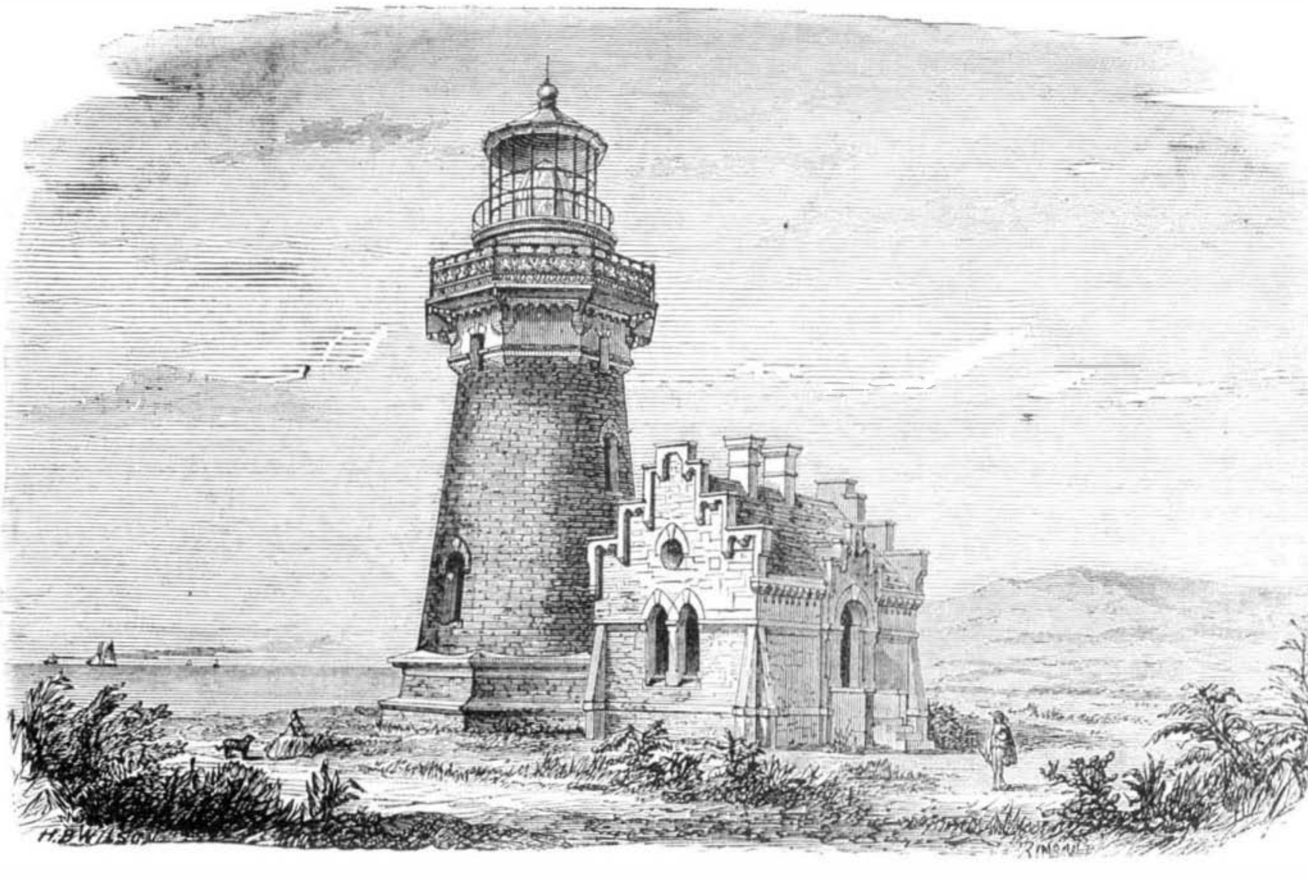
THE LIGHTHOUSES OF THE UNITED STATES.

