have been awarded a *grand prix* for their engines by the international jury.

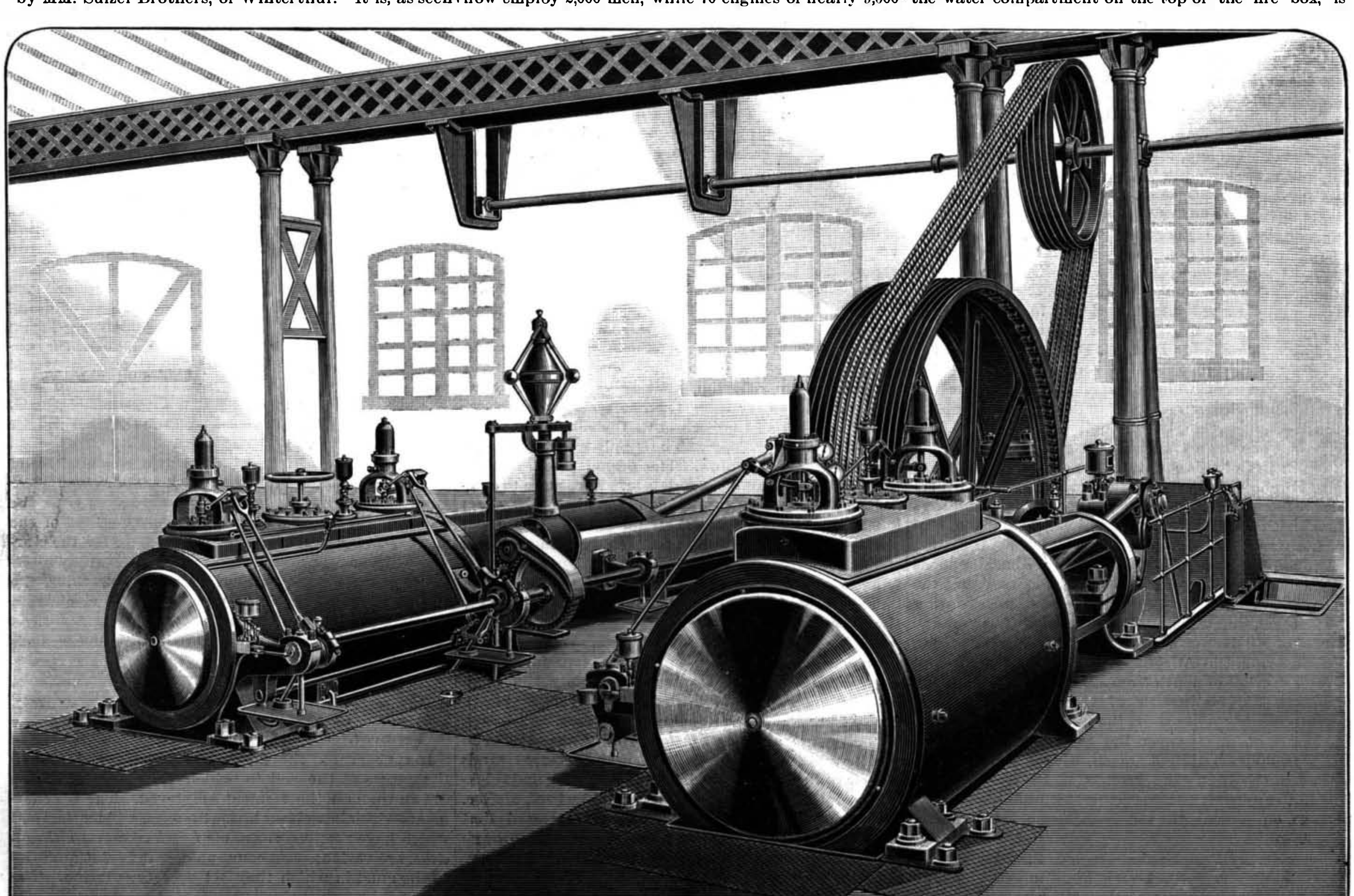
AN IMPROVED BOILER.

A boiler in which the inside of the fire box is provided with one or more coils of pipe, to insure the generation of a greater amount of steam, is illustrated



ROBERTS' BOILER.

herewith, and has been patented by Mr. John N. Roberts, of the N. P. & M. R.R., Winnipeg, Manitoba, Canada. Each coil has on its lower end a block set against the inside of the shell, with an opening registering with a corresponding opening in the shell. In the inner end of the block a plug is held on a screw rod passing through the openings and through the water space to the outside of the exterior shell. A nut screws on the outer end of the screw rod, to hold the block against the inside of the inner shell, and into an opening of the block opens one end of a curved pipe connected at its top with the lowermost elbow of the coil. The pipe and elbow are preferably so connected as to permit an extension of the coil without injuring the connection of the pipe with its block. Each coil of pipe extends along the inside of the fire box shell, and then along its top, the upper end of each coil being connected by a suitable joint with a pipe leading to the water space on the top of the fire box. The water thus heated in these coils, and discharged into the water compartment on the top of the fire box, is

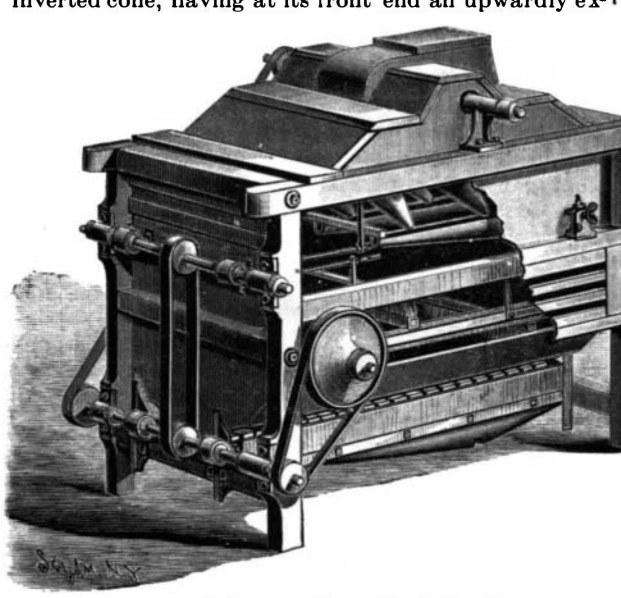


THE SULZER 400 H. P. ENGINE AT THE PARIS EXHIBITION.

designed to insure the generation of sufficient surplus steam to enable steam to be supplied by the locomotive for heating cars, etc., or to heat buildings connected with a stationary boiler having this improvement.

AN IMPROVED MIDDLINGS PURIFIER.

The accompanying illustration represents a machine patented by Mr. John A. Wahlstrom, of Wakefield, Neb., designed to purify middlings with very little waste, and at the same time to produce middlings of a higher grade. In the illustration the casing is represented partially broken away upon one side to show the interior arrangement. The main driving shaft is connected by a belt and pulleys with a second shaft carrying eccentrics, whose rods extend to the interior of the casing and are connected with the shaker or bolt, the frame of which is so supported that the bolt may be raised or lowered, and may be adjusted longitudinally forward or backward, as desired. Above the bolt are located two inclined dust-conveying troughs, to which a shaking motion is imparted by the eccentrics. The troughs discharge at their lower ends into a spout passing through the end of the casing. Into the dust troughs lead the lower ends of dust catchers, preferably six in number, each representing a slightly inclined inverted cone, having at its front end an upwardly ex-

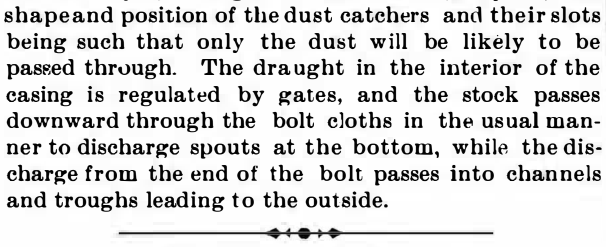


WAHLSTROM'S MIDDLINGS PURIFIER.

tending slot, wide at the bottom and narrowing toward the top. In the front and near the bottom of the hopper is the usual opening with an adjustable gate to regulate the amount of material passing on to a shaking bottom and from thence into the interior of the casing, into which it is moved by the operation of the fan wheel in the top part of the casing, sucking air between longitudinally arranged slots in the sides of the casing, forming openings sufficiently large to admit air to the under side of the bolting cloth. On the under side of the bolt operate a number of brushes, whereby the bolt cloth is kept constantly cleaned. The dust and other impurities pass upward on account of their lightness, and finally settle into the top or wide ends of the dust catchers, being thence conveyed by the dust-conveying troughs to the discharge spout, the shape and position of the dust catchers and their slots being such that only the dust will be likely to be passed through. The draught in the interior of the casing is regulated by gates, and the stock passes downward through the bolt cloths in the usual manner to discharge spouts at the bottom, while the discharge from the end of the bolt passes into channels and troughs leading to the outside.

A NEW TELEGRAPH REPEATER.

A telegraph repeater having several novel features has been patented by Mr. Richard J. McIlhenny, of Wilmington, Delaware. One of the principal objects of this invention is to simplify the mechanism and circuits of the repeater, so that any operator without



McILHENNY'S RELAY.

special training can operate it, also to provide means for preventing "kicks" in the instruments. This apparatus also permits of interrrupting the sender of a message without rendering the line inoperative.

We give an engaving of the relay used in the system. The vertical armature lever, K, is pivoted near its center to a fixed support, and is provided with two armatures which are arranged upon opposite sides of the lever, above and below its pivot. The magnet, I, is supported by standards resting on the base, C, with its poles opposite the armature, K, on the upper end of the lever. This end of the lever extends between the contact points *i i'*, and the part which engages the contact, *i'*, is insulated so that this point serves merely to limit the rearward motion of the lever.

The magnet, L, is mounted on the bed plate, C, opposite the armature, K, on the lower end of the lever, K. The magnets, I and L, although upon different sides of the lever, K, will draw it in the same direction, and if a current is sent through one magnet and then the other in succession, the second magnet will tend to hold the lever from falling away from the first magnet when the current through the latter is broken. A spring, K^2, holds the lever, K, normally away from both magnets. The transmitters are constructed something like an ordinary telegraph sounder, with the armature lever prolonged at each end and provided with contact points for making and breaking circuits.

The operation of this improved system cannot be adequately described without a full diagram of the two transmitters, the two relays of the station, and the local and line circuits. We will say, however, that the inventor appears to have overcome some of the principal difficulties met with in repeaters of the ordinary type.

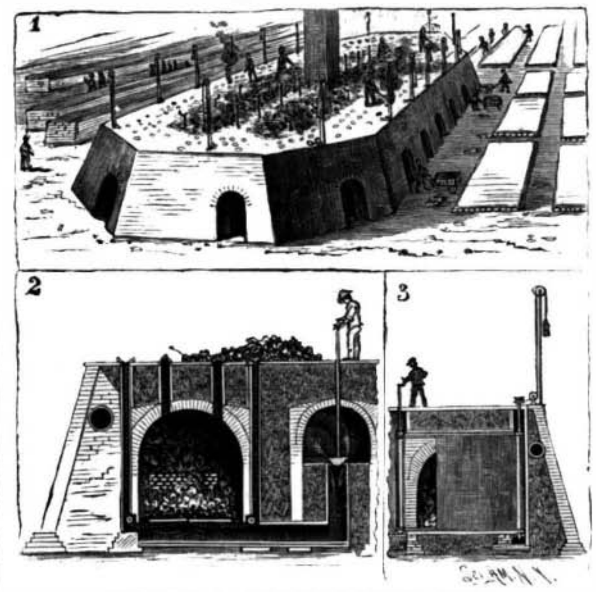
A SAFETY PILOT FOR RAILWAY TRAINS.

An apparatus to be attached to and propelled in frout of a railway train, to serve as a collapsible cushioning buffer and remove the shock to the train in case of a collision, permitting the train to be brought to a standstill without being injured or derailed, is illustrated herewith, and has been patented by Mr. Norman S. Mussey, of 45 Wall Street, New York City. The apparatus consists of a series of air chambers connected to telescope together and permit the air to be gradually driven out, and mounted on a suitable rolling support, which may be held near to, or removed some distance in advance of, the train by the folding or unfolding of the telescoping sections. Fig. 1 is a horizontal section, and Fig. 2 a vertical longitudinal section of the extended telescoping portions, Fig. 3 being a sectional view at the meeting point of these portions, and Fig. 4 a perspective view of the invention applied to a locomotive, and in folded position. The rear air chamber is attached to the front of the locomotive in any suitable manner, and is braced by vertical rods and an inclined rod.

This chamber is connected by a coupling bar with a rolling support adapted to run on the tracks in front of the locomotive, the bar having a head at one end movable in the central air chamber, and being held from being pulled out of such chamber by a flange at its forward end. The bar has an oval head at its forward end, to turn in a socket secured in an upright on the front of the rolling supports. Any desired number of air chambers may be employed, five being here shown, and preferably of a length of about five feet each, so that when drawn out they will extend some distance in front of the train. The chambers are of diminishing diameters, from about two feet for the largest one, by means of which a gradually increasing resistance is afforded when the telescoping sections are forced together in the manner contemplated by a collision. The scale of resistance in all the air chambers is regulated by means of holes irregularly located in their rear ends, and in order that the chambers may serve as perfect air cushions, each one is fitted into the succeeding one to form an air-tight piston. The rolling support has a projecting piece, to the sides of which are secured the rear air chambers of a second double series of telescoping air chambers, bars in the two front chambers being connected at their outer ends to lugs on a cone adapted to fit into a recess in the projecting piece on the rolling support. In order to move the air chambers into extended position, means are provided by which this may be effected from the locomotive, two series of telescoping tubes being arranged by means of which compressed air or steam may be admitted as desired to both series of air chambers.

A CONTINUOUS BRICK KILN AND DRIER.

