Testing Tubes.

We have received a pamphlet by Charles Legge, Civil Engineer, entitled "A Glance at Victoria Bridge," giving a very interesting history of the rise and progress of that gigantic structure. The author gives the following account of the manner in which the great tubes were tested, and of his personal experience in connection with the experiment:—

On the 15th of December, preparations were completed for a final test of the strength of the tubes; singularly enough at the same time, with the close of navigation, when vast fields of ice, under nature's superintendence, were hurling their solid masses against the masonry of the piers and testing their efficiency and strength by over one million tuns a minute. Any force or weight man could bring into comparison with this, would be puny in the extreme.

Yet notwithstanding the inability of competing with nature's test, a load had been obtained such as seldom before was seen for alike purpose. A train of platform cars 520 feet in length, extending over two tubes, was loaded, almost to the breaking limit of the cars, with large blocks of stones, and in readiness for the experiment.

Prior to this a steel wire was extended the entire length of the tubes for the purpose of measuring the deflection, and strained by heavy weights as tightly as possible over pulleys at every bearing of the tube. This wire formed the datum from which all movements were to be measured on slips of card attached to vertical staves at various points along the tube.

During the two days occupied with the test the public were rigorously excluded, none being admitted by Mr. Hodges to witness the experiment but Mr. Keefer, Deputy Commissioner of Public Works, Canada, the engineers belonging to his staff, with Mr. Ross, and the two engineers from England. At each slip of paper one of his assistants was placed and provided with a lamp and a pencil by which to make the necessary marks.

The loaded train was then taken hold of by two of the most powerful engines belonging to the Grand Trunk and, with extreme difficulty from the great weight, brought into the first two tubes, beyond which all their united efforts failed to draw it. A third engine having been obtained, the three were barely able to force the load along to the centre of the bridge; when night coming on, the test of the remaining portion of the bridge was deferred until the following day.

Early next morning, the interesting experiment was resumed, and concluded during the day.

In giving the result of the fearful ordeal to which the tubes were subjected, we will only note the deflection on a pair of the side tubes, the others being similar, and the central one.

When the train covered the first tube, the deflection in the centre amounted to ⅞ of an inch, and the adjoining one, to which it was coupled, was lifted in the middle ⅜ of an inch. The load then being placed over both tubes, the deflection was the same in each, or ¾ of an inch in the middle; and on being entirely removed, both tubes resumed their original level.

The large centre span, entirely disconnected from the other tubes, on being covered with the load throughout its entire length, deflected in the centre only 1⅞ inches, and came back to its previous level on the load being removed.

All these results were considered highly satisfactory, as being considerably within the calculated deflection for such a load according to formulæ well known and generally made use of.

Nothing exemplified more strongly the confidence felt by Mr. Hodges in the strength of the work, than the severe test to which he exposed it. The writer well remembers the "peculiar feelings" he experienced when standing at the marking-post assigned him, surrounded at the same time by an Egyptian darkness, dense enough to be felt, arising from the condensed steam and the smoke of the engines, and totally obscuring the light of a glass lamp two feet distant. To thus stand closely pressed up against the side of the tube, with eyes and lamp brought within a few inches of the datum-line intently watching its movements, and leaving but sufficient room for the slipping, groaning, puffing but invisible engines and their heavily loaded cars to pass, with but a quarter of an inch of boiler-plate between time and eternity; or when mentally reasoned back to safety and security, and while listening, during the stoppage of the train, to the surging, cracking, crashing ice far below, as it swept past, to have those feelings of personal security dissipated in a moment by the thought of an over-loaded car breaking down and burying the deflection-observer beneath its weight, was surely reason enough for the existence of the "peculiar feelings" alluded to.

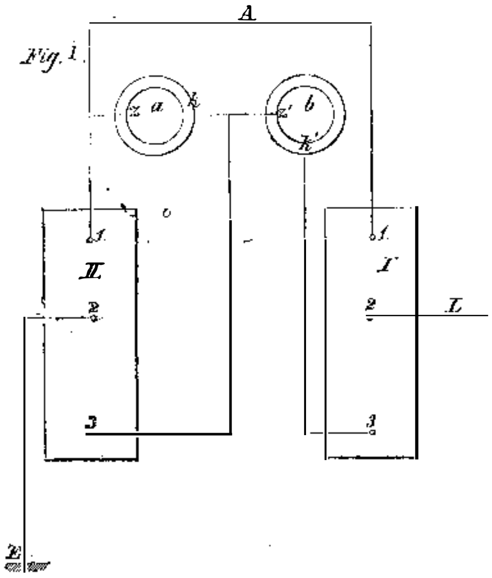
NEW METHOD OF TRANSMITTING SIMULTANEOUSLY TWO DISPATCHES ON ONE WIRE.

[Translated from the Journal of the Austrian Telegraph Association.]

In order to transmit two dispatches from one station to another simultaneously through one wire, the instruments have to be so arranged that the same make four different results possible in the four different cases. In transmitting two dispatches simultaneously in the same direction through the same wire, either two signals have to be transmitted at once, or one signal of the first or one signal of the second dispatch only, or, finally, no signal at all. Those four cases must be distinguishable at the transmitting station, and particularly at the receiving station.