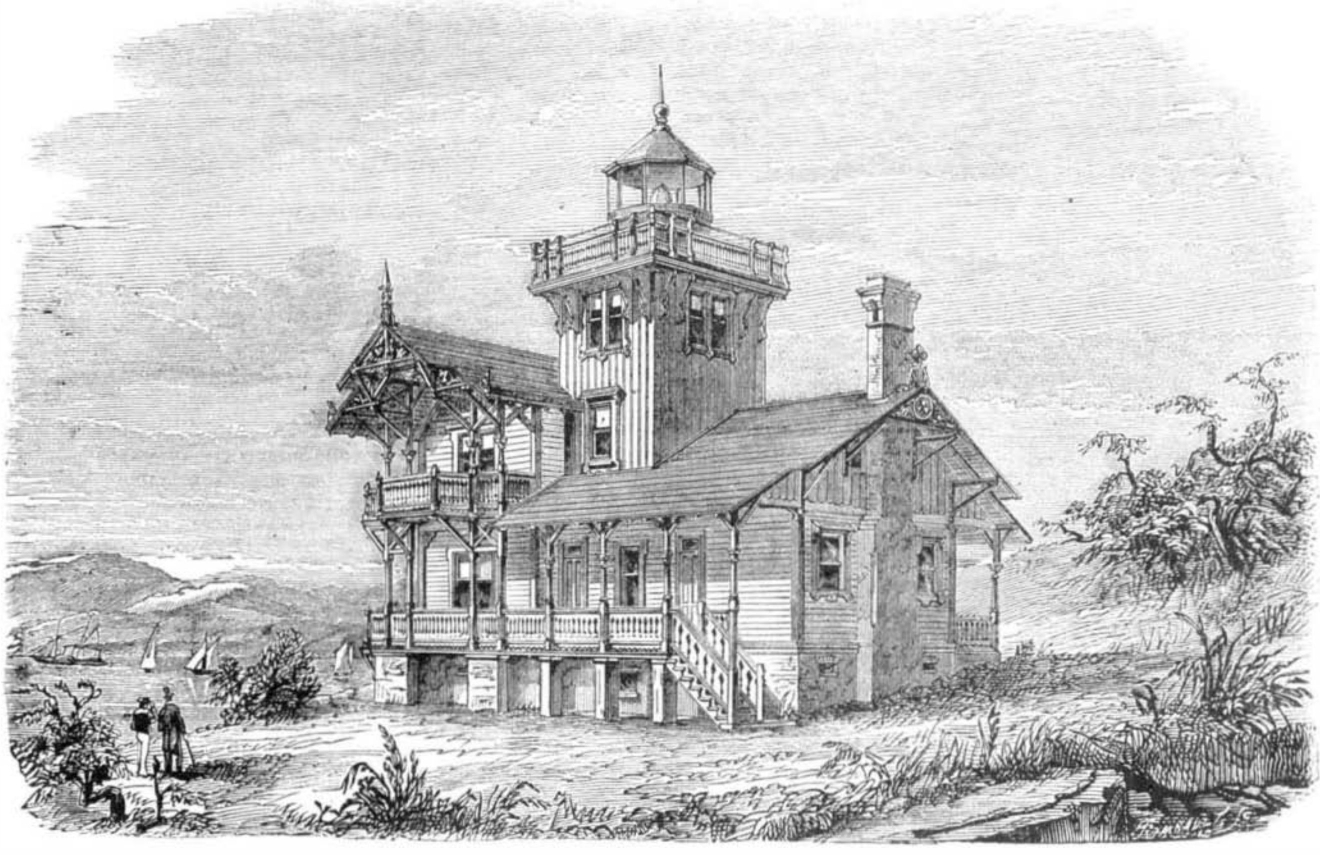
We have heretofore called attention to the efficient system of beacons which is being completed along our Atlantic and Pacific coasts, as well as on the shores of the great lakes. Most of the lighthouses are modern structures, and are commendable for their thorough efficiency and the engineering skill shown in their construction; and many of them possess considerable architectural merit.

We publish this week two more examples of American lighthouses, both on the coast of California. The first of these is at Piedras Blancas, a point about midway between the lighthouses on Points Conception and Pinos, and is distant about 150 miles from each. An appropriation of $75,000 was made for this work, which has a first-order light and fog signal.

The second illustration shows the lighthouse for the Straits of Karquines, California. An appropriation of $20,000 was made for this structure, which is to mark the entrance of the Straits of Karquines. A location on the southern shore, just opposite Mare Island, was recommended; but as none suitable was found, the final selection of site was made on the southern end of Mare Island.



