Prescott.

THE PROGRESS OF THE ELECTRIC TELEGRAPH.

IN the spring of 1860 an article was published in this magazine with the above title, giving an account of the extension of the telegraph up to that time. Its progress since has been very great in every quarter of the globe. Upon this continent the electric wire extends from the Gulf of St. Lawrence to the Gulf of Mexico, and from the Atlantic to the Pacific Ocean, connecting upwards of six thousand cities and villages; while upon the Eastern Continent unbroken telegraphic communication exists from London to all parts of Europe, — to Tripoli and Algiers, in Africa, — Cairo, in Egypt, — Teheran, in Persia, — Jerusalem, in Syria, — Bagdad and Nineveh, in Asiatic Turkey, — Bombay, Calcutta, and other important cities, in India, — Irkoutsk, the capital of Eastern Siberia, — and to Kiakhta, on the borders of China.

But however rapid the extension of the telegraph has been in the past, it is destined to show still greater advancement in the future. Neither the American nor the European system has yet attained to its ultimate development. Transient wars now delay the establishment of lines in San Juan, Panama, Quito, Lima, Valparaiso, Buenos Ayres, Montevideo, Rio Janeiro, Surinam, Caraccas, and Mexico, and the incorporating of them, with all their local ramifications, into one American telegraph system. The Atlantic cable, although its recent attempted submergence has proved a failure, will yet be successfully laid; while the equally important enterprise of establishing overland telegraphic communication with Europe *viâ* the Pacific coast and the Amoor River is now being vigorously pushed forward towards its successful completion.

The latter project, which is being carried out by the Western Union Extension Telegraph Company, with a capital of ten million dollars, embraces the construction of a line of telegraph from New Westminster, British Columbia, the northern terminus of the California State Telegraph Company, through British Columbia and Russian America to Cape Prince of Wales, and thence across Behring's Strait to East Cape; or, if found more practicable, from Cape Romanzoff to St. Lawrence Island, thence to Cape Tchuktchi, and thence by an inland route around the Sea of Okhotsk to the mouth of the Amoor River. At this point it is to be joined by the line now being constructed by the Russian Government to connect with Irkoutsk, where a line of telegraph begins, which stretches through Tomsk and Omsk, in Western Siberia, Katharinburg, on the Asiatic-European frontier, Perm, Kasan, Nijni-Novogorod, and Moscow, to St. Petersburg.

This line, which was projected by Perry McDonough Collins, Esq., United States Commercial Agent for the Amoor River, with its extension by the Russian Government to Irkoutsk, is the link now wanted to supply direct and unbroken telegraphic communication from Cape Race, in Newfoundland, on the eastern coast of America, across the Western Continent, the Pacific Ocean, and the Eastern Continent, to Cape Clear, in Ireland, the westernmost projection of Europe; and when a submarine cable shall be successfully laid between Cape Clear and Cape Race, will complete a telegraphic circuit around the earth between the parallels of forty-two and sixty-five degrees of north latitude.

The chief difficulties to be anticipated in Mr. Collins's enterprise are the extent of the territory to be traversed, its wild and rugged surface formation, and the uncivilized character of its inhabitants.

The distance to be traversed through British America is six hundred miles; through Russian America, nineteen hundred miles; the length of the submarine cable across Behring's Strait, four hundred miles; and the distance from East

Cape, by an inland passage around the Sea of Okhotsk, and through the settlements of Okhotsk, Ayan, and Shanter's Bay, which are well-known stations of the whale-fishery, to the mouth of the Amoor River, is about twenty-five hundred miles. The entire length of the line would thus be about five thousand four hundred miles.

That portion of the route which lies through British Columbia is chiefly mountainous, but divided into three ranges, whose courses are from north to south, while intervening valleys invite the introduction of telegraphs and roads. The Pacific coast of Russian America is mainly level. The portion of Siberia which lies between East Cape and the head of the Sea of Okhotsk is, for a large extent, a steppe or plain, with gentle elevations occasionally rising into mountainous ridges. At the head of the Sea of Okhotsk a range of mountains must be crossed; and the region lying between that range and the mouth of the Amoor River is of the same character as that before mentioned, which extends from the same range northward to East Cape. The electric telegraph has already been carried over steppes, in both continents, similar to those above described; and the Pacific telegraph line, in crossing the Sierra Nevada, rises to an elevation greater than that which is to be surmounted on this line.

Suitable timber for setting up the line can be found on those portions of the route lying within British Columbia and the Russian dominions on each continent, with the exception of an unwooded steppe five hundred miles wide on each side of Behring's Strait. Here the needful timber can be brought near to the line, either by sea or from the forest-covered shores of navigable rivers.