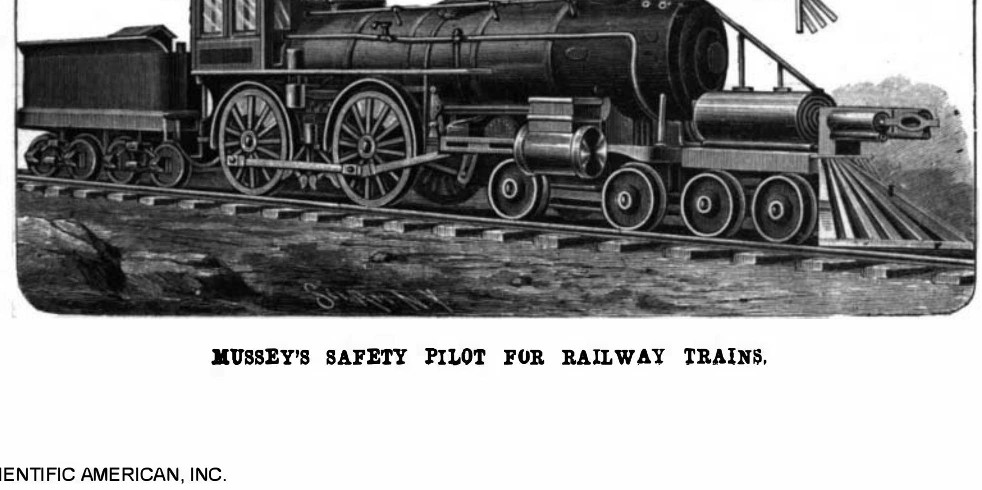
The design of the invention illustrated herewith is to furnish a construction which will serve to effectively dry, water-smoke, and burn the bricks, without moving or changing them after they are once set in the kiln until the bricks are finished. It has been patented by Messrs. John H. Thissen and Millard M. Arnold, No. 1528 Vinton Street, Omaha, Neb. Fig. 1 is a view in perspective of a kiln thus constructed, Fig. 2 being a sectional representation illustrating the feeding of the fuel and the regulating of the draught, while Fig. 3 shows the working of the



THISSEN & ARNOLD'S BRICK KILN.

transverse movable shutters or partitions dividing the continuous passage around the structure, which, as shown, is adapted to be formed into sixteen separate compartments. This continuous passage has an inner and outer wall and arched top, the several walls being covered on top with sand or similar material to retain as much heat as possible within the kiln. Into each compartment leads a door formed in the outer wall, and in the bottom, near its middle, is a transversely extending draught channel connecting at its inner end with a flue extending horizontally to the middle of the kiln, then vertically into a longitudinally extending smoke chamber connecting in the center with the chimney. The movable shutters are made of fireproof cloth, each shutter passing at its ends through vertical slots in the side walls, one end being secured to a vertical roller and the other end to flexible strips near the top and bottom, whereby the shutter can be operated by means of a crank arm extending from one of the rollers to the top of the kiln, the flexible strips being also attached to a vertical roller, and a counterbalancing device being provided whereby the shutter may be held in the proper position and at the right tension.

The end of each flue leading into the smoke chamber can be opened or closed by a damper on a rod extending through the top of the kiln, and either end of the smoke chamber can be cut off from the chimney when desired. Into the top of the continuous passageway in each compartment lead a number of firing flues, extending from the top of the kiln through the arched top into the compartment, and on the upper end of each firing flue is held a head filled with sand and adapted to be closed by a cap, these flues serving to feed coal or similar fuel into the respective com-



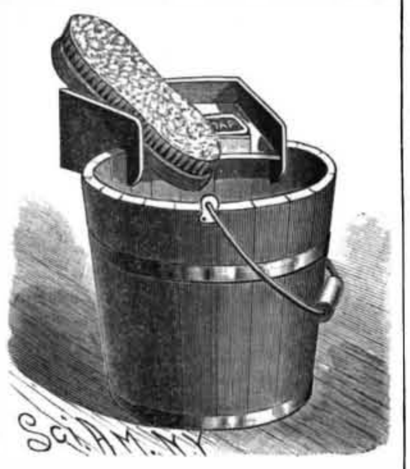
MUSSEY'S SAFETY PILOT FOR RAILWAY TRAINS.

partments. From the top of each compartment lead a number of heat escape pipes to a continuous main heat pipe, held in the outer wall of the kiln, dampers controlling the escape of the heat from the compartments to the main pipe. By the movable partitions, the draught in each compartment may be made independent of that of any other.

In commencing, the green bricks are usually set in about eight compartments, and a wall built across the first one, which is set with arches or fire holes, as in the old-fashioned kiln, and fired with wood until the bricks are hot enough to permit of burning coal. The arches are then closed and the compartment fired from the top until the bricks are thoroughly burned. The draught is opened into the compartments ahead according as the burning proceeds, the movable shutters enabling different compartments to be shut off for setting with green brick, which are then first dried and heated by the heat from the continuous main heat pipe in the outer wall of the kiln, so that none of the heat given off by the burned brick is lost, as their temperature falls. The process is continuous, one compartment after another being burned, and the heat conducted ahead, so that the kiln can be kept constantly running, filling in green bricks and removing finished burned bricks.

A SOAP AND BRUSH HOLDER.

A simple attachment which can be readily placed upon a pail, to hold a brush and soap, conveniently for use in scrubbing, etc., is shown herewith, and has been patented by Mr. Wm. P. Stott, of No. 4745 Tacony Street, Frankford, Philadelphia, Pa. Its two sides are connected by a slightly inclined bottom in segmental shape to conform to the shape of the pail, and each of the sides has near its front end a slot extending upward to the under side of the bottom, by means of which the holder can be readily placed on the pail. To the inner edge of the bottom, near one side, is secured a plate to hold a piece of soap, and adjacent thereto is a lug serving to hold the brush in place, the back of the brush being of a form to be readily thus held.



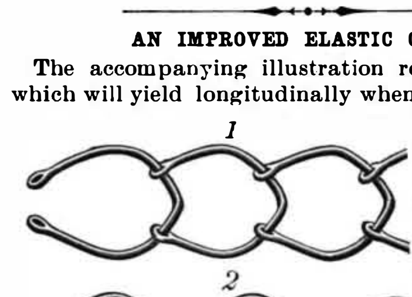
STOTT'S SOAP AND BRUSH HOLDER.

Sufficient Sleep.

In this age of hurry and worry, with its consequent nervous exhaustion, of which so much is now heard, the necessity of taking sufficient sleep cannot be insisted upon too forcibly. To lay down any hard and fast rule for its regulation is not possible, for, naturally, brain workers require more than the drones of society; in fact, every brain worker, if he wishes his powers to last, should take from eight to nine hours' sleep out of every twenty-four. Charles Lamb did not think eight hours enough, whereas Sarah Bernhardt finds six hours a sufficient quantum of sleep.—*Hospital.*

AN IMPROVED ELASTIC CHAIN.

The accompanying illustration represents a chain which will yield longitudinally when subjected to tension, one of the views representing the chain as it appears when under tension and the other showing the links in normal position. The invention has been patented by Mr. Charles Redwood, of Denison City, Texas. The chain is made with flexible wire loops, having eyes at their ends, and bulging or bowed at the middle, the body of one loop being passed through the eyes of the adjacent loop, and all of the loops being placed flatwise in the same plane.



REDWOOD'S ELASTIC CHAIN.

THERE is a large number of public libraries all over the country that would be glad to receive and store copies of all documents published by either House of Congress, or by act of Congress itself. These public libraries are multiplying to an amazing extent. Nearly every town, small or large, in my neighborhood has now its public library, established either by the munificence of some native of the town who has gone elsewhere and gotten rich, or by public contributions, municipal or personal, and there is scarcely any document published by Congress or either House of it, access to which is not essential to a complete investigation of some historical problem, the creating of some measure of proposed legislation.—*Senator Hoar.*

A STORM COAT AND VEHICLE APRON.

A garment designed to protect the clothes or person of one in a vehicle from rain, snow, wind, etc., and which is adapted for ready connection with the dashboard, is represented in the illustration herewith, and has been patented by Mr. Schooler C. Horn, of Bladensburg, Ohio. The garment is made of any suitable waterproof material, and is open behind throughout its length, but adapted to fasten about the neck or upper portion of the person by buttons or otherwise. It is of a length designed to take in the whole person, and to reach to or over the dashboard of a buggy when the wearer is seated therein, thus presenting a close front and constituting also a vehicle apron. The sleeves are in two sections, the lower one of which is extended to form a glove or mitten, while its other end telescopes into the upper section at a point between the elbow and shoulder, where it is attached by elastic cords or straps and hook and eye fastenings. The bottom front portion of the garment, forming the vehicle apron when attached to the dashboard, is readily secured to the latter by light sliding spring hooks, secured to the apron portion by eyes or staples, riveted to the garment near its lower front end, this portion being laid over the dashboard and the spring hooks pressing it down in position thereon, regardless of the width of the dashboard.

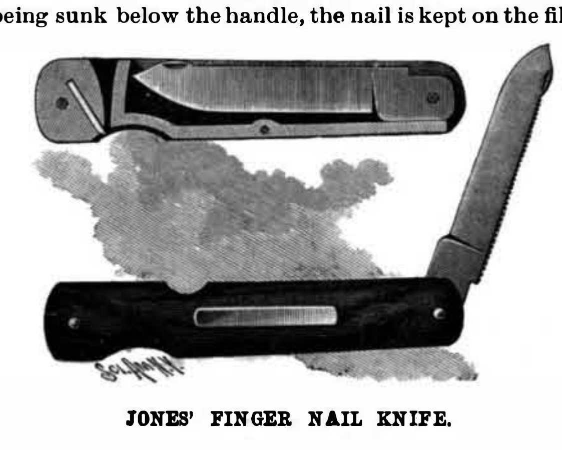
HORN'S STORM COAT AND VEHICLE APRON.

The Detroit River Bridge.

The Secretary of War has sent to the Senate the report of a board of army officers upon the practicability of and necessity for a bridge at Detroit. The board condemns a tunnel on account of cost and objections to operating it, reports against a suspension bridge of one span and a drawbridge, and recommends the plan of G. Lindenthal of a bridge 140 feet above water, with one central span of 1,000 feet clear opening and two side spans of 750 feet each, as offering the minimum impediments possible in the present state of the art of bridge building to lake traffic.

AN IMPROVED FINGER NAIL KNIFE.

In the knife shown herewith, the blade has in its back serrations, or file teeth, which lie within the edges of the handle when the blade is closed, while the handle has a concave recess in its back, with a throat extending through the handle, and a cutter is inserted in the back, with its edge projecting into the throat, and adapted to pare the edge of the nail. The invention has been patented by Mr. Samuel E. Jones, of Canon City, Colorado. The upper picture represents the knife closed, with one side of the handle removed, the other view showing the knife with blade partly open. By the concave plane shown in the first figure the nail may readily be shaved smoothly, and with the proper curve, while in using the file on the back of the blade, the knife being closed and the blade being sunk below the handle, the nail is kept on the file, and any danger of wounding the finger is prevented. The same principle may also be applied with two-bladed knives.



JONES' FINGER NAIL KNIFE.

Antibakterikon.

Under this name a Berlin chemical factory has produced a new kind of ozone water, which is said to be distinguished from other liquids of the kind by its freedom from lye of Javelle and by its durability. It is manufactured as follows: Oxygen gas is made of chlorate of potassium and pyrolusite, and conducted into a pressure gasometer, whence it is sent through a series of so-called Siemens tubes. With the help of a strong electric stream, produced by a machine similar to that which gives the electric light, a secondary stream is produced in these tubes, which discharges itself slowly but constantly, and converts the oxygen gas into an ozone solution of about 10 per cent. During this process various substances are added to the gas to prevent its evaporating. Dr. Otto Ringk, of Berlin, the inventor of this new preparation, declares that it possesses extraordinary sanative virtues, not only producing a good effect in cases of tuberculosis, cholera nostras, typhus, diabetes mellitus, toothache, etc., but also destroying the virus of diphtheria and scarlet fever with absolute certainty.

AN IMPROVED PAPER CLIP.

A paper clip which may be formed from a single piece of wire, if desired, and is designed to afford a simple and improved form of wall pocket, is shown herewith, and has been patented by Mr. Frank A. Ruggles, of Three Rivers, Mass. The wire is bent upon itself to form an essentially U-shaped back frame, in the top of which, at each side, a loop is made. At the lower ends of the members of the back frame the wire is formed into coil springs and then carried continuously upward and horizontally until the ends meet, to form a front frame, also essentially U-shaped. The ends of the wires, where they abut, may be attached in any suitable manner, and a knob or link secured there to form a hand hold by which to open the front frame from the back frame.

RUGGLES' PAPER CLIP.

PLUMBAGO PACKING.

The packing of piston, valve, and pump rods, and similar parts of steam and hydraulic machinery, is a matter deserving of a great deal of attention. The old methods of packing are entirely discarded by intelligent engineers, and improved means are employed, which prevent grooving and cutting, in many cases prolonging the use of the parts from a period of a few months to several years.

The Manhattan packing, made by the Manhattan Packing Co., and sold by Greene, Tweed & Co., 83 Chambers Street, New York, has proved its superiority by long use in large and small manufacturing establishments, in water works, upon steamboats, and elsewhere.

The packing is formed of a braided strip—either with or without a rubber center—filled with the finest "floated" plumbago, and with an oil of very high fire test, which cannot char or ignite and which is free from acids.

The packing is made in almost every imaginable size and shape, and adapted to every purpose for which packing can be used. It is particularly useful on steam hammers, where it is desirable to avoid a leakage of steam or water. It is in successful use on rotary bleach boilers, where it has proved of great value. It is, perhaps, needless to say that the packing is self-lubricating, and continues to act uniformly until entirely used up.

The Manhattan packing is an old and reliable article which continues in use wherever introduced.

A THOROUGH washing out with clean water will often prove the best cure for a foaming boiler. A little common soda may be added where grease is suspected to be the cause of foaming. This will saponify the grease and make the foaming worse at first, but after blowing out and washing out the boiler, a cure will probably be effected. A direct exhaust feed-water heater or injector is often a cause of grease in a boiler; really no exhaust steam should be allowed to mingle with the feed water until it has passed through a suitable grease extractor.

Lack of Foresight in Engineering.

Serious errors, involving trouble and expense, occur more frequently than is generally supposed, through inattention or the want of foresight on the part of architects to make proper provisions for the location and erection of steam plants. It seems to be very often the case, says the *American Engineer*, that architects design and erect buildings for manufacturing and business purposes without consultation with the superintending engineer, or even with the manufacturer of machinery who is to construct and erect the boilers, engines, elevators, and shafting, with all other details of pumps, blowers, and auxiliary adjuncts that are to be placed within the walls of those buildings. Many architects are, again, not sufficiently careful in considering contingencies that may be needed in case of repairs or removal of machinery. Engineers in charge of steam plants will constantly point out the difficulties they encounter and the inconveniences they have to tolerate through lack of foresight in the planning and locating of the machinery.