LIGHTHOUSE AT PIEDRAS BLANCAS CALIFORNIA.



LIGHTHOUSE AT THE ENTRANCE OF KARQUINES, CALIFORNIA.

The French Meter.

Sir Edmund Beckett, is a true Englishman, and does not love the French measure. He says:

"The polar axis is estimated at 7,899½ miles, or 500 millions of inches a thousandth part longer than our present standard inch, which probably only came by accident to be what it was when the standard was taken, and might just as well be a thousandth more. True, the other European nations have inches too, and some of them are rather longer than ours. The French meter, 39·371 inches, is the worst measure in the world, because it is inconsistent with any natural one: whereas our yard is the long stride of a man of good hight, and the natural length of his walking stick, and half his hight or half the stretch of his arms; and the meter is not even what it pretends to be, the 40-millionth of a meridian of the earth, for the measure taken was erroneous; and if it were, such a standard is of no more real value than the distance of the moon. Yet there are people who have engaged in the crusade of trying to force on us this bad, erroneous, arbitrary, and revolutionary measure of a nation which tried also to abolish the week and make a new one of ten days, and whose language is declining over the world, while ours already prevails over more regions of the world than any other, and is evidently destined to advance more and more."

Sir Edward, we think, is about right. The good old yard stick is a better measure than the meter.

Giant Beaver.

Drawings and specimens of the remains of the great extinct beaver, *castoroides Ohioensis*, an animal closely allied to the beaver of modern times, but of giant size, being about five or six feet in length, and weighing probably from 200 to 400 pounds, have been exhibited before the Lyceum of Natural History in this city. This specimen was found at Nashport, on the Ohio canal, in a bed of peat, which was buried under strata of clay and sand, and apparently belonged to the same age as the forest bed found in the middle portions of the drift deposits of Ohio.

Rapid Transit.

Mr. Ebenezer Hawkins, of Islip, N. Y., has recently obtained letters patent for a railroad for taking and leaving passengers without stopping the train, a desideratum which, if it could be effected, is of great importance in city and suburban railways, as a large share of the time of traveling on such roads is lost by stopping and the previous and subsequent slow travel. Mr. Hawkins' plan consists in starting from each depot an auxiliary train on a side track, to be coupled to the main line through train as soon as the former has attained a similar speed. Passengers can step from the main line train to the auxiliary, and the latter will be uncoupled in time for stoppage at the next depot, and the process will be continuous.

A REMARKABLE result has recently been obtained by Messrs. Brown & Co., of Sheffield, Eng., with a disk made from a rail saw and rotated at 3,000 revolutions per minute. As the disk was 9·6 feet in diameter, the velocity of its circumference was in the neighborhood of 86,400 feet per minute. Steel rails were cut with astonishing rapidity, and even melted. Millions of sparks were thrown off, but no heating of the disk could be detected after the cutting.

Society of Telegraph Engineers.

At a recent soirée of this Society, London, the greatest features of the evening were the electro-motograph exhibited by Mr. R. S. Culley, Engineer-in-Chief to the Post Office Telegraphs, and some specimens of boring worms exhibited by Mr. Browning under his microscopes.

The electro-motograph was discovered by Mr. Thomas A. Edison, of Newark, N. J., who, in a letter published a few weeks ago in the SCIENTIFIC AMERICAN, described his experiments in chemical telegraphy, wherein he met with the peculiar force he obtained; from that letter and the ideas contained in it, the instrument exhibited was made. It has been known for years that marks could be made on chemically prepared paper by passing currents of electricity through a style resting on the paper, which passed over a metal drum, these marks being produced by chemical decomposition. In his experiments Edison noticed that with certain compositions motion was produced in the lever holding the stylus, which was caused apparently by the sudden decrease of friction of the paper. It was found that paper prepared with caustic potash and a stylus tipped with tin gave the most favorable results. In the electro-motograph exhibited by Mr. Culley, the stylus was of tin, but held in a peculiar form of clip, which brought a very great amount of friction on the paper, so much so that, when the instrument was started, the great friction carried the stylus forward. Immediately a current was passed through it, decomposing the paper, all friction seemed to cease, the clip, by the strong force of its springs, was drawn back; and this occurred each time the current passed, and so long as the current existed the clip remained in its normal position. Immediately, however, the current ceased, the friction of the paper showed itself, and the stylus was drawn forward.

