of the changes will be greatly increased by hammering the rod in each position. In a rod which I used, the effect was increased by hammering from 12 to 80, or between six and seven-fold. If the iron had been perfectly soft it results from the experiments of Weber and Thalen that the effect would have been about 36.

A sphere of soft iron will be magnetized in the same way however held. The diameter in the line of dip will be the axis of magnetism, and the lower and north half of the surface will be red, the upper and south half blue.

In bodies of any other shape the effect will be similar, though less regular, if the shape be irregular.

In an iron ship, on the stocks, intense magnetism is developed by the process of hammering; red magnetism being developed in the part of the ship which is below and toward the north, and blue magnetism in the part which is above and toward the south.

As the usual position of the compass is near the stern, it follows that in the case of ships built head north, the compass is in a position where there is an intense blue magnetism drawing the north end of the compass strongly to the stern and downward, and generally producing a very large deviation, besides a large heeling error. In such ships it is of importance to have a standard compass well forward.

In ships built head south, there will generally be less deviation and little heeling error in the usual position of the compass.

In ships built east and west, the amount of deviation is generally small, but is less regular than in ships built head south.

Theoretical Representation of the Deviation.—If we place a magnet before the compass with its blue end turned to the compass, it will draw the north end of the needle to the ship's head, and as the ship turns round, there will be, in the first or eastern semicircle, a deviation of the north point of the compass to the right hand or east, in the second or western semicircle, a deviation to the left hand or west. This would produce one part of what is called the "semicircular" deviation.

The effect of the two magnets and the one iron rod, which we have considered, make up the whole of what is called the "semicircular" deviation.

If we place a soft iron rod vertically in front of the compass, with its upper end at the level of the compass, this end, which will be blue, will attract the north end of the needle, and produce a deviation of exactly the same kind as the magnet which we have considered. It will, therefore, simply increase the semicircular deviation caused by the first magnet. If the red end of the imaginary magnet, or the lower end of the imaginary rod, be nearest the compass, or if the magnet or rod be abaft the compass, an effect of the same kind, but in an opposite direction, will be produced.

A magnet to starboard or port of the compass will produce a similar effect, except that a deviation of one kind will be produced when the ship's head is on the north semicircle, and of the other kind when on the south semicircle. This is the other part of the "semicircular" deviation.

If we lay a horizontal soft iron rod in front of and directed to the compass, it will easily be seen that when the ship's head is N. S. E. or W. it produces no deviation. When N. E. and S. W. it produces a deviation to the right hand or E. and when S. E. or N. W. a deviation to the left hand or W.; it therefore produces what is called the "quadrantal" deviation.

A horizontal soft iron rod directed to the compass, but placed to the starboard or port, will produce an effect of exactly the opposite kind, and would correct that produced by the first rod; but if the second rod, instead of being on one side, passes, as it were, through the compass, it will produce exactly the same effect as the first rod. The two rods will then conspire to produce the quadrantal deviation.

A quadrantal deviation of the same kind will be produced if the first rod instead of being on one side of the compass passes through it, provided always that its force is less than that of the transverse rod.

The magnets and soft iron rods we have imagined must not be considered as mere possible cases, but as representing truly the actual case in all ships. They are, in fact, the physical interpretation of Poisson's general formulæ for the action of induced magnetism, which interpreted amount to this—that the effect of the iron of any body, however irregular, on a magnetic particle, is exactly the same as that of nine soft iron rods and three magnets. When the iron is symmetrically distributed, as in a ship, the rods are reduced five in number, viz., the four we have considered, and the fifth lying fore and aft, with one below the compass, which would make the heeling error greater or less with the ship's head north than it is with the ship's head south, but this is not an effect of much importance.

Effect in Particular Ships.—In wooden ships the semicircular deviation is represented by the effect of a single vertical rod of soft iron in front of the compass, and the quadrantal deviation is very small.

In iron ships the semicircular deviation is generally represented by the effect of a magnet at the part of the ship which was south in building, with its blue end turned to the compass.

Armor-plated ships are generally plated after launching; the semicircular magnetism is greatly affected by the position in which they are plated. If they are plated in the direction opposite to that in which they are built, the deviation is generally diminished; when they are built, the semicircular deviation is generally increased.