Basements seem to be considered the proper place for boilers in nine cases out of ten, because there water and coal can be brought close to them, and they are more easily put in, bricked up, and taken out again. Here good foundations and plenty of room can be secured, but artificial light has to be depended upon, during day and night. It is here, however, that soot, ashes, and dirt will accumulate and be both an annoyance and a source of danger if provision has not been made for their regular and entire removal. But how many basements can we find where special provision has been made for this purpose? How many architects consult with a superintending mechanic in regard to this when planning a building where steam power is to be used? But the basement is no place for an engine, unless completely separated from the boiler room by a well-ceiled partition.

An engine room requires ample space, plenty of light, and good ventilation—space for repairs, light that will enable the engineer to take in the condition and situation at a glance, and ventilation so good that he will not hate to stay in his engine room on account of heat and suffocating smell.

This cramping, crowding steam machinery into dark, ill-ventilated cells and damp basements is all wrong It is false, mistaken economy; it is inhuman, and distressing to engineer and fireman both physically and morally; and is in every respect wrong and hurtful. We find boilers and engines hissing and pounding under our sidewalks, in narrow, foul-smelling corners and recesses; in places where we least expect to find them, and what is as bad, if not worse, men in attendance who care little for the condition and appearance of the machinery so long as it works without making too much noise.

A very great deal of this state of things is owing to oversight and want of proper thought in planning for steam machinery, which under all circumstances should have ample room, plenty of light with suitable ventilation, and also have competent, intelligent engineers to take charge of it We do not expect professional architects to be practical engineers, but we do maintain that in planning buildings to receive steam machinery the professional architect will do well to consult with the practical constructing or superintending engineer as to how far the greatest facilities and convenience can be provided for.

The Electric Motor for Domestic Purposes.

Mr. H. B. Prindle, writing on this subject in a recent issue of *Building*, asserts that when the use of the electric current was confined to lighting, at first in public squares and important streets, then gradually extending to cover the entire city or town, and into stores and houses, we were content to know that electricity produced the light in some way, and there our investigation ceased, until, at last, its use became so general as to induce a study and knowledge of its principles. That the same subtile something should become a most powerful agent for the transmission of energy was not for a moment suspected That it has taken an important position in the world of power can no longer be questioned. Unquestionably the world has never witnessed such remarkable progress in the introduction of power-transmitting agencies so radically at variance with previously existing forms. The facts are not to be wondered at when the advantages of electric power are fully considered. The electric motor in its present form is efficient, economical, safe, and sure; yet all these advantages would amount to but little were it not for the fact that the range of the adaptability of the motor is so wide. The comparison with a steam plant may perhaps show this clearer. The installation of a steam plant requires heavy foundations, expensive boilers, with their auxiliaries, coal bins, which are a source of heat and dirt. The engine requires the best skilled attendance, and, owing to its complicated nature, necessitates repairs to which the electric motor is not subject.

The electric motor is complete within itself requiring no auxiliaries—except the wire for supplying the current—needs but little attention, and runs practically without noise. While there is competition between steam and electricity for isolated plants, there is no direct antagonism between the two, as, with the exception of cases where water power is used, steam is a necessary factor in the generation of the electric current. Electricity, therefore, advocates concentration of steam plants, an arrangement the economy of which cannot be denied, and distribution by means of wires or cables, which has been found by thorough practical trial to be the most economical method yet devised.

In applying the motor to domestic uses, it has found a ready adoption for freight and passenger elevators, possessing as it does such marked features of superiority over an isolated steam plant.

Supply and Use of Nickel and its Alloys with Steel.

The most interesting paper and the most instructive excursion of the recent meeting of the American Institute of Mining Engineers at Ottawa related to the Sudbury, Ontario, copper-nickel deposits. The paper was read by Dr. E. D. Peters, manager of the Canadian Copper Company at Sudbury, and it covered an exhaustive description of the deposits, which were originally thought to be of such importance as a source of copper supply that apprehension was felt in some quarters that they would affect the price of the metal. Such, so far at least, has not been the case, though the workings have proved immense bodies of nickel-bearing pyrrhotite, with occasional pockets of copper pyrites. In places this bed has been proved to be 100 feet thick, and its limits have not yet been ascertained. The three mines in the district belonging to the Canadian Copper Company are not uniform in character, and vary considerably in the amount of nickel contained in the ore. The Stobie mine, which possesses the largest bodies of ore, and is worked by open cast, as much as 560 tons being thrown down by one blast recently, is low in nickel, but is valuable from its iron contents, after roasting, as a flux for the ores containing a higher percentage of nickel and copper, but more mixed with gangue.

Mining on this system means cheap production, and we can quite believe that Dr. Peters is correct in his estimate that he can produce from this mine 80 tons a day, at 30 to 35 cents a ton. In the Copper Cliff mine the ore occurs in irregular masses, but is very rich in nickel, and large bodies are developed, carrying from 8 to 10 per cent in that metal. The Evans mine also has a large body of pyrrhotite, but is more highly nickeliferous than the Stobie. This mine produces about 60 tons of first-class ore a day.

The roasting and smelting arrangements, as might be expected under Dr. Peters' management, are models of ingenuity and efficiency, and the result is that about 40 tons of matte are produced a day, averaging about 27 per cent of copper and 15 to 18 per cent of nickel. The furnace work is worth recording, one smelter averaging for months of continuous work 125 tons of ore for 24 hours and having gone as high as 156 tons. Fuel seems to be the only disadvantage, Connellsville coke being used at the somewhat high cost of about $7.25 a ton, but against this is to be set the judicious handling of the ore and its fluxing qualities, which enables the fuel to carry a burden of 8 to 1.

The result of these operations at Sudbury will be an enormous increase in the world's supply of nickel. The supply hitherto has been principally from the mines of the French Company in New Caledonia, and this supply has been regulated to a great extent by the demand, at about 1,000 tons a year, maintaining the price at what the company considered a profitable basis, or rather as high a figure as it could without decreasing consumption, for it has never shown very great profits. The Sudbury production already exceeds the world's consumption, and Dr. Peters has no doubt that he can produce 2,000 tons of nickel a year.

The important question is, will there be a market for this increased supply of the metal even at considerably lower prices than those at present ruling? Mr. James Riley, the well-known metallurgist and manager of the Steel Company of Scotland, in a paper prepared by him at the request of the Council of the Iron and Steel Institute of Great Britain on tests made by him of alloys of nickel and steel, furnishes data which convince him that there will be such a market. It appears that in France a patent has been taken out for these alloys, and Mr. Riley visited the works at which the process was carried on, and continued his tests at his own works in Scotland with most remarkable and satisfactory results. His data, as usual, are clear, and the results are conclusive, although, as he says himself, several series of tests involving a very large number of separate experiments are necessary to a full investigation. We have not space to give in detail here the actual tests carried out, but some of the conclusions arrived at will be sufficient for our steel makers to appreciate the importance of the subject.

The alloy can be made in any good open-hearth furnace working at a fairly good heat. The charge can be made in as short a time as an ordinary "scrap" charge of steel—say about seven hours. Its working demands no extraordinary care, in fact not so much as is required in working many other kinds of charges, the composition being easily and definitely controlled. If the charge is properly worked, nearly all the nickel will be found in the steel—almost none is lost in the slag, in this respect being widely different from charges of chrome steel. Any scrap produced in the subsequent operations of hammering, rolling, shearing, etc., can be remelted in making another charge without loss of nickel.

The addition of 4·7 per cent of nickel raises the elastic limit from 16 up to 28 tons and breaking strain from 30 up to 40 tons per square inch without impairing the elongation or contraction of area to any noticeable extent. With only 3 per cent of nickel somewhat similar results are found, combined with an increase in the carbon to 0·35 per cent.

The hardness increases as the nickel is increased, until about 20 per cent is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile. In Mr. Riley's hardening and tempering tests he shows the possibility of very largely raising the strength and elastic limit, and the hardness of these alloys, but he is not yet prepared, from lack of time, to say to what extent. He has, however, gone up to 95·6 tons breaking strain and 54 tons elastic limit. With regard to torsion tests, it is not necessary to have a steel high in nickel, as those containing only 1 per cent gave the best results.

In the very important matter of corrodibility, the steels rich in nickel are practically non-corrodible, and those poor in nickel are much better than other steels. The theory of the inventors, from which many metallurgists dissent, is that steel is composed of crystals of metallic iron, cemented together by carbide of iron, and the extra strength given is by the nickel alloying with this carbide of iron to form a stronger "cement;" that the space between the crystals of iron is thus more completely filled, and the cohesion between them rendered much more powerful.

The applications and uses of such an alloy are boundless. Its vast increase of strength and elasticity over ordinary steel, its non-corrodibility and hardness alone, open for it a field in engineering that will render possible what was previously nearly impossible from the masses requisite to attain the object. For example, it seems to bring quite within the bounds of practicability a cantilever bridge over the North River between New York and Jersey City that shall excel even the Forth bridge with its 1,710 feet spans and 150 feet elevation, as a work of engineering skill and beauty. It is only necessary to remember the difference between 30 tons and 95 tons breaking strain, and 17 tons and 54 tons elastic limit.—*Eng. and Min. Jour.*

Sponge Trade of Cuba.

Sponges are found both on the northern and southern coast of Cuba, but the chief ports to which they are brought for sale are Batabano on the south coast and Caibarien on the north.

Consul Little, of Havana, says that the classes included are sheep wool, velvet, hard head, yellow, grass, and glova. Very little reef, if any, is found in Cuba. On the south coast, sheep wool and velvet are more abundant than on the north coast. Cuban sponges find a market chiefly in England, France, and the United States. The island itself consumes about one-tenth of all the sponges brought in, and these are used especially for the damping of tobacco and for cleaning centrifugal machines on sugar estates.

The sponge fisheries employ about 1,000 hands, chosen exclusively from among the *matriculados*, or seamen who have served on Spanish men-of-war, and are still bound to serve when called upon.

On the south coast are employed vessels ranging from about five to twenty tons, carrying from four to eight men, and each vessel is provided with from three to six small boats. On the north coast, open boats with one or two men each are used. The annual value of the sponges brought in by these vessels is between £160,000 and £180,000.

Without Friction.

After showing that friction makes perpetual motion impossible, Professor Hele Shaw reflects upon the state of affairs that would follow if friction were to cease to act. The whole force of nature would be at once changed, and much of the dry land and most of our buildings would disappear beneath the sea. Such inhabitants as remained a short time alive would not only be unable to provide themselves with fire or warmth, but would find their very clothes falling back to the original fiber from which they were made; and if not destroyed in one of the many possible ways—no longer dissipated by friction through the air, or by falling masses of water no longer retarded by the atmosphere and descending as rain—would be unable to obtain food, from inability to move themselves by any ordinary method of locomotion, or, what would be equally serious, having once started into motion, from being unable to stop except when they came into collision with other unhappy beings or moving bodies. Before long they, with all heavier substances, would disappear forever beneath the waters which would now cover the face of a lifeless world.—*Iron.*

THE FORTH BRIDGE.

(Continued from 1st page.)

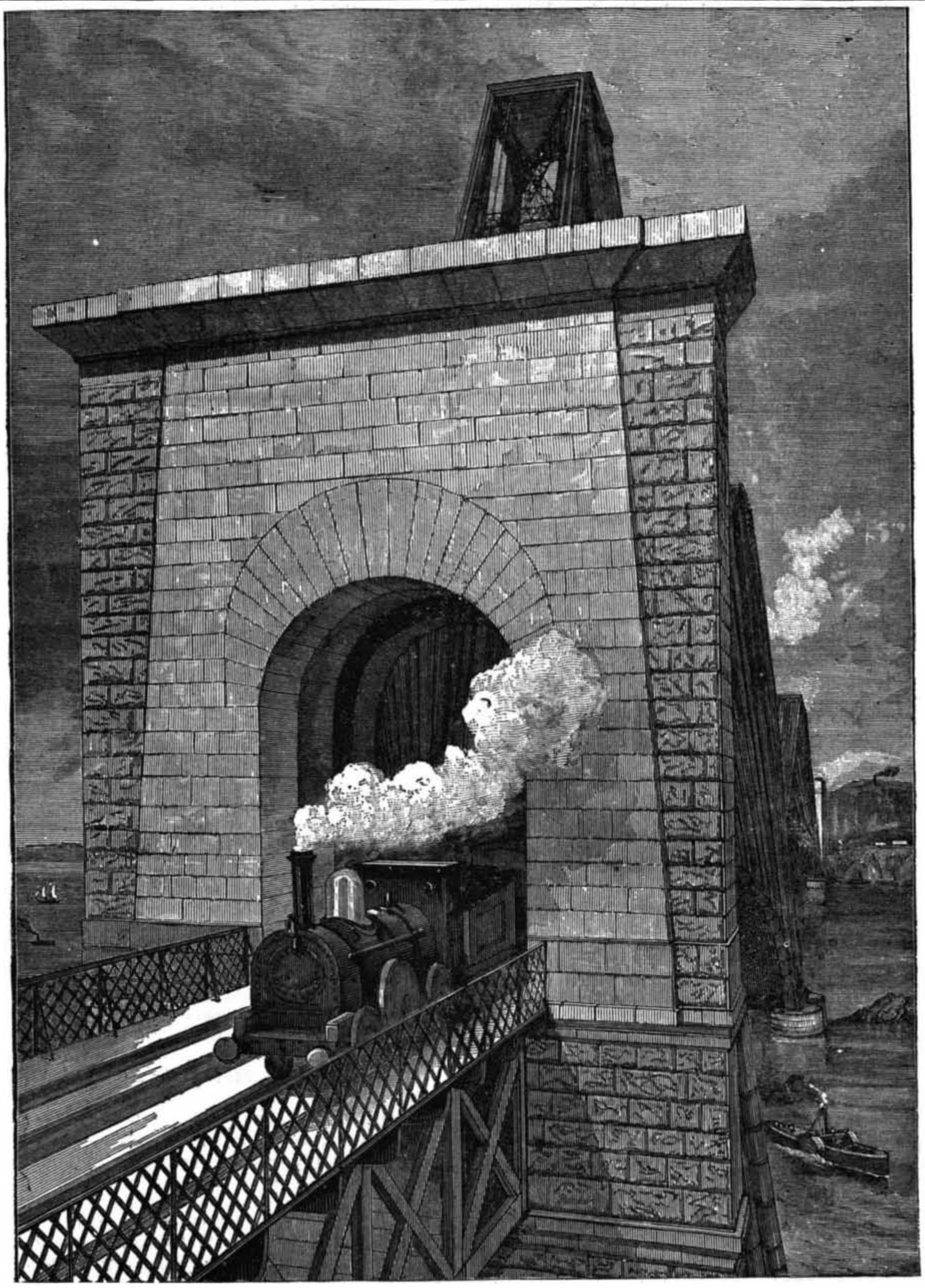
pounds per square foot striking the whole or any part of the exposed surface of the bridge at any angle with the horizon, the total amount on the main spans being estimated at nearly 8,000 tons.