This motion was made audibly manifest by the position of a small bell which was struck loudly each time a current passed and destroyed the friction. So perfect was it that the Morse signals sent by the key were perfect and accurate as recorded on the bell. This little instrument attracted crowds all through the evening, and it may be fairly characterized as one of the most interesting scientific novelties produced for a long time.

Engineering says: "It may undoubtedly be termed a new discovery in Science."

The specimens of boring worms were found in the cable between Holyhead and Dublin belonging to the Post Office, and were picked up inside the cable not far from Holyhead. They were of three varieties, two of which are of somewhat large type, ranging from one inch to three inches long, and they appear to have strong proclivities in favor of hemp. Through the slightest opening they penetrate and enjoy themselves among the covering, which they utterly destroy. The third variety is small and apparently insignificant, but to submarine cables it is a dreadful enemy; passing straight through the hemp and boring at once into the gutta percha, it finally produces a fault. These specimens were sent by

Mr. Culley to Mr. Browning, whomounted them soas toshow their leading peculiarities. Close to these microscopes were placed some specimens of gutta percha insnlated wire freely marked by them.

Another novelty was an electrical gas-lighting apparatus exhibited by Mr. Thompson. This consisted of a very small portable apparatus, held easily in the hand. At the upper part was a curved rod with a bell cup to it, which was placed over the gas to be lighted; the lower part, near the handle, contains a small electrophorus, the upper plate of which was lifted by the thumb or finger of the hand holding the handle. The electric spark from this is arranged to pass across a small space where the gas has mixed with the atmosphere in such proportions as to become explosive. Immediately the spark passes, the gas is lighted. This instrument, though new in London, has been in use here for some three years.

OCEAN TELEGRAPHY.

BY GEORGE B. PRESCOTT.

Number II.

The workingspeed of ocean cables with the mirror system is as follows:

NUMBER OF WORDS PER MINUTE.

Weight of copper strands, lbs.	Knots, 1,000.	Knots, 1,500.	Knots, 2,000.	Knots, 2,500.
100	18·3	8·1	4·6	2·9
150	27·5	12·2	6·9	4·4
200	37·0	16·4	9·2	5·9
250	46·0	20·4	11·2	7·4
300	55·0	24·4	14·0	8·8
350	64·1	28·5	16·0	10·3
400	73·2	32·5	18·3	11·7

The apparatus employed in the transmission of communications through ocean cables is the invention of Professor Sir William Thomson. Ampère suggested, as early as the year 1820, the employment of a galvanometer for the purpose of telegraphing, and in 1833 Gauss and Weber used a reflecting galvanometer as an indicator upon a line about one mile in length, uniting the Observatory and the Physical Cabinet at Göttingen. Their alphabet was made up of combinations of right and left deflections. This apparatus, the first ever employed for practical telegraphy, has lately, in the hands of Professor Sir William Thomson, become the most sensitive of all telegraphic instruments. His reflecting galvanometer is the only instrument at present with which a cable 2,000 miles in length can he successfully worked by a battery of low tension. It consists of a needle formed of a piece of watch spring, three eighths of an inch in length. The needle is suspended by a thread of cocoon silk without torsion. The needle lies in the center of an exceedingly delicate galvanometer coil. A circular mirror of silvered glass is fixed to the needle, and reflects at right angles to it in the plane of its motion. It is so curved that, when the light of a lamp is thrown through a fine slit on it, the image of the slit is reflected on a scale about three feet off, placed a little above the front of the flame. Deflections to the extent of half an inch along any part of the scale are sufficient for one signal. In so delicate an instrument, the sluggish swing of the needle in finally settling into any position would destroy its usefulness. To rectify this, a strong magnet, about eight inches long and bent concave to the instrument, is made to slide up and down a rod placed in the line of the suspending thread above the instrument. This magnet can be easily shifted, as necessity may require. The oscillations of the needle due to itself are, by the aid of the strong magnet, made so sudden and short as only to broaden the spot of light.

