Ay, eight-and-twenty years ago Ferdinand de Lesseps had earned a retiring pension. Then opened the great epoch of his life. In 1854 the new Viceroy, Mohammed Said, invited him to Egypt; and it was while traversing the desert with his host that he poured into his ear the details of his project for a canal to unite the Mediterranean with the Red Sea. The Pasha listened, and saw all the advantages his country would reap from the enterprise. While he lived, De Lesseps had a staunch and an enlightened friend. The death of Said Pasha, however, opened a host of difficulties for the energy and diplomatic experience of De Lesseps to scatter. The new Viceroy brought the works to a standstill, until Napoleon III., who consented to act as arbitrator, adjusted the differences between the Egyptian Government and his illustrious subject, and set the mighty dredgers and the colonies of workmen at their task again. Of all this heavy sum of labor, with its curious incidents and varying scenes, De Lesseps talks freely and gayly over his cutlet and his omelet. A Liberal in politics, independent in his friendships, the servant of no régime, standing rigidly aloof from clubs, committees, and coteries, "the Duke of Suez" is popular with all parties. He is a national man. Under deep obligations to Napoleon III., and connected with his Consort, he remains the friend of the Orleans Princes, and on good terms with the Count of Chambord. He has the traveled air which is alone generally wanting to make the cultivated French gentleman a perfect host or a model guest. De Lesseps has all the grace of bearing which is native to his race, but he has shaken off that exaggerated ceremoniousness which, to our English mind, mars the pleasures of social life in France. The ordinary Frenchman of good breeding makes you feel as his guest that he has done all that in him lies to honor your presence within his gates. Ferdinand de Lesseps, with a hearty, spontaneous grace, gives you a welcome that sets you completely at your ease as his *convive*. His *accueil* tells you that he is pleased rather than honored in receiving you, and the way in which he makes his conversation travel round his table from Frenchman to Englishman, Anglo-Indian, German, or Italian, proclaims the man of the world who has broken bread with many races of his kind.

Of course, in the Rue Richepanse the conversation reverts again and again to Suez and its canal; for De Lesseps is either thinking of his return to Egypt or he has just returned from the East. He travels always with his wife and young family. Breakfast over, you will delight your host by proposing to go to the Suez offices to inspect the perfect museum of plans and models of the canal works which are arranged there. But first, on returning to the *salon*, you will have to remark and admire, as well you may, the superb monumental *coupe* in *repoussé* silver—the masterpiece of a Ladeuil or the pride of a Froment Meurice—which the Empress Eugenie bore to Suez, the insignia of a Grand Cross of the Legion of Honor glittering within it, and gave to her kinsman (the *coupe* from herself, the cordon from her Consort) on the day when the canal was formally opened. Never was great event acknowledged in a more imperial manner; and who shall wonder that, let the régime be what it may in France, this trophy of French art and imperial gratitude to the subject who has done a work "enough to make a reign illustrious" will remain the central splendor of Ferdinand de Lesseps' *salon*!

"But," said De Lesseps, proud, smiling, and leading the way to an inner room, "I have something more to show you."

In a curtained room, by a sparkling wood fire, sat two Sisters of Mercy, their faces shaded by their immense snowy caps or *capuchons*.

And each Sister held a bouncing baby six weeks old in her arms.

They were De Lesseps' twins.—*N. Y. Times*.

WATER IN STEAM.

MEASUREMENT OF WATER MECHANICALLY SUSPENDED IN STEAM.

By PALAMEDE GUZZI, C. E.

THE greatest difficulty which is encountered in determining the coefficient of evaporation of a steam generator, or the weight of vapor produced in a given time, is in measuring the water which it carries over from the boiler by mechanical action.

This problem, which has acquired a greater importance since Hirn, Leloutre, and Hallauer, by their overthrow of the old theories of the steam engine, have opened the way to the true theory, is not yet completely solved.

