later, in 1870, he made a magneto, shown in Fig. 6. Here we have a horseshoe electro-magnet mounted back of, and facing, a plate armature. It is simply a powerful electro-magneto receiver, something like, but immeasurably superior to, the instruments shown in the Bell patent of six years later. Like all the other instruments shown, it will play its part in transmitting speech. Placed in circuit with a battery and a microphone such as is shown in Fig. 4, it will talk.

Our readers will feel with us that the above represents a most interesting collection of instruments. In many instances, even in suits, alleged anticipating telephones are shown by models. This always casts a shade on their testimony, for the suspicion always exists that some change in construction has been made. It may be so minute as to be indefinable in the light of the testimony concerning the originals, yet enough to change inoperative devices into practical working instruments. Such, at least, is the suspicion that is apt to be aroused by model telephones. But in the instruments here shown we have what are testified to as being instruments actually made fifteen or twenty years ago.

Prof. Van der Weyde originally used his telephones for the transmission of music. He did not at first use them for that of words. Any one who has experimented with early telephones, the Bell included, will find the articulation faint and uncertain at times. In some cases, such is the degree of this uncerta'nty that we can readily believe that the early workers with untrained ears failed to catch the feeble utterances of their instruments. Every one has noticed a great difference between individuals as speakers or listeners at ordinary telephones. If this is so with the perfected instruments of to-day, *a fortiori* must it be so with the older types. There is a sound sometimes produced by a telephone that is unmistakable—a peculiar buzzing, as if it was on the verge of talking. When that is reached, articulation is only a matter of adjustment. The early workers must often have reached this stage, and failing to recognize its importance, they did not pass it as successfully as we do.

The Reis and Van der Weyde instruments divide themselves into two classes, transmitters and receivers. It is worthy of remark that the practical working instruments of to-day follow the lines indicated by the German school teacher. A battery current is acted on by a transmitter, and the receiver delivers the message. In the Bell patents, magneto or electro-magneto telephones were prescribed for both ends of the line. Any such service is inferior. A microphone is essential at present for transmitter; the Bell instrument is of use only as receiver.

Another interesting feature of the instruments we have described is the fact that they are all American productions. There is always a certain dissatisfaction in looking to Europe for an anticipation. Legally speaking, foreign use does not anticipate; so in the case of Reis' inventions publication has to be shown, and this has to be coupled with the operativeness of the telephones. The inventors whose productions we have just spoken of were residents of America, and did their work here. Most or all of it was done within a few miles of this city. Van der Weyde concentrated his thoughts on the transmission of music; Holcomb felt that his was not sufficiently perfected to be worth patenting, and so their work went for nothing.

It is the old story, so often retold in the history of invention, that the race is to the swift. Bell, by working out a successful telephone company, has succeeded in establishing for himself and associates the most valuable patent of the world. Any of the instruments shown are far in advance of the telephones of his 1876 patent, but unpushed by business energy they passed out of sight, only to be resuscitated as useful aids in combating the claims of the Bell Company.

More Scared than Hurt.

According to *Bradstreet's* careful recapitulation, there are about 43,000 workingmen who are on strike in this country at the present time. The whole number of persons employed in manufactures, mining, trade, and transportation is about 5,640,000. So it appears that not one man in a hundred of those engaged in the industries named has stopped work in consequence of disagreement with employers. But the one striker is making more noise in the land than the ninety-nine workingmen who keep about their business. Trade is hurt more by the apprehension of mischief than by the actual extent of it.—*Phila. Record.*

Origin of Sulphur in Coal.

M. Dieulefait has been inquiring why there is so much sulphur in stone coal, and why there is so little of free alkaline carbonates in the ashes. For this purpose he has analyzed the surviving species of the families of the coal plants, particularly the Equisetaceæ, and has found in them a proportion larger than usual of sulphuric acid. Hence he deduces, as the answer to his questions, that the coal plants were more highly charged with sulphur than most existing plants, and that for that reason their alkaline constituents assumed the forms of sulphates instead of carbonates.

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 548.

For the Week Ending May 29, 1886.

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OFFICIAL REPORT ON THE PANAMA CANAL.

