COLBURN ON STEAM BOILERS.

We published, some time since, a description of the Harrison boiler, which consists of a series of small, hollow cast-iron globes communicating with each other. The advantages of this boiler were recently set forth by Mr. Zerah Colburn, C. E., in a paper read before the British Association, as follows :—

EVAPORATION TO SURFACE.

The rate at which heat may be transmitted through an iron boiler plate, without injury to its substance, has never been precisely ascertained. About 70,000 units of heat per hour, equal to the evaporation in that time of one cubic foot of water from 60 degs., is believed to be the utmost per square foot of plate of ordinary thickness. But in order to approximately apply the *whole* heat of a furnace to the purposes of evaporation, a much larger area of heating surface, per unit of work done, is requisite. Watt fixed the proportion of one square yard of heating surface per cupic foot of water evaporated per hour, and this has been sanctioned by modern practice. But the average depth, or, in other words, the thickness of the stratum, of water thus boiled away is only $1\frac{1}{3}$ inches per hour, $\frac{1}{45}$th inch per minute, or $\frac{1}{2700}$th inch per second, over the whole heating surface. From ten to twelve seconds are thus occupied in vaporizing a *couche* of water, no thicker than a single leaf of the paper upon which books are commonly printed. If, in proportion to the evaporation, an insufficient extent of heating surface be provided, there is not only a direct waste of heat the products of combustion escaping at a temperature corresponding, perhaps, to that of incandescent iron—but the furnace plates may be burnt. Notwithstanding the active convection of heat in water, an intense flame, directed against the sides or roof of a boiler furnace, will, in time, crack or blister the iron. It is not certain that this result occurs from the inability of the metal to transmit the heat, for it is more likely that, under vigorous vaporization, the gravity of the liquid water (and it is its gravity only that brings it to the heating surfaces) is insufficient to bear down effectively against the rising volumes of steam. If, by powerful mechanical means, the water could be constantly maintained in contact with the heating surfaces, it is possible that the rate of evaporation upon a given area could be increased without injury to the plate. In the hardening of anvil faces and of steel dies, the requisite rapidity of cooling is obtained, not merely by immersion in water, but by its forcible descent, in a strong jet, upon the heated metal.

EXTERNAL HEATING SURFACE.

Under the conditions, however, of ordinary practice, no restriction of the heating surface is permissible. This surface is sometimes that of the exterior only of the boiler, but it is more usual, and on most accounts preferable, to dispose it internally by means of fire boxes, flues or tubes. The external surface of a boiler can only be increased by increasing its length or its diameter, or by increasing both of these together. Plain cylindrical boilers 90 feet, and in one or two instances 104 feet in length, have been employed, but, even apart from any consideration of the great amount of space which they occupy, they are mechanically objectionable, and they are now no longer made. In increasing the external surface of a boiler by enlarging its diameter, it is weakened exactly in proportion to the increase, the bursting pressure, for a given thickness of plates, being inversely as the diameter. The danger attending the presence of a large quantity of heated water in a boiler is now well understood, and, such as it is, it increases as the square of the diameter, so that, in a boiler of a given length, the elements of weakness and danger are collectively related to the cube of the diameter. External heating surface may be provided for in a number of smaller vessels, as in the retort boilers by Mr. Dunn, but these are of the water-tube family, which, heretofore, has been found subject to choking with the solid matter deposited by the water.

INTERNAL HEATING SURFACE.