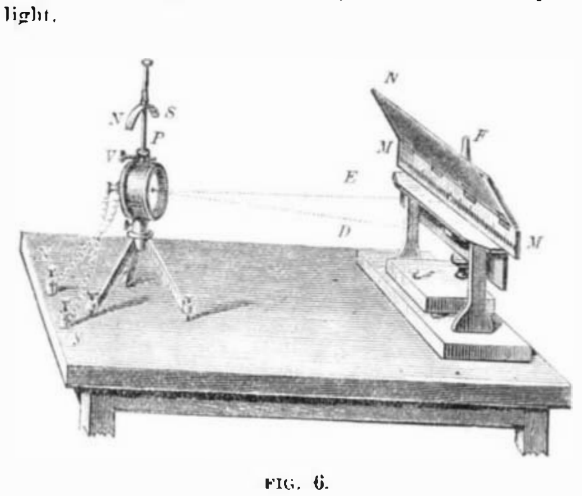


FIG. 6.

The above illustration (Fig. 6) shows the construction of the instrument. The galvanometer, P, contains the multiplication wire, divided into several layers and so arranged that it can be used for weak or strong currents, according to the requirements of the instrument. In the center of the coil the magnetic needle is suspended, to which is attached the tiny mirror, and close before it is to be found a small collective lens, whereof the focal point lies almost in the mirror, in order to produce a sharp figure of the prism on the scale.

The magnetic needle has a length of only $\frac{3}{8}$ of an inch, a breadth of $\frac{1}{12}$ of an inch, and a thickness of $\frac{1}{72}$ of an inch. The mirror connected with the needle has a thickness of only $\frac{1}{240}$ of an inch. The magnetic needle is made from a small piece of a very fine watch spring, and the little mirror, from one of the thinnest microscopic cover glasses. The magnetic needle and mirror used for signaling across the Atlantic weigh only $1\frac{1}{2}$ grains.

The entire box which encloses these parts is hermetically closed. The ends of the multiplicator wires are soldered inside the box to two screw posts, x y, wherewith the instrument is connected with the cable.

A curved steel magnet, N S, is fixed to a brass bar, P, in such a way that, by turning the micrometer screw, V, any required removal, upwards or downwards or to the right or left, can be given to it; and by this means the magnetic needle, when in a state of rest, is kept in such a position that the picture of the slit, D, which is reflected from the middle of the mirror, and likewise returns through the lens, appears upon the zero mark of the scale, M M.

Opposite the galvanometer, the scale, M M, and the lamp, F, are to be seen. The light from the lamp penetrates through the slit, D, in an oblique direction to the looking glass, and is thrown back from it to the scale somewhat upwards, in the direction, F, where the picture of the slit is to be seen as a fine light line. The screen, N, can be turned up andserves to keep the lamp light from the scale. The instrument is necessarily used in a darkened room.

The transmitting key is shown in Fig. 7. It consists of two separate levers, L and E, moving on axes at the upper end in the figure. They are kept by springs, pressing against the cross plate, C, which is in connection with one of the poles of the battery. L is connected with the cable and E to the earth. When either key is pressed down, it falls on the plate, Z, in connection with the other pole of the battery. In the normal position of the key, the cable is connected, through L, C, and E, to earth, and Z is insulated; and it is easy to see how a positive or negative current is put to line according as L or E is depressed.

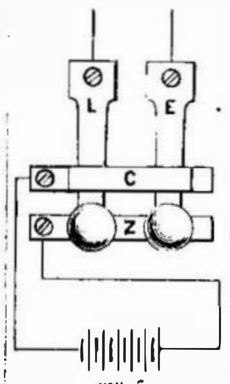


FIG. 7.

The alphabet is made by opposite movements produced by one or other of the keys. The signals need not be made from zero as a starting point. The eye can easily distinguish, at any point in the scale to which the spot of light may be deflected, the beginning and the end of a signal, and when its motion is caused by the proper action of the needle or by currents. It is thus that the mirror galvanometer is adapted to cable signaling, not only by its extreme delicacy, but also by its quickness. The deflections of the spot of light have been aptly compared to a handwriting, no one letter of which is distinctly formed, but yet is quite intelligible to the practised eye. Signals in this way follow each other with wonderful rapidity. A low speed of from twelve to sixteen words perminute is adopted for public messages; but when the operators communicate with each other, a speed of twenty-four words per minute is sometimes attained.