The temperature of the region through which the northern part of the line would pass is very low; but the winter is less severe than between the same parallels of latitude on the Atlantic coast. The telegraphic line which connects St. Petersburg with Archangel, on the White Sea, and that also which passes around the Gulf of Bothnia and connects St. Petersburg with Tornea, are maintained in operation without difficulty, although they cross as high parallels of latitude as those which lie in the way of this overland line to Europe. The waters of Behring's Strait are about one hundred and eighty feet deep, and they are frozen through one half of the year; but the congealed mass, when broken, generally takes the form of anchor ice, and not that of iceberg. Thus climate seems to offer no serious obstacle to the enterprise; while it is worthy of consideration that in high latitudes timber is far less perishable than in low, and less insulating material is required in cold regions than in more genial climates.

Indian tribes are found along the American part of the route, but they have been so well subjected to the influences of society and government, through the operations of the fur-trade, that no serious resistance from them is apprehended. The inhabitants of Asiatic Russia, who dwell inland, are nomadic Tartars, affecting much independence, but they are, nevertheless, not savages, like the American natives. After centuries of internal war, they have now settled into a state of semi-civilization, in which they are accustomed to barter with whalers, with exploring parties, and with the Government agents of Russia, and they are hospitably inclined by that intercourse. Thus it is seen that there are no insuperable obstacles, either physical or social, in the way of this projected line of intercontinental telegraph.

From New Westminster, the capital of British Columbia, situated on Frazer River, about fifteen miles from its mouth, and the terminus of the California State Telegraph, the line of the Collins Overland Telegraph has already been commenced. A letter from Mr. F. L. Pope, Assistant-Engineer of the Overland Company, dated June 13th, 1865, states that the work on this portion of the line is proceeding with great energy. Scarcely two months had elapsed since

active operations were commenced; and yet during that time nearly three hundred miles of poles had been cut and prepared for use, a large number had been set, and the remainder had been already distributed along the line. The poles are nearly all of cedar, and of good size, and will form one of the most durable lines on the American continent. When the extremely mountainous and difficult nature of the country along the Frazer River is taken into consideration, the rapidity with which this large amount of work has been done is extraordinary. It seems quite probable that the line will be finished the present season from New Westminster to Quesnell River, the terminus of the wagon-road to the mines.

The Colonial Government are now engaged in cutting a road from New Westminster to Yale, a distance of about ninety miles, along which the wire will be carried. There has heretofore been no communication between these points except by water. The river is bordered on both sides by high mountains and dense forests of heavy timber, with an almost impenetrable undergrowth. Notwithstanding these difficulties, Mr. Conway, one of the telegraph engineers, made an exploration of the entire route, during the latter part of last winter, on snow-shoes, being at one time three days in the woods without food or blankets.

From Yale to the Quesnell River, a distance of some three hundred miles, the line will follow the wagon-road, which has been built at an enormous expense by the Colonial Government, as a means of communication with the gold-mining regions of Carriboo. It will be a matter of considerable difficulty to set up a line of telegraph over that portion of this road which passes through the great canon, as in many places the road has a perpendicular wall of rock upon one side and a perpendicular precipice on the other, and in one place is carried around the face of a cliff in this manner, at an elevation of some two thousand feet, directly over the river, being in some places blasted out of the solid rock, and in others supported by a sort of staging.

Two exploring parties have been dispatched from San Francisco: one to examine the route through Eastern Siberia, between Behring's Strait and the Amoor; and the other to follow the proposed route up the Frazer River in British Columbia, and thence along the valley supposed to exist between the Rocky Mountains and the Coast Range, to the head-waters of Pelly River, following down the valley of this river and the Yerkin, into which it empties, to a point near the mouth of the latter, or in the neighborhood of Behring's Strait.

The Pacific Telegraph Line, which will form an important link in the overland line to Europe, was projected in 1859, when the measure was first brought to the attention of Congress. A bill in aid of the project was passed after some opposition, and proposals for the construction of the line were invited by Secretary Cobb. Mr. Hiram Sibley, President of the Western Union Telegraph Company, who was really the originator of the whole enterprise, submitted to the directors of the Company the question of authorizing him to send in proposals; but so formidable did the undertaking appear, that the proposition was carried only by a single vote.

After long and tedious delays on the part of Secretary Cobb, the contract for building the line was awarded, on the 20th of September, 1860, to Mr. Sibley, on behalf of the Western Union Telegraph Company. The Company at once assumed the contract, and furnished all the money required for the line east of Salt Lake.

Mr. J. H. Wade, of Cleveland, one of the officers of the Company, now visited California to confer with parties familiar with the various routes, to determine where and how to build the line, and to arrange with the telegraph companies in the Pacific States to extend their lines eastward and form a business connection. The California Company agreed to assume the construction of the line to Salt Lake City, and, if possible, to

have it completed to that point as soon as the line from the eastward reached there. The route selected was *viâ* Forts Kearney, Laramie, and Bridger, crossing the Rocky Mountains at the South Pass, and thence to Salt Lake City; and from this point, *viâ* Forts Crittenden and Churchill, across the Sierra Nevada Mountains to Placerville and San Francisco. Mr. Edward Creighton, who had already surveyed the proposed route, and was convinced of the feasibility of maintaining a line over it, was appointed superintendent of construction.

