The Life Story of
Sir Charles Tilston Bright

CIVIL ENGINEER

SIR CHARLES BRIGHT

Knighted September 4th, 1858, for laying the First Atlantic Cable—age 26.

The Life Story

OF

Sir Charles Tilston Bright

CIVIL ENGINEER

WITH WHICH IS INCORPORATED THE STORY
OF THE ATLANTIC CABLE, AND THE
FIRST TELEGRAPH TO INDIA
AND THE COLONIES

(REVISED AND ABRIDGED EDITION)

BY

CHARLES BRIGHT, F.R.S.E.

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SUBMARINE TELEGRAPHS: Their History, Construction and Working.

THE STORY OF THE ATLANTIC CABLE.

SCIENCE AND ENGINEERING DURING THE VICTORIAN ERA.

IMPERIAL PREFERENTIAL POLICY.

THE LOCOMOTION PROBLEM.

For particulars and Press Opinions, see end of this volume.

To
My Mother

Preface

IN response to a number of suggestions and in view of the present year being the Fiftieth Anniversary of the Atlantic Cable, this abridgement of the original biography [1] has been prepared by the author.

Whilst the present volume cannot profess to deal in the same complete manner with the pioneering of Submarine Telegraphy in general, it covers—in a compressed form—the entire scope of its subject as set forth in full on the title-page.

The Appendices to the two previous volumes—mainly covering Sir Charles Bright's scientific and engineering papers, addresses, official reports, and inventions—are omitted here, with the exception of that dealing with his inventions. This also applies in a measure to the contemporaneous doings of others in the same field. Even now, however, being to some extent an historical work of reference, the author has to plead indulgence for occasional repetitions under different chapters and headings.

[1] *The Life-Story of the late Sir Charles Tilston Bright, Civil Engineer, with which is incorporated the Story of the Atlantic Cable and the first Telegraph to India and the Colonies.* By his brother, Edward Brailsford Bright, and his son, Charles Bright, F.R.S.E. (London: Archibald Constable & Co., 1898. £3 3s. net.)

It only remains to be said that this biography is based on original and official documents, mostly in the author's possession. Special care has been bestowed on the Index to enable the reader to readily follow the sequence of events in regard to the history of telegraphy—under the various subject headings—or the main features of the life dealt with.

December, 1908.

Introduction

THE exploits, inventions, and scientific achievements are here chronicled of one who, when in his seventeenth year, devised his first invention, since in active use; when a youth of nineteen, carried out important telegraph work, including the laying of a complete system of wires under the streets of Manchester in a single night—without incurring any disturbance to the traffic; when twenty became Chief Engineer to the Magnetic Telegraph Company, extending its lines throughout the United Kingdom; and who, a year later, in establishing telegraphic communication between Great Britain and Ireland, was—to quote the late Lord Kelvin—"the first to lay a cable in deep water."

When but twenty years of age the subject of this Memoir had patented as many as twenty-four distinct inventions—which he had been elaborating during the three preceding years. This was at precisely the same period of life as that at which one of the most prolific inventors, Mr. Edison, took out his first patent; and many of young Bright's early inventions are still in use and essential to present-day telegraphy. Altogether he brought out no less than 119 separate inventions, and a large proportion of these proved of general utility.[1]

When twenty-three, Bright became a projector of the Atlantic Telegraph, to which, a year later, he was appointed Engineer-in-Chief. After a series of almost insurmountable difficulties, he, in 1858—and contrary to expert opinion—successfully laid the first cable between Ireland and America, at the age of twenty-six, thereby telegraphically uniting two great continents. It had been said by many who had watched his energy and talent in early days, that honours were in store for him. The prediction was verified. He became the youngest knight in that same year, for what was at the time very justly described as "the great scientific achievement of the century." It may, perhaps, be added that in those days a knighthood signified more than it does now, if only because it was an honour comparatively closely confined to men who had achieved something for their country—rather than for services to party politics.

In his Presidential Address to the Institution of Electrical Engineers, in 1889, Lord Kelvin (then Sir William Thomson) said in regard to the above undertaking: "To Sir C. Bright's vigour, earnestness, and enthusiasm was due the successful laying of the cable. We must

[1] Those in constant use to-day comprise: (1) The insulator and shackle for aerial telegraphs. (2) The acoustic bell telegraph instrument. (3) The means of finding out the position of a fault in a submarine cable, or subterranean wires, by an alternative circuit of varying resistance coils. (4) The protection of submarine cable cores with ribands of metal wound spirally and overlapping. (5) The cable compound, and method of application.

always feel deeply indebted to our late colleague as the pioneer of that great work, when other engineers would not look at it, and thought it absolutely impracticable."[1] Again, when, as President of the same Institution in 1897, Sir Henry Mance, C.I.E., M.Inst.C.E., delivered his address, he expressed himself in these terms with reference to the aforesaid topic: "If we, as engineers, desire to do honour to any one individual who pre-eminently distinguished himself in the development of oceanic telegraphy, we have simply to refer to the list of our Past-Presidents, and select the name of Charles Tilston Bright."

In this connection, Bright's youthful talent has been spoken of as scarcely second to that of William Pitt. His mind was essentially an inventive one; but he was equally a man of action. It was, probably, the union of these two qualities which enabled him to overcome the difficulties encountered in laying the First Atlantic Cable.

Afterwards carrying out many important submarine cable undertakings in the Mediterranean and elsewhere—including the first telegraph to India, and between the West Indian Islands—he also took an active part in politics, and was elected a Member of Parliament at the age of thirty-three. Whilst in the House of Commons he was

[1] Fortunately we are soon to have a biography worthy of the late Lord Kelvin, written by so distinguished an author as Dr. Silvanus Thompson, F.R.S.; and here will be provided a suitable record of his lordship's marvellous—indeed, unrivalled—contribution to the theory and practice of submarine telegraphy. As is now fairly well recognised, it was Lord Kelvin's mathematical and inventive skill in the electrical working of ocean cables which put them on a sound commercial footing.

constantly to the fore in advocating the extension of telegraphic communication with our Colonies and Dependencies, besides serving on more than one Committee with similar objects in view.

Bright also acted as expert adviser and consulting engineer to a large number of projects—for the second and third Atlantic Cables and for a variety of subsequent submarine lines, as well as other engineering enterprises.

He continued his career of practical work and invention in electric lighting as well as telegraphy, until his death in 1888. His engineering association with the former was never, however, of the same leading character as was the case in regard to telegraphy. It was, indeed, quite secondary in this country to that of Siemens, Hopkinson, Crompton, Ferranti, Kennedy, Swinburne, and Mordey.

The closing event of his life was that of becoming President of the Society of Telegraph Engineers and Electricians (now the Institution of Electrical Engineers) during the Electric Telegraph Jubilee of 1887.

Bright was amongst the foremost to take an active interest in the Volunteer movement, and when set afoot became Captain of one of the first corps.

In his home he was a genial host, who gathered many friends around him, and entered keenly into all sport.

His was in every sense a full life—full of endeavour, and full of achievement. A man of wide sympathies, he was, indeed, capable of throwing himself with enthusiasm into everything he took up; and here, perhaps, lies the secret of his usefulness.

There are not many cases in which so much ground has been covered in so short a time and at so early a period of life. Indeed, in its leading article on the occasion of his death, *The Times* remarked : " If a man's life may be measured by the amount he has accomplished, Sir Charles Bright lived long, though dying at the comparatively early age of fifty-five. Few men have ever done more useful work for his country and for commerce within less than forty years." A study of *The Dictionary of National Biography*, *Men of the Reign*, or *Men of the Time*, corroborates this view.

There is probably no branch of engineering which lends itself so readily to a full sight of the world as that of telegraphy. Thus, the present volume is centred in many climes, and partly consists of stirring narratives of adventure—suggestive of romance rather than the plain story of a man of science. It is thought, therefore, that these pages will appeal to the general reader—only in a lesser degree than to the engineer, student, and historian. Apart from his profession, indeed—in his varied tastes, sympathies, and recreations—Sir Charles was as much the traveller as the scientist ; and even when engaged on most trying cable ventures in unhealthy climates he invariably kept neatly written records of the day's performance—of what he had seen and learnt—never retiring to bed without attending to his task. In the chapter dealing with the West Indian Cables these diaries have been largely drawn from, in order to illustrate the real character of a telegraph engineer's life and the vicissitudes encountered during a cable expedition under unfavourable conditions.

Surprise is sometimes expressed that social festivities—given and received—should form a feature in cable expeditions. It should, however, be remembered that the nature of the work points to the necessity of ensuring friendly relations with those to whom the cable has been taken.

Bright's life was throughout associated with trouble. It would, in fact, have been well had he turned to lighter occupations in his closing years, when, with failing health, he no longer had the constitution for arduous work.

Essentially a man of action, and obviously endowed with great ability, his main characteristics were, in the author's opinion, intense energy, patience, fortitude under adverse circumstances, determination, perseverance and resource. He seemed constantly to be living up to Longfellow's lines :—

Each morning sees some task begun,
  Each evening sees it close ;
Something attempted, something done,
  Has earned a night's repose.

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CHAPTER I

Family Memoirs

THE subject of this biography was descended from the ancient Hallamshire family of Bright, of which he represented the senior branch—Hallamshire being formerly one of the divisions of Yorkshire.

The most notable member of the family in remote times was Colonel Sir John Bright, Bart., of Carbrook Hall and Badsworth, who was a military chief under Cromwell, and fought with Lord Fairfax in the Parliamentary wars. He raised a regiment of horse on his own estates, and was in turn Governor of York, Sheffield and Hull. During the Commonwealth, Colonel Bright was one of the six representatives in Parliament of the West Riding. When, however, the execution of King Charles was decided upon, he withdrew from the Parliamentarian ranks, and disbanded his regiment. He subsequently assisted in the Restoration, and was created a baronet.

The only surviving child of Sir John Bright married Sir Henry Liddell, Bart. The eldest son by this marriage, Thomas, was the ancestor of the first Lord Ravensworth. John, the second son, was made principal heir of his grandfather, on whose death he assumed the name and arms of

MONUMENT IN MEMORY OF SIR JOHN BRIGHT, BART.

Bright. At one time M.P. for Pontefract, he was the originator and first master of the Badsworth Hunt, which, in connection with the said John Bright's mastership, boasts the oldest hunt song in existence.

A granddaughter of the above, Mary Bright, was married to the Marquis of Rockingham, who was Prime Minister for a short time towards the end of the eighteenth century.

The pedigree of all branches of the Yorkshire Brights is given, with elaborate ramifications, in Hunter's *Hallamshire*. More recently a condensed edition, with reference to this branch of the family, was published in Burke's *Authorised Arms*.

CHAPTER II

Boyhood

BORN near Wanstead, Essex, on June 8th, 1832, Charles Tilston Bright, the youngest son of Brailsford Bright, was brought up with his brothers William and Edward, the latter being afterwards especially associated with him in telegraph and other electric engineering work. Charles Bright's second name (Tilston) came from his grand-mother—a godchild of Nelson's—who was the daughter of Edward Tilston, of Mold, the Tilstons being another Yorkshire family of distinction.

The son of a keen sportsman, young Bright seems to have had full opportunities for developing tastes which served him and his brother in good stead on subsequent travels into various wild and deserted quarters of the world.

With family connections on the governing body, these boys were sent to Merchant Taylors School (one of the oldest of our scholastic institutions) at the usual life-period at which boys go to a public school. Young Charles evinced, if anything, a greater strength in Classics than in Mathematics; but there seems little doubt that all three boys distinguished themselves bodily rather than mentally during their boyhood, representing their school in the Racquet Court as well as on the River.

In those days Merchant Taylors held a somewhat similar position in boating to Eton, and had the benefit of the best of Oxford coaches. The two younger brothers thus started their career on the river under favourable conditions. They also had an early opportunity of practising their powers at swimming, for on one of the first occasions on which they went out in an "outrigger," the eight was swamped by the swell of a passing steamer. Indeed, what with passing steamers, bridges, boat collisions, etc., the brothers had to swim for their lives eight times, in all, before completing their rowing experiences on the Thames. On one occasion, just after young Charles had been hauled aboard the steamer, and was shaking the water off himself, an old gentleman inquired, "May I ask, young man, if you're insured?" It turned out afterwards that this worthy old gentleman was a director of a Life Assurance Company![1]

[1] It were better, however, to physically prevent than to pecuniarily provide for. May it not be said, indeed, that the parents of every child ought to be compelled, by Act of Parliament, to make their progeny learn to swim; and that national baths and instructors should be instituted for the purpose?

CHAPTER III

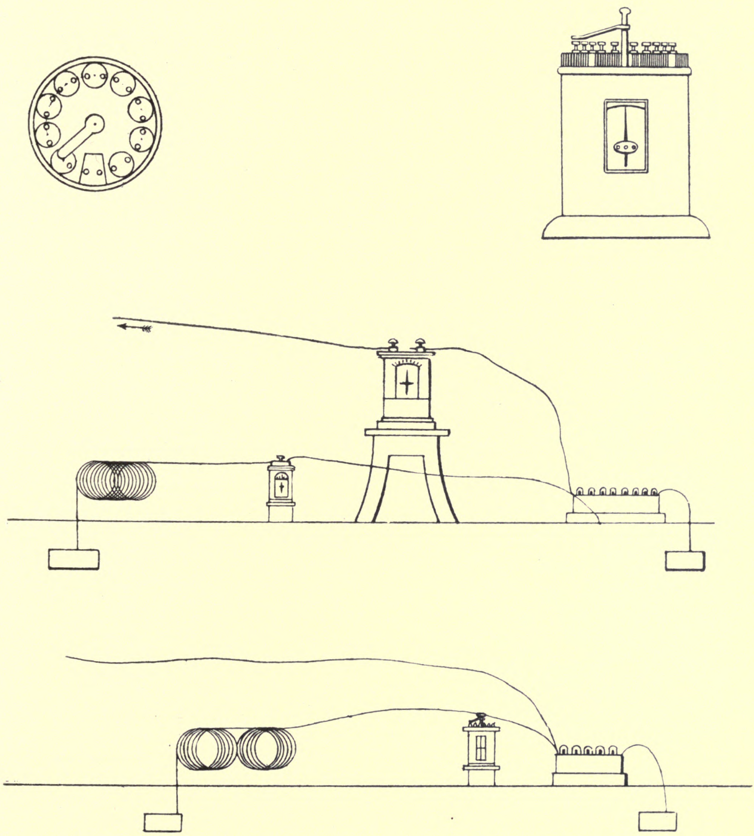
Land Telegraphs

CHARLES BRIGHT and his elder brothers were intended for an Oxford career; but owing to heavy pecuniary losses on the part of their father, the serious and more immediately practical side of life had to be at once entered upon. As schoolboys, Edward and Charles had very much interested themselves both in electricity and chemistry. Thus, soon after its formation in 1847, they joined, when respectively sixteen and fifteen years old, the Electric Telegraph Company. This came about by Charles Bright answering a *Times* advertisement "for gentlemen's sons with education." Young Charles started as a telegraph clerk at Harrow Station on the London and North-Western Railway, the telegraph work on the line being undertaken by the "Electric" Company.

Young Charles' initial occupation was, then, working the telegraph instruments in a railway signalling box, varied by sleeping in a local inn when off duty. But he foresaw a sufficient future in this new application of Electric Science to introduce his two brothers a little later to the Company. The elder brother, William, did not for long remain attached to electrical work.[1] His tastes and abilities

[1] Of an adventurous turn, he went out to Australia a little later. There he died in 1872, leaving a son, Charles Edward, who has done good service in telegraphic administration, and is now Deputy Postmaster-General to the Australian Commonwealth.

ran in other directions; but Edward was always more or less in double harness with Charles throughout their lives. Some time after these two brothers had been



BRIGHT'S TESTING AND FAULT LOCALISATION SYSTEM, 1852

working with the Electric Company they discovered that it was largely under the auspices of that great telegraphic inventor, Mr. (afterwards Sir William) Fothergill Cooke, who was a connection by marriage; but all their successes were effected off their own bat, so to speak, and without the exercise of any personal interest.

Within a year of entering upon this new field, both boys became inventors. Much of their spare time was devoted to thinking over, discussing together, and devising practical improvements on the Cooke and Wheatstone and other systems of telegraphy.

In those days, patent fees of £150 had to be paid, in addition to the heavy charges to patent agents for drafting, drawing, and completing patents. As much as this the brothers could not afford, so they contented themselves, for the time being, with starting a joint invention book, kept under lock and key, into which they, from time to time, entered up drawings, descriptions, and dates. These were afterwards, with several additions, embodied in the famous patent of October 21, 1852.[1] It suffices to say here, that many of the novelties included therein are now in common use after a lapse of forty-five years.[2]

Perhaps the most important of their early inventions was the system, devised in February, 1849, of testing insulated conductors to localise faults from a distant point, by means of a series of standard resistance coils of different values, brought into circuit successively by turning a connecting handle. The preceding drawing, reproduced from the 1852 specification, shows what is even now the best form of resistance coil arrangement in use for testing land and

[1] Patent Specification, No. 14,331 of 1852.

[2] Youthful inventors may not be very uncommon; but how many actually invent anything at the age of seventeen which ever comes into practical use?

submarine telegraphs. Indeed, capital would never have been found for the vast system of submarine cables throughout the world without the aid of this invention, which enables repairing vessels to at once go to the scene of damage, instead of having to pick up and cut the cable here, there and everywhere at haphazard.

The year 1851 saw some important changes in the lives of both the brothers. After having for some time been in charge of the Birmingham station, Charles left the "Electric" Company, and shortly after became Assistant Engineer to the lately formed British Telegraph Company, whilst Edward joined the Magnetic Telegraph Company. Thus, the two brothers became engaged in advancing the early stages of two competing concerns—a curious and novel position. Charles' headquarters were at Manchester, whilst Edward was stationed at Liverpool. As a rule, however, each passed alternate Sundays with the other.

On taking up his new position, Charles Bright was at once engaged in superintending the erection of telegraphs on the Lancashire and Yorkshire and other railways, as well as in connecting and fitting up various telegraph offices for the Company he was serving at that time. The following is a copy of a letter he wrote to the young lady to whom he was now engaged, and who shortly after became his wife :—

British Electric Telegraph Company,
LONDON,
September 5th, 1851.

I received your letter yesterday, but could not answer it, as I was fully occupied until past post time.

You may easily imagine that with 160 miles of line which I have to commence at once, and a great many more directly after—if not nearly at the same time—that I have a great deal to look after. The only person who could assist me, one of the directors, is fully engaged with bringing out a Bill for next Parliament for a new railway line. So I am the only manager of telegraphic detail for the campaign, in addition to which I have some twenty-five long patents to bear in mind as to their separate claims and intentions, so as not to infringe any other people's property.

I look forward to a stormy and active life for the next six months in various parts of the country—a life which I shall go into with pleasure, as I have *you* as the prize to look and hope for. It will not be unpleasant to me—however uncomfortable generally and disagreeable in detail—for, as you know, my aim for some time has been to weave a web of wire in opposition to the monopoly, and, as I cannot do it for ourselves, I am well content to do it for others. Having no stake or responsibility in it, I feel more comfortable perhaps than I should have had we succeeded in establishing a Company, which would have been a case of either make or mar.

I write you these business details, dearest, because I know they will not be tedious to *you*, and because I think you may have wasted your thoughts in speculations as to what I could be doing in London! . . . It is pleasant to be engaged in a work of interest to oneself, and how much more when there is an *object* to be worked for so dear as my own B—— !

You will be glad to hear that there is nothing irksome or unpleasant in my position with the Company. Though very young (I haven't told them *how* young !) I am looked up to, and I have no reason to be dissatisfied. I am treated kindly and like a gentleman, and it is astonishing how much more energetically one can work with such treatment than with that *distance* which is so common between directors and officers of a Company. The promises held out to me at first have been renewed, and I hope I shall hold even a higher position than I was sanguine enough to anticipate ; but of course I do not expect everything at once, or until the directors receive some return—or without some actual work and thought. . . .

On the success of the Magnetic Company being demonstrated, capital was quickly forthcoming for the organisation of a powerful Chartered Company under limited liability, entitled the English and Irish Magnetic Telegraph Company. The headquarters of the new Company were located in Liverpool, where most of the capital was represented.

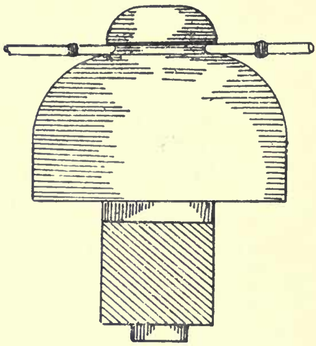
In 1852, the subject of this memoir, when scarcely twenty years of age, was asked by the Board to become their Engineer-in-Chief, which post he accepted, resigning his position on the "British." Edward Bright had been Manager of the Company for some months previously.

It was in this year that the brothers took out their famous patent, to which allusion has already been made. It contained twenty-four distinct inventions connected with telegraphs, and it may be well here to enumerate some of the more important.

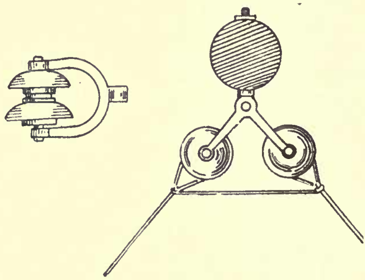
First of all, there was the porcelain insulator for fixing aerial telegraph wires mounted on posts. This has been found to be a highly efficient method of insulation.[1] It was at once adopted on an extensive scale, and, in one form or another, it continues in use to the present day. There was also its adjunct, the shackle or terminal insulator. This is also made of porcelain, and is universally employed for terminations, and whenever the wire has to be taken at

[1] In his article on the "Electric Telegraph," in the *Encyclopædia Britannica*, 8th edition, vol. xxi., the late Lord Kelvin referred to this as "the best idea for a single telegraphic insulator."

an angle—over houses, for instance, round a corner, or in any case where great strains are involved, whether owing to long spans or otherwise.

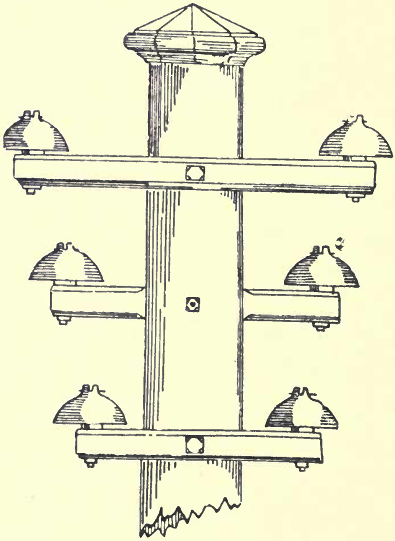


BRIGHT'S INSULATOR



BRIGHT'S SHACKLES

Then followed the now universal system of aeriel telegraph posts with varying length of arms, to avoid the chance of one wire dropping on another.



BRIGHT'S TELEGRAPH POST

After this came the brass tape device for the protection of insulated conductors of subterranean, or submarine, cables.

There was then a translator, or repeater, for re-transmitting electric currents of either kind *in both directions* on a single wire.

Another important item in the above famous master patent was the plan of testing insulated conductors for purposes of fault localisation. This, however, has already been referred to.

There was also a standard galvanometer (foreshadowing differential testing) and a new type-printing instrument, as well as what was then a novel mode of laying underground wires in troughs.