Next are the boilers with internal heating surfaces. Internal fire tubes were in use in steam boilers in the last century, and they were applied within a cylindrical barrel by the Cornish engineers, among whom was Trevithick, who employed both the straight flue and the return flue, and who ma e the fire-place within the flue. The Cornish boiler, in this form, was improved by Mr. Fairbairn and the late Mr. Hetherington, who added another fire tube, thus making the two-flued boiler now so extensively employed in Lancashire. The two flues, although somewhat smaller than the single flue, afforded a greater extent of heating surface, besides securing increased regularity in firing. The principle of subdividing the flame and heated products of combustion, so as to obtain greatly increased heating surface within a barrel of given diameter, was fully carried out in the multitubular boiler invented by Neville, of London, in 1826, employed by Seguin, in France, in 1828, and subsequently in the Liverpool and Manchester locomotives, from which it has been handed down to the present practice of engineers. Not since Watt's time, however, has the evaporative power of a square foot of heating surface been increased, the improvement in the plan of steam boilers being that, chiefly, of inclosing a greater extent of surface within a given space. The heating surface, in the boilers of the *Great Eastern* steamship, is equal to the entire area of her vast main deck, that in the *Adriatic* measures more than three-fourths of an acre, while the *Warrior* and the *Black Prince* have, in their boilers, 2,500 square yards of surface of tubes, the aggregate length of which is more than $5\frac{1}{2}$ miles.

OBJECTIONS TO MULTITUBULAR BOILERS.

But it is only where, as in steamships and in locomotive engines, the dimensions and weight of boilers must be the least possible, that the multitubular arrangement is even to be tolerated. It is costly and subject to rapid decay. In steamships, especially, the life of multitubular boilers is comparatively short. The boilers in her Majesty's vessels of war are found to last but from five to seven years; those of the West Indian Royal mailships last, according to Mr. Pitcher, of Northfield, six years only, and those of the Dover and Calais packets, taking the testimony of the former mail contractor, Mr. Churchward, need to be renewed every three and a half or four years. On land, multitubularboilers, working under constant strain, and, in most cases, as constantly concentrating a saturated solution of sulphate of lime, are nearly out of the question for the purpose of manufactories, although there are instances of their employment, even in spinning mills. A boiler rated at 40 nominal horse-power will ordinarily evaporate 60 cubic feet of water per hour, or upwards of 100 tuns of water per week of sixty hours. And feed water containing as much as 40 grains of solid matter per gallon is often regarded as very good, not only when the inorganic impurity consists of the deliquescent salts of so a, but even when it is neither more nor less than an obdurate carbonate or sulphate of lime. Whatever the solid matter contained in the water may be, it is never carried over with the steam, but is left behind in the evaporating apparatus, and 100 tuns of the water, fed in a single week to a boiler in the manufacturing districts, commonly contains a hundred weight or more of dissolved gypsum or marble, and of which all that is not held in solution is deposited in a calcareous lining upon the internal metallic surfaces. This fact will explain why not only water-tube, but multifire tube boilers cannot be economically employed under the ordinary circumstances of steam generation. The consideration of deposit or scaling, as well as that of workmanship, imposes a limit to the subdivision of heating surface among a great number of small tubes.

OBJECTIONS TO WROUGHT-IRON SPHERES.

In ordinary boiler making the geometrical advantage of the sphere cannot be turned to account. It cannot be produced economically in plate iron, nor, if made in plate iron, could it be advantageously applied in a steam boiler. The hollow sphere has this property, to wit: with a given thickness of metal it has twice the strength of a hollow cylinder of the same diameter. This is upon the assumption (which is correct where the cylinder is of a length greater than its own diameter), that the ends of the cylinder offer no resistance to a bursting pressure exerted against the circumference. Under over-pressure, a closed cylinder would take the shape of a barrel, and if of homogeneous material and structure, it would burst at the middle of its length, and in the direction of the circumference. The circumference of a sphere of a diameter of 1 being always 3.14159, the sum of the length of the two sides of a cylinder of the same diameter, and having a plane of rupture of the same area, is 1·5708, or exactly half as much. And not only are the boiler-heads of no service in resisting the strain in the direction of the circumference of the cylinder, and not only are they weak in themselves, except when of a hemispherical form, or when well stayed, but, furthermore, the whole pressure against them is exerted to produce a strain of the sides of the cylinder in the direction of its length, and where there is no through stay-rod between the opposite heads this strain is necessarily equal to one-half of that exerted in the direction of the circumference.

WEAKNESS OF ORDINARY BOILERS.