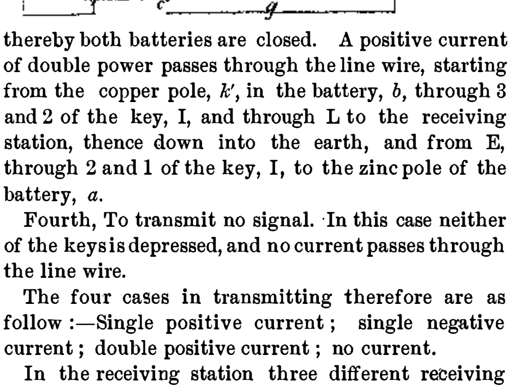
In the transmitting station two ordinary Morse keys, I and II, Fig. 1, are employed. The fulcrum, 2, of the key, 1, is connected with the line wire, L, and the fulcrum of the key, II, with the earth, E. The working contact, 3, of the first key connects with the rest contact of the second key, and in this connection the double line battery, *a b*, is inserted. The rest contact of the key, I, connects with the rest contact, *i*, of the key, II, and consequently with the zinc pole, *z*, of the battery, *a*; and, finally, a wire extends from the working contact, 3, of the second key to the wire connecting the copper pole, *k*, of the battery, *a*, with the zinc pole, *z'*, of the battery, *b*. In transmitting two dispatches simultaneously, one through each key, the following four cases may occur:—

First, Two signals are transmitted simultaneously. In this case both keys are depressed, and the battery, *b*, is closed; a positive current passes from its copper pole, *k'*, through 3 and 2 of the key, I, and through the line wire, L, to the receiving station, B, thence down into the earth, and through 2 and 3, of the key, II, back to the zinc pole, *z'*, of the battery, *b*.



Second, One signal of the second dispatch only to be transmitted. In this case the key, II, is depressed and the battery, *a*, is closed, and a current of equal power passes in an opposite direction through the line wire. If the former current is positive, this is negative, passing from the zinc pole, *z*, of the battery, *a*, through 1 and 2 of the key, I, and through L to the receiving station, thence to the earth and through the earth, and 2 and 3 of the key, II, back to the copper pole of the battery, *a*.

Third, To transmit one signal of the first dispatch only. In this case the key, I, is depressed, and



thereby both batteries are closed. A positive current of double power passes through the line wire, starting from the copper pole, *k'*, in the battery, *b*, through 3 and 2 of the key, I, and through L to the receiving station, thence down into the earth, and from E, through 2 and 1 of the key, I, to the zinc pole of the battery, *a*.

Fourth, To transmit no signal. In this case neither of the keys is depressed, and no current passes through the line wire.

The four cases in transmitting therefore are as follow:—Single positive current; single negative current; double positive current; no current.

In the receiving station three different receiving instruments are employed, one to be operated by the negative, the other by the single positive, and the last by the double positive currents. This latter instrument consists of an ordinary relay, R2, Fig. 2, the armature of which vibrates between the two points of contact, *m* and *n*, the point, *c*, being continually connected with said armature. When at rest, the armature is in contact with the point, *m*, and it is brought in contact with the point, *n*, whenever a positive current of double power passes through the line wire.

The first and second receiving instruments consist of a double relay, R1, connected and provided with two armatures, *r* and *l*, the armature, *l*, being operated by negative, and the armature, *r*, by positive currents of ordinary power.

The balance of the fixtures of the receiving station will be easily understood. M' and M2 represent the two Morse instruments; I and II two local batteries, the copper pole, K, of the first being connected with the armature, *r*, and its zinc pole, Z, with one end of the helix of the instrument, M', while the other end of this helix is connected by means of the wire, *f*, with the first end of the helix in the instrument, M2, and the second end of the latter with the copper pole of the local battery, II. The zinc pole of this local battery connects with the point, *m*, of the relay, R2, and the point, *n*, of this relay is connected with the wire, *f*, between the two instruments, M' and M2. Finally, the armature of the relay, R2, connects through the point, *c*, and wire, *g*, with the cores of the relay, R', and the armature, *l*, of this relay is connected with the wire, *f*, between the instruments, M' and M2. Consequently the relay, R', is inserted in such a manner that the local current always passes through the cores of the electro-magnets in R', and through the wire, *g*; the line current, on the other hand, circulates round the cores of the relays, R' and R2, one after the other. The spring of the relay, R2, has a greater tension than that of the relay, R', and in order to be able to regulate both springs simultaneously, according to the power of the current, they connect both to one nut, which serves to adjust the springs. The four different cases of transmitting signals produce the following results on the receiving station:—

1st. Two signals given; that is, a single positive current in the line wire. By this current the the armature, *r*, is attracted, while the armature of R2 remains in contact with the point, *m*; both local batteries are closed, the current passing from K, in the battery, I, through *r* and *g*, to *c*, and through *m* to Z' and K' of the battery, II, and through M2, *f* and M', to the zinc pole, Z, in I. Both instruments, M' and M2, operate and produce the signal on the paper. Both local batteries being closed the local current has sufficient power to operate both instruments.

2d. One signal of the second dispatch given; that is, a single negative current in the line wire. By this current the armature, *l*, of the relay, R' is attracted, and the armature of R2, remains still in contact with the point, *m*; by this the local battery, II, only is closed and its current passes from K' through M2, and *f* to *l*, thence through *g*, *c* and *m*, back to Z', in II. The signal of the key, II, therefore, is recorded by the instrument, M2.

3d. One signal of the first dispatch given; that is, a double positive current in the line wire. By this current the armature of the relay, R2, is brought from the point, *m* to *n*, and at the same time the armature *r*, of the relay, R', is attracted and brought in contact with the core; by this the local battery, I, is closed and its current passes from K through *r* and *g* to *c*, thence to *n*, and through *h*, *f* and M', back to the zinc pole, Z, of the battery, I. The signal of the key, I, is recorded by the instrument, M'.

4th. No signal is transmitted, that is, no current in the line wire. In this case neither the local battery, I, nor II is closed, since the armatures of both relays remain unaffected, and consequently no signal is recorded by either of the instruments, M' M2.

It remains to describe the arrangement of the several instruments for transmitting and recording two dispatches sent simultaneously through the same wire in opposite directions.

The district immediately around Manchester, England, contains two hundred cotton manufacturing settlements. The amount of English capital embarked in the cotton manufacture in 1836 was £35,-000.000. In 1861 it is £100,000,000.

State and county fairs are now in full blast all through the Eastern and Western States, and appear to be kept up with unflagging interest. The exhibitions of agricultural products, too, appear to be as good as usual.

The Marquis of Worcester's "Century of Inventions."