Change of Deviation from Time.—What we have called the permanent magnetism is in truth only sub-permanent, and changes much, particularly if the ship is exposed to blows or strains, so that the semicircular deviation generally alters very much in the first year after building. The alteration is generally a diminution, although it might be an increase if the compass had by accident or choice been placed in a position where the semicircular deviation from induced magnetism exactly counteracted that from the permanent magnetism.

In consequence of this change the Government has, on the recommendation of the Superintendent of the Compass Department, laid down a rule that no iron ship shall be taken up as a transport till it has made one long voyage.

There is a very remarkable change in the capacity of the soft iron for receiving magnetism by induction, which seems to indicate some molecular change in the iron, viz., that it becomes less susceptible of induction by the lapse of time. The effect of this on the strength of the iron is one of the most important points to which attention is now directed.

Change of Deviation from Change of Place.—When a ship sailing south reaches the magnetic equator, the earth's magnetism acts horizontally. The vertical soft iron rod which I have imagined will then have no magnetism, and the semicircular deviation arising therefrom will disappear. When she goes into south magnetic latitudes, the upper end will now become red, and will repel the north end of the needle, and change the direction of the semicircular magnetism caused by the rod.

There will be no corresponding change in the semicircular magnetism caused by the permanent magnetism, except that near the magnetic equator the directive force of the earth's magnetism being greater than in England, the amount of deviation which the same disturbing force produces will be proportionately diminished.

Careful observations on the changes which take place in the deviation of iron ships in different latitudes are much wanted. They are being made in some of Her Majesty's ships now in the South, but there are no means of procuring such observations from merchant ships.

No change is produced in the quadrantal deviation by a change of the ship's geographical position.

Effects of Special Arrangements of Iron.—The upper or lower ends of all vertical masses of iron produce powerful effects on the needle.

The stern post, iron stanchions, funnels, gun turrets, generally produce large deviations, but if the place of the compass is judiciously selected, they or some of them may be used as correctors.

Horizontal masses of iron, such as deck-beams, produce a great effect, generally increasing the quadrantal deviation and diminishing the directive force. Both causes of error may be reduced by having as little iron as possible immediately below the compass, or within a cone traced out by a line passing through the compass, and making an angle of 54° 45 with the vertical.

DESIDERATA.

I. *Royal Navy.*—The only desiderata seem to be that greater attention should be paid to the preparing a place for the standard compass, and to the position of the ship in building and plating. The position of the standard compass should be shown in the drawings of every ship, which, before being finally settled, should be submitted for the observations and suggestions of the Superintendent of the Compass Department.

Ships should be built as much as possible head south, and should be plated in the opposite direction to that of the building.

Careful recommendation as to the special points to be attended to have been submitted to the Admiralty by the present Superintendent of the Compass Department, and we may hope that much benefit will be derived from them.

A proof of what may be effected in this way, has already been given in the case of several of the ships of the Imperial Russian Navy, in which the arrangements made under the superintendence of Captain Belavenetz have greatly reduced the amount of deviation.

II. *Mercantile Marine.*—This is a more difficult question, from the want of any general superintendence, or any mode of establishing a uniform system, or any opportunity of receiving, recording, reducing, and discussing the observations made.

Till some change takes place in this respect, it is not probable that much improvement will be introduced, or that merchant ships will make their due contributions to the advancement of science.

What seems desirable is—

1 That in all iron steam passenger ships there should be a standard compass distinct from the steering compass, placed in a position selected from the small and uniform amount of the deviation at and around it.

2. That the deviations by the standard compass should be ascertained and returned to a department of the Government.

3. That these deviations should be carefully recorded, reduced, and discussed by a competent superintendent.

Many indirect advantages might be expected to flow from following, in these respects, the example of the Royal Navy.

THE ATLANTIC TELEGRAPH---MEETING OF THE NEW COMPANY.

The Anglo-American Telegraph Company has been established for the purpose of executing, in the course of the present year, the enterprise of laying a submarine cable between Ireland and Newfoundland, so as to connect telegraphically the Old World and the New, and to raise the cable partially laid last year in order to complete a second line to America. An important meeting was held on the 14th of March, in the Common Hall, Hackin's hey, Liverpool, for the purpose of having the prospects of the undertaking fully explained. It was very numerously attended by some of the leading ship owners and merchants of the town, and by the representatives of the various telegraph companies.