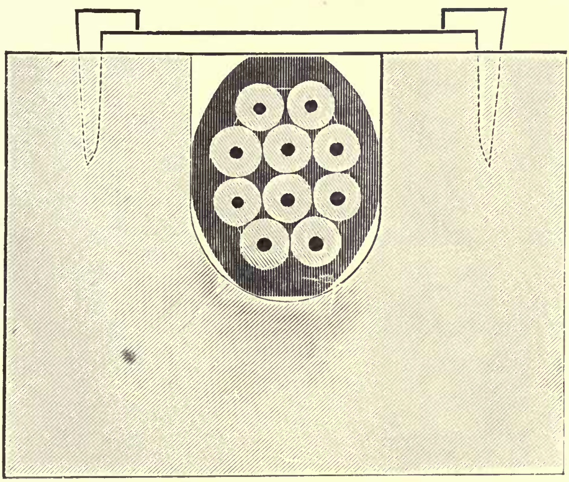
This patent was taken out when the patentees were respectively twenty-one and twenty years of age; but it contained the results of four years' combined thought.

In addition to the labour and experiments associated with the practical application of these improvements for the "Magnetic" Company, during 1852, young Bright directed the completion of a vast telegraphic system throughout the United Kingdom, which had lately been commenced by the Company. This included a main trunk line along the high-roads, consisting of ten gutta-percha-covered wires laid in troughs underground between London, Birmingham and Manchester, thence by railway to Liverpool and Preston, and six wires onwards, also underground, to Carlisle, Dumfries, Glasgow, and Greenock. From Dumfries a branch of six underground wires was laid under the roads to Portpatrick, to meet the Company's Irish cable. In Ireland, the underground system was extended from Donaghadee to Belfast, and thence, via Newry and Dundalk, to Dublin, comprising in all nearly 7,000 miles of wire. Although gutta-percha had been discovered in 1843, and its insulating qualities had been appreciated by Faraday and Werner Siemens as early as 1847, this was the first instance, in our country, in which any length of gutta-percha-covered cable had been laid underground.

Let us now consider the *nature* of this underground system. The form it should take had been very carefully gone into by Charles Bright. It was evident that the integrity of the insulating coatings of gutta-percha could not be preserved long without some external protection throughout the length of each line, as the mere compression of the soil, gravel and stones would have at once injured it ; and in opening the roads for repair they would experience still further damage.

After discussing the merits of various plans of protection, it was finally decided that the wires throughout towns should be deposited in 2½-inch cast-iron piping, divided longitudinally, so that the wires might be laid in quickly without the tedious and injurious operation of drawing through associated with the old system of street work, in which the wires were deposited in ordinary gas-piping. On the other hand, Bright decided that along the country roads—which were comparatively little liable to disturbance from the construction of sewers, or laying of gas or water pipes—the wires should be deposited in *creosoted* wooden troughs of about three-inch scantling, cut in long lengths, so as to be almost free from the chances of damage upon any partial subsidence of the soil. The tops of the troughs were to be protected by fastening to them a galvanised iron lid.

Some idea of the trough system for the public highways may be gathered from the accompanying sketch. The gutta-percha-covered wires were deposited in the square, creosoted wooden trough (shown below), after being bound together by a lapping of tarred yarn. To deposit the rope of insulated conductors in the trough it was first coiled upon a large drum, and this was then rolled slowly over the trench, which had a depth of some three feet. The rope of wires was paid off easily and evenly into its bed. The galvanised iron lid, about an eighth of an inch thick, was then



BRIGHT'S UNDERGROUND SYSTEM

fastened on by clamps (see illustration), and the trench filled in again.

The method adopted in the case of underground wires laid in iron troughs under the streets of towns must now be described in some detail ; for it was in connection with the application of this at Manchester that young Bright was first brought into public notice about this time (1852), over what was rightly recognised as a remarkable feat.

It was essential that the traffic of so busy a city should be interrupted as little as possible. Charles Bright did not interrupt the traffic at all. In one night he had the streets up, deposited the wires, and had laid the pavements down again before the inhabitants were out of their beds in the morning. He was then but nineteen, and received great credit in the public journals, notably in *The Times*, which made this piece of work the subject of a leading article.

The following arrangements for the night's work go to show the prescience and energy characteristic of him. A large number of navvies were engaged, with competent foremen. To each gang was assigned a given length of street, along which the flagstones were to be lifted, the trench opened to the requisite depth, and the under-halves of the pipes laid and linked at the bottom. Another gang at once followed, wheeling the drum (whose breadth exceeded that of the trench), and unwinding the rope of wires into the under-halves of the pipes previously laid down. A further gang followed for applying, linking, and tightening the upper-halves of the pipes, while yet another set of men filled up the trench and replaced the flags. This operation, though easily described, required at this early stage of telegraphy a great deal of consideration, coupled with very active and determined control throughout the short night.

The following letter, addressed by young Bright to his *fiancée*, will be of interest here, as picturing the scene:—

MANCHESTER,
September 11*th*, 1852.

Your letter did not arrive until last evening. I should have written sooner, but have been very busy. Last night I spent entirely out of doors, and as I have not been able to get any sleep since, I shall not write long now. . . . It is the third bedless night I have had lately, and I expect two more next week.

I was at Liverpool last night, getting our wires from the station to our offices in the Exchange. From the great traffic during the day, it is impossible either in Liverpool or Manchester to do anything by *day*, and unless I keep a sharp eye on the men, either the pipes are laid too near the surface, or they break gas or water pipes and cause expensive repairs. Moreover, they never do a third of the work at night unless I am with them!

Last night I did the quickest piece of telegraphic work which has ever been done. We began at ten, and by eight in the morning we had laid piping containing eight wires under the streets nearly half a mile, and all repaved.

Can you fancy such a scene? A long row of men with pickaxes, followed by others with spades, and after them a gang of men laying pipes and wires, and, to conclude, another set re-laying the paving-stones. This row of workmen are lighted up by large fire-grates at intervals, flaring and smoking away like beacons on the coast—a perfect Babel of voices—the continual sharp knocking of the pickaxes and the scraping and clanging of the pipes being laid and hammered up, added to continued shouting for this or that tool. If you can conjure up this, you can fancy my figure appearing in the light here and there with two or three foremen—quite in my element, only I don't like the night. I expect you would be very much alarmed if you were unexpectedly awoke by such a noise and looked out on such a scene! . . .

I tell you all about my night's doings, because I was pleased at the speed, which I had previously calculated on doing it in. The plan was a new one of my own. . . .

One of Bright's assistants has described how his chief wrote out instructions to the minutest details, even to the extent of stating where the vessels of pitch were to be placed, besides specifying the temperature of the mixture and that it was to be tested before being run into the trough.[1]

Charles Bright subsequently carried out the same work through the streets of London, Liverpool and other large towns.

The great advantage gained in laying these main trunk lines underground was that they were thereby absolutely beyond the reach of damage by stormy weather.

Thus it was that the "Magnetic" Company became at once a prosperous and successful company; but Charles Bright also personally directed the erection of overhead wires on the following railways:—The East Lancashire, Caledonian, Midland, Great Western, Great Southern and Western, Waterford and Limerick, Dublin and Drogheda, Belfast Junction, Ulster, County Down, Belfast and Coleraine, Londonderry and Enniskillen, Londonderry and Coleraine.

The Journal of the Institution of Civil Engineers, in its obituary notice,[2] contains the following testimony in regard to these undertakings: "All this work, both overhead and underground, entailed a vast amount of energy and perseverance on the part of Sir Charles Bright, and many are the stories related of the difficulties overcome in the rapid progress of the underground work."

The summer of 1853 saw great events in Charles Bright's

[1] Since the original edition, attention has been called in the House of Commons, as well as in the Press, to this striking work of young, nineteen-year-old, Bright, à propos of the disturbance to traffic often nowadays experienced in the height of the London season.

[2] *Mins. Proc. Inst. C.E.*, vol. xciii., part iii.

life. He married, at the age of twenty-one, Miss Taylor, daughter of Mr. John Taylor, of Bellevue, Kingston-upon-Hull, to whom he had for some time been devotedly attached. Mr. Taylor was head of one of the leading mercantile firms in Hull. Like the Brights, the Taylors, and their ancestors the Willots and the Gills, came originally from the West Riding of Yorkshire. Charles Bright's *fiancée* was one of the youngest in a family of nine. The young couple had become engaged nearly two years previously. They had met first while staying with mutual cousins, the Henry Brights, near Hull. The wedding took place on May 11th, 1853, at St. James', Hull. These young people started life together on an income of about £250. Later on they often looked back with pleasure on those early days of comparative poverty, which were, nevertheless, some of the happiest of their married life.

In that year (1853) the first effective cable to Ireland was made, under Bright's supervision, by Messrs. Newall & Company, of Gateshead, and laid between Donaghadee, in Ireland, and Portpatrick, in Scotland. This undertaking is dealt with in the next chapter.

At the outset of the "Magnetic" Company's operations, the brothers found it necessary to devise fresh apparatus to compensate for the inductive discharge resulting from the long underground circuits, by discharging to earth and thus neutralising the recoil currents. From that time till the spring of 1854 they carried out a series of experiments on the great lengths of subterranean wires under their control, in order to investigate this novel phenomenon, with a view to working through an Atlantic cable. This had been the great object which Charles Bright had in view in pushing on the Company's extension in the West of Ireland, his idea being at the time that a point between Limerick and Galway would be the most suitable landing-place for the cable. Some of the results of these researches were detailed and illustrated experimentally by Edward Bright, at a meeting of the British Association at Liverpool, in 1854,[1] in an address on "The Retardation of Electricity through Long Subterranean Wires."

During 1854, the brothers were heavily burdened, Charles in completing the enormous network of telegraphic wires —thousands of miles in all—that had been constructed under his direction with such wonderful rapidity throughout the kingdom; and Edward in acquiring and fitting up the stations, organising the staff, making rules and regulations for the service, arranging message tariffs and supply of news to the Press, etc.

Time was nevertheless found for other work. They engaged in experiments with the late Mr. Staite, on the electric light—then in its absolute infancy. Mr. Staite's arc lamp had been exhibited for some months on the Liverpool Landing Stage, till the pilots complained (as well as the steamboat captains) that it dazzled them and hindered their steering on the river Mersey.

At this period, both the brothers materially aided the late Admiral Fitzroy in the inauguration of his plan of daily telegraphic reports in connection with the newly-born Meteorological Department of the Board of Trade, and

[1] See *British Association Reports*, 1854.

the storm-warning system which the Admiral had organised. They arranged for the requisite barometers, thermometers, wind gauges, etc., to be set up at a number of the Magnetic Company's stations, especially in the West of Ireland and Scotland, including Cape Clear, Limerick, Tralee, Galway, Portrush, Ayr, Ardrossan, etc., where coming changes of weather are, as a rule, first indicated from the Atlantic. The "Magnetic" staff were duly instructed in the taking of observations twice daily. These were then telegraphed to the Meteorological Office in London by means of a concise code, drawn up by Admiral Fitzroy and Charles Bright, with a view to expediting the messages by reducing their length, as it did, by about one-fifth. Although at the outset these weather forecasts were somewhat tentative and were much derided, their vast utility in lessening the danger to life at sea was not long in being recognised, and the forecasting of the weather has now, by dint of experience, become almost an exact science.

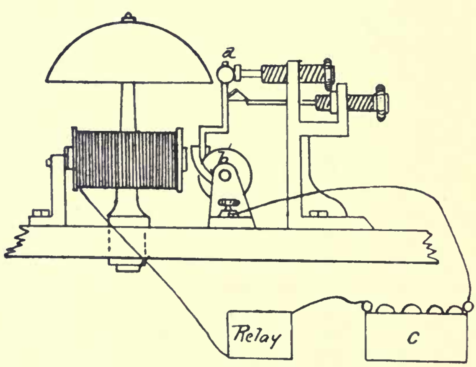
At the end of the year 1855 a revolution was effected in the telegraphic apparatus used by the "Magnetic." This company had up to the period in question employed Henley's magneto-electric telegraph instruments. Young Bright, however, perceiving the objection to any instrument based on visual signalling, set to work to devise an apparatus which would communicate signals to the ear. The result was that in 1854 he produced the Acoustic Telegraph, since commonly known as "Bright's Bells."

The cardinal features of this invention (Patent Specification No. 2,103 of 1855) were set forth in Noad and Preece's *Student's Text Book of Electricity*, as follows :—

Under the ordinary system of telegraphing, it is necessary to employ a transcriber to write down the words as interpreted from the visual signals and dictated to him by the receiving operator, whose eyes being fixed on the rapidly moving needles could not be engaged in conjunction with his hands in writing. It was found that, owing to the frequent occurrence of words *of nearly similar sound,* the transcriber sometimes unavoidably misunderstood the meaning of the receiving operator, and altered the sense of the despatch by writing the wrong word. Such words as two, too, to ; four, for ; hour, our, etc., may, for instance, be very easily confounded. These errors cannot, however, arise when the clerk, who, having heard each word pass through the acoustic telegraph *letter by letter,* is able—his eyes being at liberty—to himself write what he has received without the aid of an amanuensis. Besides the saving in staff (of writers) and in mistakes, any injury to the eyes of the clerks is prevented, and an appeal is made to an organ far better capable of endurance and accurate interpretation.

The general principle of the instrument consists in the sounding of two bells of different pitch by different currents. The letters and words are readily formed from the difference in their tone and the number of beats, the same (Morse) alphabet being employed as in other telegraph systems.

The nature of the apparatus is shown in the accompanying illustration :—



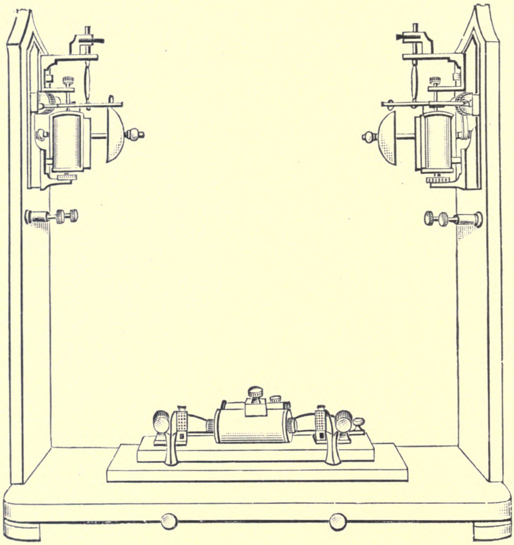
BRIGHT'S BELL INSTRUMENT

a is the hammer of the bell, held back to a stop by a flexible spring. The rod of the hammer is fixed to the projecting horns of the movable soft iron core of an electro-magnet *b′*. This electro-magnet *b′* is placed opposite to a fixed horse-shoe electro-magnet *b*; and the connections are so arranged that, on the current passing from the relay, the electro-magnets are polarised with their opposite poles to one another. Upon a current passing, the bell affected is at once struck, and the bell being muffled so as to produce a short sound, the blow may be repeated as rapidly as desired without any vibration caused by one sound interfering with that succeeding it.

A local battery supplies the mechanical power required to strike the bells. The battery is put in connection with either bell, according to the current—positive or negative—passed through a relay, shown in the next illustration, where also may be seen the general arrangement. Here, the receiving clerk—with his head between the two different toned bells, each fixed to a wooden partition—can readily distinguish the signals corresponding to the beats of the needle. As fast as he does so, he writes down their significance.

The keys with which currents are sent to work this apparatus are of a simple commutating form. By pressing down one lever, the current is made to pass in one direction, and in the reverse when the other lever is used.

This form of telegraph, like the Morse (sounder or writer) and other instruments of to-day, requires only one wire. In point of speed, however, it has a great advantage, as it utilises both positive and negative currents, while the Morse is only available for one current. Thus, the acoustic instrument only occupies in the transmission of the alphabet about half the time of the American apparatus, and is, moreover, much faster[1] than any type of visual telegraph (except, of course, those worked on the Wheatstone automatic system), for reasons already explained. It is also far more accurate. So simple and yet speedy in its working, this



BRIGHT'S ACOUSTIC TELEGRAPH

invention in still in extensive use, mainly owing to the great increase in press messages.

During 1855, young Bright thought out another important invention with his brother. This consisted of a system of duplex telegraphy, fully described in the same specification. This was worked successfully between London and Birmingham. As, however, the "Magnetic"

[1] A speed of forty words a minute is frequently attained.

Company's traffic did not then fill their wires, the system was temporarily laid on one side.

During the year 1856 some of the Magnetic Company's underground lines began to give trouble. The authorities thereupon set themselves to consider how they could best extend their overhead system. This culminated in the absorption of the British Telegraph Company, which had exclusive rights for overhead telegraphs along the public roadways. After the above amalgamation, the underground wires were only used in places where circumstances rendered them specially desirable. The new "Magnetic" had an agreement with the Submarine Telegraph Company, under which the whole of the latter's cables were to be worked in connection with the land lines belonging to the former.

Charles Bright remained engineer-in-chief to the Magnetic Company until about 1860, from which time (owing to press of other work) he held a consulting position only. Thereupon Edward Bright assumed the engineership in addition to the general management.

The business of some of the early telegraph companies with which Charles Bright was connected flourished so well that they were able to pay dividends as high as 15 per cent. per annum, the Magnetic Company maintaining a steady dividend of not less than 12 per cent. for a number of years.

CHAPTER IV

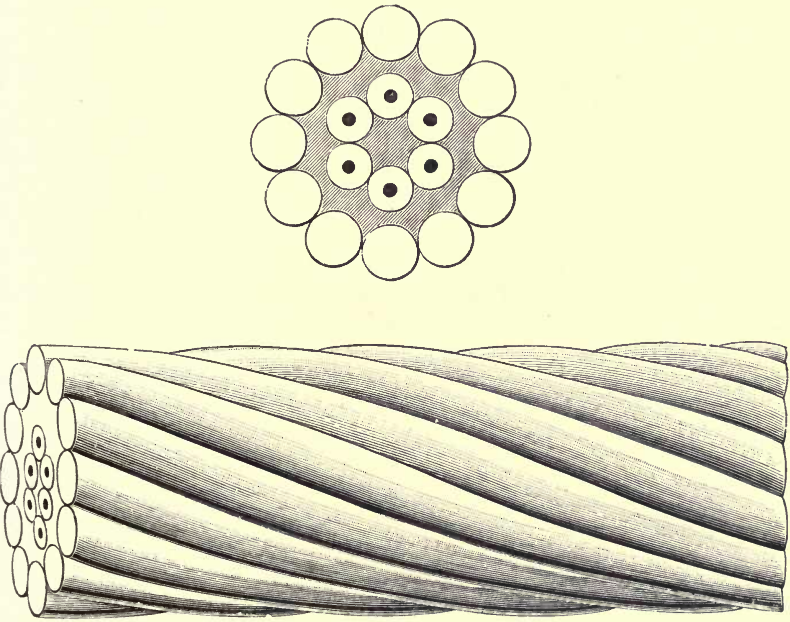
The Cable to Ireland

AT the date of the first cable to Ireland, two submarine cables had already been submerged.[1] The first serious attempt was that projected and primarily promoted by the brothers Brett; this was eventually carried to a successful issue in 1851, by Mr. Thomas Russell Crampton, a civil engineer of distinction. Prior to these, in 1849, an experimental line with a gutta-percha core had been laid by Mr. C. V. Walker, F.R.S., in the English Channel, for some distance off Folkestone. Also in the following year, another unprotected gutta-percha insulated conductor had been laid between England and France by Mr. Charlton Wollaston, acting as engineer to the Submarine Telegraph Company. Through want of armoured protection, both of these latter failed to be effective. The second successful line was that between Dover and Ostend, being also on behalf of the Submarine Telegraph Company.[2] Thus

[1] *Submarine Telegraphs: Their History, Construction and Working.* By Charles Bright, F.R.S.E., A.M.Inst.C.E., M.I.Mech.E., M.I.E.E. (London: Crosby Lockwood & Son, 1888).

[2] Since Bright's death this Company's cable system has been absorbed by the State and worked by H.M. Post Office. The transfer of the business took place in 1889, and has proved a serious matter pecuniarily to Sir Charles' family. The late Sir Julian Goldsmid, as chairman, did his best to bring about a satisfactory arrangement; but, in the end, the Company and its shareholders came off very poorly at the hands of the Government.

Bright's line to Ireland was the third submarine cable communication successfully carried out. It was, however, in much deeper water than had hitherto been experienced.[1] As three previous attempts (made by others) to lay a line across the Irish Channel had failed, every care was taken to ensure success.



THE ANGLO-IRISH CABLE, 1853

An important improvement was effected in the design of this cable as compared with what immediately preceded

[1] Referring to this line in subsequent years, the late Lord Kelvin—when speaking in regard to the proposed memorial to the Inception of Submarine Telegraphy—remarked:—"Thus, Sir Charles Bright was the first to successfully lay a cable in really deep water."

it. In this case an inner bedding of yarn was supplied for the six insulated wires (see illustration). The total weight of the cable was seven tons to the mile. The manufacture was carried out unaccompanied by any serious mishap. As fast as it was made, it was coiled up on the wharf ready for shipment. When the time for shipment came, the massive six-core cable was stowed away in the hold of the laying vessel in an oblong coil.

It so happened that the submergence of this line had to take place during the days closely following upon Charles Bright's marriage. The expedition was graced by the presence of his bride, who was thus able to assist at the telegraphic union of Great Britain and Ireland. The expedition consisted of the screw steamer *William Hutt* (with the cable and apparatus on board), the *Conqueror*, and the *Wizard*. The ships were under the navigation control of Captain Hawes, R.N., especially appointed by the Admiralty. Beside young Bright and his bride, there were on board during the expedition:—Mr. Newall, the contractor; Mr. Statham, of the Gutta-Percha Company; Mr. William Reid, and Mr. T. B. Moseley.

Starting operations from the Irish coast, the shore end of the cable was first landed at a point about two miles from the south of Donaghadee Harbour, Co. Down, and the laying of the deep-sea cable was then proceeded with. This undertaking was not, however, without its vicissitudes. The arrangements and apparatus then employed for submerging a cable were, it need scarcely be said, not of the complete character with which experience has endowed us to-day. Each coil was turned bodily over by the men below to take the turn out in emerging to the guide pulley above, whence it passed through a rotometer, or speed measurer, to a large drum on deck. Round this drum it took several turns before passing into the sea over an iron rail at the stern. The drum was fitted with a flexible iron strap on its circumference, attached to a lever hand-brake, to check the cable's rate of delivery outboard. Without this precaution, in the deeper water (nearly a quarter of a mile in places) the heavy monster would have "taken charge" altogether. As it was—when a heavyish sea arose about midway across—notwithstanding the efforts of the man in the hold, one turn got on several occasions under another, making a "foul flake," which would pass up in a tangled mass. This necessitated the stopping of the ship and a temporary cessation of paying-out operations till the great knot was unravelled. Such an operation as this is no easy matter when the extreme rigidity of this heavily armoured cable, with its twelve stout iron wires, is considered.