The Company was organized April 17th, 1862, after which time nearly all the wire, insulators, and other material had to be manufactured before the construction of the line could be proceeded with. The reader can judge of the extent of the preparations required for setting up two thousand miles of telegraph through a wilderness inhabited only by Indians and wild beasts, and a part of which was a desert. The materials and tools were taken to Omaha, Kansas, at which point everything necessary for the enterprise was gathered in readiness to start westward.

Of the force employed on the Pacific side we have no knowledge; but for the line from Omaha to Salt Lake City, Mr. Creighton had four hundred men, fitted out for a hard campaign, with a rifle and navy-revolver for each man, and with the necessary provisions, including one hundred head of cattle for beef, to be driven with the train and killed as needed. For the transportation of the material and the supplies for this army of workmen, five hundred oxen and mules and over one hundred wagons were purchased by the Company; and these not proving sufficient, other transportation was hired, making the total number of beasts of burden seven hundred oxen and one hundred pair of mules.

The first pole was set up on the 4th of July, 1862, and the line was completed to Salt Lake on the 18th of October following, — the California party reaching the same point six days later. The work proceeded at the rate of about ten miles per day.

The whole line is upon poles, — it being thought best to cross the rivers in this manner rather than by means of submarine cables. The country is for the most part bare of wood; the longest distance, however, that timber had to be drawn in one stretch was two hundred and forty miles. The poles are of large size, and stand eighty to the mile, more than half of red cedar, the remainder mostly pine. On the highest mountains, where the snow accumulates to a great depth during the winter, they are of extra size, and sufficiently tall to keep the wires above the deepest snow; they are also placed close enough together to prevent the wire being broken by an accumulation of snow and sleet.

The wire used in this line is No. 9 iron, zinc-coated, weighing three hundred and fifty pounds to the mile, and the total weight used between Omaha and San Francisco amounts to seven hundred thousand pounds. The insulators are of glass, protected by a wooden shield, of the pattern known as the Wade insulator.

The line is worked by Morse instruments, usually direct from Chicago to Salt Lake, Hicks's self-acting repeaters being kept in the circuit at Omaha and Fort Laramie. At Salt Lake the messages are rewritten, and thence sent direct to San Francisco. The stations average about one for each fifty miles, and the whole length of the line is inspected twice a week by persons employed for the purpose. The cost of construction was about two hundred and fifty dollars per mile.

No trouble was experienced from Indian depredations until the last winter. Up to that time the line had worked almost uninterruptedly. Even during the Indian difficulties of the previous summer and autumn, which compelled the suspension of the overland mail, the telegraph was not in any manner molested by the savages. This was supposed to be owing in a great measure to the influence of superstitious fear

among them in regard to the wire, which they supposed to be under the especial care of the Great Spirit; but it was probably largely due also to the many kind offices done them by the telegraph-operators, who frequently ascertained where the buffalo were in force, and informed their red-skinned neighbors, who were thus enabled to find their favorite game. The charm is now, however, unfortunately, dispelled; and the savages take every opportunity to break and carry off the wire and destroy the poles. Government is dispatching a large force of cavalry to punish the marauders and protect the line, which it is to be hoped may prove effectual.

It has already been mentioned that the Russian Government has undertaken to extend the main eastern and western line from Irkoutsk to the mouth of the Amoor River. This extension is now rapidly progressing. But this is only a single and not very prominent part of the work which the Emperor of Russia has begun. His design embraces nothing less than the following stupendous works, namely: —

A line, with the necessary submarine cables, from the mouth of the Amoor River, across the Straits of Tartary, over the island of Sakhalien, across the Straits of La Pérouse, over the Island of Jesso, through Hakodadi, and across the Straits of Sangar, to Jeddo, the capital of Japan.

A line from the confluence of the Usuri with the Amoor, seven hundred miles above the mouth of the latter, thence southward, on the bank of the Usuri, to Lake Kingka, and thence to the port of Vladi Vastok, on the coast of Tartary, opposite the port of Hakodadi, on the eastern coast of the Japanese Sea. Vladi Vastok is selected by the Emperor for his naval station on the Pacific coast.

A line from Irkoutsk, the capital of Eastern Siberia, through Kiakhta, now the entrepôt of European and Chinese overland commerce, through the vast territory of the Mongols, to the gate in the Chinese wall at Yahol, and thence to Pekin, the capital of the Chinese Empire.*

A line from a station on the main continental line at Omsk, near the southern boundary of Asiatic Russia, passing through Mongolia, and entering China at Hirck, sometimes called Illy, thence crossing Turkistan, Bokhara, and Balk, to Cabool, in Afghanistan, thence to capital places in the Punjaub, where it will meet the telegraphic system of India, and thus become a medium of communication between London and the colonial dependencies of Great Britain, Holland, Spain, and Portugal, on the shores and islands of the great Indian Ocean.

A line from Kasan, on the main central Russian line, through Georgia and Circassia, along the western shore of the Caspian Sea, to Teheran, the capital of Persia, thence to the Tigris, at Bagdad, thence descending along the banks of that river to the head of the Persian Gulf, there to be connected with the Oriental telegraph system of India.