The only solution of real importance, among the many which have been hitherto attempted, is the one suggested by Hirn, and followed by the distinguished experimenters of the industrial Society of Mulhouse, and others. Even this leaves some uncertainty, so that the Mechanical Committee of that society has recently renewed its offer of a reward for a better method.

Hirn's plan consists in measuring the total heat of a given weight of steam, and comparing it with that which would be found in dry saturated steam, as given by Regnault's formula. His apparatus consists simply of a coiled tube, surrounded by water.

But there is some indeterminate portion of the energy of the steam, which is so transformed as to be incapable of measurement. The vibrations generated by the flow of steam in the coil, and in the surrounding water and air, as well as in the boiler itself, represent a transformation of heat into mechanical energy. A part is manifested in the form of sound, and is lost; only a small fraction of the remaining portion can reappear in a greater elevation of the temperature of the water. Moreover, during the flow of steam and its condensation in the coil, recent experiments have shown that there is a conversion of thermal into electric energy.

It is true that Regnault's experiments were made under similar conditions; but for that very reason there is a greater need of other means of experimenting for purposes of comparison or confirmation.

I have devised an apparatus, consisting mainly of a vessel which is filled with the steam of which it is desired to measure the humidity, and which is protected, as much as possible, against radiation and consequent internal condensation. Its capacity, and the weight of the vapor contained in it, being known, it is easy to ascertain the amount of dissolved or suspended water.

This recipient, marked *a* in the accompanying diagram, is made of copper, in the form of a cylinder with hemispherical ends. It has an upper valve, *b*, and a lower valve, *c*, which is fastened by the screw, *d*, to the bottom of the chamber, *e*. This chamber, which serves as the envelope of the recipient *a*, is formed of the double bottom, *f*, and

the cover, *g*, which are both of cast iron, and the cylindrical sheet-iron wall, *h*. The sides and top are protected by non-conducting materials, inclosed in the external envelopes, *i, j*, which are made of polished brass. The covering receives pipe leading to the valve *b*, and contains the stop-cock, *k*, as well as the stuffing-box, *l*, through which passes the stem of thermometer, *m*.

MEASUREMENT OF WATER IN STEAM.

The double bottom *f* is put in communication, by means of the receiving valve, *n*, with the steam dome, *o*; by means of the openings, *p*, with the chamber *e*; and, when desired, with the interior of the recipient *a*. The valves *b* and *c* are worked by means of the handwheels, *s*, and the spindles, *q*, which traverse the stuffing-boxes, *r*. In order to diminish, as much as possible, the transmission of heat from *b* and *c* to *s*, the spindles are made hollow, and pierced with holes, so as to increase the surface of contact with the steam of the envelope *e*, while the heat conducting sections are diminished.

In experimenting, the air is driven from *e* by opening *k* and *m*; *k* is then closed, and after some time *b* and *c* are opened. After the air is driven from *a*, *b* is closed. After some seconds, when the equilibrium of pressure is established, *c* and *n* are closed; the cover *g* is lifted, and the spindles *q* being withdrawn, the recipient *a* is removed to be weighed. The total weight, less the weight of the receptacle, gives the weight of the mixture of water and steam; deducting the weight of an equal volume of dry saturated steam at the same temperature, we obtain the quantity of water dissolved in the steam.

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Care is needed in determining the tare of the vessel *a*. To take account of the vapor which is condensed upon the inner walls of the vessel and adheres to them, it will be well to experiment with a generator from which no other vapor has been withdrawn, and which has not been heated for some time. Subtracting from the weight of *a*, thus filled with vapor, that of an equal volume of dry saturated vapor at the same temperature, we get the weight of the empty vessel, but internally bathed; this is the tare.

The apparatus could also be applied to the determination of the density of dry saturated vapors, under high pressures, for comparison with the results of Fairbairn and Tait, and to find the values of *r* in the formula of Clausius,

$$APu = \frac{rP}{T \frac{dP}{dT}}$$

for comparison with those obtained by Regnault.

MEASUREMENT OF WATER MECHANICALLY SUSPENDED IN STEAM.

