would form so unsuitable and so unsatisfactory a foundation for his permanent way.

Not only is it easy to converse with every important place in England, but messages can be sent to every capital in Europe, and answers received in an incredibly short space of time. Once it was possible to communicate with America, and it probably will be so again before the year 1864 changes its index. Already the Atlantic Telegraph Company have received tenders from eight different firms, any one of which is competent to the task, and some of these tenders are so favorable that one of them will, no doubt, be accepted; if so, London and New York may be within speaking distance again before twelve months are over, and this time with every chance of their connection being permanent, so great has been the improvement in the manufacture of submarine cables, and so extensive the experience of the mode of laying them. While this is being debated, a cable has left England which is destined to unite Calcutta with London, and which, in all probability, will accomplish this object ere long. But communication with any point on the North American coast must embrace also New Orleans and the whole of that continent. Our communication with Calcutta extends by an easy link to Singapore, and from Singapore to Canton and Batavia; and from the latter place there is no difficulty in reaching the Australian continent. It may thus be that before many years are over we may see recorded in the morning's *Times* events that happened at Sydney, or Shanghai, or San Francisco, on the previous day. Surely this is a wonder and a triumph of scientific skill if anything ever was; and surely the men who do these things are giants!

AMERICAN DENTISTRY—PROCESS OF SETTING TEETH ON INDIA-RUBBER PLATES.

While in conversation recently with a small knot of intelligent persons, the subject of artificial teeth and dentistry engaged our attention, when one of the parties related a case in connection with himself, which evinced the superior skill of American dentists. He stated that while he was residing in Glasgow, Scotland, for a few months during the summer of 1861, he went to a dentist in that city for the purpose of having three artificial teeth secured in his upper jaw. While they were being fitted he informed the operator that he was about to return to the United States, when the dentist said, "Well, these very teeth came from America. We get all our artificial teeth from Philadelphia." The three teeth were supplied, and although apparently neatly fitted, our friend never felt easy while he used them; and soon after he arrived in New York they were removed and their places supplied by an American dentist with a new plate and teeth, which have never given him the least trouble.

American dentists stand at the head of their profession, and in the preparation of teeth and plates our artists are unrivalled. Formerly all artificial teeth were secured on plates of gold, but within the past four years that remarkable substance, "hard india-rubber," has taken the place of the metal in many cases, and its use for this purpose is extending. When gold is at such a high premium, the employment of a cheap, suitable substitute in dentistry is of no small benefit to the community. The artificial gums and plates of hard india-rubber in which sets of teeth are now made by dentists are very beautiful. They are of a light cinnamon color, and are hard, light and smooth as polished glass. Much skill and a considerable amount of science are involved in the manufacture of such rubber plates with sets of teeth. The whole of the operations and processes in connection with their manufacture have been shown and explained to us, at our request, by William C. Horne, a young and skillful dentist, of Fourth street, Brooklyn, E. D., and we will describe the method of taking the impressions, and fitting, making and finishing the plates ready to be applied to the mouth of a patient. We may, however, explain that what are called "temporary sets" of teeth are very often made and applied to patients before sets intended for permanent use are made; but our intention is simply to describe the manufacture of full "permanent sets:"—

After the patient's natural teeth have all been extracted, and the gums have become sound and properly set, the first task of the dentist who is to provide a set of artificial teeth is to take a cast of the gums and the roof of the mouth. Two instruments called "impression cups," are used for this purpose. They are composed of metal: the one for the upper jaw being formed like the hollow part of a horse's hoof, is designed for taking an impression of the upper jaw and the roof of the mouth; while the other one, for the lower jaw, is formed simply with a semicircular channel to take the impression of the lower gums. Some plaster of Paris in a soft state is put into the upper impression cup, which is placed in the mouth and pressed against the upper jaw. The plaster soon takes a set and becomes hard; when this is effected the cup is withdrawn. The plaster now contains the negative cast of the upper gums and the roof of the mouth. The lower cup is now charged with plastic bees-wax (which adheres to it), then it is laid over the lower gums in the mouth, and receives its impression at once. Plaster of Paris is perhaps the best substance for taking an accurate cast, but as the lower impression cup has to be inverted, wax is more convenient to use for taking an impression of the lower gums.