The line from Irkoutsk to Pekin American citizens residing in China are now soliciting, with good prospect of success, permission from the Chinese Government to extend through the Empire, with the needful branches, connecting the principal ports along the Pacific coast, opposite California. A company to carry out this project has been organized under the laws of the State of New York. The wires of this company are first to be put up from Canton to Macao and Hong Kong, a distance of 140 miles, — Canton having a population of 1,000,000, Hong-Kong of 40,000, and the trade of both cities world-famous. Lying 245 miles north is Amoy, with 250,000 inhabitants; and 120 miles farther in the same direction is Foochow, a city with a population of 600,000, and within 70 miles of the black-tea districts, with large commerce, and with numerous manufac-

* The Chinese Government has been informed by the Russian Ambassador that the Russian portion of this line to Pekin will be completed by the first of January, 1868.

tures of great value. Beyond it 250 miles is Ningpo, with 300,000 inhabitants, and thriving manufactures of silks. Eighty miles north is Shanghai, a city of not less than 200,000 inhabitants, and possessing a larger inland or native trade than any other in China. Yet between these great marts there is no telegraphic communication whatever, — nor, indeed, is there a line in any part of the whole Chinese Empire. The company proposes, therefore, to connect these great commercial cities, and, having done that, to carry on its line to Nankin, with its 400,000 inhabitants, and thence to Pekin, which has a population of 2,000,000, and is the capital of an empire spread over an area of 5,000,000 square miles, and containing more than 420,000,000 souls, who pay to the Government an annual revenue of $120,000,000. It may well be understood, that, for Government purposes alone, a line of telegraph thus extending between the chief cities of China will prove of incalculable value, alike in its use, and in its profits to those who erect it and receive its income. The enterprise is a great one, but its reward will be great. Its successful accomplishment seems to be well assured; and New York may expect presently to claim the honor of first giving to the oldest of existing empires the beneficent invention which the newest of nations created, and at the same time of taking the final step for the completion of the one great line which is to put all the countries of the earth in instant communication.

A line from Calcutta to Canton is already undertaken by an English company, with due authority from the British Government.

In Australia there are now in operation twelve thousand miles of telegraph-wire. This Australian system, which is at present so purely local and isolated, is nevertheless expected to be brought into combination, by alternating submarine and island wires, with the Chinese and Russian line above described.

The statistics of the telegraph-lines in Great Britain show not only an increase in the number of lines, but a great augmentation in the amount of business transacted. In 1861 there were 11,528 miles of line open for public use; in 1862, 12,711 miles; and in 1863, 13,892 miles, comprising 65,012 miles of wire. Last year, the number of stations was augmented in like proportion; and facilities were offered for the transmission of telegraphic dispatches at no fewer than 1,755 stations, containing 6,196 instruments, through which about 3,400,000 telegrams were sent. In addition to the lines on British soil, the Submarine Telegraph Company has cables stretching to Calais, Boulogne, Dieppe, Jersey, Ostend, Hanover, and Denmark, with which the other lines are more or less in connection, covering 887 miles with 2,683 miles of wire. This company has upwards of 3,000 stations on the Continent. The messages sent by it to and from foreign countries were, in 1861, 230,000; in 1862, 310,595; and in 1863, 345,784.

France possesses a system comprising 71,034 miles of wire and 1,301 stations, which transmit about 1,500,000 private dispatches annually, and nearly 175,000 official ones. Russia has 36,663 miles of wire; Austria, 22,230; Italy, 20,120; Prussia, 24,149; Spain, 17,743; Belgium, 3,773; Switzerland, 3,720; Turkey, 6,571; Persia, 2,500; Greece, 3,000; India, 10,994, and 136 stations; Australia, 12,000; South Australia, 2,000; the United States, 120,000; the British Provinces in America, 20,000; — making a total of upwards of 440,000 miles of aërial wire in operation in all parts of the world.

The following tables give the details of the principal cables hitherto laid by all makers. They are divided into three heads: 1st, Those which have been wholly successful, and are now working (September, 1865); 2d, Those which were partially successful, having worked for a time; 3d, Those which wholly failed, or never worked after their submergence.

TABLE I.

Submarine Telegraph Cables which are now in Successful Working Order.