BY JOHN TIMBS, F.R.S.

As the tourist passes by the right of the Abergavenny or great road from Monmouthshire into Wales, he will scarcely fail to notice the picturesque remains of Raglan Castle, "the most perfect decorated stronghold of which this country can boast—a romance in stone and lime." Its historic interest can be traced through five centuries; but its culminating point was during the war with Henry, fifth Earl and first Marquis of Worcester, who, in his eighty-sixth year, made here a desperate struggle in favor of King Charles I., Raglan being the lastcastle throughout this broad realm which defied the power of Cromwell. In 1642, the Marquis raised and supported an army of 1,500 foot and near 500 horse soldiers, which he placed under the command of his son, Lord Herbert, who, succeeding his father, became better known as the Marquis of Worcester, who left in manuscript the "Century of Inventions." During the civil commotions Charles made several visits to Raglan, and on these occasions particularly distinguished the young Lord Herbert, whom his Majesty subsequently invested with the command of a large body of troops. His bravery and devotedness to the royal cause led to his being commissioned by the King in Ireland, failing in which, the Marquis embarked for France. Meanwhile, Raglan was surrendered to the Parliamentary forces; we do not hear of the young Marquis until 1664, when we find him attached to the suite of Charles II., who then resided at the court of France; and in the following year he was dispatched by the exiled monarch to London, for the purpose of procuring private intelligence and supplies of money, of which the King was in the greatest need. Worcester was, however, speedily discovered, and committed a close prisoner to the Tower, where he remained in captivity for several years; he was set free at the Restoration. Of his lordship's private life we find few records. He probably found leisure for the scientific pursuits, to which he was much attached, during his sojourn in France, where he wrote the first manuscript of his "Century of Inventions," the notes of which he appears to have lost; but he rewrote them, it is said, after his committal to the Tower. This we infer from the manuscript now in the possession of the Beaufort family, which opens thus :—

A
CENTURY
OF THE
NAMES AND SCANTLINGS
OF SUCH
INVENTIONS

As at present I can call to mind to have tried and perfected; which (my former notes being lost) I have, at the instance of a powerful friend, endeavored now in the year 1665 to set these down in such a way as may sufficiently instruct me to put any of them in practice.

Artis et Naturæ proles.

During the usurpation, Worcester House, in the Strand, the London residence of the Marquis, was sold by Parliament, but at the Restoration it reverted to his lordship, who leased the house to the great Lord Clarendon, who resided here until the erection of his new house at the top of St. James's street.

In 1663 appeared the first edition of the Marquis's "Century of Inventions;" and on April 3d, in the same year, a bill was brought into Parliament for granting to Worcester and his successors the whole of the profits that might arise from the use of an engine described in the last article in the "Century." Lord Orford describes this bill to have passed on the simple affirmation of the discovery that he (the Marquis) had made; but the journals of the Lords and Commons for 1663-4 show there were no less than seven meetings of committees on the subject, composed of some of the most learned men in the House, who, after considerable amendments, finally passed the bill on the 12th of May.

There is anecdotic evidence of the latter portion of the "Century," at least, being written by the author while confined in the Tower. It is said that he was preparing some food in his apartment when the cover of the vessel, having been closely fitted, was, by the expansion of the steam, suddenly forced off and driven up the chimney. This circumstance attracting the Marquis's attention, led him to a train of thought which terminated in the completion of the above invention, which he denominated a "Water Commanding Engine."

Lord Worcester's engine was shown in operation; and when Cosmo de Medici, Grand Duke of Saxony, visited England in 1656 (at which time the Marquis was a close prisoner in the Tower), his invention was exhibited at Lambeth, as thus recorded in the Grand Duke's dairy :—

His Highness went "beyond the palace of the Archbishop of Canterbury to see an hydraulic machine, invented by my Lord Somerset, Marquis of Worcester. It raises water more than forty geometrical feet by the power of one man only; and in a very short space of time will draw up four vessels of water through a tube or channel not more than a span in width."

Precisely four years after the bill was brought into Parliament for securing the above invention, viz., upon April 3, 1667, the Marquis died in retirement near London, and his remains were conveyed with funeral solemnity to the vault of the Beaufort family in Raglan Church.

Worcester has been illiberally described as a "fantastic projector," and his "Century" as "an amazing piece of folly." But Mr. Partington, in his edition of the work published in 1825, has, throughout an able series of notes, fully demonstrated not only the practicability of applying the major part of the hundred inventions there described, but the absolute application of many of them, though under other names, to some of the most useful purposes of life. It is surely injustice and ingratitude to apply the name of a "fantastic projector" to the man who first discovered a mode of applying steam as a mechanical agent—an invention alone sufficient to immortalize the age in which he lived.

Many of Worcester's contrivances have since been brought into general use; among them may especially be mentioned stenography, telegraphs, floating baths, speaking statues, carriages from which horses can be disengaged if unruly, combination locks, secret escutcheons for locks, candle molds, &c.

We have not the space to do more than quote the table of the inventions, which will convey some idea of their great variety :—

No.
1. Seals abundantly significant.
2. Private and particular to each owner.
3. A one-line cypher.
4. Reduced to a point.
5. Varied significantly to all the twenty-four letters.
6. A mute and perfect discourse by colors.
7. To hold the same by night.
8. To level cannon by night.
9. A ship-destroying engine.
10. How to be fastened from aloof and under water.
11. How to prevent both.
12. An unsinkable ship.
13. False destroying decks.
14. Multiplied strength in little room.
15. A boat driving against wind and tide.
16. A sea-sailing fort.
17. A pleasant floating garden.
18. An hour glass fountain.
19. A coach-saving engine.
20. A balance water work.
21. A bucket fountain.
22. An ebbing and flowing river.
23. An ebbing and flowing castle clock.
24. A strength increasing spring.
25. A double-drawing engine for weights.
26. A to-and-fro lever.
27. A most easy level draught.
28. A portable bridge.
29. A movable fortification.
30. A rising bulwark.
31. An approaching blind.
32. An universal character.
33. A needle alphabet.
34. A knotted string alphabet.
35. A fringe alphabet.
36. A bracelet alphabet.
37. A pinked glove alphabet.
38. A sieve alphabet.
39. A lantern alphabet.
40. An alphabet by the smell.
41. An alphabet by the taste.
42. An alphabet by the touch.
43. A variation of all and each of these.
44. A key pistol.
45. A most conceited tinder box.
46. An artificial bird.
47. An hour water ball.
48. A screwed ascent of stairs.
49. A tobacco tongs engine.
50. A pocket ladder.
51. A rule of gradation.