The material used throughout is open hearth or Siemens-Martin steel. That used for parts subject to tension is specified to withstand a tensile strength of 30 to 33 tons to the square inch, with an elongation in 8 inches of not less than 20 per cent. That subject to compression only a tensile stress of 34 to 37 tons per square inch, with an elongation in 8 inches of not less than 17 per cent. Strips of each class 1½ inches wide are to bend cold round a bar the diameter of which is double the thickness of the strip. The tensile strength of the rivet steel is 26 to 30 tons per square inch.

The superstructure of the main spans is made up of three enormous double cantilevers resting on the three piers before mentioned. Those on the shore sides are 1,5 5 feet, and that on Inch Garvie (an island fortuitously dividing the deep water space into two channels of nearly equal width) is 1,620 feet in length. The effective depth over the piers is 330 feet, and at the ends 35 feet. The center portions of the two 1,710 foot spans on each side of Inch Garvie are formed by two lattice girders 350 feet in length and 50 feet deep in the center and 37 feet deep at the ends.

The compression members of the cantilevers are, as a rule, formed of tubes either circular in form or circular with flattened sides.

The tension members are



TRAIN PASSING OVER THE FORTH BRIDGE AT THE END PIER OF THE CANTILEVER.

girders quadrangular in section. The booms at their corners take the strains, and the vertical and horizontal bracing of the sides keep them stiff against the effects of their own weight and wind respectively.

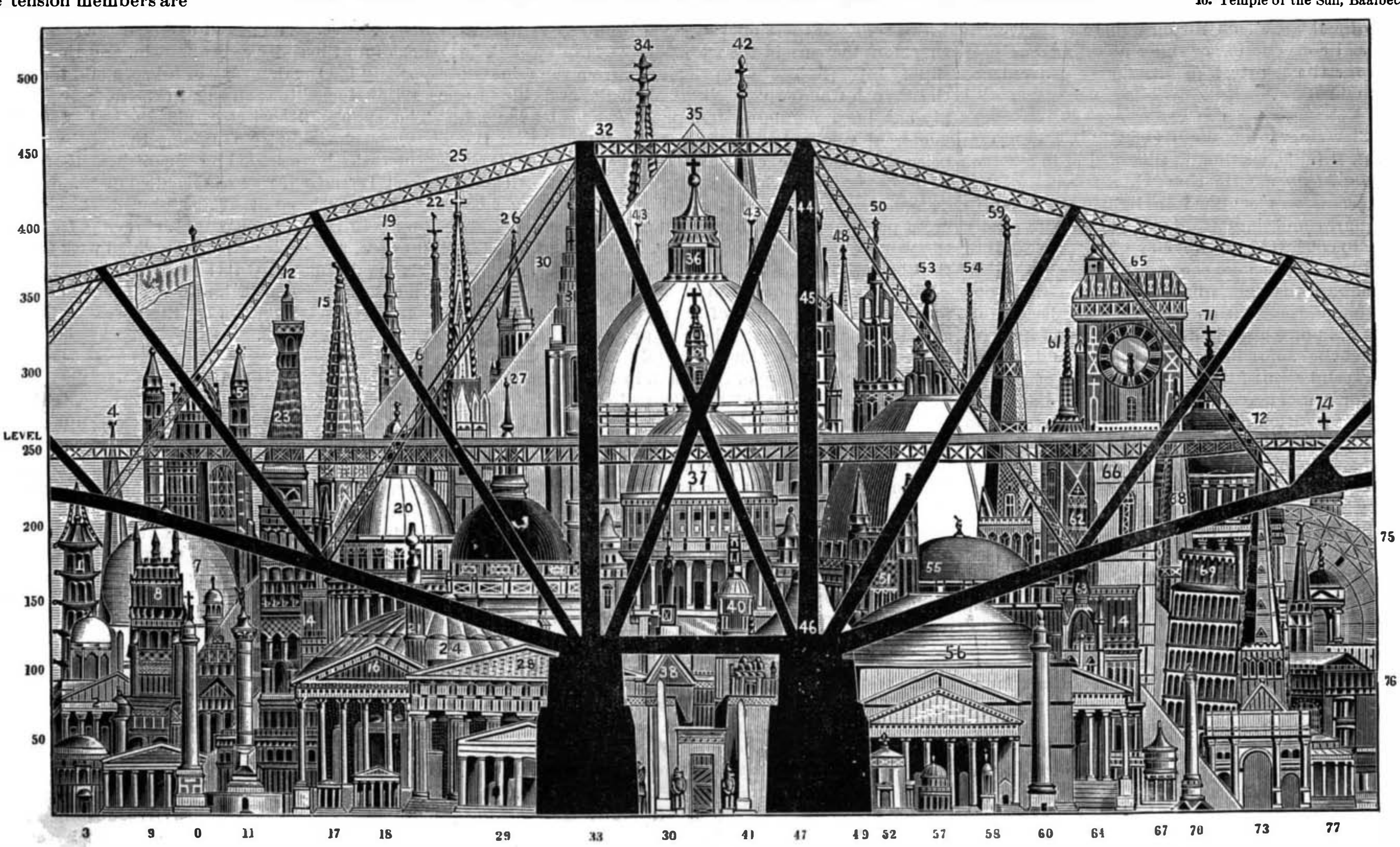
The steel was delivered at the works in plates cut nearly to size and as angle bars of various sizes and lengths.

Plates which had to be bent or shaped were so treated at a red heat in hydraulic presses with moulds of special construction, and all edges planed.

The plates and bars, whether composing circular members or the booms of the girders, with all the required covers, etc., were, as a rule, assembled in their exact positions, and operated upon by drills of special construction, which, traversing their whole length, bored nearly all the holes required for the riveting.

Our second illustration shows the relative height of the great bridge as compared with some of the notable architectural structures in various parts of the world. The following are the heights, reference being had to the respective structures by the numbers:

	Ft.
1. Porcelain Tower, Nankin, China	200
2. St. George's Hall, Liverpool	85
3. Tomb of Theodoric, Ravenna, about	50
4. Chichester Cathedral	271
5. Victoria Tower, Westminster	331
6. Boston Church, Lincolnshire	292
7. Taj Mahal, Agra	220
8. York Cathedral	198
9. Temple of Bacchus, Teos, about	50
10. Alexandrian Column, St. Petersburg	154
11. Column of July, Paris	154
12. Torre Asinelli, Bologna	370
13. Bell Tower, St. Marks, Venice	323
14. Colosseum, Rome (584 ft. in length)	157
15. Friburg Cathedral	385
16. Temple of the Sun, Baalbec.	120



HEIGHTS OF SOME OF THE GREAT BUILDINGS OF THE WORLD COMPARED WITH THE FORTH BRIDGE.

No.	Structure	Ft.
17.	Temple on the Ilissus, Athens, about	25
18.	Erechtheium, Athens, about	35
19.	Chartres Cathedral	403
20.	Church of Ste. Genevieve, Paris	274
21.	The Monument, London	202
22.	Amiens Cathedral	383
23.	Church of St. Theobald, Thann, about	320
24.	Royal Albert Hall, London	154
25.	St. Stephen's Cathedral, Vienna	441
26.	Torazzo of Cremona	396
27.	Hotel des Invalides, Paris	310
28.	Temple of the Giants, Agrigentum	116
29.	Parthenon, Athens	66
30.	Second Pyramid, Gheezeh	447
31.	Strassburg Cathedral	468
32.	Rouen Cathedral, about	460
33.	Eleanor Cross, Waltham	50
34.	Cologne Cathedral	510
35.	Great Pyramid	460
36.	St. Peter's, Rome	448
37.	St. Paul's, London	360
38.	Albert Memorial	180
39.	Obelisk, Luxor	75
	Prophylon	70
40.	Bow Church, London	235
41.	Cleopatra's Needle	68
42.	Old St. Paul's, London	508
43.	Church of St. Mary, Lubeck	400
44.	Abbey of St. Stephen, Caen	400
45.	Church of St.Martin. Landshut, about	460
46.	The Baptistry, Pisa	190
47.	Tomb at Mylasa, Caria, abt.	50
48.	Church of St. Peter, Hamburg, about	380
49.	Obelisk in Piazzi di San Giovanni in Laterano, Rome	153
50.	Antwerp Cathedral	403
51.	"Bell Harry" Tower, Canterbury	235
52.	Tower of the Winds, Athens, about	15
53.	The Cathedral, Florence	376
54.	Hotel de Ville, Bruesels	374
55.	Mosque of St. Sophia, Constantinople	182
56.	Pantheon, Rome	143
57.	Chapel of St. Pietro Montorio, Rome, about	40
58.	Choragic Monument of Lysicrates, Athens	34
59.	Salisbury Cathedral	404
60.	Trajan Column, Rome	134
61.	Cathedral, Frankfort-on-Main	326
62.	Pyramid of Mycerinus	218
63.	Church of St. Nicholas, Newcastle	201
64.	Temple of Jupiter Stator, Rome, about	98
65.	Mechlin Cathedral	319
66.	Bell Tower, Florence	266
67.	Tomb of Absolom, Jerusalem	54
68.	Norwich Cathedral	309
69.	Leaning Tower, Pisa	188
70.	Pompey's Pillar, Alexandria	100
71.	Church of St. Isaac, St. Petersburg	336
72.	Central Spire, Lichfield	252
	Western Spire	192
73.	Arch of Constantine, Rome, about	70
74.	Tower of Ivan Veliki, Moscow, about	260
75.	Central Transept, Crystal Palace	198
76.	Science Schools, S. Kensington	110
77.	Temple of Vesta, Tivoli, about	55

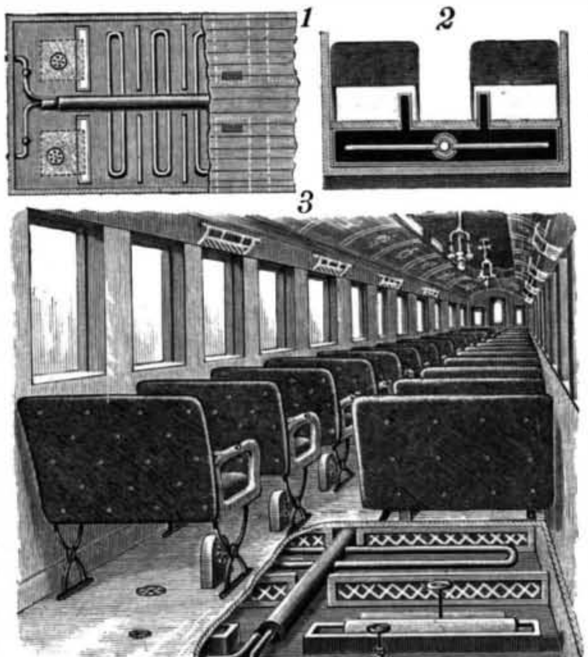
The construction of the Forth Bridge is justly regarded as one of the greatest scientific and mechanical achievements of modern times. Those who wish to trace the full details of the work from its conception to completion will find the same fully recorded and illustrated in the SCIENTIFIC AMERICAN SUPPLEMENT. The history is illustrated by over fifty engravings. The SUPPLEMENT numbers to be consulted are as follows: 218, 229, 317, 354, 457, 478, 503, 510, 512, 515, 519, 590, 626, 630, 667, 672, all of which may be obtained at this office.

Brazilian Petroleum.

Consul Burke, of Bahia, reports the discovery in that province of a mineral which has been called turfa, or brazolina, and which furnishes an oil akin to petroleum, a paraffine suitable for the manufacture of candles, and a good lubricating oil. It was originally discovered by an English clergyman named Wilson, but a company has recently been formed which has bought the concession, and is now engaged in the development of the property. Petroleum extracted from it has already been placed on the market, and has been favorably received.

AN IMPROVED CAR-HEATING SYSTEM.

The defects of most of the present systems, and what is in many cases the lack of any system, of properly heating and ventilating railway passenger cars



NEWTON'S CAR-HEATING SYSTEM.

are obvious to any one who has much traveling to do. A system designed to obviate these defects is represented in the accompanying illustration, and a patent on the construction therein involved has been allowed to Mr. Charles O. Newton, of Homer, N. Y. Fig. 1 is a sectional plan view, and Fig. 2 a vertical transverse section of a car supplied with this system, and Fig. 3 is a view in perspective, with a portion of the floor broken away, there being a lower floor supported by the transverse timbers of the car. The chamber thus formed is lined with asbestos and a sheet metal covering, and between the floors are placed latticed iron joists. Longitudinally in this chamber is arranged a steam supply pipe, surrounded by a steam discharge pipe, lateral pipes extending from the supply pipe toward the sides of the car and returning to the discharge pipe. Opposite ends of the supply pipe have branch connections extending to the car platforms, where flexible connections establish connections between the heating apparatus of adjacent cars, similar connections being made with the discharge pipe. In the floor are registers for receiving cold air, the registers having a fibrous covering, one end of which extends into a water reservoir, to impart moisture to the air. Within the inner leg of each car seat is a box register communicating with the chamber between the two car floors, and arranged to discharge warm air into the body of the car, the upper floor itself being always evenly heated. It is designed that the supply of steam shall ordinarily be furnished from the locomotive, each car being provided with valves by which the supply is controlled, but the invention also contemplates connecting the supply pipe with any suitable stationary boiler in the car house, or before a train is made up, that the car may be thus warmed before starting.

The Location of the Soul.

Considerable speculation has heretofore attended the precise location of the soul, but, according to the *Electrical World*, the mystery is now solved. Dr. A. H. Stevens, of Philadelphia, has located it in the corpus callosum, a little spongy body situated at the base of the brain, which has defied the efforts of physicians in their endeavors to ascertain its uses in the human anatomy. "The corpus callosum," says the doctor, "is the seat of the imperishable mind, and is the great reservoir and storehouse of electricity, which is abstracted from the blood in the arteries, and conveyed through the nerves up the spinal cord to the corpus callosum."