No.	Date when laid.	From	To	Number of conducting wires.	Length of cable in statute miles.	Length of insulated wire in statute miles.	Maximum depth of water in fathoms.	Weight in tons per statute mile.	Length of time the cables have worked.
									Years.
1	1851	Dover	Calais	4	27	108	30	6.00	14
2	1852	Keyhaven	Hurst Castle	4	3	12	. .	. .	13
3	1853	Denmark	Across the Belt	3	18	54	15	4.00	12
4	1853	Dover	Ostend	6	80½	483	30	5.75	12
5	1853	Frith of Forth	. . . .	4	5	20	. .	7.00	12
6	1853	England	Holland	1	120	120	30	1.75	12
7	1853	Portpatrick	Donaghadee	6	25	150	160	6.00	12
8	1854	Portpatrick	Whitehead	6	27	162	150	6.00	11
9	1854	Sweden	Denmark	3	12	36	14	6.00	11
10	1854	Italy	Corsica	6	110	660	325	8.00	11
11	1854	Corsica	Sardinia	6	10	60	20	8.00	11
12	1855	Egypt	. . . .	4	10	40	. .	6.00	10
13	1855	Italy	Sicily	1	5	5	27	6.00	10
14	1856	Prince Edward Island	Cape Breton	1	12	12	14	2.50	9
15	1857	Norway across Fiords	. . . .	1	49	49	300	2.75	8
16	1857	Across mouth of Danube	. . . .	1	3	3	. .	1.75	8
17	1857	Ceylon	India	1	60	60	45	2.75	8
18	1858	Italy	Sicily	1	8	8	60	5.25	7
19	1858	England	Holland	4	140	560	30	9.75	7
20	1858	England	Hanover	2	280	560	30	3.00	7
21	1858	Norway across Fiords	. . . .	1	16	16	300	2.75	7
22	1858	Dardanelles	Scio	1	115	115	200	1.00	7
23	1858	Scio	Syra	1	85	85	200	1.00	7
24	1859	Alexandria	. . . .	4	2	8	. .	5.25	6
25	1859	England	Denmark	3	360	1,104	30	4.00	6
26	1859	Scio	Smyrna	1	40	40	40	1.00	6
27	1859	Syra	Athens	1	105	105	150	1.00	6
28	1859	Sweden	Gottland	1	64	64	80	2.50	6
29	1859	Folkestone	Boulogne	6	24	144	32	9.50	6
30	1859	Across rivers in India	. . . .	1	10	10	. .	4.50	6
31	1859	Otranto	Avlona	1	50	50	400	1.00	6
32	1859	Malta	Sicily	1	60	60	79	3.25	6
33	1859	Jersey	Pirou in France	1	21	21	15	3.75	6
34	1859	South Australia	Tasmania	1	140	140	60	2.00	6
35	1860	France	Algiers	1	520	520	1,585	1.14	5
36	1860	Denmark	(Great Belt)	6	14	84	18	8.00	5
37	1860	Denmark	(Great Belt)	3	14	42	18	6.00	5
38	1860	In Arracan	. . . .	1	116	116	50	1.00	5
39	1860	Barcelona	Port Mahon	1	198	198	1,400	1.25	5
40	1860	Minorca	Majorca	2	35	70	250	2.00	5
41	1860	Iviza	Majorca	2	74	148	500	2.00	5
42	1860	San Antonio	Iviza	2	76	152	450	2.00	5
43	1861	Corfu	Otranto	1	90	90	1,000	2.75	4
44	1861	Norway across Fiords	. . . .	1	16	16	300	2.75	4
45	1861	Toulon	Corsica	1	195	195	1,550	1.14	4
46	1861	Malta	Alexandria	1	1,535	1,535	420	1.85	4
47	1861	Beachy Head	Dieppe	6	80	320	30	8.00	4
48	1862	Abermawr	Grenore	4	63	252	58	5.25	3
49	1862	England	Holland	4	130	520	30	9.00	3
50	1862	Across rivers in Ireland	. . . .	1	2	2	. .	. .	3
51	1862	Frith of Forth	. . . .	4	6	24	7	. .	3
52	1862	Fortress Monroe	Cherrystone	1	23	23	. .	. .	3
53	1862	Fortress Monroe	Newport News	1	3	3	. .	. .	3
54	1863	Sardinia	Sicily	1	243	243	1,200	. .	2
55	1864	Gwadur (Persian Gulf)	Fao	1	1,450	1,450	. .	. .	1
					6,979	11,127			

In addition to the above, there have been laid across American rivers, since 1854, 95 lines, in lengths of from 120 feet to two miles, and comprising from 120 feet to 6 miles of insulated wire each,—making an aggregate of 250 miles of subaqueous wire in operation on this continent, and a total of 6,979 miles of cable, and 11,127 miles of submarine wire in operation in all parts of the world.

TABLE II.

Submarine Telegraph Cables which have been successful for some Time, but are not now working.