STATEMENT OF THE ELECTRICIAN.

Mr. Varley, electrician to the company, made a long statement, from which we extract the most interesting portions. He said that Prof. Wm. Thomson, professor of natural philosophy at the University of Glasgow, who was second to none in mathematical engineering, had gone very carefully into the question relating to the effect of the water upon the operation of laying and recovering cables. And from the fact that the strain on the cable was only fourteen hundred weight during the operation of paying out, he was enabled to calculate precisely what was the action of the water during the operation of submersion; and he had found that the cable from the ship, owing to its light specific gravity, and the resistance which it experienced in passing through the water, sank so slowly that the cable from the stern of the vessel to where it touched the ground followed an incline extending over a distance of no less than seventeen miles from the stern of the vessel; in other words the cable was nearly three hours in going to the bottom of the water. From that he had calculated what would be the amount of friction in lifting the cable through the water from the bottom. The cable was paid out at the rate of six knots an hour and the operation of receiving would not be performed at a greater rate than one knot an hour, and at this latter speed the friction upon the cable from the bottom—a distance of two miles—the weight of the cable would be about 28 cwt., making a total of about 30 cwt.; and, as the breaking strain of the cable was 7 tuns 15 cwt., it would at once be seen that there was a large margin of strength. The new cable was found to lift a tun more weight than the old one. This would lift over 8 tuns without any fear, and, in addition, this cable instead of being 34 cwt. to the knot was only 31 cwt. Captain Anderson and Mr. Canning made a suggestion last autumn, which had been acted upon, which was of the utmost moment coupled with the fact which Prof. Thomson has brought to light, that the cable was 17 miles behind the ship before it reached the bottom. Their suggestion was this, that should anything happen to the cable the ship would be stopped, and the picking up would instantly commence; and should the fault be overboard, the paying out machinery could be reversed so that the cable could be picked up from the stern of the vessel without transferring the cable from the stern to the bow. That difficulty would be got over in the new machinery, and that great source of risk and delay entirely obviated.

PROSPECT OF RAISING THE OLD CABLE.

Mr. Gill said they had a great deal of this property at the present moment at the bottom of the Atlantic, and he would like to hear from Mr. Canning whether, if it was in a proper conducting electrical state, it could be used hereafter for a cable.

Mr. Canning would refer Mr. Gill to Mr. Varley. He could only say that from the tests they had read, the cable was in the same condition it was in when it was made.

Mr. Varley said since the cable was submerged it had been continually tested from Valentia, and it showed no change whatever. It insulated about four times as well as when it left the Medway in the *Great Eastern*.

Mr. Pickering asked if Mr. Canning would tell them if there was any chance of getting hold of the cable again?

Mr. Canning replied that he believed they would certainly get the cable again. When they unfortunately lost the end on the 22d August last, they all naturally thought it had gone from them for ever. They were not, however, to be beaten by such a thought as that; and although they had not appliances at the time sufficient for grappling and bringing to the bight of the cable from a depth of 2,000 fathoms, they had sufficient buoy rope to buoy it up, and it obliged to leave the buoys from stress of weather they could find these again. After a consultation upon grappling for it, they had no difficulty in finding the cable, and in hooking. In their very first attempt they met with the greatest success; and although they had at first great doubts about ever knowing when they hooked the cable, from the weight of the *Great Eastern*, the great depth of water, and their cable only bearing the weight of seven tuns, they thought they should not have the knowledge indicated on board when the cable was hooked. To their great surprise, when they came to the cable, the *Great Eastern* began to swing round to it, and there was no doubt they had hooked something at the bottom. (Hear, hear). They commenced lifting seven hundred fathoms from the bottom, when the swivel parted with it. Now, it was an indicated fact that they lifted the cable seven hundred fathoms from the bottom of the Atlantic; and he said if they could lift it through a space of seven hundred fathoms there was no doubt whatever that with stronger ropes and power of machinery for lifting they could get the cable of 1865 again, and put it in good working order during the ensuing summer. (Hear, hear). It was only a question of strength of materials for lifting the cable. (Hear, hear). They would have three good ships for cutting grapnels and holding grapnels, so that they could buoy and lift the cable in three parts.

Mr. C. E. Rawlins, Jr., remarked that there were certain buoys laid for marking the places where the cable was lost. Were these buoys in existence?