No.
52. A mystical jangling of bells.
53. An hollowing of a water screw.
54. A transparent water screw.
55. A double water screw.
56. An advantageous change of centers.
57. A constant water flowing and ebbing motion.
58. An often-discharging pistol.
59. An especial way for carabines.
60. A flask charger.
61. A way for musquets.
62. A way for a harquebus, a crock or ship musket.
63. For sakers and minyons.
64. For the biggest cannon.
65. For a whole side of ship muskets.
66. For guarding several avenues to a town.
67. For muskuetoons on horseback.
68. A fire water work.
69. A triangle key.
70. A rose key.
71. A square key with a turning screw.
72. An escutcheon for all locks.
73. A transmittable gallery.
74. A conceited door.
75. A discourse woven on tape or ribbon.
76. To write in the dark.
77. A flying man.
78. A continually-going watch.
79. A total locking of cabinet boxes.
80. Light pistol barrels.
81. A comb conveyance for letters.
82. A knife, spoon or fork conveyance.
83. A rasping mill.
84. An arithmetical instrument.
85. An untoothsome pear.
86. An imprisoning chair.
87. A candle mold.
88. A coining engine; a brazen head.
89. Primero gloves.
90. A dicing box.
91. An artificial ring horse.
92. A gravel engine.
93. A ship-raising engine.
94. A pocket engine to open any door.
95. A double cross bow.
96. A way for sea banks.
97. A perspective instrument.

The last three of the list—Nos. 98, 99 and 100—are described more in detail, as follows :—

98. An engine, so contrived that working the *primum mobile* forward or backward, upward or downward, circularly or cornerwise, to and fro, straight, upright or downright, yet the pretended operation continueth and advanceth; none of the motions abovementioned hindering, much less stopping the other; but unanimously, and with harmony agreeing, they all augment and contribute strength unto the intended work and operation; and therefore I call this a *semi-omnipotent engine*, and do intend that a model thereof be buried with me.

99. How to make one pound weight to raise one hundred as high as one pound falleth, and yet the hundred pounds descending doth what nothing less than one hundred pounds can effect.

100. Upon so potent a help as these two last-mentioned inventions, a water work is, by many years' experience and labor, so advantageously by me contrived that a child's force bringeth up an hundred feet high an incredible quantity of water, even two feet diameter. And I may boldly call it *the most stupendous work in the whole world*, not only with little charge to drain all sorts of mines and furnish cities with water, though never so high seated, as well as to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for their private occasions, but likewise supplying the rivers with sufficient to maintain and make navigable from town to town, and for the bettering of lands all the way it runs; with many more advantages, and yet greater effects of profit, admiration and consequence; so that deservedly I deem this invention to crown my labors, to reward my expenses, and make my thoughts acquiesce in way of further inventions. This making up the whole "Century," and preventing any further trouble to the reader for the present, meaning to leave to posterity a book wherein, under each of these heads, the means to put in execution and visible trial all and every of these inventions, with the shape and form of all things belonging to them, shall be printed by brass plates. Besides many omitted, and some of three sorts willingly not set down, as not fit to be divulged, lest ill use might be made thereof, but to show that such things are also within my knowledge, I will here in myne owne cypher sett downe one of each, not to be concealed when duty and affection obligeth me.

The last three inventions, says Mr. Partington, may justly be considered as the most important of the whole "Century;" and when united with the 68th article, they appear to suggest nearly all the data essential for the construction of a modern steam engine. The 68th article is as follows :—

An admirable and most forcible way to drive up water by fire, not by drawing or sucking it upwards, for that must be, as the philosopher calleth it, *infra sphæram activitatis*, which is but at such a distance. But this way hath no bounder, if the vessels be strong enough; for I have taken a piece of a whole cannon, whereof the end was burned, and filled it three-quarters full, stopping and screwing up the broken end, as also the touchhole; and making a constant fire under it, within twenty-four hours it burst and made a great crack: so that having found a way to make my vessels, so that they are strengthened by the force within them, and the one to fill after the other, have seen the water run like a constant fountain stream forty feet high; one vessel of water, rarefied by fire, driveth up forty of cold water; and a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and refill with cold water, and so successively, &c.

The Marquis has also furnished us with a "Definition" of the above engine, which is exceedingly rare, as the only copy known to be extant is preserved in the British Museum. It is printed on a single sheet, without date, and appears to have been written for the purpose of procuring subscriptions for a water company, then about to be established. The invention is described as—

A stupendous, or water-commanding engine, boundless for hight, or quantity, requiring no external, nor even additional help or force to be set or continued in motion, but what intrinsically is afforded from its own operations, nor yet the twentieth part thereof. And the engine consisteth of the following particulars:

"A perfect counterpoise for what quantity soever of water.

"A perfect countervail for what hight soever it is to be brought unto.

"A *primum mobile* commanding both hight and quantity, regulator-wise.

"A vicegerent, or countervail, supplying the place and performing the full force of man, wind, beast, or mill.

"A helm, or stern, with bit and reins, wherewith any child may guide, order, and control the whole operation.

"A particular magazine for water, according to the intended quantity or hight of water.

"An aqueduct capable of any intended quantity or hight of water.