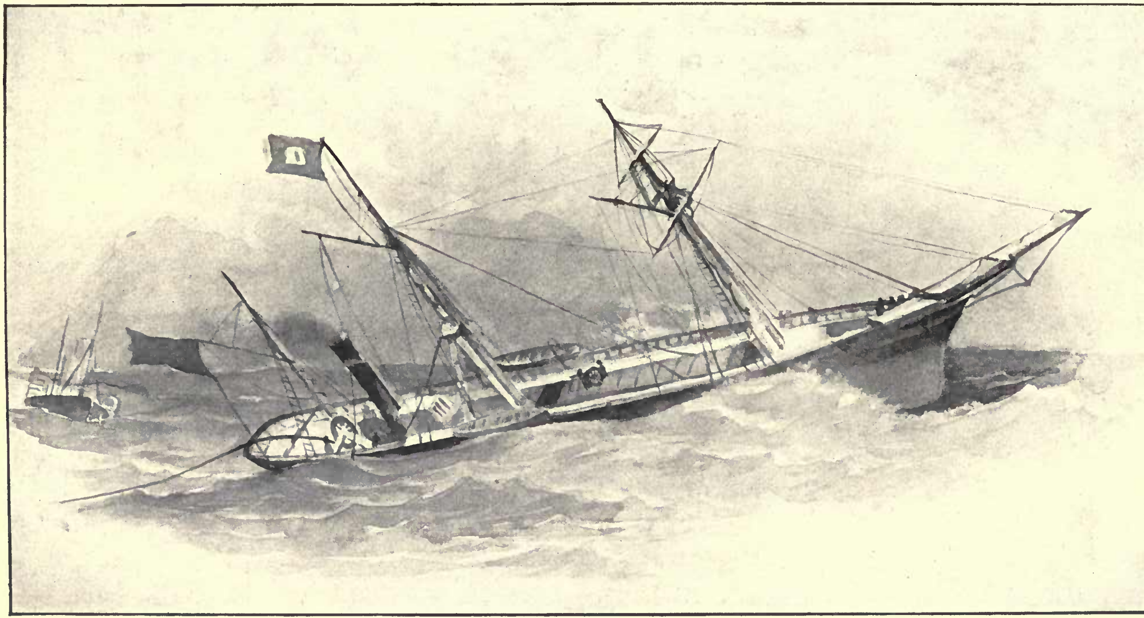
Thus it was that the expedition did not arrive and anchor off Port Patrick, on the southern border of Wigtownshire, until midnight, the landing of the shore end being deferred till the following morning. This final operation was performed, amid much enthusiasm, in Mora Bay, a little to the north of Port Patrick. As soon as the cable end had been taken up to the position assigned for it, the signalling apparatus was put into operation, and the following message despatched to Dublin :—

MORA BAY, PORT PATRICK,
May 23rd, 1853.

The Directors of the British and Irish Magnetic Telegraph Company beg to acquaint His Excellency the Lord Lieutenant that they have this morning successfully effected communication between the shores of Great Britain and Ireland by means of a submarine cable from Port Patrick to Donaghadee.

The cable lasted, with slight repairs, for many years—up to, and long after, the purchase of the Magnetic Company's lines by Government, in 1870.

In later years, when referring to this expedition, Sir Charles Bright used to humorously remark that, so long as we had telegraphic communication with Ireland, there could be no possible need for discussing the question of Irish Home Rule.



LAYING THE FIRST CABLE TO IRELAND, 1853

CHAPTER V

The Atlantic Cable

SECTION I

Investigations and Stepping-Stones

WE now come to the most arduous, as well as the most interesting and memorable achievement of Charles Bright's career, namely, the telegraphic linking of England and America by submarine cable.

In *A Midsummer Night's Dream*, Shakespeare makes Puck say, " I'll put a girdle round about the earth in forty minutes ! " Though little Puck never carried out his boast, the subject of our memoir in the undertaking here referred to went some way towards realising it in practice. From this he acquired such fame, whilst only twenty-six years old, as few men engaged in carrying out the great works of the world can ever hope to attain. This achievement was characterised by *The Times* as " the accomplishment of the age," and by Prof. Morse as " the great feat of the century."

The part Bright took in this then unprecedented enterprise included the scientific demonstration of its practicability, the projection, the provision of capital, the organisation, and the ultimate successful laying of 2,200 miles of cable across ocean depths of two to three miles, in the face of storms, repeated breakages, and every kind of difficulty. By his scientific knowledge, ingenuity, and determined pluck, he carried it through at a time when only a few short cables had been successfully laid—mostly in comparatively shallow water—and when the art of submarine cable work was in its infancy as regards construction, insulation, and mechanical appliances. Nothing so daring as a cable laid in an open seaway had, in fact, yet been attempted; and in his Presidential Address to the Institution of Electrical Engineers, in 1889, Lord Kelvin, referring to this undertaking, said: "We must always feel indebted to Sir Charles Bright as the pioneer in that great work, when other engineers would not look at it, and thought it was absolutely impracticable." Many at Bright's age would have flinched at the responsibility with so limited an experience.

Before the Atlantic Telegraph could assume a practical shape, the following had to be effected [1]:—

1. Ocean soundings, showing the depths and nature of the sea-bottom, required to be taken and placed on record.

2. Experiments had to be made to prove that a conductor, insulated with gutta percha, and of the necessary length (over 2,000 miles), could be signalled through for telegraphic purposes.

3. A suitable form of cable for the specific purpose must be designed.

4. Provision had to be made to prevent competition, so that—for some time, at least—a fair return might accrue to those who staked their capital in what then appeared so risky an enterprise.

5. The confidence of the moneyed mercantile class—who would

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[1] *The Story of the Atlantic Cable.* By Charles Bright, F.R.S.E., M.I.E.E. (London: George Newnes, Ltd., 1903).

mostly benefit by such a means of communication—required to be won ; and

6. Government recognition had to be obtained, and, if possible, Government subsidies.

Lieutenant O. H. Berryman, U.S.N., had run a line of deep-sea soundings in the Atlantic basin between Newfoundland and Ireland in the summer of 1856, from the U.S. steamer *Arctic*. The soundings gave a general depth of about two miles and a half, gradually shoaling on the Newfoundland side, but rising more quickly towards the Irish shore. The entire route was marked by an oozy bottom, of which specimens brought to the surface were shown under the microscope to consist of the tiny shells of animalcula—the indestructible outside skeletons of *diatomacea* and *foraminifera*. No sand or gravel was found on the ocean bed, from which it was deduced that no currents or other disturbing elements existed at those depths. The plateau, or ridge, which extended for some 400 miles in breadth, was, in fact, considered a veritable feather-bed for a cable, when once weather and other conditions allowed of its safe submersion. Lieut. M. F. Maury, U.S.N., Chief of the National U.S. Observatory—to whom the observations and results of Lieut. Berryman were referred—made a long report to the Secretary of the U.S. Navy, dated February 22, 1854, in which he remarked :—

This line of deep-sea soundings seems to be decisive on the question of the practicability of a submarine telegraph between the two continents, *in so far as the bottom of the deep sea is concerned*. From Newfoundland to Ireland the distance between the nearest points is about 1,600 miles ; and at the bottom of the sea between the two places there exists a "plateau," or shallow platform, which seems to have been placed especially for the purpose of holding the wires of a submarine telegraph, and of keeping them out of harm's way. . . . But whether it would be better to lead the wires from Newfoundland or Labrador is not now the point at issue; noi do I pretend to consider the question as to the possibility of finding *a time calm enough, the sea smooth enough, a wire long enough, or a ship big enough* to lay a coil of wire sixteen hundred miles in length. Still, I have no fear but that the enterprise and ingenuity of the age, whenever called upon to solve these problems, will be ready with a satisfactory and practical solution of them.

Similar conclusions to these were arrived at from the soundings taken in the North Atlantic by Commander Joseph Dayman, R.N., in H.M.S. *Cyclops*, a little while later.

The possibility of laying an Atlantic line had taken firm hold in the mind of Charles Bright, ever since the successful laying of the cables to France, Ireland, and Belgium. Between 1853 and 1855, he and his brother Edward had (as already stated) carried on an extensive series of experiments on the great lengths of underground gutta-percha-covered wires under their management. In these wires the conditions were similar, electrically speaking, to those existing in the case of a submarine cable. By linking the wires to and fro between London and Dublin—including the conductors of one of the Irish cables—or employing the ten wires between London and Manchester, Charles Bright was enabled to extend these investigations until the total length under test was upwards of 2,000 miles. He was thus able to determine the practicability of working through a cable of the length required to connect Ireland with Newfoundland.

To avoid interrupting the traffic, the experiment had to be made during the night, or on Sundays. Hence, on many occasions, young Bright was unable to return home at the end of a heavy's day work.

The inductive effect observed in the earlier stage of these trials was then an entirely novel phenomenon, as was also the consequent retardation of the current. In 1855, the practical results of these researches were included in a patent taken out by Charles Bright and his brother for signalling through long distances of gutta-percha-insulated conductors by the employment of alternating currents.

During these years the Magnetic Company's system had been completed by Bright through Ireland, and extended to the West Coast at various points, including Limerick, Galway, Sligo, Portrush, Tralee, and Cape Clear Island. The wires were erected mostly on the railways and under exclusive agreements ; and a few miles' extension from one or other of these stations would suffice to connect the system to an Atlantic cable.

While Charles Bright was engaged on the completion of his experiments preliminary to the great Atlantic work, his brother—accompanied by some of the "Magnetic" staff—took an opportunity of surveying, in the summer of 1855, the westernmost part of the Irish coast in a fishing smack, for the purpose of ascertaining the best landing-place for the proposed cable. The main conditions required by Bright were :—

(1) Freedom from anchorage.
(2) Shelter from rough weather.
(3) A smooth bottom for the heavy shore end of the cable, and the deeper part at the approach clear of rocks.

Various small harbours and bays between Bantry Bay and Ventry Harbour were examined; also Doulas Bay, Valentia, leading up to the Cahirciveen on the mainland. Valentia Harbour was eventually considered to best comply with requirements—beside being almost the nearest point to the outstretched hand of Newfoundland—and Edward Bright reported accordingly to his brother Charles.[1]

Whilst Ireland was thus telegraphically equipped as the great stepping-stone on this side of the ocean, matters on the American side were not so far advanced. The work there was much heavier, for it involved a long land telegraph across Newfoundland over a very wild country.

In 1852, Mr. Frederick Newton Gisborne, an English engineer, in concert with a small American syndicate, had obtained an exclusive concession and sole cable landing rights for thirty years in Newfoundland, subject to the erection of a line between St. John's and Cape Ray in the Gulf of St. Lawrence, whence news and messages were to be passed to and from Cape Breton, on the other side of the Gulf, by steamer or carrier pigeons. A few miles of cable were made in England, and laid between Prince Edward Island and New Brunswick with much difficulty. Mr. Gisborne

[1] The selection has been abundantly justified, as may be gathered from the number of Atlantic cables since landed there, or in the immediate vicinity.

then surveyed the route for the Newfoundland line, and even erected about forty miles of it. At this stage, his American associates stopped supplies. When in New York, in 1854, however, Gisborne was fortunately introduced to Cyrus West Field, a retired Merchant. Mr. Field was a man of sanguine temperament and intense business energy [1]; and having caught on to the idea of the Atlantic Cable, had the acumen to recognise the importance of turning to useful purpose the exclusive rights granted to Mr. Gisborne. He formed a strong syndicate with half a dozen friends, and procured a concession with improved terms.

Armed with this apparent monopoly, but as his brother, Mr. Henry Field, expressed it, "with no experience in the business of laying a submarine telegraph," the presiding genius of this Newfoundland Company was despatched to England at the end of 1854, where he ordered a cable of about eighty miles, to span the Gulf of St. Lawrence between Cape Ray and the Island of Cape Breton. There he became acquainted with Mr. John Watkins Brett, who, with his brother Jacob, had taken the foremost part in establishing the first lines to France and Belgium. In the spring of 1855, Mr. Brett took £5,000 in shares and bonds in the "Newfoundland" Company, thus becoming a partner on equal terms with Mr. Field and the other members of the syndicate.

The attempt to lay the Cape Breton cable was a failure,

[1] In his 1887 Inaugural Address to the Society of Telegraph Engineers (now the Institution of Electrical Engineers), Sir Charles described Mr. Field as "rapid in thinking and acting, and endowed with courage and perseverance under difficulties—qualities which are rarely met with" (see *Journal I.E.E.*, vol. xvi., p. 7).

partly owing to rough weather. But in the following year the Contractors (Messrs. Glass, Elliot & Co.) successfully accomplished the task; and in 1856 the aerial land line was stretched across Newfoundland.

Thus, then, the series of stepping-stones were now also completed on the American side.

Section 2

Formation of the Company and Construction of the Cable

The next step towards the realisation of the enterprise, in which Charles Bright's energy was centred, had better be told in his own words: [1]

In July, 1856, Mr. Cyrus Field, the deputy-chairman of the New York and Newfoundland Telegraph Company, left America for London, empowered by his associates to deal with the exclusive concession possessed by that Company for the coast of Newfoundland and other rights in Nova Scotia. He had been here before about telegraph business, and I had discussed the Atlantic line with him in the previous year.

On September 29th, 1856, an agreement was entered into between Mr. Brett, Mr. Field, and myself, by which we mutually, and on equal terms, engaged to exert ourselves *with the view to, and for the purpose of, forming a Company for establishing and working of electric telegraphic communication between Newfoundland and Ireland, such Company to be called the "Atlantic Telegraph Company," or by such other name as the parties hereto shall jointly agree upon.*

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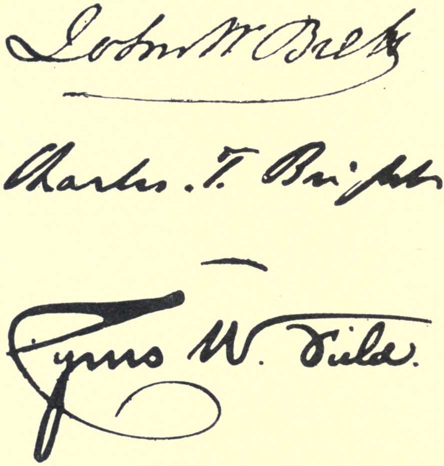
[1] Sir Charles Bright's Presidential Address to the Society of Telegraph Engineers and Electricians, 1887.

We here reproduce the signatures as they are at the foot of this agreement :—



The above "promoters and projectors" were a little later joined by Mr. Edward Orange Wildman Whitehouse, originally a medical practitioner. Mr. Whitehouse had been engaged for some time upon experiments similar to those on which the brothers Bright had worked, with a view to overcoming the difficulties incidental to long distance ocean telegraphy.

The time had now come for action. As a result of considerable discussion, the two Governments concerned came to recognise the grandeur and feasibility of this undertaking for linking together the two English-speaking nations, and the benefits it would confer upon humanity. Both the English and United States Governments gave a subsidy, which jointly amounted to eight per cent. on the capital, but payable only while the cable worked.

The Atlantic Telegraph Company was registered on October 20th, 1856.

The Magnetic Company, under the management of Charles Bright, had proved a success from its foundation in 1852. The lines had been constructed, and the staff trained, under his supervision; while the improved telegraphic apparatus, and appliances employed, were devised by him. The headquarters were in Liverpool; and the shareholders were composed of the leading merchants and shipowners there, as well as in Manchester, London, Glasgow and Dublin. The Magnetic Company's Board was composed of practical business men, who fully appreciated the immense advantages which direct communication with America would bring them, not only as regards their trade, but on account of increased traffic over the "Magnetic" lines, which alone extended through Ireland. The directors had also acquired thorough confidence in their comparatively youthful engineer, whilst appreciating the value of the experiments and scientific investigations which he had carried out.

The first meeting of the "Atlantic" Company was convened for November 12th, 1856, at the Underwriters' Rooms in the Exchange, Liverpool, by a small circular, on a half-sheet of notepaper, issued by Mr. Edward Bright from the Magnetic Company's chief office. Most of the enterprise, influence, and wealth of the town were represented, and the inspiriting addresses of Messrs. Field and Brett, accompanied by the scientific explanations (and answers to questions) of Charles Bright, were exceedingly well received.

So much enthusiasm had been aroused by the experiments and explanations already alluded to, that in the course of a few days the entire capital was raised by the issue of 350 shares of £1,000 each, chiefly taken up by the shareholders of the Magnetic Company. The public lists were opened at the latter's headquarters in the Exchange, Liverpool, and at their other principal offices. The first to put down their names were Charles Bright and two old friends, Mr. Joseph Hubback (Mayor of Liverpool), and Mr. Charles Pickering (of Messrs. Schroder & Co.), the two former for £2,000 each, and the latter for £6,000. Subsequently, Mr. J. W. Brett, who was a man of wealth, took up shares to the value of £25,000, Mr. Field following his example for a similar amount.

The formation of the Company was absolutely unique at the time, and formed a fit complement to the grandeur of the enterprise. There was no promotion money; no prospectus was published. There were no advertisements, no brokers, and no commissions were paid; nor were there either board of directors or executive officers. The election of a Board was left to a meeting of shareholders, to be held after the allotment of shares had been made by a provisional committee. Any remuneration of the projectors was made wholly dependent upon, and subject to, the profits of the shareholders amounting to 10 per cent. per annum, the surplus being then divided between the promoters and the Company.

To show the interest taken in the scheme, even those entirely unconnected with business took shares, among others being the widow of Lord Byron, and Mr. Thackeray the author.

Mr. Field had reserved £75,000 for American subscription, for which he signed, in addition to what he took for himself; but his confidence in his compatriots turned out to be greatly misplaced. The result has been thus told by Mr. Henry Field[1]:—

> In taking so large a share it was not his intention to carry this load alone. It was too large a proportion for one man. But he took it for his countrymen. He thought one-fourth of the stock should be held in this country (the United States) and he did not doubt, from the eagerness with which three-fourths had been taken in England, that the remainder would be at once subscribed in America.

It was only, in fact, after much trouble that subscribers were obtained in America for a total of twenty-seven shares—or less than one-twelfth of the total capital. The faith of the Americans in the project proved to be small; for—notwithstanding their confessed enthusiasm—they certainly did not readily rise to the occasion, and when they did so it was only after considerable pressure.

The negotiations with Government led to important results, which were thus embodied in a letter:—

> TREASURY CHAMBERS,
> *November* 10*th*, 1856.
>
> SIR,—
>
> Having laid before the Lords Commissioners of Her Majesty's Treasury your letter of the 15th ult., addressed to the Earl of

---

[1] Brother of Mr. Cyrus Field. He subsequently wrote an animating description of the enterprise.

Clarendon, requesting certain privileges and protection in regard to the line of telegraph which it is proposed to establish between Newfoundland and Ireland, I am directed by their Lordships to inform you that they are prepared to enter into a contract, based upon the following conditions, viz.—

1. It is understood that the capital required to lay down the line will be (£350,000) three hundred and fifty thousand pounds.

2. Her Majesty's Government engage to furnish the aid of ships to take what soundings may still be considered needful, or to verify those already taken, and favourably to consider any request that may be made to furnish aid by their vessels in laying down the cable.

3. The British Government, from the time of the connection of the line, and so long as it shall continue in working order, undertakes to pay at the rate of (£14,000) fourteen thousand pounds a year, being at the rate of four per cent. on the assumed capital, as a fixed remuneration for the work done on behalf of the Government, in the conveyance outward and homeward of their messages. This payment to continue until the net profits of the proposed Company are equal to a dividend of six pounds per cent. per annum, when the payment shall be reduced to (£10,000) ten thousand pounds a year, for a period of twenty-five years.

It is, however, understood that if the Government messages in any year shall, at the usual tariff charged to the public, amount to a larger sum, such additional payment shall be made as equivalent thereto.

4. That the British Government shall have a priority in the conveyance of their messages over all others, subject to the exception only of the Government of the United States, in the event of their entering into an arrangement with the Telegraph Company similar in principle to that of the British Government, in which case the messages of the two Governments shall have priority in the order in which they arrive at the stations.

5. That the tariff of charges shall be fixed with the consent

of the Treasury, and shall not be increased, without such consent being obtained, as long as this contract lasts.

I am, Sir,

Your obedient servant,

JAMES WILSON.

The first meeting of shareholders took place on December 9th, 1856, and a board of directors was elected. The first chairman was Mr. Brown, M.P. (afterwards Sir William Brown, Bart.), Mr. Samuel Gurney, M.P., and after him Mr. T. H. Brooking, being deputy-chairman, whilst Mr. Lampson (later Sir Curtis Lampson, Bart.) was vice-chairman. At a subsequent date the chair was occupied by the Right Hon. James Stuart-Wortley, M.P.

To instance the large part taken by the Magnetic Company in this undertaking, no less than ten of the Board of the "Atlantic" were also directors or shareholders of the "Magnetic," prominent amongst them being Mr. Brett and Mr. (afterwards Sir John) Pender, who was ultimately associated with so many cable enterprises.

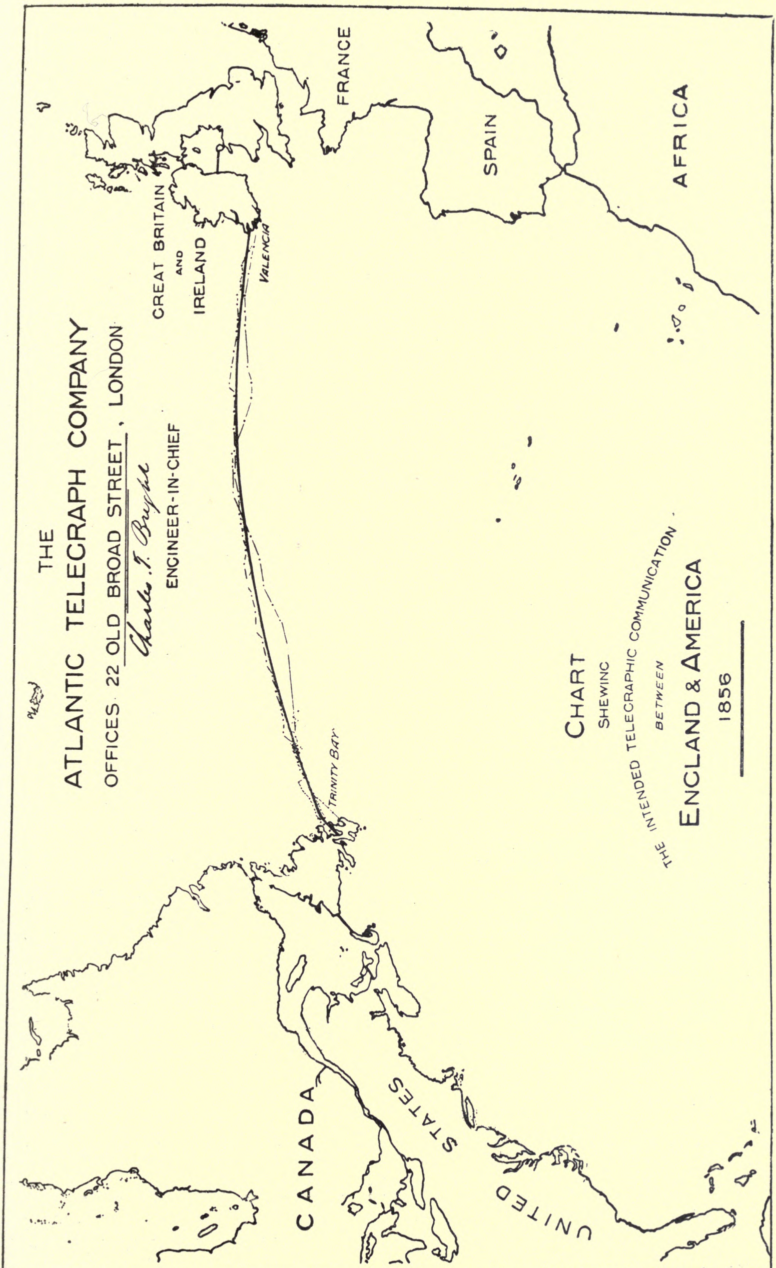
Professor William Thomson, of Glasgow—afterwards Lord Kelvin, G.C.V.O., F.R.S.—was a tower of scientific strength on the Board. He had been from the outset a great believer in the Atlantic Cable, having, indeed, stated his views as to its practicability before the Royal Society in the year 1854. His acquisition as a director was destined to prove of vast importance in influencing the development of trans-oceanic communication; for his subsequent experiments on the Atlantic Cable during 1857-58 led up to his invention of the mirror galvanometer and signalling instrument, whereby the most attenuated currents of electricity, which were incapable of producing visible signals on other telegraph apparatus, were so magnified in their effect by reflection as to be readily legible.