Mr. Canning replied that the buoys were moored quite as a temporary means, but he thought they were floating about.

Mr. C. E. Rawlins, Jr., asked if Mr. Canning was perfectly certain he could go to the place where the cable was lost.

Captain Anderson said the real object of the buoys was not so much to mark the place where the ship was at the time the cable was lost as where it was drifting. It was just as easy to find the end of the cable as it was to sail to Sandy Hook or Cape Clear. It was a matter of common nautical astronomy. (Hear, hear).

Mr. Varley said in the attempt to grapple the cable on the last occasion, they were near to the end of the cable in order to save it; but supposing any difficulty was experienced in that depth of water, they had only to run into 500 fathoms shallower water, so that it would be unnecessary to grapple two miles deep. He firmly believed that no difficulty would be experienced in getting at it from that depth, but if there should, they could run nearer to Ireland. (Hear, hear).

Mr. King—Would there be more risk in underrunning it than bringing it up?

Mr. Canning said that if they could only get the bight they would splice on a run to America. He would not think for a moment of stopping the expedition to complete the cable; he would leave another ship besides the *Great Eastern*, which would be with them to do that work. (Hear, hear).

THE WAY THE OLD CABLE IS TO BE RAISED.

At a meeting in Manchester on March 15th, the Chairman asked what means would be taken for the recovery of the old cable.

Mr. Canning said that after laying the cable of 1866 they would return to pick up the cable of 1865. Three ships would be used, the *Great Eastern* and another, which would be a chartered vessel, and a government ship fitted out with machinery for hauling up, the same as the other vessels. In lifting, the ships would be grappling at the same time at certain intervals apart, from two to three miles. The one to the west would put the greatest strain upon the cable, while the other two ships gently lifted it to the surface. The rope employed would bear a breaking strain of twenty-nine to thirty tuns; the swivels would be tested up to twenty-five tuns, and the grapnels would be tested up to the same; and therefore, he thought, with this strain, they would have an ample margin of strength. If the western ship, by hauling, should part the cable, there would then be other two ships with the bight on their grapnels, and by so doing, if the western ship should part it, that would materially lessen the strain upon the middle ship and also on the one to the eastward. If the ship to the west did not break it, and they wished to make an end, they could always do that by using the cutting or jamb grapnel which would so damage the cable by the strain put on it that it would break it and make an end. They could also adopt another mode—by lifting the cable up to a certain extent, and then buoying it, going further again, so as to get up the greater length from the ground, and get more slack, for the purpose of lessening the strain upon the cable. He thought that by these modes there was no doubt that they would be successful in recovering the lost cable. Mr. Fairbairn had gone into the calculations and agreed with him in every respect.

The Chairman said he had some doubts some time ago, but Captain Anderson had so explained the principle he intended to act upon with regard to the recovery of the cable that he had no doubt, if it was done with care, so as not to throw any severe strain upon the cable, instead of having one new cable in operation they would shortly have two cables.

Mr. Canning said he thought the fact that the directors of the Telegraph Construction and Maintenance Company had subscribed as much money as £100,000 toward this new attempt, proved the great confidence which they had in its success. Besides this, eight of these gentlemen had each subscribed £10,000 to the new company, and Mr. Cyrus Field had taken a like amount of stock in the new company.

WILL THE TELEGRAPH PAY?