The bursting pressure of steam boilers is commonly calculated from the average tensile strength of wrought-iron plates. This strength is very variable however, and it would be more logical to take the minimum. The most extensive series of experiments upon the strength of iron plates is that made by Mr. Kirkaldy for Messrs. Napier, of Glasgow. The number of samples of each description of iron tested was not large, yet the tensile strength ranged between very wide limits. That of Yorkshire iron varied between 62,544 lbs. per square inch and 40,541 lbs., both specimens being from the same makers. Staffordshire plates varied between 60,985 lbs., and 35,007 lbs., and Lanarkshire plates between 57,659 lbs. and 32,450 lbs. The conclusion cannot be resisted that engineers are frequently dealing with boiler plates of a tensile strength not greater than from 16 to 18 tuns per square inch, notwithstanding that the average strength may be 22 tuns, and the maximum 27 tuns. And the loss of this strength in punching the rivet holes is not merely that of the iron cut out, but the punch is found to sensibly injure that which remains. Mr. Fairbairn's well known and frequently verified ratio of 56 to 100, as the strength of a single riveted joint to that of the unpunched plate, must be always admitted in calculations of the strength of riveted boilers. The 40-horse Lancashire boiler, 7 feet in diameter, will thus be often found to have an ultimate strength not greater, when new, than that corresponding to a pressure of from 210 lbs. to 235 lbs. per square inch. This, however, is without taking account of the strain exerted longitudinally upon the shell of the boiler by the pressure on the ends, and it is upon the assumption, which is hardly tenable, that the boiler heads, and especially the flues, are of the same strength as the cylindrical body or shell. Without the angle-iron strengthening recommended by Mr. Fairbairn, the collapsing pressure of the flues of large boilers was found, in that gentleman's experiments, to be sometimes as little as 87 lbs. per square inch. The strain resulting from the circumferential and longitudinal components, in the outer shell, is one-eighth greater than that calculable for the circumference alone, so that, even if the heads and flues were stayed to the strength of the shell, this would correspond to a pressure of but from 190 lbs. to 210 lbs., instead of 210 lbs. to 235 lbs, as just supposed. But these estimates are for the strength of the boiler when new.

CORROSION TEE GREAT DESTROYER,

In the experience of the officers of the Manchester Boiler Association, with from 1,300 to 1,600 boilers always under their care, one boiler out of every seven, and, in some years, as in 1862, nearly one of every four, became defective by corrosion alone, while of every eight boilers examined in the course of a year seven are found to be defective in some respects Thus, in 1862, with 1,376 boilers under inspection, 85 positively dangerous, and 987 objectionable defects, were discovered, 37 dangerous and 270 objectionable cases of corrosion alone having been reported. As a boiler malady, corrosion corresponds in its comparative frequency and fatality to the great destroyer of human life—consumption. It is the one great disease. It is frequently internal, in consequence of the presence of acid in the water; but it is still often er external, and it is most insidious and certain wherever there is the least leakage of steam into the brick-work setting. Condensed steam, or distilled water is an active solvent of iron, as well as of lead, and peaty water, which, so far as *inorganic* matter is concerned, is very pure, and distilled water from surface condensers, and, indeed, any water that is quite soft, is known to eat rapidly into the substance of the boiler in which it is used. A trickling, however slight, of condensed steam, down the outside of a boiler, will fallibly cause corrosion, and to this was directly traced a large number of the forty-seven boiler explosions which occurred in the United Kingdom in 1863, and which were attended with the loss of seventy-six lives besides injuries more or less serious to eighty persons.

CAST-IRON NOT CORRODED.