Charles Bright was appointed Engineer-in-Chief by the Board, with Mr. Whitehouse as Electrician. Mr. Cyrus Field became the General Manager, and later, Managing Director.

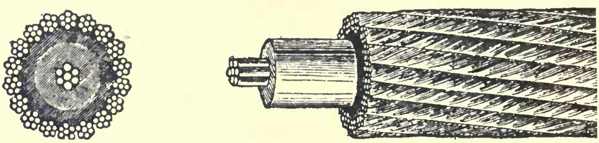
The chart on next page (a reproduction of the original) shows the route proposed and adopted for the cable, together with the line of soundings taken by Lieut. Berryman and Commander Dayman.

Charles Bright recommended a cable with a much larger copper conductor than had ever been used before, weighing, in fact, $3\frac{1}{2}$ cwt. (392 lb.) per nautical mile, and the same weight of gutta-percha for the insulator, but he found that this point had been settled and the contract given out before he became engineer.[1] Indeed, a provisional committee of those registering the Company had in their anxiety to save time—and to enable the work to be carried out during the summer of 1857—entered into contracts for a cable with only 107 lb. of copper conductor per nautical mile and 261 lb. of gutta-percha insulation. It is true that the core specified by Charles Bright would have weighed on the 2,500 miles of cable to be shipped about 460 tons more; but the cable having upwards of $3\frac{1}{2}$ times the conducting power the signalling speed he calculated on from

[1] On being consulted by the Government in regard to the proposed Falmouth-Gibraltar line in 1859, Bright recommended the same core as above. In this instance he had the satisfaction of seeing his recommendation adopted, though the cable was ultimately applied to connecting up Malta and Alexandria.


THE
ATLANTIC TELEGRAPH COMPANY
OFFICES 22 OLD BROAD STREET, LONDON
Charles T. Bright
ENGINEER-IN-CHIEF
GREAT BRITAIN
AND
IRELAND
VALENCIA
FRANCE
SPAIN
AFRICA
TRINITY BAY
CANADA
UNITED STATES
CHART
SHEWING
THE INTENDED TELEGRAPHIC COMMUNICATION
BETWEEN
ENGLAND & AMERICA
1856

the preceding experiments would then have been realised—besides which the insulation would have been more reliable. Unfortunately, those who had arranged for the smaller core were fully supported by Mr. Whitehouse's views; which, moreover, received entire approval from that great electrical *savant*, Michael Faraday, as well as from Professor Morse. The latter reported that "large coated wires used beneath the water, or the earth, are worse conductors—so far as velocity of transmission is concerned—than small ones; and therefore are not so well suited as small ones for the purposes of submarine transmission of

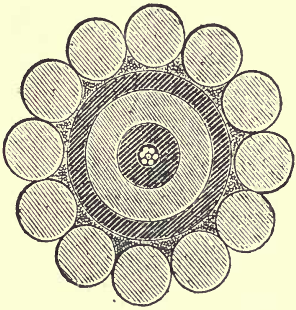


THE DEEP-SEA CABLE

telegraphic signals." Not so, however, Professor Thomson, who had previously crossed swords with Mr. Whitehouse in connection with the latter's B.A. paper of 1854, on "Experimental Observations on an Electric Cable." Mr. Whitehouse appeared to consider a low inductive capacity as the one and only point to be aimed at in the design of a submarine conductor, without regard to the resistance offered by the wire to an electric current. On his appointment as engineer, Charles Bright made every effort to get the contract altered in favour of the larger conductor which he had recommended; but this change was not considered practicable, as it would have meant the raising of a considerable amount of further capital.

What the actual manufacture of the cable alone entailed, the following detailed description will serve to show:—

The conductor, weighing 107 lb. per nautical mile, consisted of seven strands of copper wire, each of No. 22 gauge, covered with 261 lb. of gutta-percha, in three separate layers, 1·8 to No. ·00 B.W.G. $\frac{3}{8}$ inch. This insulated core was then served spirally with hemp yarn saturated with a preservative composition of tar, pitch, linseed oil, and wax. The core was next protected by an armour of eighteen iron strands, each composed of seven fine wires also of No. 22 gauge, wound around[1] in a long spiral.[2] The finished cable then received a coating of a cold mixture (referred to further on) of tar, pitch and linseed oil. Its weight in air was about 20 cwt., and in water $13\frac{1}{2}$ cwt., with a breaking strain of about $13\frac{1}{2}$ tons.



THE SHORE-END CABLE

[1] The manner in which the specimens had been given out for tender by the original provisional committee to the different firms, led to the wires being eventually applied with an opposite lay at the two sheathing factories. On Charles Bright becoming engineer he learnt what had been done by the Committee. The matter was not, however, considered to be serious, neither was it found so afterwards.

[2] This particular type of iron sheathing was adopted partly at the suggestion of the late Mr. Isambard Kingdom Brunel, F.R.S., one of the greatest engineers of the day. Mr. Glass also strongly recommended it. Nowadays, such wires would be considered too fine, besides the stranding being, on the whole, undesirable ; but at that time there was great difficulty in obtaining a high-class wire from larger gauges.

For each end approaching the shore, the sheathing (see illustration) consisted of twelve wires of No. 0 gauge, making the total weight over eight tons to the mile. This type was adopted for the first ten miles from the Irish coast, and for fifteen miles from the landing at Newfoundland, at both of which localities rocks had been found to abound plentifully.

Only six months was allowed for the manufacturers to complete the 2,500 miles. This involved the preparation and drawing of 17,500 miles of copper and stranding it into the 2,500 miles of conductor. Then the three separate coatings of gutta-percha had to be applied outside, and subsequently the yarn. Finally 315,000 miles of charcoal-iron wire had to be drawn and laid up into 45,000 miles of strand, and the core then to be covered with it. The entire length of copper and iron wire employed was therefore 322,500 miles—enough to engirdle the earth thirteen times, and considerably more than enough to extend from the earth to the moon.

The manufacture of the core was entrusted to the Gutta-Percha Company, and that for the outer sheathing divided between Messrs. Glass, Elliot & Co., and Messrs. R. S. Newall & Co., the former to cover half the cable with its outer sheath at East Greenwich, and the latter to treat the other half at Birkenhead, these firms being practically the only manufacturers of that description at the time. This subdivision of labour (by giving half the contract to Messrs. Newall) was decided upon in order, in the first place, to complete the work within the appointed time ; and secondly, with a view to checking threatened opposition. This was a somewhat prejudicial arrangement, as it precluded any testing or trial of the entire length until the ships met at Queenstown; but Mr. Field and some of his associates were anxious to hurry on. Their sole aim was to get the immense length of cable made and laid the following summer—a few months only after it was actually ordered.

The construction of the line was commenced with all despatch at the three factories.

When once the wheels had been fairly set in motion, it was necessary for Charles Bright to gather round him a competent staff of engineers, ready for the expedition. First of all, as his chief assistant, he secured the services of Mr. Samuel Canning, who had laid the Gulf of St. Lawrence cable for Messrs. Glass & Elliot, in the preceding year. The next place was filled by Mr. William Henry Woodhouse, who had laid cables for Mr. Brett in the Mediterranean. Then came Mr. F. C. Webb, who had probably been associated—in one capacity or another—with more early cable work than any other single telegraph engineer. Finally, Mr. Henry Clifford joined. He was a cousin of the Taylors, and was in this way introduced to the undertaking, besides being a mechanical engineer of considerable experience.

A few extracts from Charles Bright's diary may here be of interest, as showing the arduous and constant vigilance necessary in superintending the manufacture:—

January 1st, 1857.—At Greenwich (Glass & Elliot's), saw sample cable 60 ft. long spun off. Considered about keeping the wire in tank either always covered with water or always dry. Appointment with Edgington's *re* tarpaulin for covering coils. Talked with Canning as to undertaking part of charge of paying-out machinery. Appointment for test cable.

Saturday, 3rd.—To Brown & Lenox's, at Millwall, at one to test cable with Glass. Two samples broke off at the clamp, not fair trial; fresh appointment for Tuesday.

Tuesday, 6th.—To Brown & Lenox's to test cable; stood up to 3 tons 11 cwt. Then to Greenwich, testing joints.

Monday, 19th. To Gutta-Percha Works in morning, then to Greenwich. Spinning started with one machine. Discussion as to tarpaulin covering. Edgington's want £350 for six months' rent of tarpaulins.

Friday, 23rd.—Tar-pitch mixture (cold) answers very well for coating (with a brush) outside of cable, as a preservative against rust.

January 27th.—3 barrels tar
½ barrel pitch,
12 lb. beeswax,
6 gallons linseed oil.
} Preservative mixture decided on.

Twelve or thirteen gallons per mile.

All the contractors concerned in this work were ready with their supply within the time stipulated.

Among the illustrious visitors at Greenwich during the construction were the Prince of Wales (now His Majesty the King) and Prince Alfred (afterwards Duke of Edinburgh). Both evinced a lively interest in the work, and carefully studied each stage of the manufacture, young Bright having the honour of acting as "showman."

Section 3

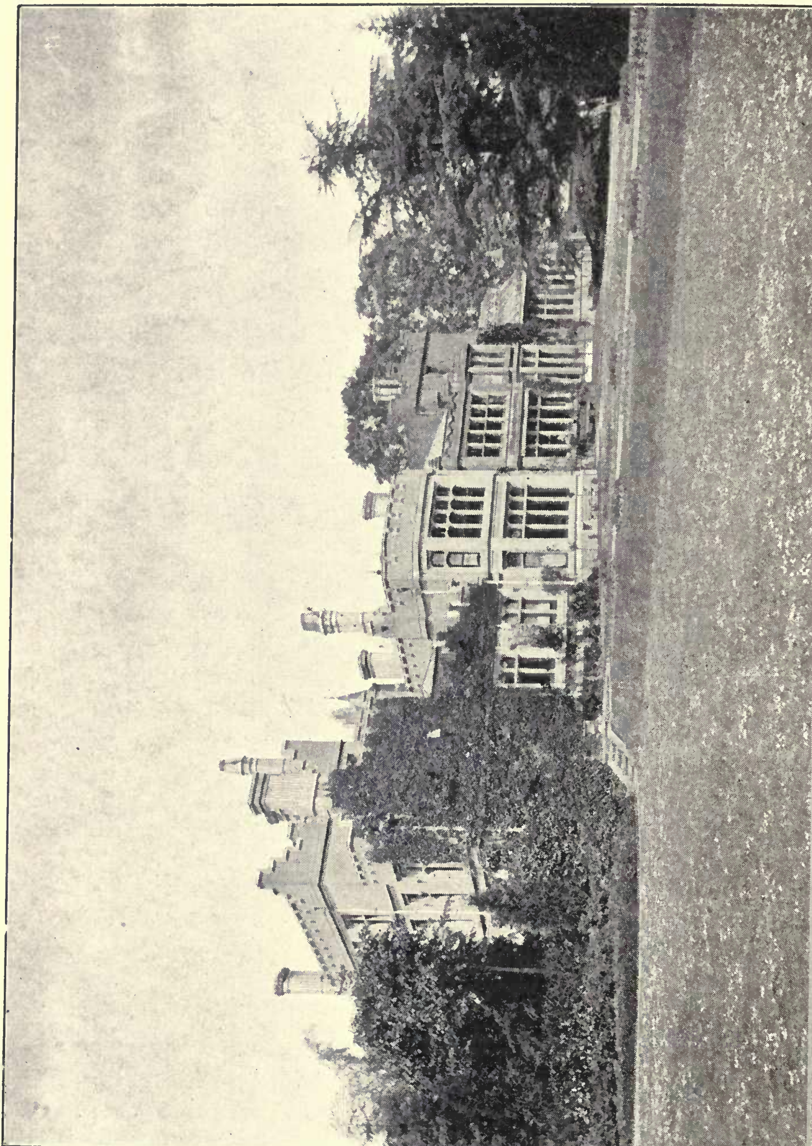
Ships, Stowage, and Departure for Valentia

Charles Bright was but twenty-four years old at the time when he was appointed Chief Engineer to carry out this important and far-reaching enterprise—enabling the people of two great Continents to speak together, in a few moments of time, though separated by a vast ocean.

The work involved was enormous, and few engineers have, at his age, been placed in a position of such heavy responsibility.

MR. C. T. BRIGHT
(From the *Illustrated London News* at this period)

Improved paying-out machinery to suit the great depths required to be devised. He had to select ships suitable to carry two thousand five hundred miles of cable, and to prepare them to receive it, together with the requisite machinery, so arranging the distribution of weight as to keep them fairly in trim. In addition there was the necessity for more or less constant attendance on the directors



—meeting as they did almost daily—and the preparation of frequent reports.

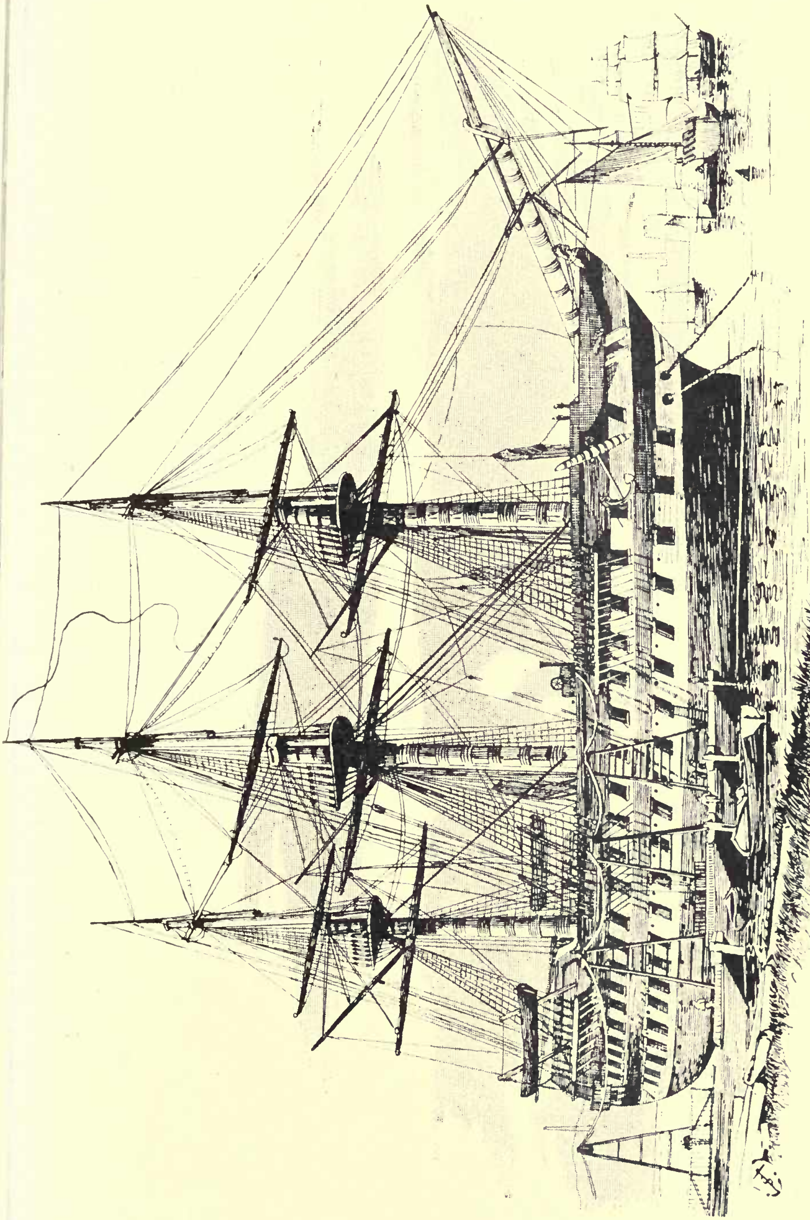
It was just about this time—the end of 1856—that the scene of young Bright's home was changed from Southport, near Liverpool, to The Cedars, near Harrow.

Soon after becoming engineer to the undertaking, in conjunction with the authorities of the Admiralty, he had

COILING THE CABLE ABOARD

visited and inspected various ships. Eventually H.M.S. *Agamemnon* was selected and placed by Government at the service of the Company. She proved to be splendidly adapted, by her very peculiar construction, for the service of receiving the cable. In this capacious receptacle nearly half the cable was stowed away. She was a screw-propelled line-of-battle ship of ninety-one guns, and one of the finest in our navy. She was to do more during her coming mission to bring about the reign of peace—by drawing together in closer communion the several nations of the earth—than any man-of-war was ever called to do, before or after. The American Government, after five months' hesitation, sent over the largest and finest ships of their navy, the U.S. frigate *Niagara*, a screw-corvette, which, with her tonnage of 5,200, exceeded in size our largest line-of-battle ship. Unfortunately, the *Niagara* had to experience much cutting about to enable her to accommodate the required length of cable. As a consort, the U.S. paddle frigate *Susquehanna* was also detailed for the expedition. H.M.S. *Leopard* was similarly provided by our Government, whilst H.M. sounding vessel *Cyclops* was to precede this little fleet, to show the way.

During the short time left, Charles Bright devised apparatus for paying out the cable on a somewhat different principle from that which had hitherto been in use for laying cables in comparatively shallow water. This was rendered necessary on account of the fresh conditions. Moreover, the apparatus previously in vogue was of a rather primitive kind, consisting of a drum, round which the cable was coiled several times, with a brake strap surrounding it, regulated by a hand lever upon a more or less "rule of thumb" system. This arrangement had repeatedly broken down, notably in 1854 in the Mediterranean, when the cable slipped upon the surface of the brake-drum used to check it, and flew out of the vessel with great force, cutting its way through the bulwarks of the ship in its passage. The same trouble of the cable surging and "taking charge" with the above rough and ready appli-



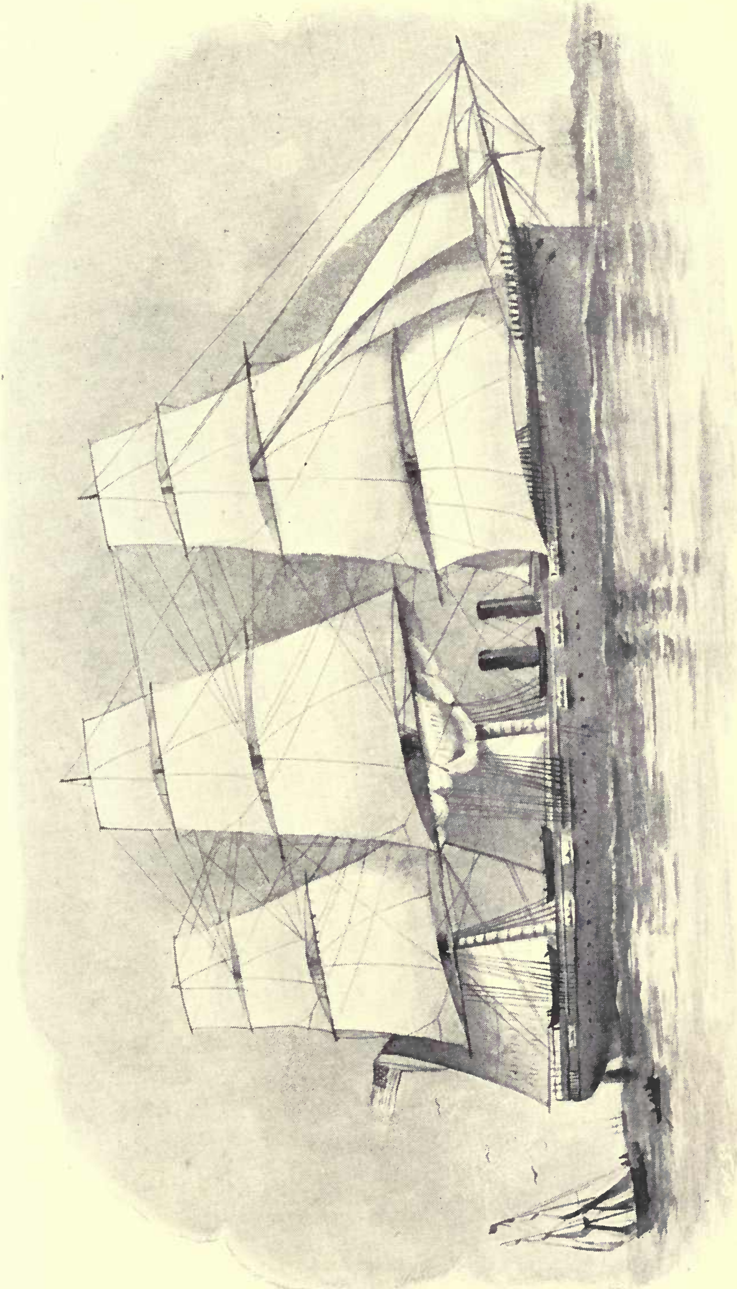
H.M.S. *AGAMEMNON* TAKING THE CABLE ABOARD.

ances, also occurred between Sardinia and Algeria in the following year.

Bright's machinery for regulating the egress of the cable from the laying vessels was constructed with a view to (1) the great depth of water to be passed over, (2) the constant strain, and (3) the number of days during which the operation must unceasingly be in progress. There were also arrangements by means of which picking up could be effected from the bows, and the cable taken aft to the "winding-in" machine.

In connection with this undertaking Charles Bright further invented a patent log, a wheel of which was "arranged to make and break an electric circuit at every revolution." A gutta-percha-covered wire was run up from the revolving wheel on to the deck of the ship, so that it should carry the current whenever the circuit was completed, and record there (upon a piece of apparatus provided for the purpose) the speed of the vessel.

It had previously been intended to start laying the cable by both ships simultaneously from mid-ocean, and Charles Bright, backed by his immediate staff—as well as by all the nautical authorities concerned—strongly urged this course. The electrician, Mr. E. O. Wildman Whitehouse, however—whose health did not permit him to sail with the expedition—together with the other electricians, urged that one ship commencing to pay out from Ireland, the other should continue the work when the first had used up all her cable. This course necessarily doubled the time taken in laying, and left the junction between the two cable ends to be effected in the deepest water, when it might



be impracticable through rough weather. Yet such was the anxiety of the Board to keep in touch with the expedition, for daily reports of progress, that they followed the counsel of the electricians.[1]

By the third week in July (within the course of as many weeks) the great ships had received all their precious cargo—the *Agamemnon* in the Thames, and the *Niagara* in the Mersey.

Then came some farewell feastings. It seemed to be considered a suitable occasion for giving a banquet in honour of Bright and others about to take part in the laying of the cable.

A few days later, the last coil of cable having been shipped on the *Agamemnon* from the Greenwich Works, the occasion was duly honoured by a scene as unique as it was beautiful.