At the Manchester meeting, Mr. Varley, the electrician, said, it was a significant fact that they had no instance on record of a cable that has been properly laid failing in deep water—all the failures had been in shallow water, or were due to faults that had existed in the cable prior to its being laid. There was no reason to fear, if this cable were properly laid, that it would fail for fifty or a hundred years, because the heavy shore ends would reach into deep water of one hundred fathoms. The question of success had been spoken to by Captain Anderson, Mr. Canning and Mr. Field. Therefore he would at once pass to the question of remuneration. It was at first proposed that only five shillings a word should be charged for the transmission of messages to America. But at the present moment there are thirty-one electric wires working between Europe and Great Britain, which were somewhere about half full—say about fifteen wires working continuously. What, then, would be the effect of one single wire connecting not only Great Britain and Europe, but Africa and Asia, with that tremendous telegraph system which had grown up in America and Canada? It was perfectly clear that one wire could in no way cope with the amount of work that would pass between the two countries, unless a high rate were charged to keep down the traffic. In the first instance, the government offered a subsidy to the Atlantic Telegraph Company of eight per cent. so long as the cable worked, and nothing the moment it stopped. That subsidy was useless, because if the cable worked at all it would earn a vast deal more than eight per cent. The government wished to limit the price to 2s 6d a word. The consequence would have been so enormous an influx of messages that before the second day's messages could be transmitted to New York the mail packet would have arrived there. (Mr. Field—That agreement is now cancelled). There was only one legitimate way in which they could limit the traffic, and that was to augment the price. The line from San Francisco to New York, which was a very costly line, passing twice up into perpetual snow and down again, charged for a message of ten words somewhere about £3, and had paid, ever since it had been in operation, from ninety to considerably over one hundred per cent per annum on the original cost. The Persian Gulf line, badly managed as the feeders to it were, paid £95,000 a year. The Malta and Alexandria line took £100,000 a year simply between Egypt and Europe. If, then, one Atlantic cable took no more messages than the Malta and Alexandria line, or the Persian Gulf line, and charged only six times the rate charged by those lines, their receipts would amount to over half a million. He had bee watching the progress of telegraphy for the last nineteen years, and he was certain that the demand upon their line would be much greater than that He did not believe that less than 20s per word would keep their line free for the first twelve months; and after the first twelve months a higher rate still would be necessary in order to limit the traffic sufficiently. He thought £1,000,000 per annum was a very moderate estimate of the earnings of the cable.

THE extremely thin sheets of iron which may now be obtained, some of them weighing no more than 0·36 gr. per square inch, and being not more than the 4,800th of an inch in thickness, have been noticed as possessing to an extraordinary degree the power of resisting oxidation. This is doubtless attributable to a fused layer of magnetic oxide, with which they are always covered; and the fact has been applied to the protection of articles of wrought iron. The latter are embedded in a pulverized layer of native oxide of iron—hematite, for instance—and kept at a full red heat for several hours, after which they are allowed to cool gradually. Plates treated in this way are perfectly covered with the oxide, and are well suited for ship-building. A combination of the oxides of zinc and iron, formed by the use of oxide of zinc also gives rise to a black coating, which is, perhaps, even more effective.

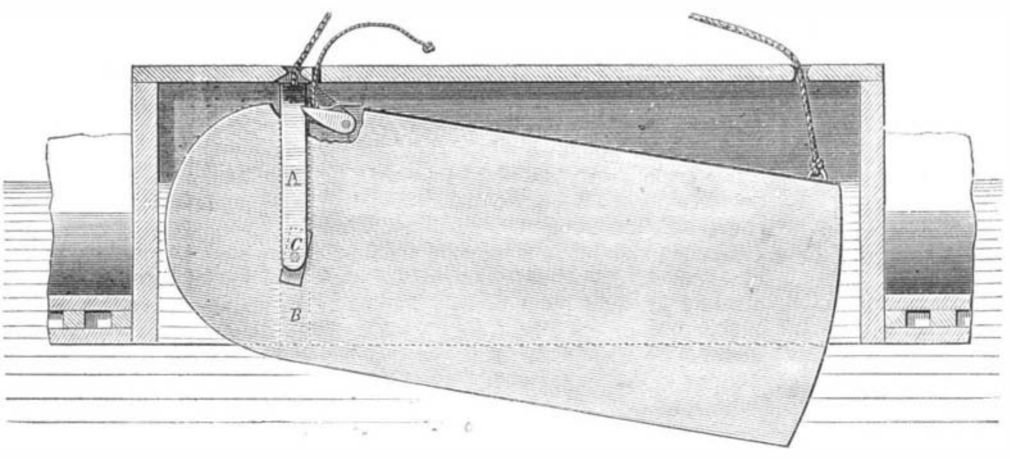
THE barque *Truelove* is a ship of the old school, recently sailed from Hull, England, being the only vessel dispatched this year from Hull to the Davis Straits whale fisheries. The *Truelove* is one of the oldest vessels afloat. She was built in Philadelphia, in the year 1764, and is consequently 102 years old.

Improved Center-board.

The subject of this invention is a new method of hanging center boards used on small vessels. By an improved method of hanging them the vessel is controlled with much more ease and certainty on rough water and may be run in shallower water than with the old style of board.