Corrosion is most rapid where the iron is comparatively pure, as in the best Yorkshire and Staffordshire plates. The presence, however, of a small proportion of carbon, as in steel, or especially of silica and carbon, as in cast-iron, renders it nearly indestructible. The experience even with kitchen utensils demonstrates this, but it is more satisfactory to observe the fact in engineering operations on the great scale. When Nelson first introduced the hot-blast he employed wrought-iron heating stoves, and although only 300 degs. Fah. was at first fixed upon for the temperature of the blast, the stoves were rapidly destroyed. It need hardly be mentioned that a wrought-iron gas retort would be worthless, where cast-iron answers well, being inferior only to fire-clay. It is the same with forge tuyeres, cast-iron lasting indefinitely. Since super-heated steam began to be generally employed, much difficulty has been experienced from the rapid corrosion of the super-heaters. The Peninsular and Oriental Company's engineers have been compelled to adopt copper, instead of plate iron, heating surfaces for this purpose. Messrs. Richardson & Sons, of Hartlepool, have, on the other hand, adopted cast-iron, and their superheaters of this material show no corrosion whatever, after four years' use. The sulphurous fumes from locomotive engines rapidly corrode the plate iron station roofs, while the cast-iron girders and cornices remain unaffected. Cast-iron bridges are indestructible by rusting, while large quantities of iron scales are being removed from wrought-iron bridges, including the Conway and Britannia tubes. From abundant experience with cast-iron steam boilers and the tubes of cast-iron heating apparatus, it may be taken as settled that, where the thickness is moderate, cast iron may be thus employed without the possibility of corrosion.

STRENGTH OF CAST IRON.

The tensile strength of cast-iron varies between 5 tuns and 15 tuns per square inch. Considered as a material for boilers only, the minimum strength should be regarded, exactly as from 16 tuns to 18 tuns has been taken for wrought-iron plates. Cast-iron boilers 8 feet in diameter and of great length, were at one time made, but these were manifestly objectionable. The spherical form, of moderate diameter, is preferable, and whatever is the bursting strength of a riveted wrought-iron cylinder, that of a cast-iron sphere of the same diameter and the same thickness of metal will be the same. The plate iron, of a strength of 18 tuns per square inch, is virtually weakened to 10 tuns by the loss in riveting, and, as the hollow sphere is twice stronger than the hollow cylinder of the same diameter and thickness, the cast iron, having no joints, becomes equal, in this comparison to the wrought plate. If we could always count upon the maximum strength of iron, to wit, 27 tuns per square inch for wrought, and 15 tuns for cast, a 14 feet cast-iron sphere would have the same strength to resist bursting as the 7 feet cylinder of the Lancashire 40-horse boiler, supposing the same thickness of metal in each case.

NO SCALE IN HARRISON BOILERS.

But there is no occasion to make a boiler as a single large sphere, for it is now ascertained from extensive experience that hollow cast iron spheres of small diameter do not retain the solid matter deposited by the water. Small water tubes, and indeed all small water spaces in ordinary boilers, always choke with deposit when the feed-water contains lime, but cast-iron boiler spheres, although they may be temporarily coated internally with scale, are found to part with this whenever they are emptied of water. This fact is the most striking discovery that has been made in boiler engineering. It removes the fatal defect of small subdivided water spaces, which can now be employed with the certainty of their remaining constantly clear of deposit. This discovery has been made in the use of the cast-iron boiler invented by Mr. Harrison, of Philadelphia, U. S., and which is now working in several of the Midland and Northern counties. Mr. Harrison employs any required number of cast-iron hollow spheres, 8 inches in external diameter, and three-eighths of an inch thick, these communicating with each other through open necks, and being held together by internal tie bolts. A number of these spheres are arranged in the form of a rectangular slab, and several of these slabs, set side by side, and connected together, form the boiler, about two-thirds of the whole number of spheres being filled with water, while the remainder serve as steam room. The bursting strength of these spheres corresponds to a pressure of upwards of 1,500 lbs. per square inch, as verified by repeated experiment, being, therefore, from six to seven times greater than that of the ordinary Lancashire boilers of large size. The evaporative power, as in all other boilers, depends upon the extent and ratio of the grate area and heating surface, but in practice from 7½ to 8 lbs., of water are evaporated per pound of coal in a cast-iron boiler, which, for each tun of its own weight, supplies steam equal to ten indicated horse-power. The joints between the spheres are made by special machinery, securing the utmost accuracy of fitting, and there is no leakage, either of water or steam. The spheres occupied as steam space are screened by fire bricks from the direct action of the heat, but enough is allowed to reach them to secure complete drying and, if desired, any degree of superheating of the steam. The slabs into which each series of sphere is assembled, are placed in an inclined position, which secures the thorough calculation of the water. The whole quantity of water carried in a 40-horse boiler is three tuns, the boiler weighing 13 tuns, and presenting 1,000 square feet of water-heating and 500 square feet of steam-drying surface. In Manchester, with the feed-water taken from the Irwell, or from the canal, a hard scale is soon formed in the ordinary boilers; but in the cast-iron boiler a succession of thin scales of extreme hardness are found to form upon and to become detached of themselves from the inner surfaces of the water spheres. These scales are blown out with the water at the end of the week, and only small quantities can be discovered when purposely sought for. A specimen of these, slightly cohered together into a friable mass, is exhibited. A pint of loose scales and dirt is the most that has yet been found in a careful internal examination after nine months' daily work. None of the iron is removed with the scale, the weight of the spheres, after three years' service, being the same as when new. In America Mr. Harrison's cast-iron boiler has been worked for six years. Messrs. Denton, chemists, of Bow-common, London, have had one in use for three years; and for the last two years the same description of boilers have been employed at Messrs. Hetherington's, and other large works in Manchester. It should be added that the system of casting the spheres is such that their thickness is necessarily the same at all points.