M. Rousseau, the delegate appointed by the French Government to inspect the work on the Panama Canal, has made a report which is likely to be more seriously disappointing to M. De Lesseps than was the exceedingly cautious and tentative one of the Hon. John Bigelow, who assisted at the inspection in behalf of the New York Chamber of Commerce, the points of which were summarized in our issue of May 8. M. Rousseau denies the correctness of the canal company's statements respecting its facilities for construction, the time when the canal will be completed, and the amount of money still required to accomplish the work. This appears to be the first public criticism in France of the canal project, the forwardness of the enterprise, and its financial condition, as these matters have been explained by its directors and promoters; and, as a result, it is announced that the Government cannot authorize a proposed issue of lottery bonds, to provide further means to prosecute the work, until the position of the company is made clear. Nearly all the capital thus far subscribed for building the canal has come from people of small means, four-fifths of it being represented by individual sums ranging from $100 to $500. It is thus also that the French national debt is mainly held. To make these small loans popular, the canal company wished to float them with a lottery scheme, but a governmental authorization of such scheme would be a most serious affair in the event of any failure to complete the canal or the interminable postponement thereof, with constantly added cost. De Lesseps may, it is true, succeed in obtaining the necessary funds to keep up work on the canal, notwithstanding this adverse report; but as the calculations of its ultimate cost increase, the difficulty and expense of placing any loans will be augmented, and it seems inevitable that, looking at the project as kindly as possible, the work must drag on for a far longer period than any that has yet been fixed for its completion, even if that is ever accomplished.

GALVESTON HARBOR.

In 1874 the improvement of Galveston harbor was commenced on plans designed by Maj. Howell, U. S. A., approved by a board composed of Generals Tower, Wright, and Newton, U. S. A. The plan contemplated two parallel jetties 12,000 feet or about 2¼ miles apart. They were to be submerged, no part of them being higher than mean low tide, and only a portion of them as high as that. From the shore out for several thousand feet, they were several feet below low tide, thus forming huge gaps to facilitate the flow of the tide to fill the bay of Galveston, a tidal basin about 450 miles in extent. The average rise of the tide is about 14 inches. These jetties were to be built of *gabions.* Each gabion was made of willows in the form of a basket, about 12 feet long, 6 feet wide, and 6 feet deep. This willow structure was plastered over with hydraulic mortar about three inches thick. They were placed end to end in the line of the jetty, and sand was then pumped in them and covers secured on them to keep the waves from washing it out. The jetties were to extend out only to 12 and 13½ feet depth, respectively.

Nearly two miles of the north jetty were built in this way prior to 1880. This entire work was completely obliterated in 1880, and then Col. Mansfield was put in charge. He recommended the building of the jetties with brush mattresses, ballasted with stone in a manner quite similar to the Mississippi jetties, and on substantially the same locations chosen by Maj. Howell. The advisory board was reconvened to pass upon the new plans, and it advised putting down a trial section of mattress work near the outer end of the old north gabionade, and also the changing of the direction of the south jetty, so that its outer end would be distant only about 10,400 feet from the north one, thus destroying the parallelism of the two jetties.

The vigorous prosecution of the south jetty was then begun (1880), and in March, 1884, Col. Mansfield reported it officially as being completed. It was then 4¼ miles long from the shore to 13½ feet water.

About this time the people of Galveston became disheartened, declared that no real benefit had resulted from the works in ten years; and after consultations and meetings, the mayor, city council, and a large number of the chief citizens of the place addressed a letter to Capt. Eads, then in England, to know if he would undertake the improvement on the "no cure, no pay" principle, which he had undertaken to do with the Mississippi jetties. The result was that an offer to do this and secure 30 feet depth of channel was made by him, and was formulated into a bill, which was introduced in the last Congress. It provided for the construction of the necessary works and made the compensation depend upon the securing of a 30 foot channel for $7,750,000.