Condensers are used at both ends of the Atlantic cables, by means of which the speed is very considerably increased. The term condenser has long been used among electricians to denote an arrangement, in a moderate compass, equivalent to a Leyden jar of enormous capacity. It is composed of alternate layers of mica or parafined paper and tinfoil. One coating of this Leyden jar is put in direct communication with the conductor of the cable, and the other is joined to the sending key. At the other end of the cable one coating of the condenser is connected with the cable and the other coating with the receiving instrument. The condensers are each equal to about 70 miles of the cable. The condenser serves two purposes: it lessens the delay caused by induction, and prevents the disturbance of the signals by earth currents. The cable and condenser being insulated, there is no voltaic circuit, and no way whereby earth currents can enter and leave the line.

The question is often asked: " What is the velocity of electricity?" or " how long does electricity take to go across the Atlantic Ocean?" Electricity cannot properly be said to have a velocity, but differs with the circumstances under which it travels. For about two tenths of a second after contact is made with the conductor of an Atlantic cable, no effect is perceptible on the opposite side of the ocean, even by the most delicate instrument. After fourtenths of a second, the received current is about 7 per cent of the maximum permanent current which the battery could produce in the circuit. One second after the first contact, the current will reach about half its final strength, and after about three seconds its full strength. The current does not arrive all at once, like a bullet, but grows gradually from a minimum to a maximum.

The Direct United States Cable, which is now being laid between Ireland and Nova Scotia, and thence to Rye Beach, New Hampshire, is 3,060 nautical miles in length. The core is composed of a thick copper wire encircled by eleven very fine copper wires, weighing 480 pounds per mile, and is served with four coatings of gutta percha, measuring about three eighths of an inch in diameter. After the serving with gutta percha comes a serving with manilla hemp, which brings the core up to a thickness of three fourths of an inch; and then follows the sheathing with iron wire, which forms the outer covering of all. Ten iron wires are employed for this purpose: but before being applied to the cable, they are each wound with five strings of manilla hemp, so as to impart greater strength, and protect them from the action of water. The hemp covered wires are served with a species of black compound resembling tar or pitch; and after being twisted around the core, they are again served in this manner, and finally whipped with Italian hemp, which, however, can scarcely be said to do more than hold the strands in their places until the whole becomes hard and dry. This is the deep sea portion of the cable. The shore ends are of varying sizes, graduating from about $2\frac{1}{4}$ inchesdown to $\frac{3}{4}$ of an inch.

The Direct United States Company expect to obtain a speed of about nine words per minute, or about one half that of the present Newfoundland and Ireland cables.

The French Atlantic Cable, laid in 1869 between Brest and St. Pierre, has 400 pounds of copper per mile, is 2,584 knots in length, and has a working speed of fifteen words per minute.

The contract price of the Direct United States Cable, laid down, is $6,055,000. The cost of the Anglo-American Cable —between Ireland and Newfoundland—laid down, was $1,500 per mile.

The Direct United States Cable has been laid from Ireland to within a distance of about 200 miles of Nova Scotia; but owing to unfavorable weather it had to be cut and buoyed. It will probably be recovered again as soon as favorable weather ensues, and its laying be successfully completed. When this is accomplished, there will be five working cables across the North Atlantic and one across the South Atlantic oceans.

Submarine telegraph cables now extend across the North and South Atlantic, Indian, and German Oceans; the Mediterranean, Red, North, Baltic, Chinese, Oriental, Japan, Java, and Caribbean Seas; the Gulfs of Biscay, Bengal, Mexico, and St. Lawrence, and the straits of Bass and Malacca: thus placing North and South America, the West Indies, Europe, India, Java, Australia, Tasmania, and Siberia in constant and instantaneous telegraphic communication, as well as affording communication with the most important ports in China and Japan.