To quote *The Times* of July 24th :—

All the details connected with the manufacture and stowage of the cable are now completed, and the conclusion of the arduous labour was celebrated yesterday with high festivity and rejoicing. All the artisans who have been engaged on the great work, with their wives and families, a large party of the officers, with the sailors from the *Agamemnon*, and a number of distinguished scientific visitors, were entertained upon this occasion at a kind of *fête champêtre* at Belvedere House, the seat of Sir Culling Eardley, near Erith. Although in no way personally interested in the project, the honourable baronet has all along evinced the liveliest sympathy with the undertaking. The tradespeople,

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[1] Charles Bright's plan was, however, adopted in the expedition of the following year.

fired with generous emulation, erected spacious tents on the lawn and provided a magnificent banquet for the guests, and a substantial one for the sailors of the *Agamemnon* and the artificers who had been employed in the construction of the cable. By an admirable arrangement, the guests were accommodated at a vast semicircular table which ran round the whole pavilion, while the sailors and workmen sat at right angles with the chord, so that the general effect was that all lunched together, while at the same time sufficient distinction was preserved to satisfy the most fastidious. The three centre tables were occupied by the crew of the *Agamemnon*, a fine active body of men, who paid the greatest attention to the speeches, and drank all the toasts with remarkable punctuality—at least, so long as their three pints of beer per man lasted. But we regret to add that with the heat of the day and the enthusiasm of Jack in the cause of science, the mugs were all empty long before the chairman's list of toasts had been gone through. Next in interest to the sailors were the workmen and their wives and babies, all being permitted to assist. The latter, it is true, sometimes squalled at an affecting peroration, but that rather improved the effect than otherwise ; and the presence of their little ones only marked the genuine good feeling of the employers, who had thus invited not only their workmen but their workmen's families to the feast. It was a momentary return to the old patriarchal times, and every one present seemed delighted with the experiment.

These festivities having come to an end, the *Agamemnon* set out for Sheerness to adjust compasses. *The Observer* in a report stated :—

When leaving her moorings, opposite Glass & Elliot's Works, the scene was one of considerable interest. Many thousands of persons thronged the river side as far as Greenwich Hospital. In the immediate neighbourhood of the factory a salute was fired as the proud vessel moved away, and a deafening cheer was raised by the assembled crowds. The crew of H.M.S. *Agamemnon* manned the gunwales, and returned the cheer with lusty lungs, while from the stern gallery ladies waved their handkerchiefs, and *savants* forgot for awhile the mysteries of electricity and submarine cable work, as they returned the hearty cheers which reached them from the shore.

The *Agamemnon* was taken in tow by three steam-tugs, one on each side, and a third in front. The tall masts of the giant ship were watched with anxious eagerness till they were lost in the far distance, and her huge hull disappeared amid the numerous bends and windings of the river.

The two ships met at Queenstown, Cork, on July 30th. Charles Bright at once ran a piece of cable between the ships, which were moored about three-quarters of a mile apart, so as to enable the entire length of 2,500 miles to be tested and worked through. The experiments were continued by Mr. Whitehouse for two days, the whole cable proving to be perfect.

What by that time had become known as the "Wire Squadron," sailed from this *rendezvous* for Valentia Bay on Monday, August 3rd.

After its full strength had been collected at Queenstown, the fleet was composed as follows:—

The U.S. screw-steamer *Niagara* to lay the half of the cable from Valentia Bay, Ireland.

The U.S. paddle-steamer *Susquehanna* to attend as consort to the *Niagara*.

H.M. screw-steamer *Agamemnon*, to lay the half of the cable on the American side.

H.M. paddle-steamer *Leopard* to attend upon the *Agamemnon*.

H.M. screw-steamer *Cyclops* to go ahead of the steamers and keep the course.

H.M. tender *Advice*, and the steam-tug *Willing Mind*, to assist in landing the cable at Valentia.

Then in Trinity Bay, Newfoundland, the U.S. screw-steamer *Arctic* and the paddle-steamer *Victoria* (chartered by the "Newfoundland" Telegraph Company) were to await the arrival of the fleet, and assist in landing the cable.

Advantage was taken of the passage from Cork to experiment with the paying-out machinery, which was found to be perfectly satisfactory.

Section 4

The "Wire Squadron" at Valentia

On arrival at Valentia Harbour, on August 4th, the ships were most hospitably welcomed by the Knight of Kerry, Sir Peter Fitzgerald, who had from the commencement taken a keen interest in the project. Then, His Excellency the Earl of Carlisle, Lord Lieutenant of Ireland—with his suite and many friends to the cable—had journeyed from Dublin Castle by special train, and the little corner of Ireland was quite *en fête* in this "the next parish to America."

During that afternoon the *Agamemnon* and *Niagara*, with their consorts, hove in sight. The following morning Charles Bright and his assistants were occupied in completing the arrangements for landing the massive shore end, which was calculated to withstand damage from any anchorage in the bay. The landing-place which had been finally selected was a little cove known as Ballycarberry, about three miles from Caherciveen, in Valentia Harbour. The two small assistant steamers—*Willing Mind*, a tug with a zeal worthy of her name, and *Advice*, ready not merely with advice but most lusty help—with several other launches and boats, were employed on this operation, which commenced at about two o'clock on the afternoon of August 5th, and was thus described in one of several newspaper reports :—

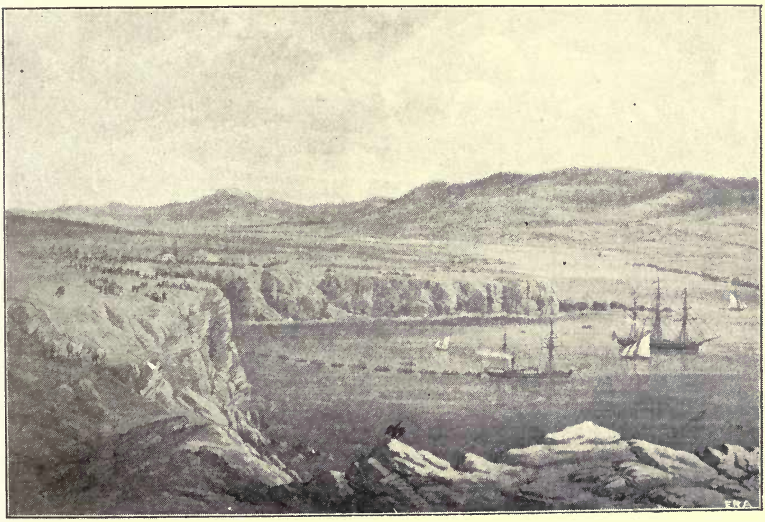
Valentia Bay was studded with innumerable small craft decked with the gayest bunting. Small boats flitted hither and thither, their occupants cheering enthusiastically as the work successfully progressed. The cable boats were managed by the sailors of the *Niagara* and the *Susquehanna*. It was a well-designed compliment, and indicative of the future fraternisation of the nations, that the shore rope was arranged to be presented at this side of the Atlantic to the representative of the Queen by the officers and men of the United States Navy ; and that at the other side the British officers and sailors should make a similar presentation to the President of the great Republic.

From the mainland the operations were watched with intense interest. For several hours the Lord Lieutenant stood on the beach surrounded by his staff and the directors of the railway and telegraph companies, waiting the arrival of the cable. When at length the American sailors jumped through the surge with the hawser to which it was attached, his Excellency was among the first to lay hold of it and pull it lustily to the shore. Indeed, every one present seemed desirous of having a hand in the great work. Never before, perhaps, were there so many willing assistants at the long pull, the strong pull, and the pull all together.

At half-past seven o'clock the cable was hauled on shore at Ballycarberry Strand, and formal presentation was made of it to the Lord Lieutenant, his Excellency expressing a hope that the work so well begun would be carried to a satisfactory completion.

After the vicar of the parish had offered a prayer for the success of the undertaking, the Lord Lieutenant closed the proceedings with some inspiriting remarks. The work connected with the landing of the shore end was not actually completed till sunset; so, as it was too late to proceed on their journey, the ships remained at anchor in the bay till daybreak.

That night there was a grand ball at the little village of Knightstown, and the day dawn caught the merry-



LANDING THE CABLE ON THE IRISH COAST

makers still engaged in their festivities. In writing to his wife, young Bright described the scene as viewed from the *Agamemnon*, in the following words:—

A bonfire of peat, piled up as high as a good-sized two-story house, sent its ruddy and cheerful light far out into the darkness, brightening up the black crevices in the frowning rocks, and throwing a glow on the faces of the light-hearted peasantry that gathered around in a huge circle.

Section 5

Laying the First Ocean Cable

Charles Bright, with his chief assistants, Messrs. Canning, Woodhouse and Clifford, had taken up quarters on board the *Niagara*, besides Bright's brother-in-law, Mr. Robert John Taylor, who accompanied the expedition as a visitor. Here were also Mr. Field and Professor Morse.[1]

Mr. Webb was quartered on the *Agamemnon*, together with Professor Thomson and Mr. H. A. Moriarty [2] as Navigating Master. The latter had been specially detailed by the Admiralty on account of his skill in that class of work. Mr. C. V. de Sauty, a gentleman of considerable practical experience, was placed in charge of the electrical arrangements on board the *Niagara*, subservient, however, to the orders of Mr. Whitehouse from shore. Mr. J. C. Laws was also there. Mr. Whitehouse was not able to go out on the expedition for reasons of health.

The ships got under way at an early hour on the morning following the landing of the shore end. Paying out was commenced from the forepart of the *Niagara*; and as the distance from that to the stern was considerable, a number of men were stationed at intervals, like sentinels, to see that every foot of the line safely reached its destina-

[1] The latter—who besides being electrician to the New York and Newfoundland Telegraph Company, held also an honorary watching brief on behalf of the United States Government—had unfortunately, to retire to his berth as soon as the elements began to assert themselves, and remained there more or less continuously throughout the expedition.

[2] Afterwards Staff-Commander Moriarty, C.B.

tion. The machinery did not seem at first to take kindly to its work, giving vent to many ominous groans. After five miles had been disgorged in safety, the bulky line caught in some of the apparatus and parted. The good ship at once put back; and the cable was under-run by the *Willing Mind* the whole distance from the shore—a tedious and hard task, as may be imagined. At length the end was lifted out of the water and spliced to the gigantic coil on board; and as it dropped safely to the bottom of the sea, the mighty ship steamed ahead once more. At first she moved very slowly—not more than two miles an hour—to avoid the danger of another accident; but the feeling that they were at last away was in itself a relief. The ships were all in sight, and so near that they could hear each other's bells. The *Niagara*, as if knowing she was bound for the land out of whose forests she came, bowed her head proudly to the waves.

In the words of Mr. Henry Field :—

> Slowly passed the hours of that day. But all went well, and the ships were moving out into the broad Atlantic. At length the sun went down in the west, and stars came out on the face of the deep. But no man slept. A thousand eyes were watching a great experiment, including those who had a personal interest in the issue.
>
> All through that night, and through the anxious days and nights that followed, there was a feeling in the heart of every soul on board, as if some dear friend were at the turning point of death, and they were watching beside him. There was a strange unnatural silence in the ship. Men paced the deck with soft and muffled tread, speaking only in whispers, as if a loud or heavy footfall might snap the vital cord. So much had they grown to feel for the enterprise, that the cable seemed to them like a human

creature, on whose fate they themselves hung, as if it were to decide their own destiny.

There are some who will never forget that first night at sea. Perhaps the reaction from the excitement on shore made the impression the deeper. There are moments in life when everything comes back to us. What memories cropped up in those long night hours! How many on board that ship, as they stood on the deck and watched that mysterious cord disappearing in the darkness, thought of homes beyond the sea, of absent ones, of the distant and of the dead! But no musings turn them from the work in hand. There are vigilant eyes on deck—Mr. Bright, the engineer-in-chief, is there; also, in turn, Mr. Woodhouse and Mr. Canning, his chief assistants. . . . The paying-out machinery does its work, and though it makes a constant rumble in the ship, that dull heavy sound is music in their ears, as it tells them that all is well. If one should drop to sleep, and wake up at night, he has only to hear the sound of "the old coffee-mill" and his fears are relieved, and he goes to sleep again.

The second day at sea was a day of beautiful weather. The ships were getting further away from land, and began to steam ahead at the rate of four and five knots. The cable was paid out at a speed a little faster than the ship, to allow for inequalities of surface on the bottom of the sea. While it was thus going overboard, communication was kept up constantly with the land.

To quote Mr. Henry Field again:—

Every moment the current was passing between ship and shore. The communication was as perfect as between Liverpool and London, or Boston and New York. Not only did the electricians telegraph back to Valentia the progress they were making, but the officers on board sent messages to their friends in America to go out by the steamers from Liverpool. The heavens seemed to smile on them that day. The coils came up from below the deck without a kink, and unwinding themselves easily, passed over the stern into the sea.

All Sunday the same favouring fortune continued; and when the officers who could be spared from the deck met in the cabin, and Captain Hudson read the service, it was with subdued voices and grateful hearts that they responded to the prayers to "Him Who spreadeth out the heavens and ruleth the raging of the sea."

On Monday they were over two hundred miles at sea. They had got far beyond the shallow waters off the coast. They had passed over the submarine mountain that figures on the charts of Dayman and Berryman, and where Mr. Bright's log gives a descent from five hundred and fifty to seventeen hundred and fifty fathoms within eight miles. Then they came to the deeper waters of the Atlantic, where the cable sank to the awful depth of two thousand fathoms! Still the iron cord buried itself in the waves, and every instant the flash of light in the darkened telegraph room told of the passage of the electric current.

Everything went well till 3.45 p.m. on the fourth day out, the 11th August, when the cable snapped after 380 miles had been laid, owing to mismanagement on the part of the mechanic at the brakes.

Thus, the familiar thin line which had been streaming out from the *Niagara* for six days was no longer to be seen by the accompanying vessels.

One who was present wrote:—

The unbidden tear started to many a manly eye. The interest taken in the enterprise by officers and men alike exceeded anything ever seen, and there is no wonder that there should have been so much emotion on the occasion of the accident.

In the course of a Report to the Directors of the Company, Charles Bright gave the full details of the expedition up to the time of this regrettable occurrence. The following is taken from the Report, and deals with the accident and with the conclusions he had arrived at for resuming the undertaking :—

I had, up to this, attended personally to the regulation of the brakes ; but finding that all was going well, and it being necessary that I should be temporarily away from the machine —to ascertain the rate of the ship, to see how the cable was coming out of the hold, and also to visit the electricians' room—the machine was for the moment left in charge of a mechanic who had been engaged from the first in its construction and fitting, and was intimately acquainted with its operation.

In proceeding towards the fore part of the ship I heard the machine stop ; I immediately called out to relieve the brakes, but when I reached the spot, the cable was broken. On examining the machine, which was otherwise in perfect order, I found that the brakes had *not* been released ; and to this—or to the hand wheel of the brake being turned the wrong way—may be attributed the stoppage, and consequent fracture, of the cable. When the rate of the wheels grew slower, as the ship dropped her stern in the swell, the brake should have been eased. This had been done regularly whenever an unusually sudden descent of the ship temporarily withdrew the pressure from the cable in the sea. But owing to our entering the deep water the previous morning, and having all hands ready for any emergency that might occur there, the chief part of my staff had been compelled to give in at night through sheer exhaustion ; and hence, being short-handed, I was obliged for the time to leave the machine without, as it proved, sufficient intelligence to control it.

I perceive that on the next occasion it will be needful, owing to the wearing and anxious nature of the work—to have three separate relays of staff ; and to employ, for attention to the brakes a higher degree of mechanical skill.

The origin of the accident was, no doubt, the amount of retarding strain put upon the cable ; but had the machine been properly manipulated at the time, it could not possibly have taken place.

For three days, in shallow and deep water, as well as in rapid transition from one to the other, nothing could be more perfect than the working of the cable machinery. It had been made extra heavy with a view to recovery work. However, it performed its duty so smoothly and efficiently in the smaller depths —where the weight of the cable had less ability to overcome its friction and resistance—that it can scarcely be said to be too heavy for paying out in deep water, where it was necessary, from the increased weight of cable, to restrain its rapid motion, by applying to it a considerable degree of additional friction. Its action was most complete, and all parts worked well together.

I see how the gear can be improved, by a modification in the form of sheaves, by an addition to the arrangement for adjusting the brakes, and some other alterations ; but with proper management, without any change whatever, I am confident that the whole length of cable might have been safely laid by the existing gear. And it must be remembered—as a test of the work which it has done—that, unfortunate as this termination to the expedition is, the longest length of cable ever laid has been paid out by it, and that in the deepest water yet passed over.

After the accident had occurred, soundings were taken by Lieutenant Dayman from the *Cyclops*, and the depth found to be 2,000 fathoms.

It will be remembered that some importance was attached to the cable on board the *Niagara* and *Agamemnon* being manufactured in opposite lays. I thought this a favourable opportunity to show that practically the difference was not of consequence in effecting the junction in mid-ocean. We therefore made a splice between the two vessels. This was then lowered in a heavy sea, after which several miles were paid out without difficulty.

I requested the commanders of the several vessels to proceed to Plymouth, as the docks there afford better facilities than any other port for landing the cable, should it be necessary to do so.

The whole of the cable remaining on board has been carefully tested and inspected, and found to be in as perfect condition as when it left the works at Greenwich and Birkenhead respectively.

One important point presses for your consideration at an early period. A large portion of cable, already laid, may be recovered at a comparatively small expense. I append an estimate of the cost, and shall be glad to receive your authority to proceed with this work.

I do not perceive in our present position any reason for discouragement; but I have, on the contrary, a greater confidence than ever in the undertaking. It has been proved beyond a doubt that no obstacle exists to prevent our ultimate success, and I see clearly how every difficulty which has presented itself in this voyage can be effectually dealt with in the next.

The cable has been laid at the expected rate in the great depths; its electric working through the entire length has been satisfactorily accomplished; while the portion laid, actually improved in efficiency by being submerged—from the low temperature of the water and the increased close texture of gutta-percha thereby effected.

Mechanically speaking, the structure of the cable has answered every expectation that I had formed of it. Its weight in water is so adjusted to the depth, that strain is within a manageable scope; while the effects of the undercurrents upon its surface prove how dangerous it would be to lay a much lighter rope, which would, by the greater time occupied in sinking, expose an increased surface to their power—besides its descent being at an angle such as would not provide for good laying at the bottom. On the other hand, in regard to any further length made, I would take the opportunity of again strongly urging the desirability of a much larger conductor and corresponding increase in the weight of insulation, in accordance with my original recommendation.

The Report here quoted from was afterwards sent by the Secretary of the Company to *The Times* for publication.

Section 6

Preparations for another Attempt

This untoward accident was naturally a cause of great sorrow to all connected with the undertaking. There was not enough cable left to complete the work, nor was there time to get more made and stowed on board to renew the attempt before the season would be too far advanced. Yet much experience had been gained, and there were many points of encouragement in Charles Bright's report. Those immediately concerned in the great enterprise were, despite their heavy disappointment, in the end undaunted.

The squadron proceeded to Plymouth to unload the cable into tanks at Keyham Dockyard, chiefly because some of the ships could not be spared by their respective Governments till the following year. The insulation was carefully tested by Professor Thomson and Mr. Whitehouse, who found that the copper wire had forced its way through the gutta-percha at several points—probably owing to the repeated coiling and uncoiling—the manufacture of gutta-percha at the proper temperature not being then understood as it is now. These defects were duly repaired. On being discharged from the ships, the cable was passed through a composition of tar, pitch, linseed-oil, and bees-wax, as a precaution against oxidation; and was coiled in compact circles in four large roofed tanks specially constructed for the purpose, with a view to storing the cable ashore until the following summer, when the undertaking was to be resumed—at least so many hoped.

In the middle of October, Bright proceeded to Valentia, accompanied by Mr. Clifford, in a small paddle-steamer, with the object of picking up some of the cable near here. After experiencing a series of gales, over fifty miles of the main cable were recovered, and the shore end buoyed ready for splicing on to in the coming year. Whilst engaged in the above work the subject of our biography penned the fol-

PICKING UP THE CABLE

lowing to his wife, which serves to describe the operation and the apparatus employed :—

VALENTIA,
October 24th, 1857.

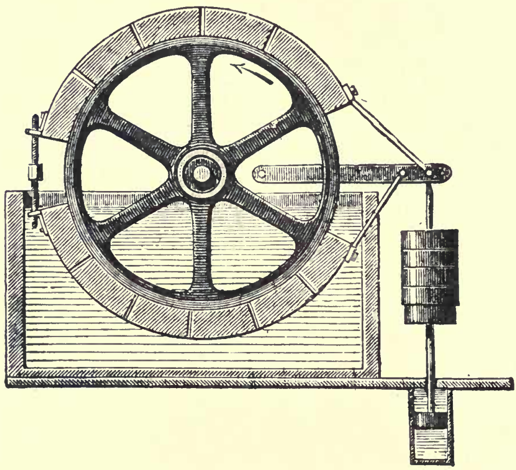
I send you a gift from Henry Clifford, a view from our window at the inn here. The steamer to the right is the *Leipzig*. The pier is the breakwater of Valentia Harbour. The queer-looking thing to the left is an apparatus I have fitted up for under-running the cable. It is composed of two very large long iron buoys fixed together like a twin ship with a platform of timber over it. On this, at each end, is a saddle with a deep groove for the cable to run in. The cable being on the near shore, it is towed along. When near the end of the heavy cable I shall take it off, cut the cable, buoy the heavy end, and begin winding up the small one as we go on.

This first expedition had opened the eyes of the investing public to the vastness of the undertaking, and led many to doubt who did not doubt before. Some even began to look upon it as a romantic adventure of the sea, rather than as a serious commercial undertaking. As Henry Field reminds us : "This decline of popular faith was felt as soon as there was a call for more money."

The loss of 335 miles of cable, with the postponement of the expedition to another year, was equivalent to a loss of £100,000. To make this good, the capital of the company had to be increased, and this new capital was not readily obtainable. The projectors found that it was easy to go with the current of popular enthusiasm, but very hard to stem a growing tide of popular distrust. And it must also be remembered that, from the very first, that section of the public which looked with distrust upon the idea of an Atlantic Telegraph was far in excess of that which did not ; indeed, the opposition encountered was much on a par with the popular prejudice which George Stephenson had to overcome when projecting his great Railway schemes.

But whatever the depression at the untimely termination of the first expedition, it did not interfere with renewed and vigorous efforts to prepare for a second. In the end, the appeal to the shareholders for more money was responded to ; and the directors were enabled to give orders for the manufacture of 700 miles of new cable of the same description, to make up for what had been lost, and to provide a surplus against all contingencies. Thus, 3,000 nautical miles in all were eventually shipped this time, instead of 2,500 miles.

A committee was arranged to confer with Charles Bright as to the machinery. This committee consisted of Mr.

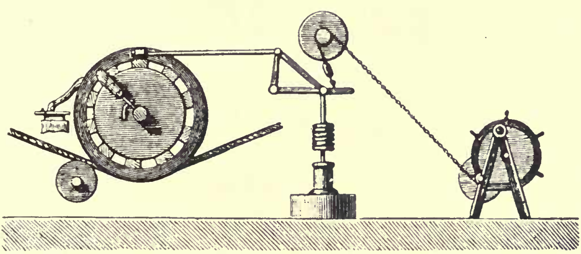


THE SELF-RELEASING FRICTION BRAKE

Thomas Lloyd, the chief of the Steam Department of Her Majesty's Navy; Mr. John Penn, of Greenwich; and Mr. Joshua Field, F.R.S., of Maudslay, Son & Field. Mr. W. E. Everett, U.S.N., was also consulted later. As the chief (ship's) engineer of the *Niagara*, on the late expedition, Mr. Everett had acquired a good deal of information from seeing the working of the apparatus on board. He also joined in approving Charles Bright's suggested alterations.