This bill was vigorously opposed by Gen. Newton and Col. Mansfield, and by others of the Engineer Corps of the army. These two officers, in their official reports to the Senate and House Committees, assured Congress that with $750,000, or less than one-tenth of what Capt. Eads proposed, they could complete the official plan of 1880, and secure a 25 foot channel. A letter substantially confirming this was also written by Col. Merrill, U. S. A., and was read in the House by Mr. Bayne, of Pennsylvania, when the measure came up for discussion. The result was that it was defeated, but no appropriation to complete the works was carried in the river and harbor bill at that session, for the reason that Capt. Eads had previously reviewed before the committees the features of the government plans, and had convinced those committees that even if the works were completed, they had four radical defects in them, either one of which would defeat the object in view: 1st. The enormous width between the jetties. 2d. They were too low, and should be carried up several feet above high tide, to prevent storm waves from injuring the channel by carrying sand over the jetties into it when the channel was once secured. 3d. The openings left between the shore and the jetties, to facilitate the inflow of the tide into the bay, were wholly wrong in principle, and would prevent the deepening of the channel. 4th. The sea ends of the jetties terminated in water too shallow to secure any permanent depth greater than that at the jetty ends.

Besides these inherent defects, the jetties would not resist destruction by teredo in the clear water at Galveston. To protect the brush from them, the water must contain sediment or mud, as at the Mississippi jetties. He declared that the jetty reported by Colonel Mansfield as completed and substantial was almost wholly destroyed already, and that it required a ten foot pole to reach its remains in many places.

A new board of army engineers was convened during the recess of Congress, 1885, to report upon the Galveston works. The board consisted of Generals Duane, Abbot, and Comstock, and their report has just been published. [Executive Doc. 85, H. R.]

This board does not give Captain Eads the least credit for the unanswerable logic with which he pointed out the errors in hydraulic engineering which their brother officers have made at Galveston, but their report is as complete a vindication of him as his friends could possibly desire. First: The board admits that 61 per cent in the height of the *substantial* and completed jetty of Colonel Mansfield is wholly destroyed already, and that the works must be built of stone and concrete. Second: That the jetties should be 5 feet above mean low tide. Third: That they should extend from the land out to 30 feet of water (about 10¼ miles, or 54,000 feet), and should have no openings in them to let the tide flow into the bay. Fourth: They reduce the original width of the opening—12,000 feet—about one mile, or to 7,000 feet. Fifth: Instead of the guaranteed channel of 30 feet proposed by Captain Eads for $7,750,000, with no money to be paid until after the stipulated depths were secured, their works are estimated to cost $7,000,000, without any guarantee of success. On the contrary, the board says: "This estimate supposes that the money is freely supplied."

Already one million and a half has been almost wholly wasted at Galveston. Two plans have been tried by our army engineers, and now they propose a third. At Charleston we are building submerged jetties on plans of General Gillmore, U. S. A., with precisely such defects as Captain Eads pointed out in those at Galveston. The late board of his brother officers at Galveston says: "The greatest scouring effect will be obtained, and the greatest security against undermining, by making the jetties tight *and by raising them above high water.*" Had we not better move slowly in these improvements, or expend the money only after *civil* engineers have approved their plans? The House, by a very decided vote, has recently taken away from the Mississippi River Commission the control of the appropriation for the improvement of the Mississippi, and has lodged it with the Secretary of War. General Gillmore is President of the Mississippi River Commission, and General Newton is the chief of the army engineers and the official adviser of the Secretary of War, and the commission is essentially a military one, which the House refuses to trust!

DEEP WATER CANAL TRANSPORTATION.

At the convention held at Utica last August, the friends of the Erie Canal favored the deepening of its waters to nine feet, and the lengthening of its locks sufficiently to permit quicker service and larger business. The cost of these improvements was calculated to be something over a million dollars. The question of asking aid from the National Government, though negatived by the convention, was afterward brought up at Albany. It was finally decided, however, that the State should retain exclusive control of the canal.

In view of this action, Mr. T. C. Ruggles, C.E., presents a number of statistics in support of the cheaper carriage which will result from the deeper water. His arguments have been reprinted by the Union for the Improvement of the Canals of the State of New York.