The following is a list of the more important cables which are in working order at the present time:

Date.	From	Length in Miles.
1851.	Dover, England, to Calais, France	25
1852.	Holyhead, Wales, to Howth, Ireland	65
	Port Patrick, Scotland, to Donaghadee, Ireland	25
	Prince Edward Island to New Brunswick	12
1853.	Denmark, across the Belt	18
	Dover, England, to Ostend, Belgium	80½
	Port Patrick, Scotland, to Donaghadee, Ireland	25
1854.	Port Patrick, Scotland, to Whitehead, Ireland	27
	Sweden to Denmark	12
	Holyhead, Wales, to Howth, Ireland	65
1856.	Prince Edward Island to New Brunswick	1
	Crete or Candia to Syra, Greece	170
	St. Petersburgh to Cronstadt, Russia	10
	Across the Amazon	105
1857.	Ceylon to Hindostan	30
	Norway across the Fiords	49
1858.	England to Holland	140
1859.	Denmark to Heligoland	46
	Isle of Man to Whitehaven, England	36
	Sweden to Gottland	64
	Folkestone, England, to Boulogne, France	24
	Malta to Sicily	60
	Jersey to Pirou, France	21
1860.	Great Belt, Denmark (two cables)	14
	Cape St. Martin, Spain, to Iviza	76
	Iviza to Majorca	74
1861.	Corfu to Otranto, Italy	90
	Dieppe, France, to Newhaven, England	80
1862.	Wexford, Ireland, to Aberman, Wales	63
	Lowestoft, England, to Zandvoort, Holland	125
1864.	Fao, Persia, to Bushire, Persia	204
	Bushire, Persia, to Masandam, Persia	450
	Masandam, Persia, to Gwadar, Beloochistan	447
	Gwadar, Beloochistan, to Kurrachee, British India	346
	Otranto, Italy, to Avlona, Turkey	50
1865.	Trelleborg to Rugen, Germany	55
	South Foreland, England, to Cape Grisuez, France	25
1866.	Ireland to Newfoundland	1,896
	Lyall's Bay to White's Bay	41
	Crimea to Circassia	40
	Colonia to Buenos Ayres	30
	England to Hanover	224
	Cape Ray, Newfoundland, to Aspee Bay, Cape Breton	91
	Leghorn, Italy, to Corsica	65
	Persian Gulf	160
1867.	South Foreland, England, to La Panne, France	47
	Malta to Alexandria, Egypt	925
	Placentia, Newfoundland, to St. Pierre	118
	St. Pierre to Sydney, Cape Breton	126
	Arendal, Norway, to Hirtshals, Denmark	68
1868.	Italy to Sicily	5
	Havana to Key West, Florida	125
1869.	Peterhead, Scotland, to Egursand, Norway	250
	Grisselhamm, Sweden, to Nystadt, Russia	96
	Newbiggin to Sondervig	334
	Malta to Sicily	54
	Tasmania to Australia	176
	Scilly Isles to Land's End, England	27
	Ithaca to Cephalonia	7
	Bushire, Persia, to Jask, Beloochistan	505
	Brest, France, to St. Pierre	2,584
	St. Pierre to Duxbury, U. S	749
	Moen to Bornholm, Sweden	80
	Bornholm, Sweden, to Libau	230
1870.	Scotland to Orkney Isles	37
	Salcombe, England, to Brignogan, France	101
	Beachy Head, England, to Cape Antifee, France	70
	Suez, Egypt, to Aden, Arabia	1,460
	Aden, Arabia, to Bombay, India	1,818
	Porthcurno, England, to Lisbon, Portugal	823
	Lisbon to Gibraltar	331
	Gibraltar to Malta	1,120
	Marseilles, France, to Bona, Africa	447
	Bona, Africa, to Malta	386
	Madras to Penang	1,408
	Penang to Singapore	400
	Singapore to Batavia	557
	Malta to Alexandria, Egypt	904
	Batabano, Cuba, to Santiago, Cuba	520
	Jersey to Guernsey, Channel Islands	16
	Guernsey to Alderney, " "	18
	Santa Maura to Ithaca	7
	Zante to Trepito	11
	Sunium to Thermia	25
	Patras, Greece, to Lepanto	2
	Dartmouth, England, to Guernsey	66
	Guernsey to Jersey	15