This gentleman had to return to America with his ship; but on again arriving in London, on January 18th of the following year, he had the satisfaction of attesting to the sterling qualities of the machine devised, adopted, and constructed in his absence, as well as in partly superintending the setting up of it aboard the ships. The above committee reported: "We consider the paying-out sheaves require no alterations except those suggested by Mr. Bright in a memorandum he was good enough to place in our hands."

Quite independently Charles Bright had decided that the checking gear, or brake, should not be left in the power of any person in charge to jamb the machine; and subsequently



THE PRINCIPLE OF THE BRAKE

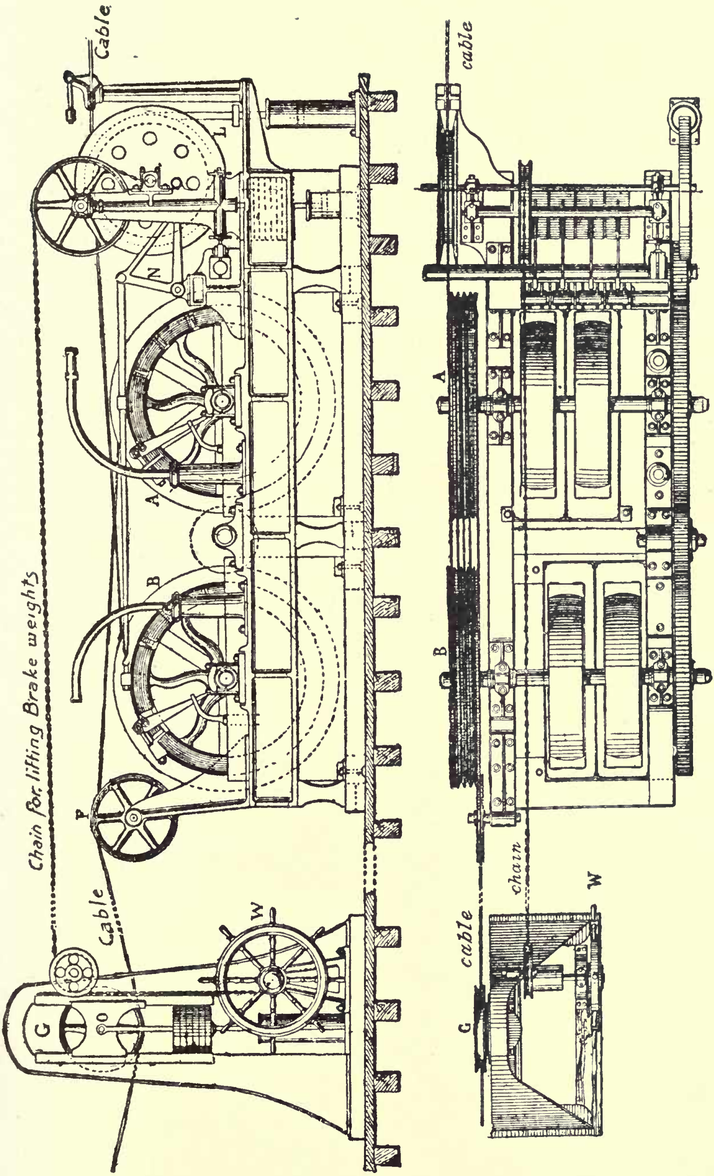
a very opportune invention of Mr. J. G. Appold, F.R.S., was considered in this connection. It consisted of a brake so arranged that a lever exercised a uniform holding power in exact proportion to the weights attached to it; and while capable of being *released* by a hand-wheel, it could not be tightened. This clever appliance had been introduced in association with the crank apparatus in gaols, so as to regulate the amount of labour in proportion to the strength of the prisoner. The above invention was especially adapted to the exigencies of cable work by Mr. C. E. Amos, M.Inst.C.E., and Charles Bright. The great feature about it was that it provided for automatic release of the brake, upon the strain exceeding that intended. Thus only a maximum agreed strain could be applied, this being regulated from time to time by weights, according to depth of water and consequent weight of cable being paid out. In passing from the hold to the stern of the laying vessel, the cable is taken round a drum.[1] Attached to the axle of the drum [2] is a wheel fitted with an iron friction-strap (to which are fixed blocks of hard wood), capable of exerting a given retarding power, varying with the weights hung on to the lever N which tightens the strap. When the friction becomes great, the wheels have an increased tendency to carry the wooden blocks round with them: thus the lever bars are deflected from the vertical line and the iron band opened sufficiently to lessen the brake power. Hence, this apparatus may be said to be partially self-regulating in its action—to the extent of avoiding an excess retarding-force.

Charles Bright also devised a dynamometer apparatus—for indicating and controlling the strain during paying out—which was a great improvement on that embodied in the previous machines.

The working connections of the friction-brake and hand-wheel referred to are shown on the previous page. A more

[1] In the actual apparatus for the laying of the 1858 cable, there were (see illustration, p. 79) *two* drums, A and B, each having two brake wheels attached to their axles.

[2] This drum is carried round by the weight of the axle as the ship moves onwards.



BRIGHT'S PAYING-OUT GEAR FOR FIRST ATLANTIC CABLE, 1858 complete notion of it, however, as well as of the entire paying-out gear (with Bright's dynamometer), as ultimately adopted for the next expedition, is best obtained from the plate on the previous page.

The working of the entire machine was as follows [1] :—

Between the two brake drums A and B and the stern of the vessel, the cable was bent somewhat out of the straight line by being led under the grooved wheel O of the dynamometer. This wheel had a weight attached to it, and could be moved up or down in an iron frame G. If the strain upon the cable was small, the wheel would bend the cable downwards, and its index would show a low degree of pressure; but whenever the strain increased, the cable, in straightening itself, would at once lift the dynamometer wheel with the indicator attached to it, which showed the pressure in hundredweights and tons. The amount of strain with a given weight upon the wheel was determined by experiment, and a hand-wheel W in connection with the levers of the paying-out machine was placed immediately opposite the dynamometer; so that directly the indicator showed strain increasing, the person in charge could at once, by turning the hand-wheel, lift up the weights that tightened the friction straps, and so let the cable run freely through the paying-out machine. Although, therefore, the strain could be *reduced*—or entirely withdrawn—in a moment, it could not be *increased* by the man at the wheel.

The dynamometer principle of Charles Bright here introduced has been universally adopted in the laying of all subsequent submarine cables.

The construction of this improved apparatus was carried out by Messrs. Easton & Amos at their works in Southwark. Mr. Henry Clifford, who, as a mechanical engineer, was an

[1] *Submarine Telegraphs.*

expert in machinery, also attended closely to the manufacture of the gear.

About this time, two able calculating engineers, Mr. T. A. Longridge, M.Inst.C.E., and Mr. C. H. Brooks, read a paper before the Institution of Civil Engineers with reference to this subject, and young Bright led off the discussion.[1] This paper was of a mathematical and almost entirely theoretical order, regarding the resistance to a rope introduced by skin friction in passing through water. These gentlemen also asserted, from their mathematical deductions, that: "The result of a stoppage of the paying-out apparatus, in a depth of 2,000 fathoms, whilst the vessel was proceeding at the rate of six feet per second, would be to bring a strain on the cable amounting to over seven tons, while its strength was only about half that." It was, however, actually in evidence that Charles Bright had stopped paying out, during the last expedition, when in very nearly that depth, for some length of time, while clearing tar off the brake machine.

The following week the "Civils" engaged once more in submarine cable talk. This time an eminently practical discourse was furnished by Mr. F. C. Webb[2]; and here was the occasion on which Professor Airy,[3] the then Astronomer Royal, expressed himself very decidedly that (1st) "it was a mathematical impossibility to submerge the cable successfully at so great a depth in safety," and (2nd) that "if it were possible, no signals could be transmitted through

[1] *Proc. Inst. C.E.*, vol. xvii. See also Appendix 8 to Vol. I. of the original biography.

[2] *Proc. Inst. C.E.*, vol. xvii.

[3] Afterwards Sir George Biddell Airy, K.C.B., F.R.S.

so great a length." Professor Airy stated in addition that: "When a cable was paid out at the angle of 10 (with the horizon), there was a strain upon it of nearly sixty-six times the minimum tension, or sixty-six times the depth of the sea at that place. When this was considered, it seemed to him, that in all the annals of engineering there was not another instance in which danger was incurred so needlessly. . . . The angle at which it should be paid out should never be less than 45° with the horizon." He also supported his theory by a series of computations. But he altogether omitted to take into account the fact that a cable ship merely moves quickly, as it were, from under the cable it carries; and that the faster the paying out can be carried on, the closer is the angle of the cable to the horizon—10° to 15° being very customary. At this meeting Charles Bright took the opportunity to correct some of the erroneous views that had obtained currency and given rise to false conclusions.

From the very outset of the project, and as soon as he was appointed engineer, young Bright had had to deal with amateurs in the art! As the "Jack-in-office" all were ready to pounce upon him: thus he was subjected to all manner of suggestions regarding the laying of cables, transmitted to him officially through the secretary of the Company.[1] These—which, with our present lights, do indeed seem ludicrous—had to be politely dealt with, notwithstanding extreme pressure of work. Some, be it added, emanated from men of highly scientific attainments.

[1] *The Story of the Atlantic Cable.*

The projected cable, and the formation of such a company, appeared, indeed, to stimulate and excite the brains of many a sanguine inventor.

It is both amusing and sad to think of some of the ideas put forward. Perhaps the most frequent was in connection with the fallacy, that, as the water increased in depth, therefore at a given point in deep water, a long way off the bottom, the cable would be held in suspense. This was a very common delusion at the time. Obviously, the pressure increases with the depths, on all sides of a cable (or anything else), in its descent through the sea; but as, practically, everything on earth is more compressible than water, it is clear that the iron wire, yarn, gutta-percha, and copper conductor forming the cable, must be more and more compressed as they descend. Thus the cable constantly increases its density, or specific gravity, in going down; while the equal bulk of the water surrounding it continues to have, practically speaking, the same specific gravity as at the surface. Without this valuable property possessed by water, the hydraulic press would not exist; but the strange blunder here described was participated in by some of the most distinguished naval men. To obviate this non-existent difficulty, it was gravely proposed to festoon the cable across, at a given maximum depth, between buoys, and floats, or even parachutes—at which ships might call, hook on, and telegraphically talk to shore!

Others, again, proposed to apply gummed cotton to the outside of the cable in connection with the above buoying system. The idea was that the gum (or glue) would gradually dissolve, and so let the cable down "quietly!"

One naval officer of eminence urged the employment of an immense floating cylinder, on which the cable was to be wound. This cylinder was then to be towed across the Atlantic, unrolling the cable in its progress. The unwieldiness of such a cylinder, with some 2,500 miles of cable encircling it, in addition to its own weight, and the practical impossibility of regulating delivery in its revolutions—or of dealing with it even in an ordinary roughish sea—did not appear to be held of much account by the projector.

It was also suggested that the proper place to pay out was from the centre of the ship, as the point of least motion, and therefore least liable to damage the cable; and it was proposed to have an opening in the middle to let it down. But as the cable in paying out leaves the ship at an angle only a little removed from the horizontal, the absurdity of such a suggestion is manifest.

Again, a trail, or flexible pipe, was strongly advocated, "to hang down from the ship's stern to the bottom of the sea, through which the cable was to be allowed to pass." The promoters of this plan omitted, however, to consider the effects of the friction resulting from 2,000 miles of cable passing through it. Of whatever substance such a trail might be made, a day or two's rubbing of the cable would have worn it through.

Some again absolutely went so far as to take out patents for converting the laying vessel into a huge factory, "with a view to making the cable on board in one continuous length, and submerging it during the process."

Another party (a retired naval officer) gravely asserted that no soundings could have been obtained across the

Atlantic, as " both modern science and actual experiment demonstrate that, long before any such depths could be reached, the lead must necessarily have displaced its own specific gravity in so dense a medium as water, and consequently at once then stop, remaining suspended, equilibrated."

Let us now return to the active and practical preparations for the forthcoming expedition. It is difficult for the uninitiated to realise what these meant. They would have driven many crazy, if only on account of their vast and varied character. In this connection, Charles Bright notes in his diary :—

> It was only by dint of bribing, bullying, cajoling, and going day by day to see the state of things ordered, that anything is ready in time for starting.

He then says :—

> At first one goes nearly mad with vexation at the delays ; but soon one finds that they are the rule, and then it becomes necessary to feign a rage one does not feel.

Further :—

> I look upon it as the natural course of things that if I give a order it will not be carried out ; or, if by accident it is carried out, it will be carried out wrongly. The only remedy is to watch the performance at every stage.

All this incessant toil seems to have additionally inspired the following note :—

> When idle, one can love, one can be good, feel kindly to all, devote oneself to others, be thankful for existence, educate one's mind, one's heart, one's body.[1] When busy, one sometimes seems too busy to indulge in any of these pleasures.

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[1] The truth of this need not necessarily conflict with the fact that, in most instances, the *permanently* idle find no time for any of the above virtues.

As soon as one of the machines for paying out the cable was completed and set up in working order, all Bright's staff inspected the working of the machine; whilst at the same time receiving instructions, as above, for the coming expedition. There then followed the trial mentioned, during which a complete rehearsal was gone through of the various operations to be performed with the apparatus.

Bright's arrangement for stowing the cable aboard formed a subject for discussion at the hands of some of the naval officers concerned with the undertaking. Our young engineer had determined this time that the large coil in the hold of the *Agamemnon* must be made as truly circular and also as large as he had insisted on for the *Niagara* in the previous year. He also decided that a cone in the middle of each coil, and a large margin of space to the hatchway-eye above, were both essential provisions for safe paying out. These alterations were all duly made, although one of the naval experts had expressed himself that the cable "should be stowed in long Flemish flakes." The same officer also considered that "no other machinery for paying out was necessary or desirable than a handspike to stop the egress of the cable"(!) Charles Bright, whilst always ready to listen to suggestions, had sometimes to remind his critics, in effect, that "criticism is always easier than art."

Whilst the cable was stored in the tanks at Keyham Dockyard, Mr. Whitehouse—partly in conjunction with Professor Thomson—took the opportunity of conducting a fresh series of experiments through the entire length, with various apparatus and under various conditions. These experiments were more especially in the direction of testing, and improving on, the rate of working. As a result, a speed of four words per minute was attained through the 2,000 odd miles.

Since the manufacture of the cable in 1857, Professor Thomson had become impressed with the conviction that the electric conductivity of copper varied greatly with its degree of purity. Resulting from the professor's further investigations, the extra length of cable made for the coming expedition was subjected to systematic and searching tests for the purity and conductivity of the copper. Every hank of wire was tested; and all whose conducting power fell below a certain value rejected. Here, then, we have the first instance of an organised system of testing for conductivity at the cable factory—a system which has ever since been rigorously insisted on.

And now, in the spring of 1858, an invention was perfected that was destined to have a remarkable effect on submarine cable enterprise. For within about a year of his entering the ranks of telegraphic scientists, Professor Thomson (afterwards Lord Kelvin) devised and perfected the mirror-speaking instrument, then often described as the marine galvanometer, that entirely revolutionised long distance signalling and electrical testing aboard ship. It is only to be regretted that the electrician responsible for the subsequent working-through operations did not sooner appreciate the great beauties of this apparatus, and the advantage of a small generating force such as it only required.

The Board decided "that it would be desirable to begin paying out the cable in mid-ocean." Thus, they reversed the starting from shore of the previous expedition. The latter, it will be remembered, was a concession to the electricians, though strongly opposed by Charles Bright and the whole of his engineering staff at the time. The grounds on which the former plan was preferable were (1) the ability to choose the day for joining the ends in good weather; (2) the reduction of the time taken over the laying operation by one-half, with thus a better chance of fine weather being maintained throughout the expedition; and (3) that the most difficult part of the work, in the deepest water, would be dealt with first.

It was also arranged by Charles Bright that the main cable should be buoyed at each end, and the connections to it by the heavy cable from shore effected at the earliest opportunity afterwards.

Section 7

The Trial Trip

All the 3,000 miles of cable was coiled into the two large ships and the improved machinery fitted on board of them by the end of May. The *Agamemnon* was on this occasion in naval command of Captain (afterwards Vice-Admiral) G. W. Preedy, R.N.—in place of Capt. Noddall, R.N.—but her navigating master was Mr. H. A. Moriarty, R.N., as before.

Thus equipped, the fleet again set forth from Plymouth on May 29th, 1858, but this time without any show of public enthusiasm. Charles Bright was accompanied by the engineering and electrical staff already referred to. With him on the *Agamemnon* were Mr. Canning (his chief assistant), and Mr. Clifford ; whilst on the *Niagara* he was jointly represented by Mr. Everett and Mr. Woodhouse, the former taking charge of the machinery, and the latter—with a greater experience in such work—of the cable. They were assisted by Captain John Kell. Mr. Cyrus Field also accompanied the *Niagara*. Mr. Whitehouse being again unable to take passage, Professor Thomson agreed to supervise the testing-room arrangements in the *Agamemnon*, whilst Mr. de Sauty and Mr. Laws—together with Mr. John Murray—had the electrical force of the *Niagara* under their charge.

Although the improved paying-out gear had passed through most satisfactory experiments at Messrs. Easton & Amos' works, it was arranged by Charles Bright to test it practically in very deep water—besides making splices at sea, picking up, buoying and exercising all hands in their work generally—before commencing to lay in mid-Atlantic. So the cable-laden ships, with H.M.S. *Valorous* and H.M.S. *Gorgon* as consorts, first made a trial trip to the Bay of Biscay as far as lat. 47°12′N., long. 9°32′W., about 120 miles north-west of Corunna, where the *Gorgon* got soundings of 2,530 fathoms, or nearly three statute miles, in depth. The *Agamemnon* and *Niagara* were then backed close together, stern on, and a strong hawser was passed between them.

Each ship had on board some defective cable for the experiment about to be conducted. The further proceedings may now be observed from a perusal of Bright's diary, written aboard the *Agamemnon* :—

Monday, May 31*st.*—10 a.m., hove to, lat. 47°11′, long. 9°37′ Up to midday engaged in making splice between experimental cable in fore coil and that in main hold, besides other minor operations. In afternoon, getting hawser from *Niagara*, and her portion of cable to make joint, and splice. 4 p.m., commenced splice; 5.15, splice completed; 5.25, let go splice frame (weight 3 cwt.) over gangway, amidships, starboard side. 5.30, after getting splice frame (containing the splice) clear of the ship and lowering it to the bottom, each vessel (then about a quarter of a mile apart) commenced paying out in opposite directions.

9 p.m., got on board *Niagara's* warp and her end of cable, to make another splice for second experiment.

June 1*st.*—1 a.m. (night), electrical continuity gone, the cable having parted after two miles in all had been paid out. [1]

Since 1 a.m., engaged in hauling in our cable. Recovered all our portion and even managed to heave up the splice frame (in perfect condition), besides 100 fathoms of *Niagara's* cable, which she had parted. Fastened splice to stern of vessel and ceased operations.

9.23 a.m., second experiment. Started paying out again. Weather very misty.

9.40, one mile paid out at strain 16 cwt.; angle of cable 16° with the horizon; running out straight; rate of ship 2, cable 3.

9.45, changed to lower hold. 9.56, two miles out; last mile in 16½ minutes; strain 17 to 20 cwt.; angle of cable 20°. 10.10 last three miles out in 14 minutes.

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[1] This did not, of course, come as a surprise; for the length of cable employed for these experiments had long since been condemned as imperfect.

10.32 a.m., four and a half miles out. Third experiment stopped ship, lowered guard, stoppered cable.

10.50, buoy let go, strain 16 cwt. when let go, the cable being nearly up and down. 11.6, running at rate of $5\frac{1}{3}$ knots paying out, strain 21 to 23 cwt., varying. Cable shortly afterwards parted, through getting jammed in the machinery.

The subsequent experiments were mainly in the direction of buoying, picking up, and passing the cable from the stern to the bow sheave for picking up. All of these operations were in turn successfully performed; and, finally, in paying out, a speed of seven knots was attained without difficulty.

And now, the programme being exhausted, there was nothing left to be done but to return to Plymouth. On the whole, the trip proved eminently satisfactory. The paying-out machinery had behaved well, the various engineering operations had been successfully performed, and the electrical working through the whole cable was perfect. Professor Thomson had brought with him that offspring of his brain—his reflecting and testing instrument—and this gave excellent results.

Section 8

The Storm

The "wire ships" thus additionally experienced arrived at Plymouth on Thursday, June 3rd. The results were duly reported by Charles Bright, and some further arrangements made, principally connected with the electrical department.

A week later—having taken in a fresh supply of coal—

the expedition again left England "with fair skies and bright prospects." The barometer standing at 30·64, it was an auspicious start in what was declared by a consensus of nautical authorities to be the best time of the year for the Atlantic. This prognostication was doomed to a terrible disappointment, for the voyage nearly ended in the *Agamemnon* "turning turtle." She was repeatedly almost on her beam ends, the cable was partly shifted, and a large number of those on board were more or less seriously injured.

Charles Bright, with Messrs. Canning and Clifford, were—as during the trial trip—on the *Agamemnon*, and also Professor Thomson, who again took charge of the electricians' department, Mr. Whitehouse being ashore. Messrs. Everett and Woodhouse were once more on the *Niagara*, with Mr. de Sauty superintending the signalling. Mr. Cyrus Field, as before, sailed in the American ship.

In order that laying operations should be started by the two ships in mid-ocean, it was arranged that the entire fleet should meet in lat. 52°2′, and long. 33°18′ as a *rendezvous*. The *Porcupine*, the smallest ship of the squadron, had been sent to St. John's, Nova Scotia, with orders to meet the *Niagara* on her way to Trinity Bay. Besides the laying vessels, there were the *Valorous* and the *Gorgon*, the former acting as an escort to the *Agamemnon*, and the latter doing similar duty for the *Niagara*.

As it is impossible to follow the movements of more than one ship at a time, and as the vessel which Charles Bright sailed with—the *Agamemnon*—had the more exciting experience, we will confine our attention to her up to the date of the *rendezvous*. The day after starting there was no wind, but on the Saturday, the 12th, a breeze sprang up, and, with screw hoisted and fires raked out, the *Agamemnon* bowled along at a rare pace under royals and studding sails. The barometer fell fast, and squally weather coming on with the boisterous premonitory symptoms of an Atlantic gale, even those least versed in such matters could see at a glance that they were "in for it."

On Sunday the sky was a wretched mist—half rain, half vapour—through which the attendant vessels loomed faintly like shadows. The gale increased; till at four in the afternoon the good ship was rushing through the foam under close-reefed topsails and foresail. That night the storm got worse, and most of the squadron gradually parted company. The ocean resembled one vast snowdrift, the whitish glare from which—reflected from the dark clouds that almost rested on the sea—had a tremendous and unnatural effect, as if the ordinary laws of nature had been reversed.