By J. B. KNIGHT.

Having for a long time felt the want of a more satisfactory method of determining the amount of water carried out of the boiler by the mechanical action of the steam, when determining the evaporative efficiency of steam boilers, I conceived a device, about January 1st, 1874, which, so far as depending upon the weight of a measured quantity of entrapped steam, was identical with that of Palamede Guzzi, an account of which is given above.

Preferring to submit my design to the test of experiment before publishing it, and being prevented from doing so up to this time, Mr. Guzzi is, of course, entitled to the claim of priority.

It now becomes desirable, however, that I should give my plan, as it covers some points not embodied in his, and which seem essential to the accuracy of the result.

The advantages claimed for my plan are: entrapping the steam to be tested, in exactly the condition in which it passes from the boiler in the normal condition of working; and depending entirely upon the weight of the steam entrapped, thus avoiding errors arising from losses of heat during the experiment.

All the methods heretofore proposed, including that of Mr. Guzzi, fail entirely in one or the other of these particulars.

The article referred to gives the plan of Professor G. A. Hirn as the best yet suggested, and which consists in measuring the total heat of a given weight of the steam under examination, and comparing it with that of dry saturated steam at the same pressure and temperature. The apparatus there described consists of a simple condensing coil.

Another form of apparatus for this method is that used in the boiler tests at the Centennial Exhibition, and described in detail in the *Journal of the Franklin Institute*, and considered the best in use in this country.

By this method, whatever the apparatus used, corrections have to be made for losses by radiation from the conducting pipe and condensing vessel, and for absorption by the vessel if of wood, and the specific heat of the vessel and of the stirring apparatus, none of which can be more than approximately ascertained.

In the apparatus of Mr. Guzzi, the copper vessel in which the steam is to be weighed is inclosed in and filled from an outside chamber with non-conducting sides, connected by a pipe to the steam dome of the boiler. With this arrangement, the steam, not being taken from the principal outlet of the boiler, is not of the normal quality, and is subject to some loss of heat by radiation from the chamber and connections. Moreover, after entering the weighing vessel, the steam is allowed to stand in a quiet state, and all the water held in suspension will be precipitated.

The apparatus proposed by myself is shown in the figure, as intended to be inserted in the steam-pipe leading to the engine. A chamber, *a*, formed by an enlargement of the pipe, has an opening at the top, large enough to admit the vessel, *b*; the opening to be covered by means of the lid, *c*. At each end of the chamber are the stop valves, *d, d'*, and just beyond these is a by-pass, having in it the valve *e*. It is obvious that when the valves *d, d'* are open and *e* closed, all the steam on its way to the engine must pass through the chamber *a*; or if it be desired to open the chamber, the valves being reversed, the steam will pass around the chamber through the by-pass.

The copper vessel *b* (made spherical in form for the purpose of inclosing a given space with the least weight of metal) has outlets on each side through the cocks, *g, g'*, operated by the handles on the spindles, *h, h'*, passing through the bottom of chamber *a*. At the bottom of the vessel *b*, and operated from the outside in the same manner as the cocks *g, g'*, is a small cock, *i*, by means of which any water resulting from heating it up to the temperature of the steam can be drawn off.

In the lid or cover of the chamber is a stuffing-box, through

steam in the latter must be, in every particular of temperature, pressure, and saturation, in exactly the same condition as all that leaves the boiler.

When this has continued for a sufficient length of time to insure the proper heating of the chamber and its contents, close the cocks *g g'* and *i* simultaneously, and we have entrapped in the vessel *b* a quantity of steam of the quality due to the normal working of the boiler.

Now open the valve *e* and close *d d'*; remove the lid *c*, when the vessel *b* may be taken out and weighed. From this weight deduct that of the empty vessel, and the remainder will be the weight of the mixture of steam and water contained in it. A comparison between this and the weight of the same volume of dry saturated steam at the same temperature will give the percentage of water carried out of the boiler by the mechanical action of the steam.