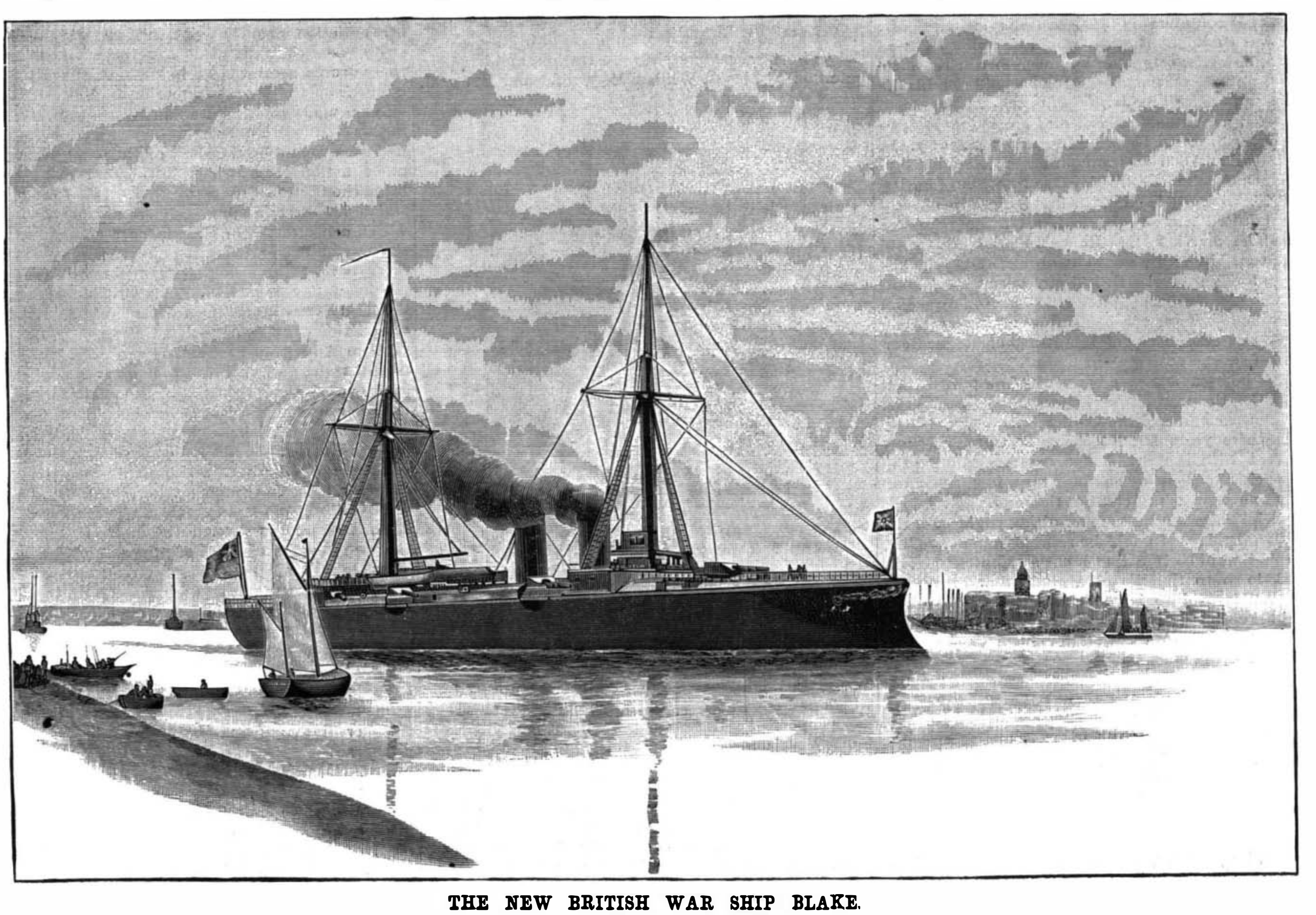
THE NEW BRITISH WAR SHIP BLAKE, THE FASTEST AND MOST FORMIDABLE CRUISER AFLOAT.

We give herewith a portrait of the new war ship Blake, lately launched, which, it is calculated, will be the fastest war vessel afloat, and, for her class, the strongest fighting ship.

Displacement, 9,000 tons; length, 375 feet; beam, 65 feet; draught, 25 feet 9 inches; twin screws, 20,000 horse power; maximum speed, 22 knots per hour, or over 25 miles. As a ram, at this high velocity and her great weight of 9,000 tons, it is doubtful if any vessel could withstand the shock.

The Blake is constructed of steel throughout, has six-inch armored turtle-back steel deck, covering the magazines, torpedo rooms, engines, and boilers. Fuel space, 1,500 tons. She is to carry two 9 inch 22 ton breech-loaders and ten 45 pounder quick-firing guns, each capable of firing 12 times per minute, worked by two men, and will pierce 12 to 15 inches of armor plate. Cost, $1,840,000.

Such in brief is the Blake. She is far faster and stronger for fighting purposes than any of the new American vessels so far ordered, and costs much less.



THE NEW BRITISH WAR SHIP BLAKE.

Horatio Allen.

Horatio Allen, the well known civil engineer, under whose direction the first locomotive brought to America was built and run, died at his home in Montrose, N. J., on Tuesday evening. He had no specific disease, and retained his faculties to the last. He was the son of Dr. Benjamin Allen and Mary Benedict Allen, and was born at Schenectady, N. Y., in 1802. His father was the principal of an academy at Hyde Park, N. Y. Young Allen entered Columbia College in 1821, and was graduated near the head of his class in 1823, taking especially high rank in physics. He studied law at first, but after a short time decided to make civil engineering his work, and entered the employ of the Delaware and Hudson Canal Company, under Judge Wright, then constructing engineer of the line. He was sent to St. George, Del., as rodman, and within two weeks was placed in full charge of a party. In the fall of 1824 he was appointed resident engineer of the Delaware and Susquehanna Canal. A year later he was appointed resident engineer of the summit level of the Delaware and Hudson Canal, under John B. Jervis, then chief engineer of the company,

In September, 1825, the first successful locomotive was put in operation on the Stockton and Darlington Railroad, in England, by George Stephenson. The news of its success reached this country early in 1826, and so greatly interested Mr. Allen that he decided to go to Europe and study the new motive power. He received an appointment from the Delaware and Hudson Company as contracting agent, to purchase in England the railroad iron required to build the sixteen miles of road from the company's mines in the Lackawanna Valley to the Lackawaxen, a tributary of the Delaware, and also authority to purchase three locomotives for the new railroad, to be built on plans to be decided on by him.

Mr. Allen, on arriving at Liverpool, made the acquaintance of George Stephenson, with whom he consulted in the carrying out of his plans. Two of the locomotives were ordered, from Mr. Stephenson, and one from Foster Rastrick & Co., of Stourbridge. It was the latter—the "Stourbridge Lion"—that was the first locomotive ever run in America. The locomotives were received in New York in the winter of 1828-29, set up, and tested while suspended in the air, and it was not until August, 1829, that they were taken to the road for which they were built. This road terminated at Honesdale, Pa., and ran about 600 yards in a straight line, then crossing the Lackawaxen Creek by a sharp curve of 750 yards radius. When the "Stourbridge Lion" was swung in the air preparatory to being placed on the track, it was discovered for the first time that the axles had an unyielding parallel position and that there was no truck with king bolt that would permit of the engine accommodating itself to the curve of the road. Further, the road had been built of green timber in long lengths, and the timbers had warped considerably in places. Nevertheless, Mr. Allen was confident that all would be well. He tried in vain, however, to get an engineer to run the locomotive, and no official of the road would risk his life in the apparently foolhardy enterprise. Mr. Allen then acted as engineer himself and ran the locomotive three miles down the track and returned in safety.

In 1829 Mr. Allen was appointed chief engineer of the South Carolina Railroad, extending from Charleston, S. C., to Augusta, Ga., the first long railroad built in the United States. In 1834, after the road was finished, he married Miss Mary Moncrief Simons, of Charleston. In 1835 they went abroad and spent two years in foreign travel. In 1837 Mr. Allen was appointed principal assistant engineer of the Croton Aqueduct Department, and on the completion of the aqueduct, in 1842, was chosen one of the Board of Water Commissioners.

In 1844 he became a member of the firm of Stillman, Allen & Co., the proprietors of the Novelty Iron Works, building the engines of the Collins Line of steamships. During these years Mr. Allen was at different times connected with the Erie Railway system, holding the office of chief consulting engineer for a long time, and served one term as president of the road. Mr. Allen's last official place was that of consulting engineer of the Brooklyn Bridge. In 1870 he retired from active life, and building himself a fine home at Montrose, N. J., settled down to the life of a student and inventor. Mr. Allen is said to have designed the eight-wheel passenger coach truck now so universally used, and was the inventor of a cut-off for steam engines that is widely known.

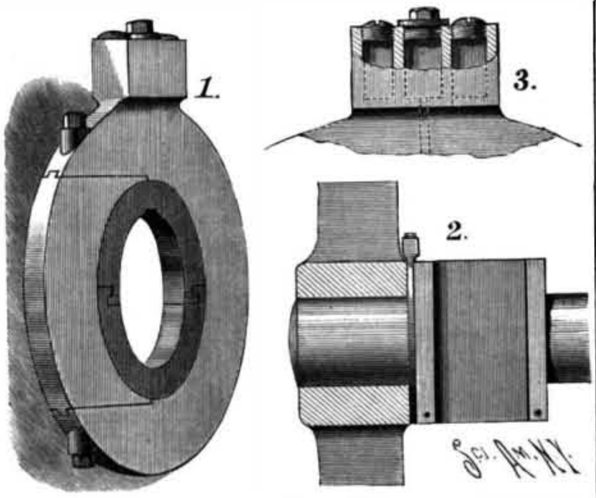
To Make Red Lines on Blue Prints.

C. J. Bates, in the *Railroad Gazette*, says: To the red aniline ink now used add about 25 per cent of a solution of carbonate of potash. I used a solution of 60 grains of carbonate of potash to the ounce of water. The action is evident, the carbonate of potash destroys the blue, leaving the red, which appears especially bright compared to the surrounding blue. It would probably be just as good to dissolve a few crystals of carbonate of potash in the ink, as it does not injure the ink for ordinary usage.

AN IMPROVED ANTI-FRICTION CLUTCH.

An anti-friction ring to be placed upon axles and shafts between the collars or bosses of wheels and journal boxes, to furnish a bearing having less friction than would exist between the boss, or collar, and the journal box, and intended for locomotive driving and truck axles, propelling shafts for steamers, etc., is represented in the accompanying illustration, and has been patented by Mr. Joseph J. Ladd.

Fig. 1 is a view in perspective of the clutch, and Fig. 2 shows the application of the collar to an axle, Fig. 3 being a block on the edge of the collar through which lubrication is effected. The ring fitted to the shaft is formed in two parts, united by right-angled hooks



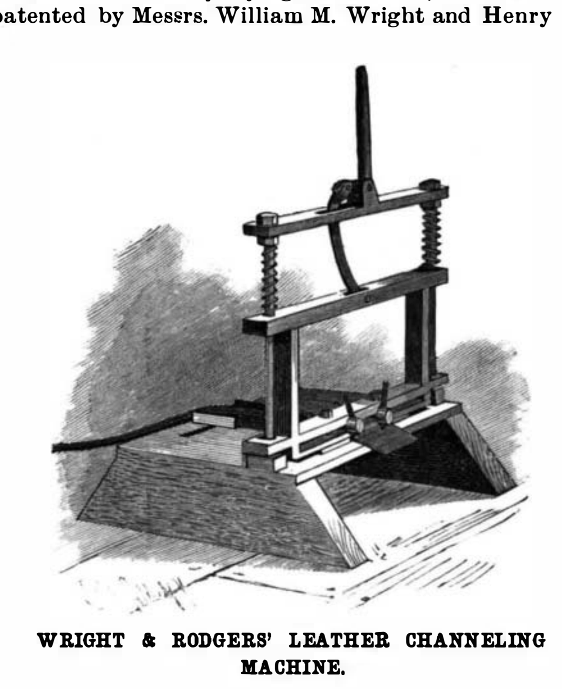
LADD'S ANTI-FRICTION CLUTCH.

formed on their ends, and one of the parts having a key seat. This split ring is preferably made of hardened steel, and upon it is fitted a collar, preferably made of Lowmoor iron, case-hardened. This collar has upon one side a removable section of sufficient width to allow the collar to be placed upon the ring, this section being grooved, and the edges of the ring adjoining the section having each a tongue to enter the grooves, while the collar and the removable section are bored to receive a bolt, the collar having bosses forming bearings for the head and nut of the bolt. The block on the edge of the collar, shown in Fig. 3, has three chambers closed by screw plugs, below which are passages communicating with a central chamber and passage to the interior of the collar, whereby oil is gradually supplied to maintain a perfect lubrication.

For further information relative to this invention address the inventor, care of Messrs. Martin Reinberg & Co. Guyaquil, Ecuador.

AN IMPROVED LEATHER CHANNELING MACHINE.

A machine adapted for adjustment to produce channels upon round lines, reins, and traces, and for splitting straps to be used as crown pieces of bridles, etc., is shown in the accompanying illustration, and has been patented by Messrs. William M. Wright and Henry J.



WRIGHT & RODGERS' LEATHER CHANNELING MACHINE.

Rodgers, of Waverly, Ill. The base plate has integrally connected side supports, and two upwardly extending bosses which support vertical bolts carrying nuts whereby an upper crossbar is adjustably supported. The vertical bolts serve as guides for a sliding frame which is kept under an adjusted spring tension by means of coiled springs about the bolts, and the frame has two horizontal cross bars slotted to provide for the passage of the shanks of gauges held to place by nuts. Between the cross bars are placed the shanks of cutter heads having recesses adapted to receive the knife blades, the recesses being such that when the knives are placed therein, the edges of the blades will bear against the faces of the cross bars, in which position they are clamped by winged nuts. Different knives are employed, according to the nature of the channel to be cut. On the upper cross bar of the frame is mounted a bell crank lever, pivotally connected by means of a link with the sliding frame between the lower cross bars of which the cutter heads are arranged. If the channel to be cut is to extend inward at right angles, the knives are adjusted therefor, the lever having been thrown down to horizontal position to raise the sliding frame, and, when the leather has been placed on the base plate, between the gauges, the lever is raised to vertical position, bringing down the sliding frame in such position that the cutting edges of the blades will enter the upper surface of the leather, which is then drawn forward between the gauges to form the channel. If the channel is to enter the leather at an angle, the knives are adjusted accordingly, the channeler being designed to operate upon any thickness of leather.