The self-scaling action, which has been found to be the same in all cases where the boiler has been worked, can only be explained by conjectures, which it is not, perhaps, necessary to introduce into the present paper. It deserves the careful investigation of the chemist and mechanical philosopher, with whom the author prefers to leave the subject.

The Battle for Life between the New and Old Worlds.

The *Scientific Record*, a popular scientific journal recently started in England, cites a large number of facts to prove that the animals and vegetables of the new world are being supplanted by those of the old. It says:—

"It would appear that, as in the case of the human inhabitants, there is a law that the new comers should eventually take the place of the native denizens of the soil. W. T. Locke Travers, Esq., F.L.S., an active New Zealand botanist, thus writes from Canterbury: 'You would be surprised at the rapid spread of European and other foreign plants in this country. All along the sides of the main line of road through the plains a *Poligonum aviculare* called 'Cow Grass,' grows most luxuriantly, the roots sometimes two feet in depth, and the plants sometimes spreading over an area from four to five feet in diameter. The dock *Rumex obtusifolius* or *R. crispus*, is to be found in every river bed extending into the valleys of the mountain rivers, until these become mere torrents. The water-cress increases in our rivers to such an extent as to threaten to choke them altogether. In some of the mountain districts, where the soil is loose, the white clover, *Trifolium repens*, is completely displacing the native grasses, forming a close sward. In fact the young vegetation appears to shrink from competition with these more vigorous intruders. Dr. Hooker says that he has in vain urged on his colonial correspondents the importance of systematically recording and collecting facts on this important subject. Every problem of the geographical diffusion of plants is directly interfered with by these intruders. Mr. Darwin is the only author who has had the boldness to approach the subject. 'This great naturalist,' says Dr. Hooker, 'believes that the facts hitherto observed favor the supposition that, in the struggle for life between the denizens of the Old continents and the New, the former ones are prepotent; and he attributes this to the longer period during which they have been engaged in strife and the consequent vigor acquired. European weeds have established themselves abundantly in North America, Australia, and New Zealand, but comparatively few plants of these countries have become naturalized, and ultimately complete weeds in England. We may hence infer why it is that the indigenous plants of St. Helena and Madeira show no tendency to increase, whilst European and African trees, shrubs, and herbs are rapidly covering these islands.' The rapid propagation of European animals is no less remarkable than that of plants. J. Hart, Esq., Government geologist, Canterbury, writes as follows to Mr. Darwin: 'The native (Maori) saying is, 'as the white man's rat has driven away the native rat, so the European fly drives away our own; and as the clover kills our fern, so will the Maories disappear before the white man himself.' It is wonderful to observe the botanical and zoological changes which have taken place since Captain Cook first set foot in New Zealand. Some pigs which he and other navigators left with the natives, have increased and run wild in such a way that it is impossible to destroy them. There are large tracts of country where they reign supreme. The soil looks as if ploughed by their burrowing. Some station holders of 100,000 acres have had to make contracts for killing them at 6d. per tail, and as many as 22,000 on a single run have been killed by adventurous parties without any diminution of their number being discernible. Not only are they obnoxious by occupying the ground which the sheep farmer needs for his flock, but they assiduously follow the ewes when lambing, and devour the poor lambs as soon as they make their appearance. Another interesting fact is the appearance of the Norwegian rat. It has thoroughly extirpated the native rat, and is to be found everywhere growing to a very large size. The European mouse follows closely, and what is more surprising, where it makes its appearance, it drives to a great degree, the Norwegian rat away. Amongst other quadrupeds, cattle, dogs, and cats are found in a wild state, but not abundantly. The European house-fly is another importation. When it arrives it repels the blue bottle of New Zealand, which seems to shun its company. But the spread of the European insect goes on slowly, so that settlers, knowing its utility, have carried it in boxes and bottles to their new island stations.' 'It must be long,' says Dr. Hooker, 'before facts enough to theorize upon can be collected. Meanwhile, the inquiry appears to be, perhaps, the most interesting and important in all biology, and as such, it is most earnestly desired that all who are favorably circumstanced to pursue it, will do so both systematically and carefully.'"