It is evident that no allowances have to be made for radiation, or for the specific heat of the materials used, as we simply weigh the supersaturated steam carried from the boiler in actual service, and compare it with dry saturated steam.—*Journal of Franklin Institute.*

IMPROVED THRASHING AND FINISHING MACHINE.

OUR engraving illustrates the thrashing machine shown at the Smithfield Show by Messrs. Garrett & Sons, of the Leiston Works, Suffolk, Eng. The fan is keyed on the drum spindle, and by means of it two double blasts are obtained each equal in operation to the effect of an ordinary dressing machine. By aid of this high-speed fan a great amount of blowing power is secured, which is easily regulated by means of the valves in the canals, which are actuated by screwed levers of which the extremities are in each case adjacent to the chaff delivery spouts. If it be found that the effect of the blast is insufficient or excessive, it can be thereupon instantly and easily adjusted by means of the hand-wheel, without the attendant leaving the chaff spout.

IMPROVED THRASHING AND FINISHING MACHINE.

The cast-iron fan case acts as a rigid connection and stay to the trussed frame of the machine, to the four principal components of which it is attached, and at the same time as a rigid bracket for one of the two plunger blocks which carry the drum and the solitary fan of the "finishing machine." Both these bearings are, under the new arrangement, external and accessible. Another feature in the arrangement is the expansion of the wind canals, in which the blast is gradually modified and softened after leaving the fan itself, and so can be adapted to the peculiarities of the most variable conditions of corn and chaff.

The great extension of the blowing power is noticed in this machine, the area of which is so great that with a moderate amount of care and supervision it is almost impossible to pass out corn with the chaff, or for the chaff to escape the influence of the blast. It will be observed that in the "grist blast" there is a spout provided for the discharge of the long straws or other substances, which are carried over the blowing sieves, but which are still too heavy to be carried out with the chaff.

By means of a slip board or false bottom, this arrangement can be dispensed with under certain conditions, as, for instance, in the case of tough or long-tailed barley, of which too large a proportion would pass over the end of the sieve.

The machine is supported on a steel bracket on the rear axle, so that all four of the traveling wheels are brought under the main sills of the frame. In working the machine, wedges are driven between the sills and the wheels, so that the whole structure is rigid.—*Engineering.*

A NEW IRON STEAMSHIP.

THE new iron steamship Oregon was built at Chester, Pa., for the Oregon Steamship Company, by John Roach & Son, at a cost of about \$420,000. She will start for San Francisco in a few days, and will run between that port and Portland, Oregon. Her dimensions are: Length, 294 feet; beam, 38 feet; depth from spar deck, 25 feet 10 inches. She has two compound surface condensing engines of 1,650 horse power. The propeller is of the Hirsch pattern, and is 15 feet in diameter, with a pitch of 24 feet 9 inches, and can make 70 revolutions a minute. There are three decks, including the hurricane deck. The spar deck is entirely and the main deck partially of iron. The deck-frames are all iron. The vessel has a donkey boiler and engines to be used in clearing the bilge, supplying the main boilers, and in case of fire. The capacity of her coal-bunkers is 600 tons. Her mean low draught is 17 feet. She is brigantine rigged, and carries about 13,000 square feet of canvas. Both of her masts are of iron. Her hoisting as well as her steering apparatus is worked by steam. She has an upper and lower saloon, and can accommodate 200 cabin passengers. In her steerage are quarters for 300 persons. The measurement of the Oregon is 2,335 tons, and she will be able to make 15 knots an hour. The saloons and state-rooms are furnished elaborately, and contain many improvements for the comfort of passengers.

THE average annual locomotive mileage in various countries is computed as follows:—France, 23,475 miles; United States, 21,900; Great Britain, 16,865; Germany, 11,834; Austria, 11,700; all Europe, 15,300; East Indies, 13,400.

COMPOUND HYDRAULIC COTTON PRESS.