Electrical Execution.

On December 30, 1889, the decision in the well known Kemmler case was rendered by Judge Dwight of the fifth department of the Supreme Court of the State of New York, in Rochester, N. Y. Kemmler is the first murderer condemned to death by electricity, and the judgment against him was appealed from to the Supreme Court, on the ground of unconstitutionality of the act of the legislature prescribing that punishment. The present decision is against the appellant. The court reviews the English common law as bearing upon the case, and the prohibition of "cruel and unusual" punishments which is a provision of both the Federal and New York State constitutions. The question was thus narrowed down to one issue, whether the infliction of death by electricity would be cruel and unusual. If it is so, the act prescribing it would be unconstitutional as regards the New York State constitution. Judge Dwight suggested that it could safely be presumed that the legislature had passed upon this question of fact. He considered it also in the light of the evidence presented to the court, and concluded that while unusual the general consensus of scientific testimony proved it not to be cruel. He stated that if the question were of the advisability in the change of the mode of inflicting death by capital punishment, the discussion might be prolonged.

An appeal to the Court of Appeals is now in order as the last step upon which Kemmler can base any hope. This will probably be taken at an early day.

Electric Car Brakes.

The expression electric brake is now often heard, and requires a word of explanation. There are various forms of so-called electric brakes which are practicable and even efficient working devices. In none of them, however, does electricity furnish the power by which the brakes are applied; it merely puts in operation some other power. In one type of electric brake the active braking force is taken from an axle of each car. A small friction drum is made fast to the axle. Another friction drum hung from the body of the car swings near the axle. If, when the car is in motion, these drums are brought in contact, that one which hangs from the car takes motion from the other, and may be made to wind a chain on its shaft. Winding in this chain pulls on the brake levers precisely as if it had been wound on the shaft of the hand brake. The sole function of electricity in this form of brake is to bring the friction drums together. In a French brake which has been used experimentally for some years with much success, an electric current, controlled by the engine driver, energizes an electro-magnet which forms part of the swinging frame in which the loose friction pulley is carried. This electro-magnet being vitalized is attracted toward the axle, thus bringing the friction drums in contact.

In an American brake lately exhibited on a long freight train, a smaller electro-magnet is used, but the same end is accomplished by multiplying the power by the intervention of a lever and wheel. The other type of so-called electric brake is that in which the motive power is compressed air, and the function of the electric device is simply to manipulate the valves under each car by which the air is let into the brake cylinder or allowed to escape, thus putting on or releasing the brakes. All of these devices have this advantage, that whatever the length of the train, the application of the brakes is simultaneous on all the wheels, and stops can be made from high speed with little shock.—*Scribner*.

The Yankton Artesian Well.

Gray Bros. & Co., artesian well borers of Milwaukee, have just completed a well at Yankton, Dak. It is a six inch well, 1,500 feet deep. It throws a solid stream of water 9 feet straight up before it is broken. The discharge of water amounts to 4,000 gallons per minute. There are now about twenty-five artesian wells already in Dakota, and more are being drilled. The wells vary in depth from 900 to 3,000 feet. The firm has thirteen gangs of men constantly employed in different States. Two artesian wells are being sunk for the city of Kaukauna, Wis., and one in Milwaukee, at the plant of the Milwaukee Car Wheel Company, at North Avenue.

RECENTLY PATENTED INVENTIONS.

Engineering.

LOCOMOTIVE. — Anthony H. Rank, Philadelphia, Pa. This locomotive has high and low pressure cylinders supported side by side in the front end of the main frame, and the front and rear wheels each have a crank arm and are connected by pitmen, links connecting the arms, while crank disks are mounted on the axle between the front wheels, whereby both sets of wheels and the front axle are balanced.

FURNACE.—Joseph H. Behee, Leavenworth, Kansas. This invention provides a form of furnace designed to afford increased radiating surface, and so arrange the several parts of the furnace that the draught may be regulated according to the weather, while the flues are so arranged that they may be quickly and readily cleaned.

TRACTION ENGINE.—Albert J. Hart, Cromwell, Ind. This invention provides a mechanism for balancing the machine, at the same time gearing the four independent wheels with each other, whereby the weight will be equally distributed, and the machine will go readily over soft mud and through sand, and can be easily turned around.

Railway Appliances.

TRAIN SIGNAL.—Daniel S. McElroy, New York City. The cars are provided with electric conductors and keys, whereby the circuit extending through the train may be opened, ground wires running to the axle boxes, and having a switch, whereby the train circuit may be grounded in any car, to enable the train men or passengers to signal the engineer, while causing an automatic signal in case of the separation of the train.

RAILROAD SWITCH.—John M. Kincade, Westville, Ohio. A switch is pivoted between the tracks and a crank shaft connected with the switch rails, a trip port being connected with the crank shaft, making an automatic attachment adapted for connection with any switch, whereby the switch may be operated from the train while in motion or from the vicinity of the track.

STATION INDICATOR.—James N. Winn, Darien, Ga. This is a device to be located in the cars of the train and be under the control of the engineer or fireman, to be operated by compressed air or steam transmitted through a continuous pipe, the invention covering novel features of construction and arrangement of the various parts.

CAR STEP. — James F. and John F. Wood, Wilmington, Del. This invention covers an improvement on an extensible car step formerly patented by the same inventors, the guiding rods from extensible treads working in connection with a piston in a cylinder in connection with a compressed air reservoir, a spring holding the tread normally in raised position.

COAL TIPPLE.—Thomas Walkins and James H. Brown, Coal Bluff, Pa. This invention provides devices whereby clear coal, three-quarter coal, or the run of the mine may be loaded in cars on two contiguous tracks, or clean coal and nut coal, or mixed nut coal and slack, may be loaded at the same time in cars on different tracks, also providing means whereby the clear coal may be weighed and the delivery chutes manipulated to load either open or box cars.

CABLE GRIP CENTER BAR. — Vernon T. Lynch, Chicago, Ill. This invention consists of two parallel steel bars and an iron head cross piece extending over their ends, with two iron plates placed on opposite sides of the bars and cross piece, and fastened thereto, forming an effective and cheaply made center bar, which can be readily repaired when a part breaks or wears out.

AXLE LUBRICATOR. — Isaac B. Abraham, San Francisco, Cal. This invention covers a lubricating collar for car axles, there being combined with the box a spring presser for feeding the lubricating material to the axle and wear blocks operating within the box, the blocks being automatically fed in contact with the axle by the spring presser.

Mechanical.

LOOM PICKER. — Cornelius Chippendale, Auburn, Me. This invention consists of a housing and means for connecting it to the picker staff, the housing being formed of layers of leather or other yielding material adapted to strike against the shuttle, dispensing with the ordinary picker loop and the screw by means of which pickers have heretofore been fastened to their staffs.

SAW. — George N. Clemson, Middletown, N. Y. The saw blade, according to this invention, is formed with oblong tapering apertures at its ends, the apertures being rounded at both ends and free from angles, with their smaller ends toward the ends of the blade, whereby the saw may be retained firmly in its frame, so that it will not move upon the fastening screws or pins.

LADLE CARRIER. — Jacob Kitzinger, Buffalo, N. Y. This carrier is made with a handle having a forked inner end, a ladle support between its ends, an inverted cup at its outer end, and a ball arranged to turn in the cup, the ball being mounted to turn in a track laid in the foundry from the cupola to the moulds. permitting the moulder to pour the metal without additional help.

NUT LOCK. — Jacob M. R. Gedney, Little Falls, N. J. The washer is formed with a boss or projection having an undercut groove adapted to receive a head formed upon a shank made integral with the nut, the bolt being formed with a squared or irregularly shaped shoulder, making a simple and durable nut lock which is also applicable for use in connection with rail joints.

PULP SCREENING MACHINE.—Edmund Victory, Watertown, N. Y. Combined with a series of separate screens is a series of independent bellows plates having flexible bellows joints at their sides and ends, the drive shaft having eccentrics alternately arranged upon it, the arrangement being such that the paper pulp is drawn down through the screen plates upon the concave face of independently working bellows.

AUGER BITS. — Robert Crichton, Parsons, Kansas. This invention covers a machine for making drills or auger bits, a tube being mounted to turn and carrying a pair of twisting rollers and traveling grippers for pulling the bar to be twisted through the tube and rollers, serving to conveniently twist a bar of any desired length into an auger bit or twist drill.

SHIFTING ECCENTRICS. — Jesse M. Branch (Emma L. Branch, administratrix), Gaylord, Mich. By this invention a disk is held to slide across the main shaft, with inclines mounted to slide and passing centrally through the disk and turning with the main shaft, the eccentric being designed to cut off at any desired point, or for stopping or reversing the motion of the machine whenever desired.

SAWMILL PLANER.—Hiram N. Berry, Meridian, Miss. This invention provides a planer adjustable longitudinally toward and from the log, and also adjustable vertically at its front or planer end to slightly incline the planer head, to cut off any thickness desired, with one side dressed or planed.

CROSSCUT SAW.—John Flesher, Edgington, Ontario, Canada. This saw has a central drag tooth, with a recess at each side inclining in opposite directions, the block of teeth at each side of the drag tooth being inclined in the direction of the end of the saw blade.

RIB FOR SAW GINS. — Thomas H. Abernethy, Beam's Mills, N. C. This is a rib having a protecting shoe or wear plate, the shoe protecting the rib from being worn away by the action of the saw, the improved rib being also adapted for insertion in place of one ordinarily worn out, while ribs thus protected are designed to last the lifetime of the gin.

SHOE BURNISHER. — Walter Lawes, New Bedford, Mass. This invention provides a tool having twin burnishers, each section capable of burnishing the heel or sole, and the wax being automatically fed, the machine burnishing the dry blacking, waxing the surface burnished, and burnishing the waxed surface, without its motion being stopped.

WAGON WHEEL MACHINE. — John L. Zesiger, Switzer, Ohio. This is a machine for dishing wheels and cooling tires, having an open metal frame giving room to operate with the tongs and seize over the felly and tire, with a water tank sinking down about six inches below the open frame on which the wheel rests, while the immediate and complete cooling of the tire is effected when the tank is raised, preventing the burning of the fellies.

ORE STAMP. — George E. Smith, Cooney, and Charles H. Wilkie, Silver City, New Mexico. This invention covers an attachment for the stamps of quartz mill batteries, forming a strong and simple device capable of communicating a positive rotary motion to the stamp stem during the entire drop, whereby the capacity of the battery is greatly increased.

STONE CRUSHER. — William H. Howland, Bergenfield, N. J. Combined with a fixed jaw is a movable jaw and a driving shaft formed with a section the axis of which is at an angle to that of the shaft, the movable jaw being mounted upon the section, whereby the stone between the two jaws will be subjected to a constantly varying pressure, and the pressure upon the shaft is distributed gradually from end to end.

SOLDIER'S CART. — Herman Gentzen, Fort Ringgold, Texas. This is a light, strong cart, adapted to carry the rations, baggage, etc., of one man, and adapted also when two or more are coupled together for the safe carriage of disabled men from the field, or to be so coupled that one animal will draw the baggage of from six to ten or more men.

FEED REGULATOR.—Marcus A. Swing, Washington, Ind. This is a device for regulating the feed of roller mills, designed to do away with all the small pulleys and belting heretofore used on the outside of the roller frame or casing, this feed regulator being driven from and off the mill roll on the inside of the roll frame or casing.

Agricultural.

CULTIVATOR.— Jasper Roberson, Tarkio, Mo. This cultivator has four wheels and a front section capable of being readily turned at the end of the row and yet rigidly held when the row is being cultivated, the invention covering novel details in the construction and combination of parts to form a simple, durable, and economical implement.

CUTTER BAR.—Francis E. Parker and Roswell M. Clark, Kansas City, Mo. This invention provides means whereby the necessity of riveting or bolting the sickle knives to the cutter bar may be done away with, and the knives may be quickly locked to or detached from the cutter bar, the construction being simple, cheap, and very effective.

WIRE FENCE TIGHTENER. — Dwight H. Scott, Flora, South Dakota. This is a tension device for expeditiously taking up the slack in wire fences and retaining the wire under tension, and has a tubular body with a flange at one end through which extends a diametrical slot, a series of teeth radiating from the opposite end of the body and inwardly and laterally inclined over the body, the device being substantially in the form of a metal spool cast in one piece.

DUST CONVEYER.—William S. Miller, Meyersdale, Pa. This is a construction for employment in connection with thrashing machines, to clear the fan blades and distribute the suction, clearers being arranged in connection with the fan, and a casing forming a conduit or way from beneath the fan chamber to the induction ports leading to the chamber.

DIGGING MACHINE. — William J. Young, Centreville, St. Mary's Parish, La. This invention covers an improvement in the teeth and teeth carriers of stubble digging machines, providing means whereby broken teeth may be readily removed, or teeth which become bent may be quickly detached and straightened.

POULTRY VERMIN EXTERMINATOR.— Elhanan Foop, Centre View, Mo. This invention covers a closed feed box with a feed opening in one side near its top, and an elastic absorbent material over the opening, adapted to hold the insect exterminating compound, whereby, when the fowl pushes in its head, the vermin exterminating compound will be applied to its head and neck.

Miscellaneous.

STRAINER.—George W. Rush, Bridgeton, N. J. This strainer is made in egg shape, in two parts of steel wire gauze, and is designed for use in an ordinary coffee or teapot, the full aroma and flavor being extracted from the coffee or tea placed in the strainer, while the fluid is kept clear and free from sediment.

SAFETY GAS BURNER.—Ray P. Williams, Boise City, Idaho. This invention covers an attachment for gas burners and fixtures, whereby the gas will be immediately relighted should the flame from the burner be blown out, an auxiliary pipe holding a small lighted tip a distance above the main burner, the tip being necessarily lighted when the main burner is.

SELF-LOADING DIRT CART. — Samuel M. Stevenson, Bastrop, La. This invention covers an improvement on a former patented invention of the same inventor, scoops being rigidly connected to two pivotally mounted and rearwardly extending levers formed with side flanges, in combination with double lever arms rigidly connected to the wheel boxes, the object being to distribute the strain incident to the raising of the loading scoops.

VALVE.—John H. Daly, Portage, Wis. This valve is adapted to be seated on the under side of a movable cylinder open at both ends, mounted independently, and is especially designed for catch basins, permitting a ready emptying and cleaning of the basin and of the sewer line, and resisting back pressure in case of high water.