The inventor provides a yoke, A, which slides in a groove in the casing, B, straddles the center-board and is confined by a bolt, C. The usual tackle is fastened to the upper end of this yoke and another line to the rear of the board. It is easy to see, therefore, that by lowering either one or the other of these lines, or both at the same time, a greater or less amount of the center-board surface will be below the vessel, and that it is capable of being placed on line with the heel when desirable. These fixtures can be applied to boards now in use, and any change may be made in the shape of the upper end of the yoke so as to use different kinds of tackle, according to the weight and size of the board.

A patent was obtained on this invention through the Scientific American Patent Agency on Feb. 20, 1866, by J. F. Hall, of Westerly, R. I., whom address for further information.



HALL'S CENTER-BOARD.

Periodic Phenomena.

Considerable interest attaches to what may be termed the "periodic phenomena" of nature. Of such a character are the appearance and disappearance of animals, as bats and badgers, which conceal themselves during the winter, and pass through a period of hibernation; the change of dress at different seasons by the ermine, the stoat, and their allies; the coming and going of the regular winter or summer migratory birds; the retirement and hibernation of reptiles; the movements of certain fish up and down stream for the purpose of spawning; the appearance, transformations, and disappearance of insects; the leafing of trees; the flowering of plants; the ripening of seeds; the fall of leaves—all these, and more, are worthy of the attention of the lover of nature, and not beneath the dignity of man. Linnæus constructed for himself a floral clock, in which the periods of time were indicated by the opening or closing of certain flowers. Gilbert White, and others since his time, not disdaining to be his disciples in such a work, constructed a calendar, of which periodic phenomena presented themselves to their notice. Humboldt observes of the insects of the tropics, that they everywhere follow a certain standard in the periods at which they alternately arrive and disappear. At fixed and invariable hours, in the same season, and the same latitude, the air is peopled with new inhabitants; and in a zone where the barometer becomes a clock (by the extreme regularity of the horary variations of the atmospheric pressure) where everything proceeds with such admirable regularity, we might guess blindfold the hour of the day or night by the hum of the insects, and by their stings, the pain of which differs according to the nature of the poison that each insect deposits in the wound. And the Rev. Leonard Jenyns, the naturalist, remarks:—"If an observant naturalist, who had been long shut in darkness and solitude, without any measure of time, were suddenly brought blindfolded into the open fields and woods, he might gather with considerable accuracy from the various notes and noises which struck his ears, what the exact period of the year might be.

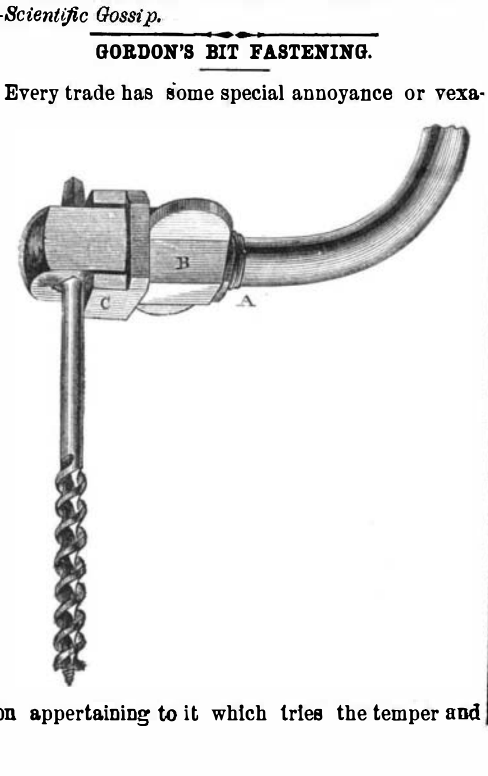
All such observation as we have alluded to are easily made and as easily recorded, and of all, none are of more interest than the migratory movements of birds. We know that some visit us in the spring and abide during the summer; others direct their flight hither late in the autumn, and spend with us their winter. But why this change, whence do they come, and whither do they go? We can partly answer this question, but only partially. We may declare, in general terms, that self-preservation and the perpetuation of the species, is the great moving cause. That the journey is undertaken in search of food, or a milder climate, or both, as a consequence the former of the latter, or in search of suitable conditions for rearing their young; yet there are many special circumstances in which this answer is inapplicable or insufficient."