The impressions taken of the gums are next varnished and oiled for the purpose of taking positive casts from them, called "the model," to represent the natural gums. These are made by taking casts in plaster from the molds in the impression cups. After the models are taken, to obtain the size and form of the gums and roof of the mouth, the next object is to get the thickness of the plate for the teeth. This is called the "trial plate," and is made either with plastic gutta percha or bees-wax, which is carefully built on by the dentist with his fingers and a proper instrument, upon the model, to the hight judged according to the length of the patient's teeth and the natural position of the jaws. This part of the process must be performed in a very skillful manner.

The trial plates are now taken from the model and tried upon the patient. A true perpendicular line is then drawn through the center, toward the chin, of both jaws, and marked on the plates, and a cross mark is also made at each side on the plates, where the jaws come in contact. After this these test plates are taken and put upon the models, which are then placed in an instrument called "the articulator." In form it is almost like two shallow cups, secured by a joint, to represent the upper and lower jaws of the face. The articulator has three movements regulated by screws. One movement is up and down, the second lateral, and the third back and forth. The object and use of the articulator is to get the true position of the patient's jaws, and the natural distance between the teeth. Considerable judgment must be exercised in its use, as in order to secure the capacity for eating with artificial teeth, they must be set somewhat closer than natural teeth. The length of time between the period when the teeth were extracted and the new set fitted, must be taken into consideration.

The next operation is to select the teeth for the set, and they must be of such a size as will suit the patient's mouth and cast of countenance. Elderly persons should not desire what are called "white, pretty teeth," as these are only suitable for young persons. Artificial teeth for permanent rubber sets are prepared by dentists, in blocks of three for the sides and in blocks of two teeth for the front. For temporary sets and for gold plates, the blocks are of single teeth. A full description of the manufacture of artificial teeth was published on page 341, Vol. II, Scientific American (current series). Those for rubber sets have metallic pins on their base with heads upon them.

After a suitable number for a set has been selected they are placed on the trial or test plates of wax, and the joints are ground to make good junctions, both the upper and lower sets being prepared at the same time. When accurately arranged the teeth are secured in position on the trial plate with soft wax, then they are tried in the mouth of the patient to obtain perfect articulation, which being effected, they are next secured upon the model with soft wax. It will be understood that the plaster model represents the gums of the patient, and the rubber plates with the teeth in them are to be fitted upon the models of the upper and lower gums. The upper plate extends back upon the roof of the mouth, otherwise the two plates for a set are similar. A description of one, however, will suffice for both, as the operations involved are alike.

The wax of the trial plate upon the model is now made quite smooth to obtain a smooth cast from it of what is called the "counterpart," or the back section of the mold. This cast secures the perfect form and thickness of the india-rubber which is to be applied to take the place of the trial plate, and it is also necessary for keeping it in perfect shape while being vulcanized. The model, with the test plate of wax and the artificial teeth set on it, is now placed in a small iron flask, provided with adjustable screws, and soft plaster of Paris is now poured into the flask, which, when set, forms a cast of the counterpart of the trial plate and model. The space between the plaster counterpart and the plaster model is occupied with the wax trial plate, which forms the measure of the india-rubber to be supplied, and the wax must be removed to give place to it. The flask is next subjected to a gentle heat, opened, and the wax trial plate carefully removed, leaving the teeth and the space occupied by it to be packed with the india-rubber. This article, designed for dentistry, is prepared by the Goodyear Rubber Company, and comes in thin square sheets of a bright red color, said to be effected with the oxide of gold. When exposed to a moderate temperature, the rubber becomes sufficiently plastic to be packed in the mold in the flask, around the base of the teeth, occupying the place of the wax trial plate. It had been found that unless rubber plates had been made very thick, some of them were liable to crack at the bottom of the channels fitting on the gums. To obviate this evil and secure strong and thin plates, Mr. Horne fits a continuous small plate of gold upon the whole ridge of the model, and fastens it with small gold loops, securing it firmly in the rubber. The model and rubber being now packed around the teeth in the flask, the "counterpart" is placed upon it and gently screwed down until the proper thickness and form of the trial plate is produced on the rubber, holding the teeth in it perfectly, and occupying the place of the removed wax. During this operation of screwing down the flask it is kept warm, so that the rubber is maintained in a plastic condition, and any surplus of it is forced out by the pressure of the counterpart upon it, through small vents provided in the flask.