"Put some Ice in it."

The highly-polished surface of ornamental silver vessels is well known to occasion considerable trouble to the photographer, not only from the brilliant mass of light reflected, but from the number of irregular reflections from surrounding objects, the effect of which materially interferes with due rendering of the design. Some very unsatisfactory results of this kind being obtained by a photographer for a large firm at the West End, the manager of the artistic department, an Irish gentlemen of great resource, exclaimed to the photographer, "Why don't you put a piece of ice in the jug?" The question was solved in a moment. A piece of ice in the silver vessel would rapidly cool it, and cause it to condense vapors on its surface from the surrounding atmosphere. This would just sufficiently dim the excessive luster to render a good photographic representation possible.—*Photographic News.*

POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

The Association held its regular weekly meeting at its room at the Cooper Institute on Thursday evening Oct. 6, 1864, the President, D. S. Tillman, Esq., in the chair.

NEW SMELTING FURNACE.

Prof. Fleury gave a description of a furnace invented some time since in Russia, and now patented all over the civilized world. It is quadilateral in form, flaring towards the top. Its principal peculiarity is the arrangement of the tuyeres, which enter on the long sides of the hearth, those on one side being opposite the middle of the spaces between those on the other side. The speaker read a long paper giving many statistics to show that these furnaces were cheaper to construct, and produced more iron in a given time and with less fuel than the circular bosh furnaces at present in use. He also stated that these furnaces are better adapted than any others to the smelting of copper and lead ores. They are called the Rachette furnace.

MAKING GLOVES.

The regular subject of the evening, glove making, was then taken up, when the President read a paper containing in the main the same facts that appeared in our last week's issue.

Dr. Richards:—Glove making was first established on any considerable scale in this country at Johnstown, in this State. When the country was new this was the frontier part of Sir William Johnson, and the Indians brought their deer skins to it for sale. The manufacture of gloves was started to utilize the skins. The gloves were cut out and distributed among the farmers of the vicinity to be sewed by the women. The business was afterwards established at Gloversville, where it was carried on in the same way. Thus for two or three generations the women of that region have been trained to glove sewing, and they have acquired a skill and proficiency that defies competition. Attempts have been made to start glove manufactories in other places, but they have failed from want of skill among the women in the vicinity of those places in this special art.

At first all of the skins were bought of the Indians, but now they are purchased in this city. Some imported cow skins are used, as well as the deer skins of this country.

Dr. Rich:—Some years ago I had a special interest in making inquiries in France into the details of the glove manufacture, and I found that the making of fine kid gloves pays very low wages even for the cheap labor of that country. I do not believe that the manufacture can be introduced into this country unless machinery can be employed.