SUSPENDER BUCKLE. — Jacob Myers, Eureka, Cal. This is a clamp-like device of novel form, to be used as a buckle, but having no teeth to cut or punch holes in the suspender web or strap, being also applicable to other straps or strap-like articles.

TOY APPLIANCE. — James E. Gause, Brownsville, Tenn. This is a guideway for traveling toys, vehicles, etc., which may be readily laid and taken up, and which can be packed in small space when not in use, and one which will direct the toys in both straight and curved directions for any desired distance.

LINIMENT. — Joseph G. and Peter H. Knipper, Rochester, N. Y. This is a composition for use in the treatment of sprains, bruises, swellings, etc., and is composed of tincture of myrrh, tincture of henbane, and other ingredients, compounded and applied as specified.

TRICYCLE. — Leonhard Levin, San Francisco, Cal. A large front wheel is journaled in the frame, in which also are journaled drive shafts, while a rear axle carrying small wheels is swiveled to the rear portion of the frame, a hand rod being attached to each drive shaft, levers fulcrumed on the frame attached to the hand rods, and a link connection between the levers and the rear axle.

BICYCLE BRAKE.—John J. Astor, Jr., New York City. This invention covers a brake shoe made of spring metal and slotted longitudinally to cause it to adapt itself to the periphery of the tire without regard to the cross sectional shape of the latter.

GATE LATCH. — Samuel Corrothers, Grafton, West Va. This invention consists in providing one of the panels of the fence section adjacent to the latch post of the gate with a wooden bar secured thereto, and having a free elastic end arranged to project in the path of the front bar of the gate, and adapted when engaged by the bar to hold the gate closed.

SILK WINDING SWIFT. — William F. and Louis P. Hochspeier, Union Hill, N. J. The hub of this device has radial hollow slotted arms which may be projected and held extended from the hub as desired to hold and spread out the skein thereon, so that it may be readily and quickly loosened, and can be beaten to spread the silk and prevent it from catching.

LACE TUCKS ON FABRICS. — Jean Wiget, New York City. This invention covers a method of producing needle lace embroideries on muslins or like vegetable fiber fabrics not affected by a chemical solution, which will cut away or remove animal fiber fabrics on which embroidery patterns are worked prior to joining the two fabrics together.

TABLE. — Joseph Cornell, Potsdam, N. Y. This is a table of the class generally known as "knockdown" tables, the invention covering a construction of the frame to which the table top is attached, whereby improved clamping sockets are provided for the legs.

EGG CASE. — Ebenezer Butterick, Brooklyn, N. Y. This invention relates to a class of egg carriers in which a series of horizontal pockets are detachably secured within a transporting frame, each pocket consisting of a series of complete cells arranged end to end, to be filled before placing the pocket in the frame, the invention providing a carrier in which the eggs can be safely transported, and one which can be quickly packed or unpacked.

SHIPPING OR RECEIPT BOOK.— Grattan H. Wheeler, Tacoma, Washington Ter. This is a book in which the leaves are separately bound together in a manner described, and copies can be readily made by the interposition of carbon sheets, the leaves and the carbon paper being readily secured to their places in the cover, and the receipts being detached with facility.

AUTOMATIC FAN.—Frank Comminge, Houston, Texas. This is a fan designed for use on beds in houses or sleeping cars, and to be run by an electric motor, a pitman extending between the fan-shank and the crank of the motor, while the fan rod is adapted to be adjusted in any desired position.

EXPLOSIVE COMPOUND. — John F. A. Mumm, Dayton, Ky. This is a composition of matter designed to be more powerful than ordinary gunpowder, and safer to make and handle than dynamite or nitro-glycerine, and consists of chlorate of potash, antimony, charcoal, flowers of sulphur, glycerine, collodion, sulphuric acid, and other ingredients, in specified proportions.

MANUFACTURE OF EXPLOSIVES.— Wilbraham E. Liardet, Cambria, New South Wales. This invention covers a process designed to secure absolute safety in the manufacture of an explosive compound of great power, and safe for the purposes of storage and carriage, the compound containing as ingredients picric acid combined with nitrate of potash or other similar substances.

KNAPSACK.—Charles D. Weldon, Mica, Washington. This is a knapsack adapted to carry part of the wearer's load in front of the body in a pocket over each breast, thus distributing the load more uniformly on the shoulders.

SHOE.—Christian Wurtele, St. Joseph, Mo. This is a shoe having a vertically extending side opening in one side, with its opposite side closed, and a transversely divided sole, whereby the heel part may be swung laterally away from the opposing parts of the shoe.

BUCKLE. — Louis Hausmann, New Orleans, La. This is an improvement in suspender buckles having inwardly bent perforated ears and a toothed gripper or jaw, the invention providing ears with openings and narrow slots leading to them, the gripper with its trunnions being adapted to pass through the slots, whereby the plate and jaw may be quickly connected and disconnected.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1675) J. M. B. asks for some kind of solution to be put on soft rubber goods, such as small tubings and sheetings, to hide the smell of the rubber. I have tried shellac, but that will crack and wear off soon, and spoil the rubber. A. We can recommend nothing that is very effectual. Possibly celluloid varnish or simple collodion might answer. Where an undrying solution is required, glycerine is excellent as an application.

(1676) J. N. H. asks: 1. How are tubes of different kinds bent so as to have a curve without a seam or wrinkle? A. By filling with melted resin, and bending when cold. 2. Is there any machine for bending same? A. A flexible mandrel, made of coiled steel wire, is sold for this purpose. 3. What is the E. M. F. of Smee battery with carbon instead of platinized silver plate? A. 0·47 volt with silver platinized plate; about the same with carbon, but in the latter case liable to rapid polarization. 4. How long will it last with one charge in constant use? A. This depends on the work. It will run down in half an hour, owing to polarization. With platinized plates it will remain constant for many hours. 5. What is the E. M. F. of Fuller mercury bichromate battery? A. 1·8 volts. 6. I want to use field magnets in an electric motor of a shape that makes it troublesome to use wrought iron cores. What can I do to make cast iron compete in efficiency with wrought? A. Anneal them by heating to redness and burying in powdered quicklime or forge cinders. This however is not necessary if the iron is of g od quality.

(1677) C. M. asks: 1. Was any apparatus ever invented which would generate perpetual motion? A. No. 2. If not, what forms did the most practical of attempts in this direction take, and on what principle did they act? A. Dierck's "Perpetual Motion," $4, gives many of the absurd vagaries of inventors in this direction. 3. Is there any substance known whose gravity will be lessened or increased by entering alternately two elements of different degrees of density, as from air to water? A. All substances immersed in a liquid or gas are buoyed up by the weight of the medium they displace. Hence there is an apparent change such as you seem to mean. Cork floats in water, but not in air. 4. Is there more than one way of producing sulphuric acid, and what is the most simple? A. Yes. Distillation of sulphate of iron is the simplest. Perpetual motion is regarded as an impossibility.

(1678) J. W. S. writes (1) for a receipt for making a first class silver polish. A. Use infusorial silica. 2. Also a good polish to clean store windows, show cases, etc. A. Use whiting. Both are to be applied wet, allowed to dry, and then polished off. For a general metal polish, putz pomade is excellent. It is said to be thus made: Oxalic acid 1 pint, oxide of iron (crocus) 25 parts, rotten stone 20 parts, palm oil 60 parts, vaseline 4 parts. It is often perfumed with artificial oil of bitter almonds. Apply with a rag, rub hard, and wipe off with a clean cloth.

(1679) G. W. B.—Soaking the plate in water 1 oz., bichromate of potash 20 grs., will make it insensitive to light.

(1680) S. S. B. writes: What is the nature and use of the alkali or lye of anthracite ashes? I poured water upon a pan of ashes which, when settled, gave a specific gravity of 5° Baume, and the suggestion comes to me that this alkali should be utilized in some way—but how? A. The alkali, consisting of soda salts principally, is of no value. Wood ash lye derives its value from the potassium carbonate which it contains.

(1681) W. L. W. asks (1) how to make luminous paint. I do not mean the kind that they put on cheap match safes, but something that will show up distinctly in the dark. A. Balmain's luminous paint is generally considered the most successful, and is the faintly luminous color you fail to appreciate. See our SUPPLEMENT, Nos. 249 and 549. You cannot get an intense light by phosphorescence. 2. Are there two kinds of substances, such that if a stick be dipped in each and then held together or against each other will cause ignition? A. This class of preparation is always dangerous. A little sodium or potassium on a stick will ignite on being moistened, which may be done by touching with a second stick that is wet. Potassium is the surest, but most expensive and dangerous. The end of the sodium stick should be wrapped with paper dipped in alcohol, to become ignited from the sodium.

(1682) R. E. P. asks: How the tips of gas burners are made, also what is meant by, say, that a certain burner gives a three or four foot light? How is this ascertained and explained? A. The process by which they are made is not disclosed. They are baked like pottery. A three foot or four foot burner is supposed to be one consuming three or four feet per hour, but as this factor varies with the pressure, and as the pressure is not stated for each burner, the designation is little better than arbitrary. We cannot without a special search answer your other query.

(1683) J. P. asks: What substance is used for coloring tinned salmon, and what used to one pound salmon? A. We strongly advise you not to color food preparations. Annatto may be used for salmon in quantity sufficient to impart the desired color.

(1684) L. W. G. asks (1) for some way to soften broom corn brush, so as to prevent shrinkage when tied to a broom. A. We advise thorough seasoning of the corn before making up. Glycerine and water mixed in equal parts might be sprinkled upon it. 2. The proper method of bleaching the bush to make it a nice bright green? A. Cut before it is too ripe, and dry out of sun. 3. Can common India rubber be melted, and how? A. No. See our SUPPLEMENT, Nos. 249, 251, and 252, for India rubber manufacture.

(1685) A. G. P. R. asks (1) for a recipe for a good imitation razor hone. Also in which book I may find some more recipes of similar kind. A. For razor strop composition mix 18 parts of fine paper pulp with 3 of flour of emery and 2 of starch. For stone composition use flour of emery 3 parts and shellac 1 part, melted together, and pressed into shape while warm. We recommend the Techno-Chemical Receipt Book, which we can supply for $2.

(1686) B. H. M. writes: I have a medal about the size of a half dollar, which I wish to copy in some soft metal like lead. How can I make a mould? A. Use a mixture of plaster of Paris and sifted coal ashes or ground pumice stone in equal parts made into a paste with water. Or soak paper in water and press it in successive layers, with flour paste between, down upon the coin, beating it in with a stiff brush. Let either mould dry, bake in a rather cool oven, and cast at a low temperature.

(1687) W. D. asks: 1. What is the weight of a cubic foot of air? A. At 62° Fah. and 31 inches barometer 0·076097 pound or ·532 67-100 grains. 2. The weight of a cubic foot of water? A. At 39·2° Fah., 62·425 pounds. 3. The weight of a cubic foot of gas. A. It depends on the gas. For ordinary coal gas about ·475, or 253 grains, that of air, or for water gas about ·550, or 293 grains.

(1688) O. S. D. says: Please tell me how to remove a large kerosene spot from black woolen cloth. A. Hold the cloth near to a hot coal fire until the oil evaporates. Take care and not set fire to the cloth.

(1689) J. H. N. asks for a process to oxidize small articles in white metal, now so fashionable. A. Plate with silver and treat with sulphide of potassium in solution in water.

(1690) A. A. asks for a cheap preparation to dye brown straw that will not wash off and that will not affect the straw. Walnut or tobacco color preferred. A. Try diamond dyes as they are called or aniline colors; dissolve in water and immerse the straw. Extract of black walnut husks is also to be recommended as more permanent.

(1691) H. G. writes: How can I reduce hard rubber so I can pour it in a mould, and if it will be as hard after it has been softened. I wish to make a disk for a battery that will be acid proof. A. You cannot treat India rubber as you describe. Use gutta percha, soften it in hot water, and mould it by pressure between warm dies.

(1692) H. D. B. asks for a method of preserving cider sweet. A. Add ¼ ounce sulphite of lime (not sulphate) to each gallon of cider.

(1693) A. T. L. asks: Could you tell me something about foxing in SCIENTIFIC AMERICAN, which is used in dyeing skins? A. You undoubtedly mean fuchsine, which is a dye called aniline red, or rosaniline, one of the coal tar products.

(1694) M. N. asks for a receipt to prepare something that will clean wall paper and fresco painting. A. Use fresh bread crumbs or India rubber sponge.

(1695) T. H. W. writes: What will remove smoke discoloration from a white marble mantel, immediately over a coal heater? A. We fear you will have trouble in doing this. Try washing with soap and ground pumice stone. Try a paste of washing soda 1 oz. and whiting ¼ lb., soft soap ¼ lb., and a lump of bluestone the size of a walnut. Apply; after an hour wash off. Or use whiting mixed with benzine, applied as above.

(1696) L. D. L. asks: Does air cause decay? That is, if there was no air, or nearly so, would fish, eggs, etc., keep fresh forever? If air does not cause decay, what does? A. The question is a very broad one. Decay is generally supposed to be started by some germs of bacteria from the air colonizing on the object. By absolute exclusion of such germs decay properly speaking may be indefinitely retarded. Such germs cannot exist without air, so in that sense the action of air may be said to be generally essential. Yet some products might decompose without air, and it would not be safe to say that absence of germs and of oxygen would prevent all decomposition. It is easy to see that chemical decompositions may occur that air has nothing to do with, that one may be brought about by the low affinities of the elements for each other in that combination yielding to stronger affinities brought out by other groupings.

(1697) G. H. F. writes: I have an induction coil having a brass spring as a "make and break" piece, and on this spring (where the point of the tightening screw touches it) there is a piece of white metal glued or stuck in some way to the brass spring. Is this small sheet of metal platinum? If so, how is it fastened to the brass spring? A. The metal is platinum. It is fastened to the spring by means of rivets, or the platinum itself is formed into a rivet with a large flat head, and this is fastened by riveting.

(1698) McG. writes: I have a white cockatoo set up, which has become much soiled and discolored by dust and fly specks; what will clean it without injury to the feathers? A. Use a broad camel's hair brush dry, and afterward wet with a little alcohol. You will probably never succeed in restoring its original brightness.

(1699) A. D. M. asks: 1. What is the ratio of the tensile strength of malleable iron to wrought? A. Malleable iron has a guaranteed tensile strength of 56,000 lb. to square inch; wrought iron, 45,000 to 76,000. 2. Recipe for making a gum such as used on postage stamps.