The rubber plates being perfectly molded and the teeth secured in it in the flask, it is ready for what is called the "vulcanizing process." This consists in subjecting the rubber to an elevated temperature in a moist atmosphere, when it undergoes a complete chemical change becoming hard, inelastic and very permanent in its character. To effect this, the flask containing the prepared rubber plate is put into a small, portable, metallic oven, containing some water, the lid of which is firmly screwed down and a thermometer secured in it to indicate the temperature. The oven is heated either with a gas jet flame or an alcohol lamp, and when the temperature rises to 320° Fah. this heat is maintained for about one and a half hours. The water in the oven generates steam and the rubber is subjected to a moist heat and considerable pressure. As thermometers differ slightly, different dentists may vulcanize with a slightly lower or higher temperature than that specified. While the rubber is heated in the flask, the mold in which it is confined keeps it in perfect shape. The flask is next taken out of the oven and cooled with water, then unscrewed and the vulcanized plate removed with the teeth set perfectly in it. It will be understood that the plate for each set is vulcanized in a separate flask. The plate has now to undergo the finishing operations, and is first filed and scraped with fine tools; it is then ready for rubbing down and polishing. It is next subjected to the action of a hard revolving brush wheel and ground pumice stone; then to the action of a similar wheel and rotten stone powder, and finally to a softer brush wheel and fine whitening. When finished, such india-rubber plates are hard and smooth as polished glass, and are then ready to be placed permanently in the patient's mouth. The artificial teeth appear to be as firmly secured in the rubber as if they had grown in it, and the operations connected with india-rubber dentistry are certainly scientific and ingenious. Gold plates are all soldered to teeth with a blow-pipe, and the metal is swaged in a die. As the rubber is molded in casts of the patient's gums, such plates are more accurate than those of swaged metal. They are also about one half lighter, and many persons prefer them to gold, as they feel more like the natural gums and the roof of the mouth.

We have thus described the method of manufacturing india-rubber plates with sets of artificial teeth.

There can be no doubt that if they are not so desirable they are really more beautiful than natural teeth. American dentists have achieved a triumph of skill in their manufacture, and have conferred a benefit upon suffering humanity.

Correspondence

Strength of Steam Boilers.

MESSRS. EDITORS :—I do not intend here entering into the causes of the large number of boiler explosions that take place, but having lately read in the daily press accounts of the bursting of several locomotive boilers, it struck me that some simple and general rule by which to ascertain their strength would be useful to all who either make or use them; and especially because, although the general principle herein conveyed is well known, still I have found few, especially amongst practical men, who have any idea of the actual pressure it would be safe to test boilers to. I therefore subjoin a table I have worked out, which shows one-third of the pressure per square inch a boiler one inch in diameter will bear without bursting, and no material should be loaded with a greater strain. For boilers of any size it is only necessary to divide the number of pounds in the table, opposite the thickness of plate used, by the diameter in inches; the result will be the greatest load that ought to be put on a safety valve in pounds, per square inch. The iron used is understood to be of the best quality, with a tensile strength equal to 70,000 pounds per square inch. Although all boilers should be tested to the extent given by the table, they should not be regularly worked up to that pressure, on account of their depreciation by wear and tear, by oxidation and otherwise, which, according to the time they have been in use, will of course proportionately lessen their efficiency.

1-8th-inch plate,	2,500 pounds.
3-16th-inch plate,	3,750 pounds.
1-4th-inch plate,	5,000 pounds.
5-16th-inch plate,	6,250 pounds.
3-8th-inch plate,	7,500 pounds.
7-16th-inch plate,	8,750 pounds.
½-inch plate,	10,000 pounds.
9-16th-inch plate,	11,250 pounds.
5-8th-inch plate,	12,500 pounds.
3-4th-inch plate,	15,000 pounds.

Suppose, for instance, we have a locomotive boiler made of 5-16th-inch plate (their usual thickness) and 45 inches diameter, the table would give 6,250÷45= 139 lb., the greatest amount to which the safety valve should be loaded; whereas another boiler, 35 inches diameter, and the same thickness of plate, would, by the same rule (6,250÷35), bear 178 pounds per square inch, without any extra strain on the iron. If, however, we make the 35-inch boiler of 1-4th-inch iron, we find opposite 1-4th-inch, 5,000, which, divided by 35, gives 143 pounds, showing that 1-4th-inch plate in a 35-inch boiler, will bear more pressure than 5-16th-inch plate in a 45-inch boiler. This also shows conclusively that by making two boilers of different diameters, that have to work at the same pressure, of the same thickness of plate, that either one is too weak, or there is a waste of material in the other.