"A place for the original fountain or river to run into, and naturally of its own accord incorporate itself with the rising water, and at the very bottom of the aqueduct, though never so big or high.

"By Divine Providence, and heavenly inspiration, this is my stupendous water-commanding engine, boundless for hight and quantity.

"Whosoever is master of weight, is master of force; whosoever is master of water, is master of both; and consequently to him all forcible actions and atchievements are easie."

Among the documents in the possession of the Duke of Beaufort is the following impressive memorial of the success of the engine and the pious gratitude of the inventor :—

The Lord Marquesse of Worcester's ejaculatory and extemporary thanksgiving Prayer, when first with his corporal eyes he did see finished a perfect trial of his Water-commanding Engine, delightful and useful to whomsoever hath in recommendation either knowledge, profit, or pleasure.

Oh! infinitely omnipotent God! whose mercies are fathomlesse, and whose knowledge is immence and inexhaustible; next to my creation and redemption I render thee most humble thanks from the very bottom of my heart and bowels, for thy vouchsafing me, (the meanest in understanding,) an insight in soe great a secret of nature, benificent to all mankind, as this my water-commanding engine. Suffer me not to be puffed upp, O Lord, by the knowing of it, and many more rare and unheard off, yea unparalleled inventions, tryals, and experiments. But humble my haughty heart, by the true knowledge of myne own ignorant, weake, and unworthy nature: proane to all evill, O most mercifull Father my creator, most compassionating Sonne my redeemer, and Holyest of Spiritts, the sanctifier, three divine persons, and one God, grant me a further concurring grace with fortitude to take hould of thy goodness, to the end that whatever I doe, unanimously and courageously to serve my kind and country, to disabuse, rectifie, and convert my undeserved, yet wilfully incredulous enemyes, to reimburse thankfully my creditors, to reimmunerate my benefactors, to reinhearten my distressed family, and with complacence to gratifie my suffering and confiding friends, may, voyde of vanity or selfe ends, be only directed to thy honor and glory everlastingly. Amen.

As the pensive tourist strays amidst the desolate courts and roofless halls of Raglan, or views from its battlements the golden glories of sunset, he may reflect upon the vicissitudes of the noble owners of this "famous castle fine ;' and should the visitor extend his walk to the burial place of the Beauforts in Raglan Church, he will there see the arched stone vault which enshrines the remains of Edward, Marquis of Worcester.

Of his greatest invention no record has been preserved beyond the articles to which reference has been made in the present *précis* of his labors ; but in our day Professor Millington has designed an engine on similar principles, and which, with a few alterations, might be made available for the purposes recommended by our author.

In the "Transactions of the Society of Arts," Vol. III., p. 6, is recommended to the attention of every mechanic the "Century," "which, on account of the seeming improbability of discovering many things mentioned therein, has been too much neglected ; but when it is considered that some of the contrivances, apparently not the least abstruse, have by close application been found to answer all that the Marquis says of them, and that the first hint of that most powerful machine, the Steam-engine, is given in that work, it is unnecessary to enlarge on the utility of it."

Manufacture of Rails and Armor Plates.

The following is the substance of a paper read before the Institution of Mechanical Engineers, by Mr. John Brown, of Sheffield, and published in the London *Mechanics' Magazine*:—

After alluding to the great importance of the quality of railway bars, and to their ordinarily brief duration under heavy traffic, the author referred to two modes which had been practiced to some extent, and the object of which was to increase the hardness of the wearing surfaces, and thus to prolong their duration. The first of these was the rolling of a steel bar along with the iron bars of the rail pile, so as to form the bead or wearing surface of the rail. The second was the process of partially converting or case hardening the wearing surfaces of an ordinary rail after it had been manufactured in the usual manner. Both of these processes fulfilled their purpose to a certain extent, but by neither was the resistance of the iron increased throughout the whole body of the rail, nor did either prevent lamination between the imperfectly welded bars forming the pile. Although it was admitted that the life of the rail was prolonged by these processes, the extent of this prolongation was uncertain. Mr. Bessemer's mode, however, of converting pig iron into either malleable iron or steel furnished a pure, homogeneous, hard and tough material, admirably adapted for the purposes of rail making. And although rails thus made were expensive in first cost, it was believed that in certain situations—as for crossings, and in the neighborhood of important stations—it would be economy to substitute them for iron. In making rails the ingot of steel was made of the right size, in each case, for a single rail. Thus, for a rail 18 feet long, and weighing 84 pounds to the yard, an ingot of steel was cast 9 inches square, and 26 inches long ; this ingot being heated and hammered to 6 inches square and 5 feet long, and afterward rolled out in the usual manner. It was as easy to make long as short rails, and the process, so far as facility of manufacture was concerned, had some advantage over the ordinary mode of piling. The Bessemer rails had no tendency to laminate, and their toughness and ductility were shown by a number of samples upon the table, these samples being short lengths of heavy rails, which had been bent and twisted in an extraordinary manner, and without the least appearance of fracture. The tensile strength of these rails was, at the same time, upward of forty tuns per square inch. Cast-steel rails, it was stated, were not an absolute novelty, the Ebbw Vale Iron Company having made a few several years ago, and which, having been laid on the bridge at the North end of the station at Derby, were still in good order. But as these rails were made from ingots cast by the old process, their cost was such as effectually to preclude their general adoption. They had, nevertheless, proved the great resisting power of steel for the purpose, and now Mr. Bessemer's process enabled the manufacturers to produce, at a moderate price, rails of equally good quality, and which bid fair to constitute real "permanent way."

With regard to the general question of armor plates, the author expressed himself with some hesitation, the results which were finally to determine their application not having yet been definitely ascertained. No limit had yet been assigned to the magnitude of future artillery, nor had any degree of impenetrability of plates been declared as unattainable. The race between the gun and the plate to resist it was still running.