A. Dextrine	2 parts.
Acetic acid	1 "
Water	5 "
Alcohol	1 "

3. After a patent has been issued in the United States Patent Office *Gazette*, can the inventor buy the plates from which the illustrations are printed? A. The engravings are printed from stones—not plates. The only way is to have plates made.

(1700) W. E. S. asks: 1. If a cylinder holds 100 cubic inches of air at its natural state, how many cubic inches in the cylinder will the air occupy after it has been compressed enough to produce one pound pressure to the square inch? A. The general rule is that the volume of a gas is in inverse ratio to its pressure. Thus, under ordinary conditions, air is subjected to a pressure of about 14·7 lb. per square inch. If this pressure was increased to 15·7 lb., the volume would decrease in inverse ratio, so as to be $\frac{147}{157}$ of the original volume. 2. Would the cubic inches of space that the air would occupy in the cylinder decrease, in compressing the air to produce two or more pounds pressure to the square inch, in the same proportion as they did in producing the first pound pressure? A. The same rule applies; its volume under two pounds additional pressure would be $\frac{147}{167}$. 3. Also any rules or information about the subject that are not generally known. A. The rule quoted may be put in the form of a proportion, thus: New pressure : original pressure : : original or standard volume : new volume. Remember to add or subtract the increment or decrement of pressure to or from the standard (14·7 lb.) or original pressure.

(1701) A. E. G. asks: 1. Are electromotors provided with governors, like steam engines, for controlling the speed? If they are, how do they work? A. The best motors are wound so that they govern themselves by a counter current generated within the motor itself. 2. Do they keep the speed as even as steam engines with as great variations of load? Some motors are shunt wound and some are series wound. I wish to know how the different kinds are governed? A. Yes. The shunt and compound wound machines are governed in the manner mentioned above, while the series wound machines are generally governed by a centrifugal governor, which regulates the current by opening and closing the circuit, or by throwing in or cutting out resistance, or by increasing or diminishing the current passing through the field magnet. 3. If all the current from one dynamo is used to run a number of small motors, to be stopped or started independently, as in running separate machines, how do they prevent short-circuiting when they are all stopped at once? A. If the motors are run by a current from a self-regulating dynamo, the current will, of course, be regulated automatically by the dynamo itself; but if the dynamo is not automatic, the regulation must be effected by substituting resistance for the motor.

(1702) C. W. W. asks how to tin articles made of wire so they will not rust and have the appearance of being nickel plated. A. The articles should be cleared of grease by boiling in caustic soda water, washing in clean hot water, pickled for a few minutes in a bath of hydrochloric acid 1 part, water 5 parts, washed again in hot water, and tumbled in cleaned white sand, washed again in hot water, and dipped in a solution, proportionally, of 5 ounces tin salt (chloride of tin), 5 ounces alum, 3½ ounces cream of tartar, in 10 gallons of water. A basket of tinned wire may be used for dipping small articles. Let the articles remain in the bath for from 1 to 4 hours, according to the thickness of coating required. Then rinse in hot water containing one ounce of carbonate of magnesia to a gallon, dissolved.

(1703) Scholar says: Text books say that sun spots appear first on eastern limb of sun, travel across, and disappear on western limb. Is this correct, and what direction does the sun rotate on its axis? A. It is correct. The sun revolves in the same direction that the earth moves in its orbit. When their surfaces are face to face, as at noonday, their apparent motions are contrary, the face of the sun moving westward, the spots moving with it. By making a diagram of the motions of the sun and earth, the true relation will become apparent.

(1704) P. J. L., T. P., and W. T. R. ask for receipts for blacking for shoes, liquid and solid. A. 1. Blacking.—Ivory black 50 pounds, cod liver oil 1 gallon, oil of vitriol 10 pounds, powdered gum arabic or senegal 1 pound, molasses 4 gallons, vinegar 15 gallons. Grind together the ivory black, gum, and oil with a portion of the vinegar, add the molasses, and while stirring pour in slowly the oil of vitriol. When all action ceases add the rest of the vinegar. 2. Paste blacking.—Ivory black 25 pounds, molasses 2 gallons, oil of vitriol 4 pounds, cod liver oil 4 gallons, vinegar 6 gallons, powdered gum arabic or senegal ½ pound. All the ingredients except the oil of vitriol are first thoroughly mixed and ground, then the oil of vitriol is slowly stirred in. It is kept for a week and stirred daily to insure combination. 3. Liquid stain polish for shoes.—Gum tragacanth 2 ounces, isinglass 1 ounce, beer 1 gallon, glycerine 1 pound, extract of logwood 2 ounces, powdered galls 1 ounce, copperas 2 ounces. Steep the logwood, galls, and copperas in the beer for some days, add the glycerine, strain and dissolve the gum and isinglass in the mixture and if necessary strain again. This formula makes a preparation suitable for light leather.

(1705) P. N. writes: 1. We have on hand some swelled canned corn; the contents do not appear to be sour, but have a decayed or rotten smell. Could this be caused by the can in which it was packed being made of a tin plate in which too large a proportion of lead to tin had been used in plating? A. The material of the can has nothing to do with the decay of the corn, but, if the latter sours, may affect its purity then by contaminating it with metallic salts. 2. By what process can we determine the amount of each (tin and lead) used in coating any certain tin plate? A. You should submit it to a chemist for analysis. A weighed portion of the plate may be treated with nitric acid in excess and the solution evaporated to dryness, treated with hot water, and filtered. The residue is ignited at an intense heat to constant weight, and is weighed as stannic oxide, and the tin calculated therefrom. In the filtrate the lead may be precipitated by sulphuric acid and weighed as sulphate.

(1706) C. M. A. writes (1) whether or not it is possible to perform the routine of vaporizing and burning kerosene oil of 150 degrees test in a burner as gasoline as used in gasoline stoves, without lampblack or soot. A. Yes, but it will be difficult to start. 2. What is the highest degree of test in kerosene oil that is refined? A. It may be refined up to 400° Fah. boiling point or more. 3. Has gun cotton been used as a motive power to be exploded in a receiver and used in the place of steam in the ordinary steam engine, or has gun cotton ever been used in any way as a motive power, except for blasting and projectiles? A. It is far too violent and sudden, except for such work as driving up the ram of pile drivers, etc. It has never been successfully applied as you describe.

(1707) R. C. M. asks: What kind of a telescope do they use on a transit, and generally what is the magnifying power? Also what kind and number of lenses are generally used, and if the theodolite has the same kind of a telescope? A. Transits for astronomical purposes, as for time observations, have a Ramsden eyepiece, which gives an inverted image, and flat field for better observation of the passage of the sun or star across the micrometer filaments. Transits, levels, and theodolites, used in surveying, are generally furnished with the terrestrial eyepeiece, which inverts the image from the object glass, so that objects are seen in their proper position. Astronomical transits magnify from 25 to 100 diameters. The telescopes of surveying instruments magnify from 10 to 25 times. For a description of these eyepieces see SCIENTIFIC AMERICAN SUPPLEMENT, No. 399.

(1708) F. P. D. asks how to oxidize silver jet black such as you see upon the jewelry in the show windows. It is not obtained by sulphide of sodium, potassium, ammonium, or chloride of platinum. I have tried all of these, and the sulphide of potassium, though preferable to the rest, gives only a blue black or dark steel color, and not the jet black I speak of. A. Dip the cleaned articles to be oxidized first in a solution of mercurous nitrate, by which it becomes coated with a thin film of mercury, which forms a silver amalgam, and then in the sulphide of potassium or sodium, by which a mixture is formed of mercury sulphide and silver sulphide, which is much darker than the silver sulphide alone. A few trials will give you the time of dipping for best effect.

(1709) E. H. B. writes: My coat is of a light stone color. It is stained with lemon juice. I would like to know, by the simplest means to your knowledge, if I can bring back the original color? A. Try ammonia. If the stain is old, it is probably ineradicable.

(1710) W. F. A. writes: Which will make the best plate for false teeth, and what are the objections to rubber? A. A properly made India rubber plate for artificial teeth is very good. If of good material, there is no danger of any ill effects. Mercurial poisoning has been suggested in the case of rubber, but without proper basis in fact.

(1711) Sub. R. asks: What is mixed with flour to make it self-raising, and in what quantity? Is it in any way injurious? Will such flour keep good for any length of time? A. Use 188 parts by weight of bitartrate of potash and 84 parts of bicarbonate of soda. One teaspoonful is enough for a quart of flour. The mixture should be very thorough, and such flour will keep for a long time. It is not perceptibly injurious.

(1712) A subscriber asks how rubber stamps are made. A. A cast is taken of the characters in plaster of Paris. Generally type are used as the original. Unvulcanized rubber mixed with the vulcanizing material (sulphur, etc.) is laid upon the mould, and is by a press forced down upon it so as to enter all its interstices. The plaster surface should first be well coated with talc to prevent adhesion. Then the whole arrangement is put into a vulcanizer which is essentially a steam digester and exposed to heat until hard. In our SUPPLEMENT, Nos. 249, 251, and 252, you will find the whole subject of India rubber manufacture admirably treated.

(1713) A. M. R. asks: 1. In making vinegar will it keep for a few months in a large tank as well as in barrels, or would it lose its strength or get flat? Would it be necessary to keep it covered over the top? A. It will lose strength. It should by all means be kept covered as closely as possible.

(1714) W. S. asks (1) how wax is prepared and what kind it is that is put on wood so that blacklead will stick to it. A. Use no wax, but rub on with a brush. Paraffine or beeswax dissolved in turpentine may be used. 2. To oxidize copper black? A. Various methods are used. You may dip it into sulphide of sodium in solution in water, dry at a gentle heat, and polish. This will give a dark bronze. For full black, wash with nitrate of copper solution, heat moderately, repeat if necessary, and finally polish with oil. Or wash with a mixture of 1 part nitrate of tin and 2 parts chloride of gold or platinum, and after 12 or 15 minutes wipe it off with a cloth. An excess of acid increases the intensity of the color.

(1715) Static asks: 1. Are the effects of an induction coil controlled as much by the state of the atmosphere as in the case of frictional apparatus? A. No. Induction coils are almost entirely independent of the state of the atmosphere. 2. What is the smallest size (in length of spark) which would be practicable to demonstrate for a class in physics? A. A coil giving a ½ inch spark will show Geissler tubes, light gas, etc. 3. What current and what voltage will it require? A. One Grenet cell giving a current of 2 volts will answer.

(1716) A. B. F. asks: Does oiling a rope used in hoisting electric lamps exposed to the weather give it any longer life—does it preserve the rope? A. To a certain extent it tends to, yet in practice it is not found advantageous. On ships the standing rigging is tarred to preserve it, but the running rigging is untreated. A species of heating may be induced in the heart of an oiled rope, analogous to spontaneous combustion. Wire hoisting ropes are now made with hemp core thatare very durable.

(1717) W. G. S. asks for a receipt for redressing rubber overshoes after the India rubber has become dull. What will give a gloss, etc.? Down here in Maine the lime will dull the rubber long before it is worn out. A. Wiping off with ammonia or glycerine might benefit them. Oil is not to be recommended. You will not by any method succeed in restoring the original gloss.

(1718) S. P. writes: Can you give me a liquid that will dissolve shellac, without the aid of alcohol, and that will keep it in liquid form? A. Use saturated solution of borax in water. This will not give you a very strong solution. Wood alcohol is often used; it is about half as expensive as grain alcohol. To prevent cracking, if in alcohol, add a little castor oil; if in water, add glycerine.

(1719) H. B. H. asks for a receipt for making liquid glue that will stay liquid all the time. A. Dilute 2 to 2½ parts nitric acid with 40 or 50 of water. In this soak 25 parts of glue for twenty-four hours, and then heat until it is all of one consistency. The quantity of acid depends on the quality of the glue to a certain extent.

(1720) E. G.—Iodine is extracted from the mother liquors from the nitrate of soda works in South America, and also from certain species of sea weed, the *Fucus palinatus* and *saccharinus*. The cost of extraction has so many factors that it is impossible to give it. Resublimed iodine sells for $3.75 per pound.

(1721) H. G. asks: How does Patti, the great opera singer, dye her hair, and keep it to look so perfectly natural? It is said to be very beautiful, and that no one, unless having positive information otherwise, would dream that its color and condition was anything but entirely natural. A. She probably uses binoxide of hydrogen for making it light in color. What oils, tonics, and general preparations she may employ, we do not know.

(1722) B. D. B. asks for a formula to make a chalk engraving plate for the production of newspaper cuts? A. In our SUPPLEMENT, No. 720, you will find described several methods of making relief plates. One formula reads thus: Sulphate of baryta, 1 oz 2 drachms; silicate of magnesia, 5 oz. 5 drachms; silicate of soda solution, 180 drops; water, 68½ drachms. The whole must be intimately ground, spread in a rather thick layer upon a perfectly level polished and blued steel plate, dried, and baked. The design is cut through this with a steel point, and melted type metal is poured upon it to form the relief plate.

(1723) M. L. asks (1) for a formula for an experiment in making ice in a chemistry class. A. Place a thin metal vessel (a tin pail) on a board or slate that is wet with water. Half fill the pail with ice water, and stir into it with a wooden stick about ½ its volume of nitrate of ammonia. In a few minutes the board will adhere to the pail, being frozen fast thereto. A test tube of ice water stirred about in the same solution will be frozen. 2. In measuring altitudes, is the barometer gradnated, or does the height have to be calculated? A. By a complicated formula given in works on physics or in engineers' hand books. In a rough way allow one thousand feet change of altitude to one inch variation.

(1724) E. L. I. asks: 1. What is the best solution for the chloride of silver battery? A. Solution of sal ammoniac. 2. What is the best way of keeping the silver chloride in contact with silver plate? A. The chloride of silver may be melted and cast in a mould around the wire, or it may be inclosed in a parchment bag with the wire in the center. We do not understand what battery you refer to in your third query.

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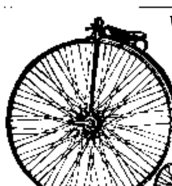

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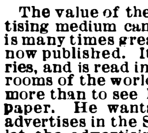

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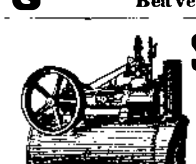

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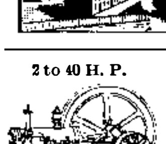

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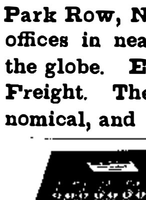

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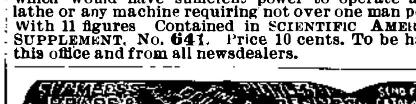

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