WILLIAM TOSHACH.

Schenectady, N. Y., Jan. 15, 1864.

Nature and Art---King-Crab War Ships.

MESSRS. EDITORS:—Perfection is only to be found amongst the numerous specimens of the handiwork of the Great Creator, which he has placed so lavishly around us for our use and instruction, and we should make the proper application of the lessons which are continually placed before us. If we seek color, form, or perfect adaption to the use intended, we can find them all among the many models which nature has given us for guides. It was many years before the principle of the arch was discovered and applied, and yet every human being carried a perfect illustration of it in the arrangement of the bones of his body. And for lighthouses and towers, where can be found for stays or supports a better system than that shown in the roots of the sturdy oak. The design of the roof of the London Crystal Palace was taken from a leaf. A new and fashionable design for a calico pattern was found to have existed as a fossil many thousand years old. Palissey, the famous potter, discovered in a fossil shell a perfect system of defensive fortification. And now when the public mind and the minds of inventors are run wild over the changed system of warfare inaugurated with heavy guns and shot-proof vessels, let us see what nature will do for us. She furnishes a model of an engine of war, which, if made of suitable size, could destroy any vessel now afloat, in spite of iron plates, big guns, and almost anything else. I allude to the species of crab (L. *cyclops*) the king crab or horse hoof found on the coast of New Jersey. This creature is provided with almost everything requisite for a first-class ram ship, and to this I would invite the attention of scientific men and naval constructors. I will not enter into a scientific description of the animal in detail, but will simply state its most prominent features for the purpose specified.

In shape it is like a turtle, covered with a thick shell or armor, and armed with a sharp stylet or prow. The back of it is brought down wedge-shape, which will enable it to have considerable speed through the water. Its propelling power is placed underneath, so that its feet or paddles are hid and are not liable to be injured. It has apparatus to lower and raise itself in the water, around the bow, and it is armed with a row of smaller spikes, which would be sure to strike anything met in its path through the water. A vessel constructed to contain in itself the above-mentioned principles, with the addition of a telescopic smoke-stack and pilot-house, and perhaps a revolving prow, would be really formidable. Manned with a pilot, engineer and fireman, it could attack any vessel with impunity; being submerged when in action, and showing nothing but the smoke-stack, it could approach a vessel without being seen, and then, with its great speed and weight, it could strike a blow with the force of a dozen "Swamp Angels," thus utterly demolishing its opponent. If attacked and surrounded by boats, it could rise to the surface, spin around and scatter its assailants like chips. In fact, under almost any circumstances, I can see in a monster king crab admirable means for protection and defense.

C. D. K.

Frankford, Pa.

An Effectual Corset Wanted.

MESSRS. EDITORS:—The air we ladies have to breathe up here in Vermont circulates all round the world and is breathed by all the filthy creatures on the face of the earth, by rhinoceroses, cows, elephants, tigers, woodchucks, hens, skunks, minks, grasshoppers, mice, racoons, and all kinds of bugs, spiders, fleas and lice, lions, tobacco-smokers, catamounts, eagles, crows, rum-drinkers, turkey buzzards, tobacco-chewers, hogs, snakes, toads, lizzards, Irish, negroes, and millions of other nasty animals, birds, insects and serpents; besides it is filled with evaporations from dead decaying bodies, both animal and vegetable, and all sorts of filth, and we ladies are obliged to breathe it over after them, ough! bah!

Now we want, and must have, some contrivance that will effectually keep this foul, disgusting stuff out of our lungs. We have tried the three kinds of corsets which you noticed in your paper the last year; but when we do the best with them that we can, about a teacupfull of this nasty air will rush into our lungs in spite of these miserable contrivances, and when we blow it out again another teacupfull of the disgusting stuff will again rush in, and when we blow that out still another will rush in; and so we are obliged to keep doing from the time we wake up in the morning till we go to sleep at night, and I do not know but we do all night.