No.	Date when laid.	From	To	Number of conducting wires.	Length of cable in statute miles.	Length of insulated wire in statute miles.	Maximum depth of water in fathoms.	Weight in tons per statute mile.	Length of time the cables have worked.
1	1850	Dover	Calais	1	25	25	30	. .	1 day.
2	1853	England (Three Cables)	Holland	1	360	360	30	2.00	5 yrs.
3	1854	Holyhead	Howth	1	75	75	70	2.00	5 "
4	. .	Nantucket	Cape Cod	1	25	25	16	. .	. . .
5	1855	Varna	Balaklava	1	355	355	300	0.10	9 mos.
6	1855	Balaklava	Eupatoria	1	1	1	. .	. .	9 "
7	1856	Martha's Vineyard	Cape Cod	1	5	5	15	. .	2 wks.
8	1856	Newfoundland	Cape Breton	1	85	85	360	2.50	9 yrs.
9	1857	Sardinia	Bona	4	150	600	1,500	. .	3 "
10	1857	Varna	Constantinople	1	170	170	. .	0.75	5 "
11	1857	Cape Cod	Naushon	1	1	. .	. .	. .	2 "
12	1857	Martha's Vineyard	Nantucket	1	30	30	16	. .	4 "
13	1857	Sardinia	Corfu	1	700	700	1,000	0.90	1 yr.
14	1858	England	Channel Islands	1	102	102	60	2.50	3 yrs.
15	1858	Ireland (Atlantic)	Newfoundland	1	2,500	2,500	2,400	1.00	23 ds.
16	1859	Singapore	Batavia	1	630	630	20	0.04	2 yrs.
17	1859	Suez (Red Sea and India)	Kurrachee	1	3,500	3,500	1,910	0.94	6 mos.
18	1859	Spain	Africa (Ceuta)	1	25	25	. .	1.00	1 yr.
19	1859	England	Isle of Man	1	36	36	30	2.50	3 yrs.
20	1859	South Australia	Tasmania	1	100	100	60	2.00	1 yr.
21	1859	Liverpool	Holyhead	2	25	50	14	3.10	1 "
22	1859	Syra	Candia	1	150	150	. .	0.89	3 yrs.
23	1860	Across the Mersey	. . . . .	1	3	3	. .	. .	1 yr.
					9,053	9,527			

TABLE III.

Submarine Telegraph Cables which are Total Failures.

No.	Date when laid.	From	To	Number of conducting wires.	Length of cable in statute miles.	Length of insulated wire in statute miles.	Maximum depth of water in fathoms.	Weight in tons per statute mile.
1	1852	Holyhead	Howth	1	75	75	70	0.45
2	1852	Portpatrick	Donaghadee	2	17	34	160	. .
3	1852	Portpatrick	Donaghadee	5	15	75	160	4.80
4	1854	Holyhead	Howth	1	65	65	70	2.00
5	1855	Sardinia	Africa	6	50	300	800	8.00
6	1855	Cape Ray	Cape North	3	30	90	360	. .
7	1855	Sardinia	Africa	3	160	480	1,500	3.70
8	1857	Ireland (lost in laying)	Newfoundland	1	300	300	2,400	. .
9	1859	Candia	Alexandria	1	150	150	1,600	0.89
10	1865	Ireland	Newfoundland	1	1,300	1,300	2,400	1.75

It will be seen from the above list of failures, that the great extension and success of submarine cables has been attained through many great failures,—among the most prominent being the old and new Atlantic, the Red Sea and India, (which was laid in five sections, that worked from six to nine months each, but was never in working order from end to end,) the Singapore and Batavia, and Sardinia and Corfu. None of these cables, with the exception of

the new Atlantic, were tested under water after manufacture, and every one of them was covered with a sheathing of light iron wire, weighing in the aggregate only about fifteen hundred pounds per mile.

These two peculiarities are sufficient to account for every failure which has occurred, with the exception of the new Atlantic. No electrical test will show the presence of flaws in the insulating cover of a wire, unless water, or some other conductor, enters the flaws and establishes an electrical connection between the outside and inside of the cable. All cables now manufactured are tested under water before being laid.

Communication between the Ottoman capital and Western Europe passes through Vienna. From this city to Constantinople there are two distinct lines, — one passing by Semlin and Belgrade to Adrianople, the other by Toultcha, Kustendji, and Varna. There is a third line to Adrianople by Bucharest; and by the opening of the submarine line between Avlona and Otranto, in Italy, the Turkish telegraph service will be in direct communication with the West, without going through Servia or the Moldo-Wallachian Principalities.

Communication between Constantinople and India is maintained over the following route: — To Ismid, 55 miles; thence to Mudurli, 104 miles; thence to Angora, 111 miles; thence to Guzgat, 113 miles; thence to Sivas, 140 miles; Kharpoot, 178 miles; Diarbekir, 77 miles; Mardeen, 61 miles; Djezireh, 104 miles; Mosul, (Nineveh,) 91 miles; Kerkook, 114 miles; Bagdad, 189 miles. From Bagdad to Fao, at the mouth of the Shat-el-Arab, on the Persian Gulf, is 400 miles. From Fao to Kurrachee the submarine cable stretches along the bottom of the Persian Gulf for 1,450 miles; and thence are 500 miles of aërial line across a portion of British India to Bombay.

The accounts of the successful opening of this line tell of the astonishment of the savage Beloochees and Arabs along the Mekran coast at the marvel of a blue spark flashing for the Sahib to the Indus and back again in less time than it takes to smoke a hookah. At Gwadur, no sooner was the cable landed than the people of the surrounding country flocked down to hear and talk of the Feringhee witchcraft. Chiefs of the Beloochees, Muscatees, and Heratees, with their retainers, trod upon each other's toes in their eagerness to see it work. Gwadur has given up the idea that Mahomet taught everything that could be known, and now sits upon the carpet of astonishment and chews the betel-nut of meditation.