THE large cotton presses which we illustrate have been designed by the inventor to meet the requirements indicated by long practice in cotton and jute packing in India. Though it is over eighty years since the celebrated Bramah invented and largely applied the hydraulic press with rams having but comparatively short ranges, it is only a short time since the old methods of packing cotton and jute by hand in India have been superseded by the much more rapid and dense packing effected by the long stroke press, operated by water under very great pressure. The first hydraulic presses that were used in India were, we believe, fitted with a single ram of about 8 ins. in diameter.

After this Messrs. Fawcett, Preston & Co., the makers of the presses we now illustrate, sent one to Bombay with a 14 in. ram. Both these were actuated by pumps which were too small to give a much greater speed to the ram than was characteristic of hydraulic presses generally. The advantage attending their use in place of the hand-worked screw and lever presses was therefore not very great, the time occupied in the ascent of the ram being several minutes, so that only four or five bales could be pressed per hour. In 1857, Messrs. Nasmyth, Wilson & Co. sent out a press with two 11 in. rams, having a range of 12 ft. Five other presses were sent out, when it was found that these rams could be raised in less than two minutes, the five being worked by two pairs of engines. These engines worked two sets of pumps, the plungers of one set being only about one-fourth the size of the other. The engines, however, being of the same power, the water could be delivered from the small pumps at a pressure fourfold that from the others, but in one-fourth the quantity. Thus a quick speed was obtained during the first part of the stroke of the press ram, by running both high and low-pressure pumps at the same time. When the resistance of the cotton to compression overcame the power of the engine working the low-pressure or large plunger pumps, the engine of course became sta-

arrangement illustrated on page 1800. Some idea may be formed of the rapidity with which baling may be effected with these presses when it is stated that last season four of them turned out 1100 bales in a day of 15 hours, and four others turned out 1150, or 22 bales per press per hour, and we are informed that presses of this description are turning out 20 bales per hour, with hoop iron 17 times round the bale. The consumption of coal per bale is 9 lbs., or in value about 1/4d. This, it need hardly be said, is extremely economical, and is principally due to the arrangement described, by which the box is ready for filling while the preceding bale is being finished.

For working these presses Mr. Watson uses short-stroke in preference to long-stroke pumps, as he has been enabled to run these through a season of four or five months, working often night and day, without frequent or serious stoppages. Objection is made to the direct-acting long-stroke pumps on account of their speed of from 250 ft. to 350 ft. per minute, and of the still greater speed at which the water is forced between the valve seat and face. At such high speeds, water is found to cut and groove these faces and the pump-plunger to such an extent that it becomes impossible to maintain the necessary pressure in the press when finishing the bale, and, owing to the grooving of the plunger, leakage not only takes place, but the packing has to be so tightened that a great deal of engine power and fuel are lost. By adopting a low speed of pump, with small plungers and large valves, most of these difficulties have been overcome and the objections to short-stroke pumps removed. The aversion to the use of multiple short-stroke pumps, on account of the number of valves employed being increased by the number of pumps, has more-over lost its force by the facility of removal of these valves and substituting these in good order, which has been secured by the arrangement illustrated below.

It will be seen that the valve boxes are made separately from the pump body, and the parts are so constructed that, by having a few duplicate valves and boxes, a set in proper repair may be put into a pump in a few minutes; and as all

tionary, and the other engines and small pumps finished the bale at the slower speed.

From this time the use of high speed hydraulic presses gradually rose in the favor of the baling merchants, and in 1862 the same firm sent out a press having three 9 in. rams, the object of which was to dispense with the engines working the low-pressure pumps. The water from the pumps was admitted at first, while the cotton was loose and compression easy, into the center cylinder only, the outer rams rising with the follower and central ram. The two outside cylinders as their rams rose were filled with water by gravity from a supply tank. When the resistance to compression balanced the pressure under the central ram, the water from the pumps was admitted to the outer rams and the compression of the bale completed by the three rams together. This was an ingenious arrangement, however familiarity with it may have partly concealed the fact.