Very heavy weather continued till the following Sunday, June 20th, which ushered in as fierce a storm as ever swept over the Atlantic. The narrative of this fight of nautical science with the elements may best be continued in the words of Mr. Nicholas Woods, who, representing *The Times*, was an eye-witness throughout—especially as it is probably the most intensely realistic description of a storm that has ever been written:—

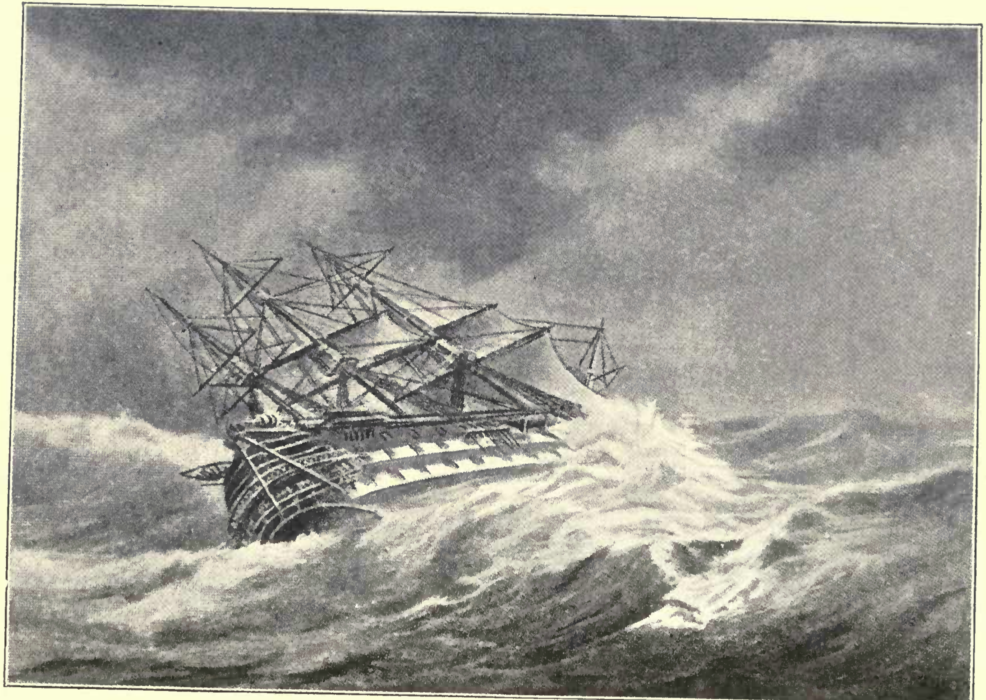
The *Niagara*, which had hitherto kept close—whilst the other smaller vessels had dropped out of sight—began to give us a very wide berth, and, as darkness increased, it was a case of every one for themselves.

Our ship, the *Agamemnon*, rolling many degrees, was labouring so heavily that she looked like breaking up. The massive beams under her upper deck coil cracked and snapped with a noise resembling that of small artillery, almost drowning the hideous roar of the wind as it moaned and howled through the rigging. Those in the improvised cabins on the main deck had little sleep that night, for the upper deck planks above them were "working themselves free," as sailors say; and, beyond a doubt, they were infinitely more free than easy, for they groaned under the pressure of the coil, and availed themselves of the opportunity to let in a little light, with a good deal of water, at every roll. The sea, too, kept striking with dull heavy violence against the vessel's bows, forcing its way through hawse-holes and ill-closed ports with a heavy slush; and thence, hissing and winding aft, it roused the occupants of the cabins aforesaid to a knowledge that their floors were under water, and that the flotsam and jetsam noises they heard beneath were only caused by their outfit for the voyage taking a cruise of its own in some five or six inches of dirty bilge. Such was Sunday night, and such was a fair average of all the nights throughout the week, varying only from bad to worse. On Monday things became desperate.

The barometer was lower, and, as a matter of course, the wind and sea were infinitely higher than the day before. It was singular, but at 12 o'clock the sun pierced through the pall of clouds, and shone brilliantly for half an hour, and during that brief time it blew as it has not often blown before. So fierce was this gust, that its roar drowned every other sound, and it was almost impossible to give the watch the necessary orders for taking in the close-reefed foresail. This gust passed, and the usual gale set in—now blowing steadily from the south-west, and taking us more and more out of our course each minute. Every hour the storm got worse, till towards five in the afternoon—when it raged with such a violence of wind and sea that matters really looked "desperate" even for such a strong and large ship as the *Agamemnon*. The upper deck coil had strained her decks throughout; and, though this mass, in theory, was supposed to prevent her rolling so quickly and heavily as she would have done without it, yet still she heeled over to such an alarming extent that fears of the coil itself shifting again occupied every mind, and it was accordingly strengthened with additional shores bolted down to the deck. The space occupied by the main coil below had deprived the *Agamemnon* of several of her coal bunkers; and in order to make up for this deficiency, as well as to endeavour to counterbalance the immense mass which weighed her down by the head, a large quantity of coals had been stowed on the deck aft. On each side of her main deck were thirty-five tons, secured in a mass, while on the lower deck ninety tons were stowed away in the same manner. The precautions taken to secure these huge masses also required attention as the great ship surged from side to side. Everything, therefore, was made "snug," as sailors call it; though their efforts by no means resulted in the comfort which might have been expected from the term. The night passed over without any mischance beyond the smashing of all things incautiously left loose and capable of rolling, and one or two attempts which the *Agamemnon* made in the middle watch to turn bottom upwards. In other matters it was the mere ditto of Sunday night; except, perhaps, a little worse, and certainly much more wet below. Tuesday, the gale continued with unabated force; though the barometer had risen to 29·30, and there was sufficient sun to take a clear observation, which showed our distance from the rendezvous to be 563 miles. During this afternoon the *Niagara* joined company, and, the wind going more ahead, the *Agamemnon* took to violent pitching, plunging steadily into the trough of the sea as if she meant to break her back and lay the Atlantic cable in a heap. This change in her motion strained and taxed every inch of timber near the coils to the very utmost. It was curious to see how they worked and bent as the *Agamemnon* went at everything she met head first. One time she pitched so heavily as to break one of the main-beams of the lower deck, which had to be shored with screw-jacks forthwith. Saturday, June 19th, things looked a little better. The barometer seemed inclined to go up and the sea to go down ; and for the first time that morning—since the gale began some six days previous—the decks could be walked with tolerable comfort and security. But, alas ! appearances are as deceitful in the Atlantic as elsewhere ; and during a comparative calm that afternoon the glass fell lower, while a thin line of black haze to windward seemed to grow up until it covered the heavens with a sombre darkness, and warned us that the worst was yet to come. There was much heavy rain that evening, and then the wind began—not violently, nor in gusts, but with a steadily increasing force. The sea was " ready-built to hand," as sailors say ; so at first the storm did little more than urge on the ponderous masses of water with redoubled force, and fill the air with the foam and spray it tore from their rugged crests. By-and-by, however, it grew more dangerous, and Captain Preedy himself remained on deck throughout the middle watch.

At 4 a.m., sail was shortened to close-reefed fore and main-topsails and reefed foresail. This was a long and tedious job, for the wind so roared and howled, and the hiss of the boiling sea was so deafening, that words of command were useless ; and the men aloft—holding on with all their might to the yards as the ship rolled over and over almost to the water—were quite incapable of struggling with the masses of wet canvas, that flapped and plunged as if men, yards and everything were going away together. The ship was almost as wet inside as out—and so things wore on till 8 or 9 o'clock, everything getting adrift and being smashed, and every one on board jamming themselves up in corners or holding on to beams to prevent their going adrift likewise. At 10 o'clock the good ship was rolling and labouring fearfully, with the sky getting darker, and both wind and sea increasing every minute. Half an hour later three or four gigantic waves were seen approaching the ship, coming slowly on through the mist, nearer and nearer, rolling on like hills of green water, with a crown of foam that seemed to double their height.

The *Agamemnon* rose heavily to the first, and then went down quickly into the deep trough of the sea, falling over in the act, so as to nearly capsize on the port side. There was a fearful crashing as she lay over this way, for everything broke adrift, whether secured or not, and the uproar and confusion were terrific for a minute ; then back she came again on the starboard beam in the same manner—only quicker and deeper than before. Again, there was the same noise and crashing, and the officers in the ward-room, realising the danger, struggled to their feet and opened the door leading to the main deck. The scene, for an instant, defied description. Amid loud shouts and efforts to save themselves, a confused mass of sailors, boys, and marines with deck-buckets, ropes, ladders, and everything that could get loose, and which had fallen back to the port side—were being hurled again in a mass across the ship to starboard. Dimly, and only for a moment, could this be seen ; and then, with a tremendous crash, as the ship fell over still deeper, the coals stowed on the main deck broke loose, and, smashing everything before them, went over among the rest to leeward. The coal-dust hid everything on the main deck in an instant ; but the crashing could still be heard going on in all directions, as the lumps and sacks of coal, with stanchions, ladders, and mess-tins, went leaping about the decks, pouring down the hatchways, and crashing through the glass skylights into the engine-room below. Matters now became most serious ; for it was evident that two or three more such lurches and the masts would go like reeds, while half the crew might be maimed or killed below. Captain Preedy was already on the poop, with Lieutenant Gibson, and it was "Hands, wear ship," at once ; while Mr. Brown, the indefatigable chief engineer, was ordered to get up steam immediately. The crew gained the deck with difficulty, and not till after a lapse of some minutes ; for all the ladders had been broken away, the men were grimed with coal-dust, and many bore still more serious marks upon their faces of how they had been knocked about below. There was great confusion at first, for the storm was fearful. The officers were quite inaudible ; and a wild, dangerous,



H.M.S. *AGAMEMNON*, WITH THE CABLE, IN A STORM sea, running mountains high, heeled the great ship backwards and forwards, so that the crew were unable to keep their feet for an instant, and in some cases were thrown right across the decks. Two marines went with a rush head-foremost into the paying-out machine, as if they meant to butt it over the side; yet, strange to say, neither the men nor the machine suffered. What made matters worse, the ship's barge, though lashed down to the deck, had partly broken loose; and dropping from side to side as the vessel lurched, it threatened to crush any who ventured to pass. The regular discipline of the ship, however, soon prevailed; and the crew set to work to wear round the ship on the starboard tack, while Lieutenants Robinson and Murray went below to see after those who had been hurt. The marine sentry outside the ward-room door on the main deck had not had time to escape, and was completely buried under the coals. Some time elapsed before he could be got out; for one of the beams which had crushed his arm very badly, still lay across the mangled limb—jamming it in such a manner that it was found impossible to remove it without risking the man's life. The timber had, indeed, to be sawn away before the poor fellow could be extricated. Another marine on the lower deck endeavoured to save himself by catching hold of what seemed like a ledge in the planks; but, unfortunately, it was only caused by the beams straining apart, and, of course, as the *Agamemnon* righted they closed again, and crushed his fingers flat. One of the assistant engineers was also buried among the coals on the lower deck, and sustained some severe internal injuries. *The lurch of the ship was calculated at forty-five degrees each way for five times in rapid succession.* The galley coppers were only half filled with soup; nevertheless, it nearly all poured out, and scalded some of those who were extended on the decks, holding on to anything in reach. These, with a dislocation, were the chief casualties; but there were others of bruises and contusions, more or less severe, and a long list of escapes more marvellous than any injury. One poor fellow went head-first from the main deck into the hold without being hurt; and one on the orlop deck was "chevied" about for some ten minutes by three large casks of oil which had got adrift, and any one of which would have flattened him like a pancake had it overtaken him.

As soon as the *Agamemnon* had gone round on the other tack the *Niagara* wore also, and bore down as if to render assistance. She had witnessed our danger, and, as we afterwards learnt, imagined that the upper deck coil had broken loose and that we were sinking. Things, however, were not so bad as that, though they were bad enough, Heaven knows, for everything seemed to have gone wrong that day. The upper deck coil had strained the ship to the very utmost, yet still held on fast. But not so the coil in the main hold. This had begun to get adrift, and the top kept working and shifting over from side to side, as the ship lurched, until some forty or fifty miles were in a hopeless state of tangle, resembling nothing so much as a cargo of live eels.

Going round upon the starboard tack had eased the ship to a certain extent. The crew, who had been at work since nearly four in the morning, were set to clear up the decks from the masses of coal that covered them. About six in the evening it was thought better to wear ship once more and stand by for the *rendezvous* under easy steam. Her head accordingly was put about and once more faced the storm. As she went round, she of course fell into the trough of the sea again, rolling so awfully as to break her waste steam-pipe, filling her engine-room with steam, and depriving her of the services of one boiler when it was sorely needed. The sun set upon as wild and wicked a night as ever taxed the courage and coolness of a sailor. There were, of course, men on board who were familiar with gales and storms in all parts of the world ; and there were some who had witnessed the tremendous hurricane which swept the Black Sea on the memorable November 14th, when scores of vessels were lost and seamen perished by the thousand. But of all on board none had ever seen a fiercer or more dangerous sea than raged throughout that night and the following morning, tossing the good ship from side to side like a mere plaything among the waters. The night was thick and very dark, the low black clouds almost hemming the vessel in; now and then a fiercer blast than usual drove the great masses slowly aside, and showed the moon, a dim, greasy blotch upon the sky, with the ocean—white as driven snow—boiling and seething like a cauldron. But these were only glimpses, alternated with darkness, through which the waves rushed upon the ship as though they must overwhelm it, and dealing it one staggering blow, went hissing and surging past into the darkness again. The grandeur of the scene was almost lost in its dangers and terrors, for of all the many forms in which death approaches man there is none so easy in fact, so terrific in appearance, as death by shipwreck.

Sleep was impossible that night on board the *Agamemnon*. Even those in cots were thrown out, from their striking against the vessel's side as she pitched. The berths of wood fixed athwart-ships in the cabins on the main deck had worked to pieces. Chairs and tables were broken, chests of drawers capsized, and a little surf was running over the floors of the cabins themselves, pouring miniature seas into portmanteaus, and breaking over carpet-bags of clean linen. Fast as it flowed off by the scuppers it came in faster by the hawse-holes and ports, while the beams and knees strained with a doleful noise, as though it was impossible they could hold together much longer. It was, indeed, as anxious a night as ever was passed on board any line-of-battle ship in Her Majesty's service. Captain Preedy never left the poop throughout—though it was hard work to remain there, even holding on to the poop-rail with both hands. Morning brought no change. The storm was as fierce as ever; and whilst the sea could not be higher or wilder, the additional amount of broken water made it still more dangerous to the ship. Very dimly, and only now and then, through the thick scud, the *Niagara* could be seen—one moment on a monstrous hill of water and the next quite lost to view, as the *Agamemnon* went down between the waves. Even these glimpses showed us that our Transatlantic consort was plunging heavily, shipping seas, and evidently having a bad time of it. But she got through it better than the *Agamem-*

non, as of course she could. Suddenly it came on darker and thicker, and we lost sight of her in the thick spray, and had only ourselves to look after. This was quite enough, for every minute made matters worse, and the aspect of affairs began to excite serious misgivings in the minds of those in charge. The *Agamemnon* is one of the finest line-of-battle ships in the whole navy; but in such a storm, and so heavily overladen, what could she do but make bad weather worse, and strain and labour and fall into the trough of the sea, as if she were going down head foremost? Three or four hours more, and the vessel had borne all she could bear with safety. The masts were rapidly getting worse, the deck coil worked more and more with each tremendous plunge; and, even if both these held, it was evident that the ship itself would soon strain to pieces if the present weather continued. The sea, forcing its way through ports and hawse-holes, had accumulated on the lower deck to such an extent that it floated the stoke-hole, so that the men could scarcely remain at their posts. Everything was smashing and rolling about. One plunge put all the electrical instruments *hors de combat* at a blow, and staved some barrels of strong solution of sulphate of copper, which went cruising about, turning all it touched to a light pea-green. By-and-by we began to ship seas. Water came down the ventilators near the funnel into the engine-room. Then a tremendous sea struck us forward, drenching those on deck, and leaving them up to their knees in water, and the least versed on board could see that things were fast going to the bad unless a change took place in the weather or the condition of the ship. Of the first there seemed little chance. It certainly showed no disposition to clear—on the contrary, livid-looking black clouds seemed to be closing round the vessel faster than ever. For the relief of the ship, three courses were open to Captain Preedy—one to wear round and try her on the starboard tack, as he had been compelled to do the day before; another, to fairly run for it before the wind; and, the third and last, to endeavour to lighten the vessel by getting some of the cable overboard. Of course the latter would not have been thought of till the first two had been tried and failed—in fact, not till it was evident that nothing else could save the ship. Against wearing round there was the danger of her again falling off into the trough of the sea, losing her masts, shifting the upper deck coil, and so finding her way to the bottom in ten minutes ; while to attempt running before the storm with such a sea on was to risk her stern being stove in and a hundred tons of water added to her burden with each wave that came up afterwards, till the poor *Agamemnon* went under them all for ever. A little after ten o'clock on Monday, the 21st, the aspect of affairs was so alarming that Captain Preedy resolved at all risks to try wearing the ship round on the other tack. It was hard enough to make the words of command audible, but to execute them seemed almost impossible. The ship's head went round enough to leave her broadside on to the seas, and then for a time it seemed as if nothing could be done. All the rolls which she had ever given on the previous day seemed mere trifles compared with her performances then. Of more than 200 men on deck at least 150 were thrown down, falling over from side to side in heaps—while others, holding on to ropes, swung to and fro with every heave. It really appeared as if the last hour of the stout ship had come, and to this minute it seems miraculous that her masts held on. Each time she fell over, her main chains went deep under water. The lower decks were flooded, and those above could hear by the fearful crashing —audible amid the hoarse roar of the storm—that something alarming had happened. It was then found that the coals had, once more, got loose below, had broken into the engine room, and were carrying all before them. During these rolls the main deck coil shifted over to such a degree as to entirely envelope four men, who, sitting on the top, were trying to wedge it down with beams. One of them was so much jammed by the mass which came over him that he was seriously contused. He had to be removed to the sick bay, *making up the sick list to forty-five*—of which ten were from injuries caused by the rolling of the ship, and most of the rest from continual fatigue and exposure during the gale. Once round on the starboard tack, and it was seen in an instant that the ship was in no degree relieved by the change. Another heavy sea struck her forward, sweeping clean over the fore part of the vessel, and carrying away the woodwork and platforms which had been placed there round the machinery for under-running. This and a few more plunges were quite sufficient to settle the matter; and at last Captain Preedy reluctantly succumbed to a storm he could neither conquer nor contend against. Full steam was got on, and, with a foresail and foretopsail to lift her head, the *Agamemnon* ran before the wind, rolling and tumbling over the huge waves at a tremendous pace. It was well for all that the wind gave this much way on her, or her stern would certainly have been stove in. As it was, a wave partly struck her on the starboard quarter, smashing the quarter galley and ward-room windows on that side; and sending such a sea into the ward-room itself as to wash two officers off a sofa. This was a kind of parting blow; for the glass began to rise, and the storm was evidently beginning to moderate; and although the sea still ran as high as ever, there was less broken water, and altogether, towards midday, affairs assumed a better and more cheerful aspect. The ward-room that afternoon was a study for an artist; with its windows half darkened and smashed, the sea water still slushing about in odd corners, with everything that was capable of being broken strewn over the floor in pieces, and some fifteen or twenty officers, seated amid the ruins, holding on to the deck or table with one hand, while with the other they contended at a disadvantage with a tough meal—the first which most had eaten for twenty-four hours. Little sleep had been indulged in, though much lolloping about. Those, however, who prepared themselves for a night's rest in their berths rather than at the ocean bottom, had great difficulty in finding their day garments of a morning. The boots especially went astray, and got so hopelessly mixed that the man who could "show up" with both pairs of his own was, indeed, a man to be congratulated.

But all things have an end; and this long gale—of over a week's duration—at last blew itself out, and the weary ocean rocked itself to rest. Throughout the whole of Monday the

Agamemnon ran before the wind, which moderated so much that at 4 a.m. on Tuesday her head was once more put about; and for the second time she commenced beating up for the *rendezvous*, then some 200 miles further from us than when the storm was at its height on Sunday morning. So little was gained against this wind, that Friday, the 25th—sixteen days after leaving Plymouth—still found us some fifty miles from the *rendezvous*. It was, therefore, determined to get up steam and run down on it at once. As we approached the place of meeting the angry sea went down. The *Valorous* hove in sight at noon; in the afternoon the *Niagara* came in from the north; and at even, the *Gorgon* from the south, and then, almost for the first time since starting, the squadron was re-united near the spot where the great work was to have commenced fifteen days previously—as tranquil in the middle of the Atlantic as if in Plymouth Sound.

Section 9

The Renewed Effort

That evening the four vessels lay together side by side, and there was such a stillness in the sea and air as would have seemed remarkable even on an inland lake. On the Atlantic, and after what had been so lately experienced, it seemed positively unnatural.

The boats were out, and the officers were passing from ship to ship, telling their experiences of the voyage, and forming plans for the morrow. Captain Preedy had a sorry tale to tell. The strain to which the *Agamemnon* had been subjected during the storm—by the great weight, rendering her almost unmanageable, and owing to the peculiar nature of her cargo—had opened her "waterways," where the deck and the sides were joined, by about two inches. Then again, one of the crew, a marine, had been literally frightened out of his wits, and remained crazy for some days. One man had his arm fractured in two places, and another his leg broken.

The *Niagara*, on the other hand, had weathered the gale splendidly, though nevertheless with her it had been a hard and anxious time. She had lost her jib-boom, and the buoys she carried for suspending the cable had been washed from her sides, no man knew where. After taking stock of things generally, a start was made to repair the damage. The shifting of the upper part of the main coil on the *Agamemnon* into a hopeless tangle, entailed recoiling a considerable length of cable.

We will now once more continue our narrative in the words of Mr. Nicholas Woods, in reporting for *The Times* from the *Agamemnon* :—

Neither Mr. Bright, nor Mr. Canning, nor Mr. Clifford was to be daunted by the aspect of a difficulty, however formidable. Absurd as the statement seemed at first, they were all positive that the tangle did not extend far down the coil; and they were right. Captain Preedy gave them his hearty assistance; men were at work day and night, drawing it out of the hold and coiling it aft on the main deck. For the first twenty-four hours the labour seemed hopeless, for so dense was the tangle that an hour's hard work would sometimes scarcely clear a half-mile. By-and-by, however, it began to mend, the efforts were redoubled, and late on Friday night 140 miles had been got out, the remainder being clear enough to start work with. On the morning of Saturday, the 26th of June, all the preparations were completed for making the splice and commencing the great undertaking.

The end of the *Niagara's* cable was sent on board the *Agamem-*

non, the splice was made, a bent sixpence put in for luck, and at 2.50, Greenwich time, it was slowly lowered over the side, and disappeared for ever. The weather was cold and foggy, with a stiff breeze and dismal sort of sleet, and as there was no cheering or manifestation of enthusiasm of any kind, the whole ceremony had a most funereal effect, seeming as solemn as if we were burying a marine, or some similar mortuary task. As it turned out, however, it was just as well that no display took place, for every one would have looked uncommonly silly when the same operation came to be repeated, as it had to be, an hour or so afterwards. Not to make a long story longer, I may say at once, that when each ship had paid out three miles or so, and they were getting well apart, the cable broke on board the *Niagara*, owing to its over-riding and getting off the pulley leading on to the machine.