The establishment of the electric telegraph in India presented some curious as well as difficult problems. In the first place, it was discovered that the air of India is in a state of constant electrical perturbation of the strongest kind, so that the instruments there mounted went into a high fever and refused to work. Along the north and south lines a current of electricity was constantly passing, which threw the needles out of gear and baffled the signallers. Moreover, the tremendous thunder-storms ran up and down the wires and melted the conductors; the monsoon winds tore the teak-posts out of the sodden ground; the elephants and buffaloes trampled the fallen lines into kinks and tangles; the Delta aborigines carried off the timber supports for fuel, and the wires or iron rods upon them to make bracelets and to supply the Hindoo smitheries; the cotton- and rice-boats, kedging up and down the river, dragged the subaqueous wires to the surface. In addition to these graver difficulties were many of an amusing character. Wild pigs and tigers scratched their skins against the posts in the jungle, and porcupines and bandicoots burrowed them out of the ground. Kites, fishing-eagles, and hooded-crows came in hundreds and perched upon the line to see what on earth it could mean, and sometimes after a thunder-storm, when the wires were wet, were found dead by dozens, the victims of their curiosity. Monkeys climbed the posts and ran along the lines, chattering, and drop-

ping an interfering tail from one wire to another, which tended to confound the conversations of Calcutta. Parrots, with the same contempt for electrical insulation, fastened upon one string by the beak and another by the leg; and in one village, the complacent natives hung their fishing-lines to dry upon them.

In 1856 there were four thousand miles of telegraph-wire stretched over India: some upon bamboo posts, which bent to the storms and thus defied them; some, as in the Madras Presidency, upon monoliths of granite,—these, during the Mutiny, proving worth ten times their cost.

Whilst the telegraph has been thus rapidly encircling the globe with its iron threads, great improvement has been made in the apparatus for transmitting the electrical signals over them. Instruments called translators, or repeaters, have been devised, by which aërial lines may be operated, without repetition, over distances of many thousands of miles. Through the use of this valuable invention upon the California line, operators in New York and San Francisco are able to converse as readily and rapidly as those situated at the extremities of a line only a hundred miles in length.

The enormous increase in the amount of matter to be transmitted over the wires has stimulated the inventive genius of our own country and Europe to produce an apparatus by which the capacity of a wire may be greatly increased. Mr. M. G. Farmer of Boston, Mr. J. G. Smith of Portland, Maine, Dr. Gintl of Germany, and one or two other persons, have solved the problem of the simultaneous transmission of messages over a single wire in opposite directions. But while their apparatus, with the proper arrangement of batteries, will unquestionably permit the accomplishment of this apparent paradox, the natural disturbances upon a wire of any considerable length, together with the inequalities of the current caused by escape in wet weather, have precluded its practical use.

In this country, General Lefferts of New York, and in Europe, Professor Bonelli, have devoted much time and expense to the perfection of apparatus for securing greater rapidity of transmission over the aërial lines.

General Lefferts owns several patents covering inventions of great ingenuity and value, which are now being perfected and will shortly be brought into operation. The apparatus consists of an instrument, operated by keys similar to those of a piano-forte, for punching characters, composed of dots and lines, upon a narrow strip of paper. The paper, when thus prepared, is passed rapidly through an instrument attached to a telegraph-wire, at the other end of which is a similar instrument which runs in unison. The first instrument is provided with a flexible metallic comb, which presses through the perforations in the paper and thus closes the circuit at each dot and line, while the second instrument is provided with a metallic stylus, or pointer, which rests upon a fillet of paper prepared with chemicals, and produces, whenever the circuit is closed, dots and lines of a dark blue color upon the prepared paper. When the paper is prepared by the perforating apparatus, it can be run through the instrument at any rate of speed that is desirable, and it is estimated that with this apparatus one wire may easily perform as much work in a day as ten can under the ordinary arrangement.

In Professor Bonelli's system the dispatch is set up in printing-type, and placed on a little carriage, which is made to pass beneath a comb with five teeth, which are in communication with five aërial wires of the line, at the extremity of which these same wires are joined to the five teeth of a second comb, under which passes a chemically prepared paper, carried along on a little carriage similar to the one at the other end on which the printing-type is placed. If under this arrangement the electric circuit of a battery composed of a sufficient number of elements, and distributed in a certain order, be completed, then, at

the same time that the first comb is passing over the printing-type at the one end, the second comb at the other end will trace the dispatch on the prepared paper in beautiful Roman letters, and with so great a rapidity that it may be expected that five hundred messages of twenty words each will be transmitted hourly.

On Wednesday, April 19th, the day of Mr. Lincoln's funeral, eighty-five thousand words of reports were transmitted between Washington and New York, between the hours of 7, P. M., and 1, A. M., being at the rate of over fourteen thousand words per hour. Nine wires were employed for the purpose. Thirteen thousand six hundred words were transmitted by the House printing instruments on a single wire after half past seven o'clock.

A telegraphic message was recently received in London from India in eight hours and a half. This message was forwarded by the Indo-European Telegraph Company, *viâ* Kurrachee and the Persian Gulf, crossing one half of Asia and the whole of Europe.