If these corsets are worth anything to keep this disgusting air out of a body, and we have not put them on right, please come immediately yourself or send the inventors to show us how. If they are a humbug I hope their inventors will be tarred and feathered and rode on a rail, and you, for noticing them in the SCIENTIFIC AMERICAN, be obliged to breathe about 60 pints of the nasty, foul, nauseous, filthy, disgusting, dirty, defiled, loathsome, hateful, detestable, odious, abominable, offensive, stinking air which surrounds this earth per minute for a hundred years.

SUSIE PINKINS.

[We can suggest but one kind of corset which would effectually meet our fair correspondent's wishes. Instead of the ordinary laced-up corset, take a piece of strong hempen cord and apply it closely about the neck, tie one end of it to a beam, and let the whole weight of the body suspend at the other end. We guarantee that if the cord is strong enough it will put an end to all future complaints on this subject.—EDS.

The French Railway System.

The reform of the French railroad system has lately been a subject of serious inquiry by the Government, and the report of a commission appointed two years ago, presided over by M. Michel Chevalier, has been published by order of the Minister of Public Works. It appears that the government directly controls the management of French railways, and there is not that freedom and individuality, and enterprise manifested in conducting them, as in America and Great Britain. The trains are slow but are generally very safe. The express trains in France carry the mails, hence they have frequent stoppages; and their total speed is below that of trains in the United States. The commission very warmly recommend a reduction in the fares of passengers—a recommendation which the companies are not inclined to follow, without special reasons. Passengers cannot be compared to merchandise: a company provides as many trucks as can be filled, but must always be prepared to carry a number of empty passenger-carriages at a loss. It would often be easy to reduce fares if every train could be filled. The goods traffic seems to suffer, while the passenger traffic gains, by the regulations imposed in return for monopoly. As French railways are not bound to dispatch any goods not delivered the day before the train starts, or to deliver them until the day after their arrival, it follows that, between several towns (Paris and Rheims, for instance), goods are a longer time on the way than by the old road waggons. The time of goods trains between Marseilles and Paris is nine days; the fast carriers on the road did it in ten days. The French companies defend their delay on the grounnd of the time required for weighing, classifying, marking, loading, and unloading; all which are well done, but too well done. It seems that there are constant disputes and law-suits in France between the owners of merchandise sent and delayed and the railway companies. Frenchmen are now crying out for greater speed, more branch lines, and easier terms for merchandise.

The Great West.

The four States of Indiana, Illinois, Iowa, and Wisconsin, have a computed area of 124,000,000 acres, or a surface of about one half greater than the whole British Isles. From 1850 to 1860 the area under cultivation rose from 11,956,269 acres to 25,949,886 acres—an increase of 142 per cent. At the same time the value of the farms advanced from $278,704,593, to $1,027,292,333; and the value of the farming implements rose from $15,924,442 to $39,645,875.

The population of these four states was 2,337,491 in 1850, and 4,513,208 in 1860.

The aggregate live stock of the four states was:—

	1850.	1860.
Cattle of all classes	1,946,756	3,724,726
Sheep	2,291,392	3,523,827
Swine	4,660,196	6,033,368
Horses and Mules	668,739	1,340,054

In other words swine increased in numbers 29 per cent., sheep 54, cattle 90, and horses 100 per cent.

The immense grain crops of these four states increased as follows:—

	Crop of 1849.	Crop of 1859.	Est. for 1862.
Wheat, bushels	21,445,745	63,624,450	83,812,946
Rye, do.	263,325	2,446,137	2,603,524
Barley, do.	391,063	2,605,133	2,971,680
Indian corn do.	119,257,125	233,620,654	290,639,035
Oats, do.	20,681,272	37,303,750	43,247,662

Such are the kind of products which constitute the foundation of our nation's material power.

AN English inventor, in the Eastern counties, has constructed a small paddle-wheel boat which is propelled by a pendulum. It is a jolly-boat, and the pendulum is worked by four men. He contends that it is operated with half the power of an oared boat. This principle is nothing new. It has been tried and found unsuccessful, for obvious reasons, well understood by scientific men. Many years ago, a Mr. Lenet, of Albany, tried the experiment on the Hudson, and found the direct application of power to the paddle-wheel was more effective than through the pendulum.

NEW RAT POISON.—The *Journal d'Agriculture Prctique*, recommends artificial carbonate of baryta to be mixed with various kinds of food for rats. This salt is almost tasteless, and it is said, does not become poisonous until after the action of the gastric juice renders the salts of baryta soluble.