Knapp, in his "Journal of a Naturalist," remarks of the willow wren:—"It is a difficult matter satisfactorily to comprehend the object of these birds in quitting another region, and passing into our island. These little creatures, whose food is solely insects, could assuredly find a sufficient supply of such diet during the summer months in the woods and thickets of those mild regions where they passed the season of winter, and every bank and unfrequented wild would furnish a secure asylum for them and their offspring during the period of incubation. The passage to our shores is a long and dangerous one, and some imperative motive for it must exist; and, until facts manifest the reason, we may, perhaps, without injury to the cause of research, conjecture for what object these perilous transits are made."

The record of periodic phenomena made in the same district over a series of years is always of interest; but contemporaneous records made at numerous stations distant from each other, and in which the same kind of observations are made, would be of more interest still. Take, for instance, the first appearance of a swift for ten successive years in twenty stations between the Isle of Wight and Caithness; or the last note of the cuckoo heard between the Land's End and the Tweed. Many such trifles, apparently insignificant in themselves, become of importance when carefully and faithfully recorded, and such a work may be accomplished by those who make no pretensions to be men of science, but are content to call themselves "lovers of nature."—*Scientific Gossip.*

GORDON'S BIT FASTENING.

Every trade has some special annoyance or vexation appertaining to it which tries the temper and delays the workman, and we are sure that many can bear witness to one trial carpenters and joiners have to bear; that is, when withdrawing a bit from a hole just bored, to have it part company with the brace and fall out. This does not matter much where there is but one hole to be made but when there are many the evil is a serious one.



The reader will see in this engraving a remedy for it. The shank of the brace is provided with a screw thread, A, and nut, B. This nut, when screwed up, forces a jaw, C, up to the protruding end of the bit, and also against the body of it below, so that it is firmly held in place beyond the possibility of accidental detachment.

Besides the sense of security thus given, the bit bores better and straighter. Sometimes the shanks of the bits do not fit the squared socket in the brace, and they wabble about. With this fastening any bit can be securely held.

Patented through the Scientific American Patent Agency on Jan. 16, 1866, by J. P. Gordon, whom address at West Garland, Me., for further information.

POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

INFLUENCE OF INVENTIONS ON CIVILIZATION.

Dr. R. P. Stevens read a long paper on the "Influence of Inventions on Civilization." The paper was mostly made up of statements of facts showing the wonderful effect of different inventions in increasing the rewards of labor and improving the condition of mankind. The most impressive of these statements was one made to illustrate the effect of railroads. "When Queen Elizabeth moved her court, 24,000 horses were called into requisition, and the consumption of provisions was sufficient to support 190,000 men. The royal progress was more dreaded than the march of an invading army, and the region through which it passed was reduced to famine from which it required years to recover. When Queen Victoria visits Scotland, she is carried in a special train at an expense of about $5,000."

EXPERIMENT TO ILLUSTRATE THE ACTION OF WATER IN BOILERS.

Mr. Norman Wiard presented an apparatus to illustrate the sudden rise and fall of water in steam boilers. He had a cylindrical glass beaker, about four inches in diameter and twelve inches in hight, divided by ten tin diaphragms half an inch apart. The lower diaphragm had an inch hole through the center, and the one next above four half inch holes near the periphery, and all the diaphragms were punched in the same alternate manner, about one-seventh of the area being removed. The object of these diaphragms was to obstruct the escape of bubbles of steam which were formed at the bottom of the beaker. The vessel was filled with water to a level with the diaphragm next to the upper one, and the water was made to boil by a spirit lamp under the beaker. So soon as ebullition commenced, the surface of the water rose about an inch and a half; the action being manifestly due to an increase of volume by so large a portion of the space being occupied by bubbles of steam. On injecting a very little cold water, which was led by a pipe to the bottom of the beaker, the boiling was stopped, bubbles of steam ceased to be formed, and the surface of the water instantly fell to its first level.

The experiment was designed to illustrate the cause of the sudden fall of water in boilers on the cessation of ebullition—a phenomenon that has been frequently observed by engineers, especially in boilers having narrow water spaces, where the free rise of bubbles of steam to the surface is obstructed. The boiling may be stopped either by opening the furnace doors, or by starting the feed pump, or by closing the safety valve.