Prof. Fleury:—I wonder that asbestos gloves are not used by firemen in this country. In Austria I have seen a man with a complete suit of asbestos walk right through a flame. His eyes were protected by plates of mica, and he carried a moist sponge over his mouth. He was also provided with bags of asbestos for carrying off valuable articles from burning buildings. I suppose a full suit might be obtained at the present time for seventy dollars.

Mr. Nieman:—Kid skins, to be suitable for gloves must be taken from the young animals before they are weaned. After they begin to live on grass the skin undergoes a change, which impairs its value for this purpose. A glove maker, or an experienced dealer, will detect the skin from a grass-fed animal as soon as he sees it.

Mr. Ely:—I have seen it stated on apparently good authority that the very finest gloves are made from the skins of kids that are obtained by killing the dam and taking the kid from her womb. I have also seen a statement of the sum which is annually paid to the French Government for the privilege of entering the sewers of Paris for the purpose of killing rats; the object being to obtain their skins to be used in glove making.

Dr. Rich:—I do not think a rat's skin is large enough to yield pieces of suitable size for gloves that are of uniform thickness and quality.

Mr. Nieman:—We sent some rat skins to Paris, but they would not sell. Even if the skins were large enough, they are spoiled by the rats biting one another so much. If you take up a dressed rat skin you will find it full of either holes or scars.

The skins of tame animals are generally better than those of wild animals, and the skins are tough in proportion to the agility of the animals.

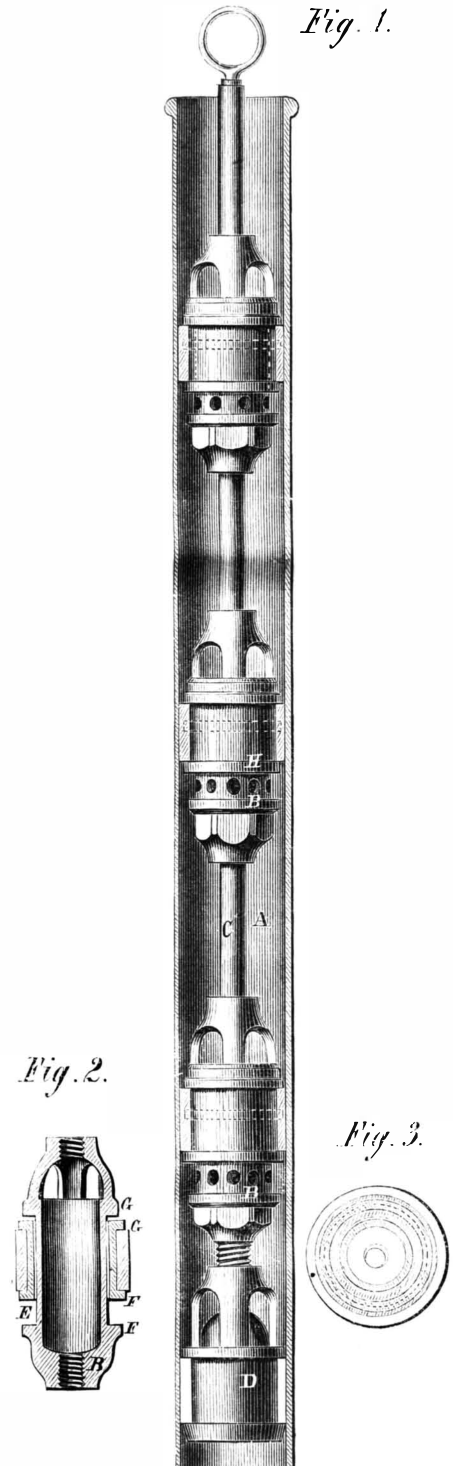
Dr. Rowell:—The very toughest skin that saddle makers can find is a hog's skin. I do not know that the hog excels in agility.

Dr. Richards:—I was at one time interested in the manufacture of leather, and we found that calves of the most improved breeds furnished better hides than ordinary cattle.