During the late Rebellion in this country the telegraph was extensively employed both by the Government and the Insurgents. In the course of the past year, there have been in the service of the Government thirty field-trains, distributed as follows: — In the Army of the Potomac, five; in the Department of the Cumberland, five; in the Department of the Gulf, three; in the Department of North Carolina and Virginia, three; in the Department of the South, two; in the Department of the Tennessee, six; in the Department of the Ohio, two; at the Signal Camp of Instruction, Georgetown, D. C., three; at the United States Military Academy, West Point, New York, one. Of these trains, some were equipped with five, and others with ten miles of insulated wire. There were carried in the trains lances for setting up the wire, when necessary, — reels, portable by hand, carrying wire made purposely flexible for this particular use, — and various minor appliances, which experience has proved useful. A military organization was directed for each train.

In duty of this kind, the construction of the trains, the equipment to be carried by them, and the military organization to be provided for their use, to enable them to be most rapidly and anywhere brought into action, are the subjects for study: the particular instrument to be equipped is a secondary consideration. The soldiers drilled to the duty of construction acquire in a short time a remarkable skill in the rapid extension of these lines. As was anticipated, they have proved valuable auxiliaries to the services of the corps, and have sometimes rendered them available when they would have been otherwise useless. The greatest distance at which the instruments are reported to have worked is twenty miles. The average distances at which they are used are from five to eight miles. The average speed of the most rapid construction is reported to be at the rate of a slow walk.

At the first Battle of Fredericksburg field-trains were for the first time in the history of the war used on the battle-field, under the fire of the enemy's batteries. The movements to be made on the day of that battle were of the first magnitude. The movements of the retreat were perilous to the whole army. The trains in use contributed something to the success of those movements.

Many incidents are recorded of operators accompanying raiding parties into the enemy's territory and tapping the telegraph-lines, sometimes obtaining valuable information. One is related by the "Selma Rebel." The operator at that place was called to his instrument by some one up the Tennessee and Alabama Road, who desired information as to the number of the forces and supplies at Coosa Bridge. After getting all the information he could, regarding the location and strength of the Rebel forces, he informed the Selma operator that he was attached to the expedition under General Wilson, and that, at that particular time, he was stationed with his instruments up

a tree near Monticello, in the hardest rain he ever saw! Permission being given, he sent a dispatch to a young lady in Mobile, and another to a telegraph-operator in the Rebel lines, telling him he loved him as much as before the war. After some other conversation, the Yankee operator clambered down from the tree, mounted his horse, and rode away.

THE FIELD OF GETTYSBURG.

IN the month of August, 1865, I set out to visit some of the scenes of the great conflict through which the country has lately passed.

On the twelfth, I reached Harrisburg, — a plain, prosaic town of brick and wood, with nothing especially attractive about it, except its broad-sheeted, shining river, flowing down from the Blue Ridge, around wooded islands, and between pleasant shores.

It is in this region that the traveller from the North first meets with indications of recent actual war. The Susquehanna, on the eastern shore of which the city stands, forms the northern limit of Rebel military operations. The "high-water mark of the Rebellion" is here: along these banks its uttermost ripples died. The bluffs opposite the town are still crested with the hastily constructed breastworks, on which the citizens worked night and day in the pleasant month of June, 1863, throwing up, as it were, a dike against the tide of invasion. These defences were of no practical value. They were unfinished when the Rebels appeared in force in the vicinity. Harrisburg might easily have been taken, and a way opened into the heart of the North. But a Power greater than man's ruled the event. The Power that lifted these azure hills, and spread out the green valleys, and hollowed a passage for the stream, appointed to treason also a limit and a term. "Thus far, and no farther."

The surrounding country is full of lively reminiscences of those terrible times. Panic-stricken populations flying at the approach of the enemy; whole families fugitive from homes none thought of defending; flocks and herds, horses, wagon-loads of promiscuously heaped household stuffs and farm produce; men, women, children, riding, walking, running, driving or leading their bewildered four-footed chattels, — all rushing forward with clamor and alarm under clouds of dust, crowding every road to the river, and thundering across the long bridges regardless of the "five-dollars-fine" notice (though it is to be hoped that the toll-takers did their duty): — such were the scenes which occurred to render the Rebel invasion memorable. The thrifty German farmers of the lower counties did not gain much credit either for courage or patriotism at that time. It was a panic, however, to which almost any community would have been liable. Stuart's famous raid of the previous year was well remembered. If a small cavalry force had swept from their track through a circuit of about sixty miles over two thousand horses, what was to be expected from Lee's whole army? Resistance to the formidable advance of one hundred thousand disciplined troops was of course out of the question. The slowness, however, with which the people responded to the State's almost frantic calls for volunteers was in singular contrast with the alacrity each man showed to run off his horses and get his goods out of Rebel reach.

From Harrisburg, I went, by the way of York and Hanover, to Gettysburg. Having hastily secured a room at a hotel in the Square, (the citizens call it the "Di'mond,") I inquired the way to the battle-ground.

"You are on it now," said the land-