The Erie Canal was originally four feet deep. Prior to 1866 it was increased to seven feet. It is now proposed to make an increase of from two to three feet, by raising the banks for half that distance and lowering the bottom in the same proportion. Over culverts and aqueducts, the depth will remain as at present. The advantages of a greater depth of water would be in the lessening of the cost of transportation, resulting from a higher rate of speed and the less motive power required. The great difference in cost is due to the less resistance of a deeper body of water and the increased tonnage it makes possible. In 1880, the total tonnage on the canal is placed at 4,774,648 tons and the cost of transportation at $1.001 per ton. This was with a depth of seven feet. It is estimated that with a depth of nine feet the cost would be reduced to 72 cents per ton, effecting an annual saving of $1,333,246, or almost the cost of the improvements. Could the depth be increased to ten feet, the saving would be even greater.

Speaking of the value of deeper water, Mr. Sweet, the present State Engineer, said: "The same boats and same crews, without extra cost, could have carried 650,000 additional tons to tide water." As the result of an actual trip between Buffalo and Rochester, where the canal averages eight feet, Mr. Horatio Seymour, Jr., states that one-third better time was made with one-half the cost than over a like distance where the depth was but seven feet. If such marked differences in cost and speed result from the addition of only one foot of water, there is a strong inducement to make the increase in depth as large as possible, when the improvement is once undertaken. On the Erie Canal, a steamer and consort weigh 130 tons and carry 580 tons, giving 4·4 tons of freight to one of dead weight. On the journey from Buffalo to New York, they require six men to handle them, which equals 97 tons to the man. On the ocean, the average is about 60 tons to the man, but the freight, of course, is a better paying class. It is believed that the deepening of the canal, by permitting a better speed, will attract a more profitable class of freight. The yearly capacity of the canal, with the depth of nine or ten feet, could be made nearly equal to that of the railroads in 1884—22,123,895 tons. Those who have studied the question of canal transportation state that there should be at least two feet of water under horse boats, and that the propellers require even more. On almost any canal at the present time, the track of a propeller can be seen in a long trail of muddy water which has been churned up from the bottom at the cost of large waste of power. On the present seven foot canal, one ton of fuel effects a carriage of 49 miles, while on the Hudson this is increased to 81 miles. A depth of nine or ten feet would produce a marked lessening of this discrepancy, as there would be three feet of water under the bottom of the boat, instead of, as at present, only from four to nine inches. This would greatly reduce the friction, and, therefore, both the fuel and time required by the journey.

THE OREGON DISASTER.

Just how the mishap to the Oregon came about is not yet known with anything like certainty, though the subject has been looked into by the Wreck Commissioners' Court, London, and attracted no little attention among sailors, landsmen, and marines the world over.

When the various stories of the passengers and crew were compared one with the other, and again with the informal statement of the master of the ship and his first officer, there seemed little to sustain the theory advanced by the latter that the injury to the ship came from contact with the bows of a schooner, and inferentially that it was one of those casualties of the sea which no proper precaution, at least on the part of the officers of the steamer, could have served to prevent. There is evidence to prove that the weather was hazy at the time of the accident, and under such circumstances it is not at all surprising that the officer in command of the deck, unable to see with anything like distinctness, should formulate a theory of the collision leaving the responsibility for the mishap with the stranger. It was pointed out in these columns that, under the prevailing conditions of tide and wind, a coaster would scarcely have occupied the position attributed to the stranger. Bound down the Long Island coast, a sailing vessel with a west by north wind behind her would make a course parallel with that pursued by the Oregon, but in a contrary direction; and if bound into New York, with head wind and tide, or lying at anchor, she would have been tailing the direction from which the Oregon was advancing. This being the case, it was suggested in these columns that nothing ran into the Oregon, but, on the contrary, that *the Oregon ran into the stern* of another vessel, which vessel was either quietly lying at anchor waiting for a slant into New York, or beating to windward, bound for that port.

This view of the disaster seems to be shared by a British contemporary, the *Scottish News*, which is said to echo the opinion held upon the Clyde after a consideration of the evidence as presented to the recent court of inquiry.