The general question, however, of the applicability of armor plates belonged to the naval architect, while to the ironmaster belonged the question of how to produce the largest plate of iron of the maximum degree of toughness. Two methods of producing large masses of wrought iron are in use, one being "building up" under the hammer, and the other "building up" in the rolls. The general tendency of the hammering process was, it was believed, to produce brittleness—a quality most undesirable in a plate of iron to be subjected to the action of heavy shot at short range. The author criticised, also, the whole mode of making heavy plates from scrap iron and under the steam hammer, believing that, from the original irregularity of the material, it was extremely difficult to obtain a plate of uniform quality. The rolling process, it was contended, produced a tougher and more uniform plate. The difficulty of making armor plates was due to their immense size and weight, and the intolerable heat at which they were worked. The general size of the plates for the mail-clad frigates was from 15 feet to 18 feet long, and from 2 feet 6 inches to 3 feet 10 inches wide, the thickness being $4\frac{1}{2}$ inches. The weight of the finished plate varied, therefore, from 80 cwt. to 140 cwt., from 3 inches to 4 inches being cut off the sides, and from 10 inches to 12 inches from each end after rolling. In respect of waste, it was admitted that the hammer had the advantage over the rolls.

The process of making a five tun plate was described as follows :—Bars are first rolled 12 inches wide and 1 inch thick, and then sheared to a length of 30 inches. Five of these are piled and rolled down to a rough slab. Five more are similarly treated, and these two slabs are then welded and rolled down to a plate $1\frac{1}{4}$ inch thick, and which is sheared to 4 feet square. Four of these plates are then piled together and rolled down to one 8 feet long, 4 feet wide, and $2\frac{1}{2}$ inches thick, and lastly, four of these, piled together in a mass 8 feet long, 4 feet wide and 10 inches deep, are rolled into the entire plate. There are thus 160 thicknesses of plate, each of which was originally 1 inch thick, in the final plate of $4\frac{1}{2}$ inches. The thickness of each of the original bars is thus reduced to one thirty-fifth of what it was at first, and in all the operations from 3,500 to 4,000 square feet have to be welded together by rolling. It is not surprising that blisters and other defects sometimes exist, and the difficulties in this respect increase in seriousness and magnitude with the weight of the plate. The final job of welding four plates 8 feet by 4 feet by $2\frac{1}{2}$ inches thick, is one of great difficulty. To prevent burning the edges of the pile, and at the same time to complete the whole process while the iron is at a working heat, requires the greatest care, the loss of a few moments being fatal. The four largest plates for the final rolling, are heated in a special furnace, which drawn out by heavy chain tackle upon a truck, which is run upon rails up to the mouth of the rolls, an incline in the tramway to throw the edge of the pile upon the fore-plate. After passing through the rolls the plate is received upon an inclined frame, formed of long rollers ; this gives the heated pile a tendency to return, and, at the same moment, the motion of the rolls is reversed, and the plate passes through them in the opposite direction ; this to-and-fro movement being repeated until the final thickness of the plate is attained. The plate is then lifted by a crane and placed upon a large cast iron bed-plate. In this position an iron cylinder, weighing 9 tuns, is rolled to and fro over it, to remove the curvature by rolling. As soon as the plate has become sufficiently cooled it is taken to the planing machine, where it is trimmed to its intended size, this operation completing the whole process.

Reducing Silver from Old Baths.

[From La Lumiere.]

Of all the processes that I have tried for reducing silver the following is much the best, and the most expeditious. Having to do so, I reduced the silver from its chloride by zinc and diluted sulphuric acid, then reformed the salt of silver, and after having acidulated it by nitric acid. This last method is very expeditious, but the reduced silver is always mixed with acetate of silver, which produces, on dissolving it in nitric acid, a magma of a brick color, which is scarcely soluble in water, and produces very bad baths. The reduced silver from the chloride is more favorable, but there always remains some chloride unacted upon.

In reducing the chloride in the manner in which I have indicated, the nitrate of silver formed is very pure, and the reduction is made with the greatest facility, when one operates upon small quantities—the only case in which the process is applicable, and which makes me recommend it to amateur photographers.

After reducing and washing the chloride of silver, produced by pouring some hydrochloric acid into the ordinary silver baths, and separating this chloride by aid of a filter, it is placed together in the hollow of a piece of charcoal. I then blow upon this charcoal with an ordinary bellows in such a manner that the flames of the charcoal pass over the chloride. This melts first ; then, on continuing to blow, it is very quickly reduced into a piece of metallic silver which is almost entirely free from lead—the only metal which produces an insoluble chloride like that of silver. During the reduction the chloride disengages white fumes and the operation is ended when these cease to appear.

English Patent Law Reform.

At the late Social Science Congress held in Dublin, J. Webster, Esq., read the following resolutions adopted by a committee which had been appointed for the purpose of examining into this subject :—

1. That all applications for grants of letters patent should be subjected to a preliminary investigation before a special tribunal. 2. That such tribunal should have power to decide on the granting of patents, but it should be open to inventors to renew their applications notwithstanding previous refusals. 3. That the said tribunal should be formed by a permanent and salaried judge, assisted, when necessary, by the advice of scientific assessors, and that its sittings should be public. 4. That the same tribunal should have exclusive jurisdiction to try patent causes, subject to a right of appeal. 5. That the jurisdiction of such a tribunal should be extended to the trial of all questions of copyright and registrations of design. 6. That the scientific assessors for the trial of patent causes should be five in number, to be chosen from a panel to be nominated by the Commissioners of Patents, for adjudication upon facts, when deemed necessary by the judge, or demanded by either of the parties. 7. That the right of appeal should be to either of the Courts of Exchequer Chamber, with a final appeal to the House of Lords. 8. That, for the preliminary examination, the assessors, if the judge require their assistance, should be two in number, named by the Commissioners of Patents, from the existing panel, the decision to rest with the judge. 9. That the committee approve of the principle of compelling patentees to grant licenses on terms to be fixed by arbitration, or, in case the parties should not agree to such arbitration, then by the proposed tribunal, or by an arbitrator or arbitrators appointed by the said tribunal. 10. That a report be drawn up in conformity with the resolutions passed by this committee, and that the council, if such report be approved by them, be requested to allow it to be read at the meeting of the British Association, to be held at Manchester this year.