The Watson press, which we illustrate, was afterward made, and numbers of them have since been sent out and are largely used in India. These were also compound presses in that they were fitted with fast working rams of smaller diameter for effecting the packing to a certain degree of density from the loose state, and slower moving rams of larger diameter by which the packing was completed under the greater pressure. Most of these presses have been made with a box 15 ft. 6 ins. in length and 4 ft. wide, and with two bottom or preparing rams of 6 1/2 ins. diameter, and two for finishing of 16 ins. diameter. Four such presses are worked by an engine with 20 in. cylinder and 3 ft. stroke, driving eighteen pumps, ten for working the lower rams—five being 2 ins. and five 2 1/2 ins. in diameter—and eight for the upper rams, 2 ins. in diameter, and all of 6 in. stroke. The great advantage secured by Watson's press is in the saving of time effected by the particular arrangement of the two pairs of rams and grids, by which one bale is being finished by the top ram while the box is being again filled and the preliminary pressing effected by the lower rams. This will be seen by the following description of the mode of working:

Let it be supposed that the press is empty. The top doors, A, are shut, and consequently the grid, B, thrown out; the filling doors, C C, are opened, and the box filled. The lower rams then ascend until the lower follower is in position for the grid B to be thrown in below the bale. At this point, the stop-bolt, D, by a simple arrangement withdraws the lock-bolt at the doors A; these doors fly open and give the signal to put in the grid, an operation occupying about three seconds. As soon as the grid is in position, the lower rams are lowered to the bottom of the box, when the cloth is put in through the doors, E. The box is then filled again, and at the same time the bale already taken up is being pressed by the descent of the top rams, and being lashed (or hooped) at top. When the bale has been hooped, the top rams, F F, and the follower, G, are drawn back off the bale by the small ram, H, at the top of press. The bale is then tumbled out, and the doors being shut, the lower rams ascend again with a fresh supply of cotton.

Only one floor is required for operating the press, that is for filling the box and hooping the bale—this floor being nearly on a level with the bottom of the filling doors. The bale undergoing the finishing pressure and hooping is 2 ft. 6 ins. higher than the floor, a convenient height for lashing or hooping. All the space below that floor is thus available for warehouse purposes—this will be seen from the general

the pumps are under control this may be effected without ever stopping the engine. To work a set of four Watson's presses, each with two 6 1/2 in. preparing rams and two 22 in. finishing rams, a set of twenty pumps is employed, ten of which are 2 ins. in diameter, and on one side of the pump driving shaft, for the finishing rams. All these are provided with regulators by which the engineer in charge can stop them from throwing water at any pressure or part of the stroke of the press rams he may think best adapted for the most economical working of the press. They can be stopped, for instance, thus: up to 25 cwt. all at work, 28 cwt. stop three pumps, then at 35 cwt. three pumps, finishing with remaining four or any other like arrangement. The ten pumps on opposite sides of the shafts work the bottom or preparing rams, and are of 2 in., 2 1/2 in., and 3 in., worked with regulators as already described. This plan of making pumps for this purpose is new, though pumps have long been made with separate valve boxes. It secures great economy of time and facility of repair, and we are informed that a set of three pumps and presses ran for three months night and day with only a ten-minute stoppage each morning to oil crank pin and put in freshly done up seats and valves. The high and low-pressure and discharge pipe are marked respectively A B and C D.

The diagram which we give, illustrating the increase of pressure brought to bear upon a cotton bale from the commencement to the completion of the baling operation, is of some interest, and shows the necessity for small, quick rams to perform the preliminary pressing if economy is to be secured. The lower part of the diagram in full lines gives the pressure upon the bale from the lower rams, and the upper full line diagram shows the pressure during the finishing

under the big rams. The part of the diagram in dotted lines indicates the upper diagram inverted upon the lower one, so that it shows the continuous form it would take if the whole pressing was done by the lower rams. It will be particularly noticed that the pressure required is really small and almost constant for two-thirds of the stroke of the lower rams. The diagram is self-explanatory with reference to the remaining information to be gathered from it. We have omitted to