The editor says: "The first officer tells us that if the jibboom had been there it would have struck him. Where was it, then? Obviously, at the other end of the schooner; and the fact that Seaman Rogers, looking out on the promenade deck, saw a red light as the schooner passed after the collision, not only destroys the popular theory, but supplies a key to her position. Assuming that the Oregon was struck by the schooner at right angles, she would pivot on her stem, and the Oregon, going at a speed of eighteen knots, would pass her on the starboard side; but Rogers says that he saw a red light as she passed, and therefore she pivoted on her stern. This is an incontrovertible position in itself, but the injury to the Oregon proves it to a demonstration.

"The breaches in her side could not have been made by the stem and anchor, but they are exactly what would result from a counter and rudder. The divers report the first hole 25 feet before the bridge, 18¾ feet at the top and 12 feet halfway down. This hole was apparently above the water line originally, and was made by the first contact, as the counter of the schooner crushed into the Oregon by the impetus of the steamer. The rudder of a sailing vessel would naturally—before this impetus was spent—attack the side of the steamer below the water mark and further aft. Thus we have what the divers describe as a breach 12 feet below the main deck, extending down about 6 feet and 3½ feet wide.

"The Oregon, still steaming ahead, would draw the stern of the schooner with her, and ultimately leave her exactly in a position to show Rogers the red light. This was seen also by Lucey, a seaman who was carrying the mails, and by Wittle, the boatswain. This is the only light that was directly and unequivocally testified to—except the flash light just before the collision; and the chief officer stated that if the Oregon had been overtaking the schooner, the white light only would have been seen. Mr. Rothery's answer to the Board of Trade's thirteenth question, therefore, needs revision. It is fair to admit, in this connection, that the officers say nothing about the anchor or the second blow; these are merely popular rumors; for what would the anchor be doing below the water line?"

The editorial, which throughout deals with the sworn evidence as a judge would, thus emphatically concludes: "We regret that we cannot congratulate the public upon the perspicacity of a court on which it relies for ascertaining the causes of misfortunes at sea. If the efficiency of the mercantile marine depended upon the Wreck Commissioners' Court, the ocean traveling public would be indeed unfortunate."

Removing Fixed Stoppers.

The *Chemist and Druggist* has gathered from various sources a list of well known methods for getting fixed stoppers from bottles, which are well worth preserving in this collated form by every housekeeper.

When a stopper is found to be immovable, it may often be loosened by gripping the neck of the bottle firmly in the left hand, applying the thumb at the same time with a firm upward pressure against one side of the head of the stopper, and smartly tapping the opposite side with the handle of a spatula or other suitable piece of wood. The force should be applied in the direction of the longer axis. The operation may often be expedited by placing a drop of oil or other liquid—according to the nature of the contents of the bottle—on the line at the junction of the stopper and the neck of the bottle; when the stopper is tapped a minute space is momentarily formed, into which the liquid slips, and so gradually gets between the stopper and the neck of the bottle, and allows of the former being easily withdrawn.

Another method is to use a stopper extractor. This can easily be made out of a block of wood three inches square and two inches thick, by cutting a hole through its center large enough to receive the head of a stopper of a forty ounce wide-mouthed shop round. The use of the above is preferable to pulling out two drawers, sticking the head of the stopper between them, and twisting the bottle round, as this latter method has a tendency to mark the shop fittings, which does not improve their appearance. To apply the extractor, it is placed over the stopper and grasped firmly in one hand while the neck of the bottle is held by the other. A gentle, but firm and steady, twisting motion is then used, care being taken to keep both hands moving in the same plane, but in opposite directions. If the pressure be applied too vigorously or spasmodically, or if the lines of the direction of the opposite forces be not quite parallel, there is a danger of wrenching off the head of the stopper or breaking the neck of the bottle. If either or both of these methods fail, the application of heat may be tried. This may either be induced by friction, by means of a string passed once round the neck of the bottle and drawn rapidly backward and forward, the bottle being held fast meanwhile, or it may be applied by dipping the corner of a towel in hot water, squeezing, and wrapping it round the neck of the bottle, and repeating this at short intervals. When the glass has sufficiently expanded, the stopper should be immediately removed, and not be inserted till the bottle has cooled. By one or other of these methods, or a combination of them, together with patience and perseverance, the most intractable stopper may be drawn.