How to make Steel from Scrap Iron.

Take scrap or bar iron cut into small pieces, and place 40 pounds in a crucible with 8 ounces of charcoal in powder and 4 ounces of the black oxyd of manganese. The crucible is covered and then placed in a blast furnace and exposed for about one hour and a half to a high heat. The crucible is now withdrawn and its contents poured into ingot molds, forming cast steel.

BLACK ASPHALT VARNISH.—Take asphaltum 2 lbs., fuse in an iron pot, add of hot boiled oil, 1 pint ; mix well, remove the pot from the fire, and, when cooled a little, add oil of turpentine, 2 quarts. Used to black and polish grates and ironwork.

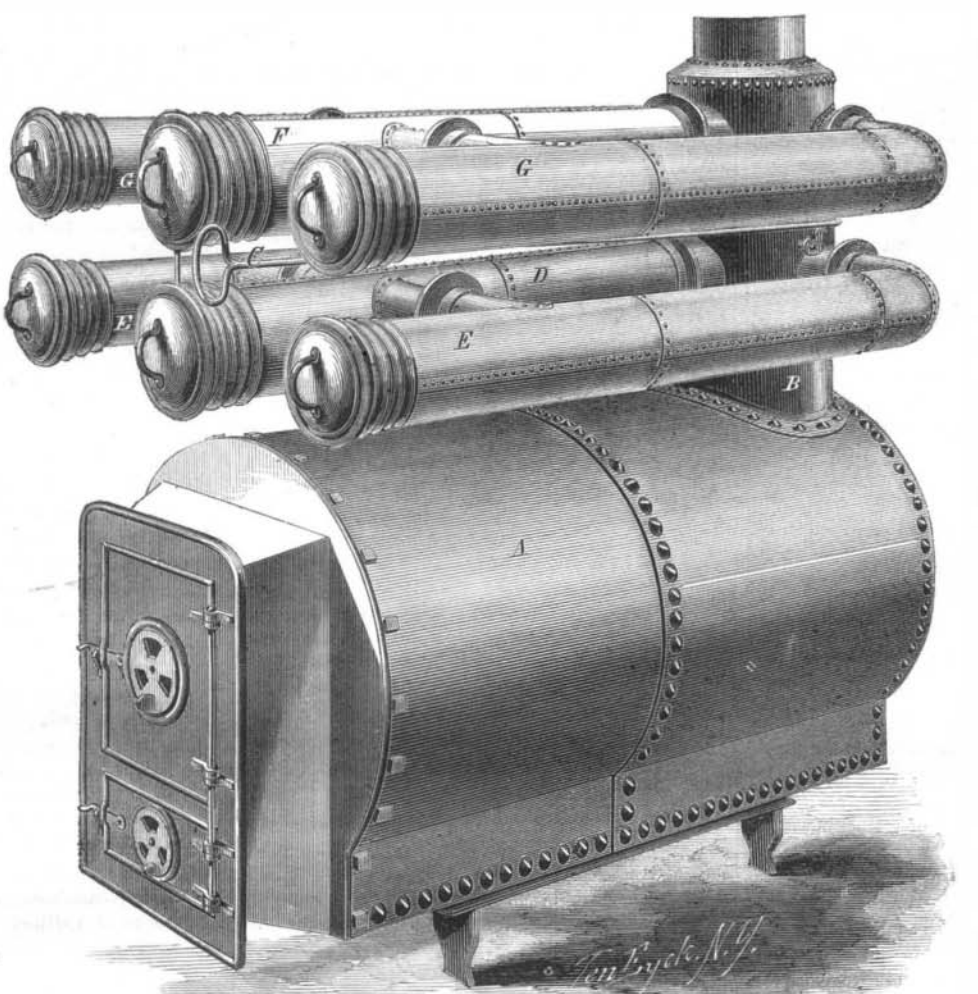
IN Clinton, Mass., there are five factories which have been doing almost nothing for several months past, but they are all expected to go on in full time this month.

THERE are three Western gunboats now being built at Mound City, which are to be named G. B. McClellan, N. P. Banks and Joe Holt. About 300 men are at present employed upon them.

Improved Hot-Air Furnace.

In furnaces for warming dwellings by hot air, if the draft is allowed to pass directly from the fire into the chimney, a very large portion of the heat is wasted, and it is therefore customary to conduct the smoke through a series of pipes or passages so that it may part with the principal portion of its caloric in heating large surfaces which will transmit the heat to the current of air that enters the dwelling. But this interruption of the draft obstructs the combustion of the fuel—an effect not objectionable after the fire is well under way, but causing inconvenience in kindling the fire. The furnace here illustrated, invented by Edwin H. Camp, is designed to overcome this difficulty in a very simple and effectual manner, by opening the drafts directly into the chimney during the process of kindling the fire, and then closing them by dampers so as to send the smoke and heat around through a series of radiating pipes.

The engraving is a perspective view of the furnace, which is to be enclosed as usual in a chamber of brickwork. The fire is made in the stove or shell, A, of which B is the chimney. Valves are arranged in the chimney, B, to be opened or closed by means of the rod, C, and while the fire is being started these valves are opened, so as to allow the smoke to pass directly up the chimney. When the fire gets sufficiently kindled the valves in the chimney are closed, so that they send the products of combustion first through the middle pipe, D, of the lower horizontal series, then back through the two outer pipes, E E, of this series into the chimney, where they are turned by a second valve through the middle pipe, F, of the upper series, and return in their final passage to the chimney through the two outer pipes, G G, of the upper series.



CAMP'S HOT-AIR FURNACE.

It will be seen that the air in the air chamber is exposed to a very large heating surface, and that the smoke and other products of combustion must part with nearly all of their caloric before they escape into the chimney.