The new mode of travel by the pneumatic tube was selected as the subject for the next meeting, and the Association adjourned.

WARREN'S DEEP-WELL OIL PUMP.

Ordinary oil wells range from 400 to 1,000 feet in depth, and when in working order the pumps therein are subjected to an immense strain from the hydro-



static pressure due to the long column of oil that has to be lifted at each stroke. This pressure is very great, and not only causes the packing to wear leaky in a short time, but it also endangers the safety of the pump barrel itself, which not unfrequently bursts from the severe strain of resisting the movement of the column. The great hydrostatic pressure referred to causes the pump piston to become so leaky in a short time that no vacuum can be maintained, and the apparatus is wholly deranged in consequence. Many rich wells have been declared dry from the failure of the pumps to act. Where such important interests are concerned, proprietors of, or others interested in oil wells, should not fail to adopt this pump, as it is devised on sound mechanical principles, and will work well if properly made. The details are as follows:—

The engraving represents a long pump barrel, A, which has the pistons, B, in it. These pistons are all connected by one rod, C, and move simultaneously. At the bottom of the pump is a foot valve, D, of the ordinary kind, which opens upward, allowing oil to enter but not to return.

The pistons have a loose sleeve, E, where the packing is in ordinary pumps, (see Fig. 2) which moves up with the piston when the two flanges, F F, come together. It also moves down when the other flanges, G, come in contact. The sleeve therefore slides easily on the body of the piston. These three sliding partitions, so they may be called, virtually divide the pump barrel into as many compartments, for although the pistons move simultaneously the loose sleeves are of different lengths, so that each one moves a little in advance of the other. In this way each piston lifts only the column directly above it. So soon as the top piston moves up the flange, F, on it, strikes the loose sleeve and raises it; the oil which entered through the holes, H, is shut off from the column below, and the piston goes away from it. The second piston then meets the other loose sleeve and shuts off the oil from the openings, H, and raises its load, and so the operation goes on down the barrel. The times of lifting the load on each individual piston is regulated by the distance the loose sleeves travel on the pistons which shut off communication between one compartment and the other, earlier or later, as occasion requires. Although the aggregate load on the pump rod and bottom piston is the same as in any ordinary pump the *pressure* on the latter is far less, being only that due to the column resting upon it, as any intelligent person can see at a glance.

These pumps give great satisfaction, and can be obtained of Messrs. Hart, Ball & Hart, Buffalo, N. Y.

The invention was patented on May 10, 1864, by John Warren, of Buffalo, N. Y., from whom all further information can be obtained.

CHANGING IRON TO STEEL BY CARBONIC OXIDE

Le Genie Industriel publishes the following note recently presented to the Academy of Sciences, Paris, by M. Fred Marguerite:—

"The idea of carburation by a gas is due to Clonet, who thought that iron has such an affinity for carbon that at a very high temperature it would remove it even from oxygen. He relied for this opinion on the fact that having heated iron divided into small pieces with a mixture of carbonate of lime and clay, he obtained steel. He concluded that the carbonic acid of the carbonate of lime was decomposed, yielding its carbon to the iron.

"But Mushet, repeating the experiment of Clonet, operated with lime deprived of carbonic acid, or simply with sand, and obtained steel; thus demonstrating that the carbon was not furnished by the carbonic acid of the mixture, but by the gas from the furnace which penetrated through the walls of the crucible.

"Collet-Descotils and Marckensie proved that, in the same circumstances, the iron might be perfectly melted without its properties being sensibly altered.

"M. Boussingault, following rigorously the indications of Clonet, obtained a product which analysis demonstrated not to be steel, but the silicide of iron.

"Later, M. Leplay gave his ingenius theory of the treatment of minerals in high-furnaces, which he summed up thus:—

"Carbonic oxide reduces all the compounds, and carburets all the metals which can be reduced and carburetted by cementation.

"But in the researches followed in common by MM. Laurent and Leplay, the action of carbonic oxide was found absolutely null, and their experiments had for conclusion that carburetted hydrogen is the cause of the cementation and the carbonic oxide of the deoxydation.'