The patent for this invention was procured through the Scientific American Patent Agency, Aug. 6, 1861, and further information in relation to it may be obtained by addressing the inventor, Edwin H. Camp, at Jackson, Michigan.

New York Medical College.

From the new catalogue of the faculty of the New York Medical College and Charity Hospital, just issued, we learn that Charles A. Seely, formerly connected with the Scientific American, succeeds Professor Doremus as Professor of Chemistry and Toxicology. We congratulate the College on the acquisition of this able and learned chemist, and have no doubt that the appointment will prove advantageous to the reputation of the institution.

We perceive that this school, eminently progressive, is adapting its preliminary or fall course of lectures to the times; Professor Carnochan lecturing on amputations, and Professor Raphael on gunshot wounds.

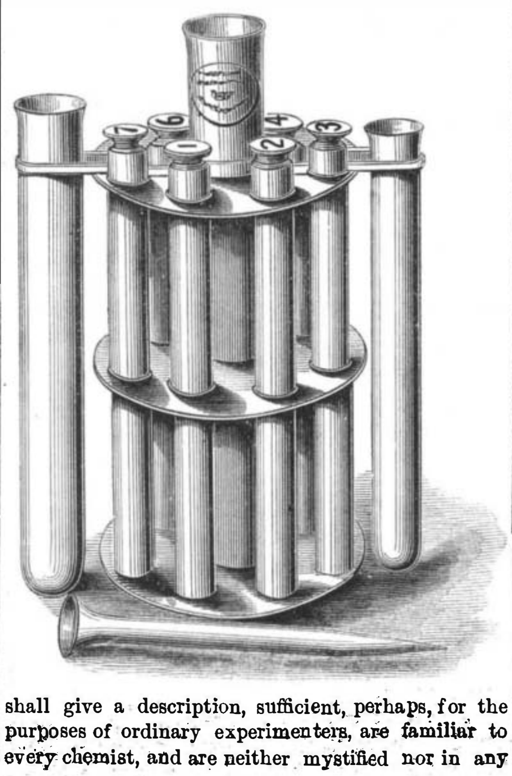
Iron Masts for Vessels.—The London *Times* says that the masts for one of the new iron-plated ships, the *Defence*, are now lying at the Thames Iron Works. Each is 115 feet long by 32 inches wide, and though only a ton heavier than a wooden spar of the same size, is more than ten times as strong.

DANCHELL'S TESTS FOR WATER.

[From the London Engineer.]

We have alluded, on a former occasion, to the pocket case of tests, for ascertaining the impurities of water, fitted up by Mr. F. Hahn Danchell, of No. 5, Red Lion-square, Holborn. A knowledge of the properties of "the water we drink" is so important, and its pursuit so simple and yet interesting, that many of our readers will, we apprehend, desire to enter upon this branch of qualitative analysis, the more so when the requisite materials can be obtained in a form so convenient and attractive, and at so low a price as in the apparatus under notice.

The tests, consisting of substances of which we



shall give a description, sufficient, perhaps, for the purposes of ordinary experimenters, are familiar to every chemist, and are neither mystified nor in any way claimed by Mr. Danchell. He has selected merely the most useful tests, and arranged them in the most convenient form, with test tubes, dropping glass, and full instructions for instant use. The tests, in seven phials, are as follow:—

No. 1. Test for ammonia.—This is a slightly colored solution of zinc, producing, in water containing ammonia, a cloudy appearance. Organic matter may be suspected in water containing ammonia.

No. 2. Test for organic matter.—This is a solution of permanganate of potash, or Condy's fluid, a violet rose or Magenta colored liquid, which, on a few drops being mixed with water containing organic matter, imparts to it a dull, cloudy appearance after an interval varying from a few minutes to a few hours, according to the foulness of the water.

No. 3. Negative test for lead.—This is a solution of acetate of lead. If poured into pure water the lead is taken up without change of color. If poured into water charged with lead the lead cannot be retained in solution, but is precipitated to the bottom, imparting a milky appearance to the water. Water which presents a clear appearance on the addition of No. 3 does not, and cannot contain lead in solution.

No. 4. Positive test for lead.—This is a solution of bichromate of potash, and precipitates lead, if that poison be present in the water experimented upon.

No. 5. Test for bi-carbonate of lime.—This is simply a solution of chalk (carbonate of lime) and acts on the principle of Dr. Clark's process for purifying water from lime.

No. 6. Test for sulphate of lime and sulphuric acid.—This is a solution of baryta in water.

No. 7. Test for iron.—This is a solution of prussiate of potash, and, if the least iron be present, its action is instantaneous and most remarkable. Although the water charged with iron may be almost colorless, and that containing three or four drops of the test solution equally so, they will instantly form, when mixed, an exceedingly dark solution of Prussian blue. If gallic acid were used instead of prussiate of potash the resulting mixture would be black ink.

The whole testing apparatus in enclosed is either a silver-plated, a morocco, or a japanned case, according to price, this case being hardly larger in diameter and no longer than a pocket spy glass.

India Rubber Cement.—A cement called *marine glue* from not being affected by water is made as follows:—Take one pound of india rubber, cut it into small pieces and disolve it in about four gallons of coal-tar naphtha, the mixture being well stirred for some time, till perfect solution has taken place. After ten or twelve days, when the liquid has acquired the consistence of cream, two parts, by weight, of shellac are added to one of the liquid. This mixture is put into an iron vessel having a discharge pipe at the bottom, and heat applied, the whole being kept well stirred. The liquid which flows out of the pipe is spread upon slabs and preserved in the form of plates. When required for use it is heated in an iron pot to about 248° Fah., and applied hot with a brush.

The workmen in the demolition of the old houses near the Tuilleries, Paris, have been assisted lately by railroads of strong wire, which convey down and up to them all the rubbish they must carry away from the destroyed and all the pieces they must insert in the building.