The mishap was, of course, instantly detected: both vessels put about and returned, a fresh splice was made, and again lowered over at half-past seven. According to arrangement, 150 fathoms were veered out from each ship, and then all stood away on their course, at first at two miles an hour and afterwards at four. Everything then went well, the cable running out easily at five and a half miles an hour, the ship going four. The greatest strain upon the dynamometer was 2,500 lb., and this was but for a few minutes, the average giving only 2,000 lb. and 2,100 lb. At twelve at midnight, 21 nautical miles had been paid out, and the angle of the cable with the horizon had been reduced considerably. At about half-past three, forty miles had gone, and nothing could be more perfect and regular than the working of everything, when suddenly, at 3.40 a.m., on Sunday, the 27th, Professor Thomson came on deck, and reported a total break of continuity; that the cable, in fact, had parted, and, as was believed at the time, from the *Niagara*. The *Agamemnon* was instantly stopped, and the brakes applied to the machinery, in order that the cable paid out might be severed from the mass in the hold, and so enable Professor Thomson to discover by electrical tests at about what distance from the ship the fracture had taken place.[1] Unfortunately, however, there was a strong breeze on at the time, with rather a heavy swell, which told severely upon the cable; and, before any means could be taken to sufficiently ease the motion on the ship, it broke—the dynamometer indicating a strain of nearly 4,000 lb. In another instant a gun and a blue light warned the *Valorous* of what had happened. This roused all on board the *Agamemnon* to a knowledge that the machinery was silent, and that the first part of the Atlantic cable had been laid—and effectually lost.

The great length of cable on board both ships allowed a large margin for such mishaps as these; and the arrangement made before leaving England was that the splices might be renewed and the work recommenced till each ship had lost 250 miles of wire, after which they were to discontinue their efforts and return to Queenstown. Accordingly, after the breakage on Sunday morning, the ships' heads were put about; and for the fourth time the *Agamemnon* once more entered on the weary work of beating up against the wind for that everlasting *rendezvous* which we seemed destined to be always seeking. Apart from the regret with which all regarded the loss of the cable, there were other reasons for not wishing the cruise to be thus indefinitely prolonged. The fact is there had been a break in the continuity of fresh provisions; and for some days previous the *pièces de resistance* had been inflammatory-looking *morceaux*, salted to an astonishing pitch, and otherwise uneatable—for it was beef which had been kept three years beyond its warranty for soundness—to which all were then reduced.

It was hard work beating up against the wind; so hard, indeed, that it was not till the noon of Monday, the 28th, that we again met the *Niagara*; and, while all were waiting with

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[1] By subsequent tests it was clear that at any rate the cable remaining on board was perfect. But after comparing notes with the *Niagara*, a strong belief was held that the cable parted probably at the bottom.

impatience for her explanation of how she broke the cable, she electrified every one by running up the interrogatory, "How did the cable part?" This *was* astounding. As soon as the boats could be lowered, Mr. Cyrus Field, with the electricians from the *Niagara*, came on board; and a comparison of logs revealed the painful and mysterious fact that at the same second of time both vessels discovered that a total fracture had taken place at a distance of certainly not less than ten miles from each ship. The logs on both sides were so clear as to the minute of time—and as to the electrical tests showing not merely leakage or defective insulations of the wire, but a total fracture—that there was no room for doubt as to what had happened. Of all the many mishaps connected with the Atlantic telegraph, this was the worst and most disheartennig; since it proved that, despite what human skill and science could effect in laying the wire down with safety, there may be some fatal obstacles to success at the bottom of the ocean which can never be guarded against. Was the bottom covered with a soft coating of ooze in which it had been said the cable might rest undisturbed for years, as on a bed of down? or were there, after all, sharp-pointed rocks lying on that supposed plateau of Maury, Berryman and Dayman? These were the questions that some of those on board were asking.

But there was no use in further conjecture, or in repining over what had already happened. Though the prospect of success appeared to be considerably impaired, it was generally considered that there was but one course left, and that was to splice again and make another—and what was fondly hoped would be a final—attempt. Accordingly, no time was lost in making the third splice, which was lowered into 2,000 fathoms of water at seven o'clock that evening. Before steaming away—as the *Agamemnon* was now getting very short of coal—it was agreed that if the wire parted again before the ships had gone each 100 miles from the *rendezvous* they were to return and make another splice. If, on the other hand, the 100 miles had been exceeded, the ships were not to return, but each make for Queenstown.

With this understanding the ships again parted; and, with the wire dropping steadily down between them, the *Niagara* and *Agamemnon* steamed away, and were soon lost in the cold raw fog which had hung over the *rendezvous* ever since the operations had commenced.

The cable, as before, paid out beautifully, and nothing could have been more regular and more easy than the working of every part of the apparatus. At first the ship's speed was only two knots, the cable going three, with a strain of 1,500 lb., the horizontal angle averaging as low as seven, and the vertical about sixteen. By-and-by, however, the speed was increased to four knots, the cable going five, at a strain of 2,000 lb., and an angle of from twelve to fifteen. At this rate it was kept, with trifling variations, throughout Monday night, neither Mr. Bright, Mr. Canning, nor Mr. Clifford ever quitting the machine for an instant. Towards the middle of the night, while the rate of the ship continued the same, the speed at which the cable paid out slackened nearly a knot, while the dynamometer indicated as low as 1,300 lb. This change could only be accounted for on the supposition that the water had shallowed to a considerable extent, and that the vessel was, in fact, passing over some submarine Ben Nevis or Skiddaw. After an interval of about an hour the strain and rate of progress of the cable increased again, while the increase of the vertical angle seemed to indicate that the wire was sinking down the side of a declivity. Beyond this there was no variation throughout Monday night, or, indeed, through Tuesday. The upper deck coil, which had weighed so heavily upon the ship—and still more heavily upon the minds of all during the past storms—was fast disappearing, and by twelve at midday on Tuesday, the 29th, seventy-six miles had been paid out to something like sixty miles progress of the ship. Warned by repeated failures, many of those on board scarcely dared to hope for success; but the spirits of all rose as the distance widened between the ships. Things were going in splendid style—in such splendid style that "stock had gone up nearly 100 per cent." Those who had leisure for sleep were able to dream about cable-laying and the terrible effects of too great a strain. The first question which such as these ask on awakening is about the cable. For those who do not derive any particular pleasure from the mere asking of questions, the harmonious music made by the paying-out machine during its revolutions supplies the necessary information.

Then, again, the electrical continuity—after all the most important item—was perfect, and the electricians reported that the signals passing between the ships were eminently satisfactory. The door of the testing-room is almost always shut, and the electricians pursue their work undisturbed; but it is impossible to exclude that spirit of scientific inquiry which will satiate its thirst for information even through a keyhole! Further, the weather was all that could be wished for. Indeed, had the poet who was so anxious for "life on the ocean wave, and a home on the rolling deep" been aboard, he would have been absolutely happy, and perhaps even more desirous for a fixed habitation.

The only cause that warranted anxiety was that it was evident the upper deck coil would be finished by about eleven o'clock at night, when the men would have to pass along in darkness the great loop which formed the communication between that and the coil in the main hold. This was most unfortunate; but the operation had been successfully performed in daylight during the experimental trip in the Bay of Biscay, and every precaution was now taken that no accident should occur. At nine o'clock by ship's time, when 146 miles had been paid out, and about 112 miles distance from the *rendezvous* accomplished, the last flake but one of the upper deck coil came in turn to be used. In order to make it easier in passing to the main coil, the revolutions of the screw were reduced gradually, by two revolutions at a time, from thirty to twenty, while the paying-out machine went slowly from thirty-six to twenty-two. At this rate, the vessel going three knots and the cable three and a half, the operation was continued with perfect regularity, the dynamometer indicating a strain of 2,100 lb. Suddenly, without an instant's warning, or the occurrence of any single incident that could account for it, the cable parted, when subjected to a strain of less than a ton.[1] The gun that again told the *Valorous* of this fatal mishap brought all on board the *Agamemnon* rushing to the deck. This time, few could believe the rumour, that had spread like wildfire about the ship ; but there stood the machine silent and motionless, while the fractured end of the wire hung over the stern wheel, swinging loosely to and fro. It seemed almost impossible to realise the fact that an accident so instantaneous and irremediable should have occurred, and at a time when all seemed to be going so well. A variety of ingenious suggestions were, however, soon afloat, showing most satisfactorily how the cable must and ought to have broken. There was a regular gloom that night on board the *Agamemnon.* From first to last the success of the expedition had been uppermost in the thoughts of all. Every one had laboured for it early and late, contending with each danger and overcoming numerous obstacles and disasters with an earnestness and devotion of purpose that is beyond all praise. Immediately after the mishap, a brief consultation was held by those in charge. As it was shown that they had only exceeded the distance from the *rendezvous* by fourteen miles, and as there was still enough cable on board the two vessels, it was determined to return to the *rendezvous* with a view to making another effort at carrying the undertaking to a successful issue. The journey to the *rendezvous* had, of course, to be effected under sail, the coal bunkers having to be closely guarded lest, if in coming to paying out the cable again, steam should run short—thereby endangering the success of the whole enterprise.

For the fifth time, therefore, the *Agamemnon's* head went about, and after twenty days at sea she was once more beating up against the wind. The following day the wind was blowing strongly from the south-west, with mist and rain, and Thursday,

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[1] This was from the last turn in the coil, and subsequently it was discovered that, owing to the disturbance in the flooring of the tank during the storm, the cable had been damaged here.

the 1st of July, gave every one the most unfavourable opinion of July weather in the Atlantic. The wind and sea were both high—the wet fog so dense that one could scarcely see a mast's head, while the damp cold was really biting. Altogether it was an atmosphere of which a Londoner would have been ashamed even in November. Later in the day a heavy sea got up; the wind increased without dissipating the fog, and it was double-reefed topsails, and pitching and rolling as before. However, the upper deck coil of 250 tons being gone, the *Agamemnon* was as buoyant as a lifeboat, and no one cared how much she took to kicking about, though the cold wet fog was a miserable nuisance, penetrating everywhere, and making the ship as wet inside as out. What made matters worse was that in such weather there seemed no chance of meeting the *Niagara*—unless she ran into us, when cable-laying would have gone on wholesale! In order to avoid such a *contretemps*, and also to inform the *Valorous* of our whereabouts, guns were fired, fog bells rung, and the bugler stationed forward, to warn the other vessels of our vicinity. Friday was the ditto of Thursday, and Saturday worse than both together; for it almost blew a gale, and there was a very heavy sea on. On Sunday, the 4th, it cleared; and the *Agamemnon*, for the first time during the whole cruise, reached the actual *rendezvous*, and fell in with the *Valorous*, which had been there since Friday, the 2nd. But the fog must have been even thicker there than elsewhere, for she had scarcely seen herself—much less anything else—till Sunday.

During the remainder of that day and Monday, when the weather was very clear, both ships cruised over the place of meeting, but neither the *Niagara* nor *Gorgon* was there, though day and night the look-out for them was constant and incessant. It was evident, then, that the *Niagara* had rigidly—but most unfortunately—adhered to the mere letter of the agreement regarding the 100 miles, and after the last fracture had at once turned back for Queenstown. On Tuesday, the 6th, therefore, as the dense fogs and winds set in again, it was agreed between the *Valorous* and *Agamemnon* to return once more to the *rendez-*

vous. But, as usual, the fog was so thick that the whole American navy might have been cruising there unobserved. The search was, therefore, given up; and at eight o'clock that night the ship's head was turned for Cork. The voyage home was made with ease and swiftness—considering the lightness of the wind and the trim of the ship; and at midday on Tuesday, July 12th, the good ship cast anchor in Queenstown harbour, having met with more dangerous weather and encountered more mishaps than often falls to the lot of any ship in a cruise of thirty-three days.

Thus ended the most arduous and dangerous expedition that has ever been experienced in connection with cable-work. It, at any rate, had the advantage of supplying the public with some exciting reading in the columns of *The Times*, and Mr. Woods' graphic descriptions were much appreciated—even by other eye-witnesses.

As regards Charles Bright's diary during this period—with the constant strain of responsibility on his shoulders—it had necessarily consisted, in the main, of rough pencil notices referring to details such as miles run, cable paid out, strain on dynamometer, percentage of slack, etc. The subject of our biography used to say that, arduous as it was, the life on board resembled a good ball—"the excitement keeping one going." For purposes of accuracy it is to be regretted, of course, that those holding responsible positions seldom have time to write a record of the events, or even to attend to representatives of the press. If it were otherwise, there would be fewer false statements, which are passed on to posterity very often for want of being contradicted by the few who know better but have other matters to see to. In this particular instance, however, not only did Mr. Woods tell his story of the Atlantic cable-laying in a most palatable form—far more so than would be possible by any of the officials engaged in the work—but his account was notably accurate.

The *Niagara* had reached Queenstown as far back as July 5th. Those in charge having found they had run out a hundred and nine miles when "continuity" ceased, considered that, in order to carry out their instructions, they should return at once to the above port—which they did. Before bearing homewards, however, and whilst the line was still hanging on to the ship's stern, opportunity was taken to make what proved to be an eminently satisfactory test in regard to the strength of the cable. After all hope of the continuity being restored was abandoned, the brakes were shut down so that the paying-out machine could not move. In this way the process of paying-out was stopped for about an hour and a half, during which the whole weight of the *Niagara* was literally held by the slender cord, the wind blowing fresh all the time. And yet the cable did not break until the pressure put upon the brakes had reached an equivalent of over four tons strain!

On the two ships meeting at Queenstown, discussion immediately took place (1) as to the cessation of continuity, and (2) regarding the plan adopted by the *Niagara* in returning home so promptly. The non-arrival of the *Agamemnon* till nearly a week later had been the cause of much alarm as regards her safety.

SECTION 10

Finis coronat opus

The sad tale of disaster commenced to spread abroad immediately on the *Niagara's* arrival in Queenstown; and when Mr. Field hastened to London to meet the other directors of the Company, he found that the news had not only preceded him but had already had its effect. The Board was soon called together. It met in the same room in which, six weeks earlier, it had discussed the prospects of the expedition with full confidence of success. Now it met as a council of war summoned after a terrible defeat, to decide whether to surrender or to try once more the chances of battle.

As described by Mr. Henry Field:

> "Most of the directors looked blankly in one another's faces." With some the feeling was one akin to despair. It was thought by many that there was nothing left on which to found an expectation of future success, or to encourage the expenditure of further capital upon an adventure so "completely visionary." Sir William Brown (the first chairman), whilst recommending complete abandonment of the undertaking, suggested "a sale of the cable remaining on board the ships, and a distribution of the proceeds amongst the shareholders."

Mr. Brooking, the vice-chairman, also now convinced of the impracticability of the undertaking, sent in his resignation.

Bolder counsels, however, were destined to prevail. There were those who thought there was still a chance—like Robert Bruce, who, after twelve battles and twelve defeats, yet believed that a thirteenth *might* bring victory. Besides the projectors—J. W. Brett, Charles Bright and

Cyrus Field—Mr. Curtis Lampson (who succeeded Mr. Brooking as deputy-chairman) made a firm stand for action at once, as did also Professor Thomson [1] and Mr. Whitehouse. These advocates of non-surrender at length succeeded in carrying an order for the immediate sailing of the expedition for a final effort. It was this effort which proved to the world the possibility of telegraphing from one hemisphere to the other.

The order to advance having been given, the ships immediately took in coal and other necessaries.

During this interval, and whilst in London, Charles Bright availed himself of the opportunity to run down to his country home near Harrow for a single day and night, thus catching a glimpse of those dearest to him. On leaving, he remarked to his young wife, "I don't say we shall do it even this time, but we shall do it *some* time." This was very characteristic of the man. It will probably be admitted that the failing with many is that though they set their teeth at a thing, they do not do so for long enough. That could scarcely be said of young Bright.

When everything and everybody had been shipped, the squadron left Queenstown once more on Saturday, July 17th. As the ships sailed out of the harbour of Cork, it was with none of the enthusiasm which attended their departure from Valentia the year before, or even the small amount excited

[1] Whilst the ships were lying at Queenstown, Professor Thomson had transmitted signals through the entire length of cable on the two ships, thereby again demonstrating the electrical practicability of the line.

when leaving Plymouth on June 10th. Nobody so much as cheered. In fact, their mission was by this time spoken of as a "mad freak" of "stubborn ignorance"!

The squadron was the same as on the last occasion. It was agreed that the ships should not attempt to keep together this time, but that each should make its way to the given latitude and longitude. The staff were composed and berthed as before, Mr. Field once more taking up his quarters aboard the *Niagara*. Moreover, the expedition was again accompanied by the same literary talent; and we cannot do better now than give the story as it is continued by Mr. Nicholas Woods on behalf of *The Times*,[1] so far as the *Agamemnon* (containing Charles Bright) is concerned—

As your readers have already been informed by telegraph, the submarine communication between the Old and New Worlds is now an accomplished fact. In the face of difficulties and dangers, the engineers engaged in this undertaking have, with almost untiring energy, adhered to their task with that perseverance which is sure, sooner or later, to lead to success. There were but few some twenty days ago who, after the unsuccessful return of the squadron to Queenstown, would have dared to predict such a speedy and glorious termination to all the trials and difficulties that the promoters of this enterprise have undergone. The final accomplishment of the scheme seemed indeed up to the last moment to hang upon a hair. Many serious difficulties had to be encountered during the six days and a half that the operations lasted. Any one of these might have ruined the expedition and delayed the advance of ocean telegraphs perhaps more than half a century. But the difficult task has now been accomplished; and it only remains for us to accept

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[1] *The Times*, Wednesday, August 11th, 1858.

the benefits which it will undoubtedly confer upon the community. Wonderful as the conception of conveying sensations across the almost unknown depths of the ocean may seem to us now, yet in a very little time people will forget the marvel while profiting by the fact; and, without remembering the years of anxious toil and discouragement which those who have secured this boon to the community have undergone to secure success, the wonder will be, not that the undertaking has been carried out at all, but that it had not been accomplished long before. It has been the custom of mankind to honour the lives and celebrate the deeds of great statesmen, successful warriors, and eminent divines. Indeed, of such materials are the links in the chain of history chiefly composed. But those men who, by patient thought and persevering action, have achieved victories over matter—which secure to the community permanent advantages—very often have their trouble for their reward. It is to be hoped that this may not be the case with those who have been mainly instrumental in bringing this great work to a successful termination. It must be confessed that the prospects of success were very remote when the squadron left Queenstown on the 17th of last month. The amount of cable in the two ships had been reduced by nearly 400 miles; and the recollection of three separate and most unaccountable breakages was still fresh in the minds of all who had accompanied the first expedition. There was no assurance whatever that the very same thing would not occur again. The cable might, and evidently did, as far as the contractors are concerned, fulfil all the guaranteed requirements; and the numerous accidents which occurred might be due to the cable having become injured during the gale. This supposition, though it may be gratifying to Messrs. Glass, Elliot & Co., and to Messrs. Newall & Co., was no consolation to either the engineers or the shareholders. Under these circumstances, it is not surprising that many regarded the prosecution of the scheme as a waste of the shareholders' money. However, in spite of the most vehement opposition, the majority of the directors determined to despatch the expedition to try their fortune once again in mid-ocean before they finally abandoned the project as impracticable. Accordingly, on the morning of Saturday, the 17th of July the *Valorous*, *Gorgon*, and *Niagara*, having completed coaling, steamed away from Queenstown for the *rendezvous*. The *Agamemnon*, having to wait for Professor W. Thomson, one of the directors, who took charge of the electrical department on board,[1] did not weigh anchor till two o'clock on the following morning. As the ships left the harbour there was apparently no notice taken of their departure by those on shore or in the vessels anchored around them. Every one appeared impressed with the conviction that we were engaged in a hopeless enterprise; and the squadron seemed rather to have slunk away on some discreditable mission than to have sailed for the accomplishment of a grand national scheme.

It was just dawn when the *Agamemnon* got clear of Queenstown Harbour. Of the voyage out there is little to be said: It is not checkered by the excitement of continual storms or the tedium of perpetual calms, but we had a sufficient admixture of both to render our passage to the *rendezvous* a very ordinary and uninteresting one. With very little breeze, or wind, the screw was got up and sails set, so as to husband our coals as much as possible; but it soon fell calm, and obliged Captain Preedy to again get up steam. In consequence of continued delays and changes from steam to sail, and from sail to steam, much fuel was expended, and not more than eighty miles of distance made good each day. On Sunday, the 25th, however, the weather changed, and for several days in succession there was an uninterrupted calm. The moon was just at the full; and for the next few nights it shone with a brilliancy which turned the smooth sea into one silvery sheet, which brought out the dark hull and white sails of the ship in strong contrast to the sea and sky as the vessel lay all but motionless on the water—the very

[1] The gentleman holding the position of electrician to the Company—Mr. Whitehouse—was still, under medical advice, prevented from accompanying the expedition.

impersonation of solitude and repose. Indeed, until the *rendezvous* was gained, we had such a succession of beautiful sunrises, gorgeous sunsets, and tranquil moonlight nights as would have excited the most enthusiastic admiration of any but persons situated as we were. But by us scenes of this sort were regarded only as the annoying indications of the calm which delayed our progress and wasted our coals. To say that it was calm is not doing full justice to it—there was not a breath in the air, and the water was as smooth as a mill-pond. Even the wake of the ship scarce ruffled its surface ; and the gulls—which had visited us almost daily, and to which our benevolent liberality had dispensed innumerable helpings of pork—threw an almost unbroken shadow upon it as they stooped in their flight to pick up the largest and most tempting. It was generally remarked that cable-laying under such circumstances would be mere child's play. In spite of the unusual calmness of the weather in general, there were days on which our former unpleasant experiences of the Atlantic were brought forcibly to mind—when it blew hard, and the sea ran sufficiently high to reproduce on a minor scale some of the discomforts of which the previous cruise had been so fruitful. These days, however, were the exception and not the rule. They served to show how much more pleasant was the inconvenient calm than the weather which had previously prevailed.

The precise point of the *rendezvous*—marked by a dot on the chart—was reached on the evening of Wednesday, the 28th July, just eleven days after our departure from Queenstown. The voyage out was a lazy one. Now things are different, and we no longer hear of the prospects of the heroes and heroines of the romances and novels which have formed the staple food for animated discussion for some days past. The rest of the squadron were in sight at nightfall, but at such a considerable distance that it was past ten o'clock on the morning of Thursday, the 29th, before the *Agamemnon* joined them. Some time previous to reaching the *rendezvous* the engineer-in-chief (Mr. Bright) went up in the shrouds on the look-out for the other ships, and accordingly had to "pay his footing"—much to the amusement of his staff. Most of them being more advanced in years would probably have been less equal to the task in an athletic sense.

After the ordinary laconic conversation which characterises code flag signals[1] we were as usual greeted by a perfect storm of questions as to what kept us so much behind our time, and learned that all had come to the conclusion that the ship must have got on shore on leaving Queenstown Harbour. The *Niagara*, it appeared, had arrived at the *rendezvous* on Friday night, the 23rd, the *Valorous* on Sunday the 25th, and the *Gorgon* on the afternoon of Tuesday, the 27th.

The day was beautifully calm, so no time was to be lost before making the splice in lat. 52°9′N., long. 32°27′ W., and soundings of 1,500 fathoms. Boats were soon lowered from the attendant ships, the two vessels made fast by a hawser, and the *Niagara's* end of the cable conveyed on board the *Agamemnon*. About half-past twelve o'clock the splice was effectually made, but with a very different frame from the carefully rounded semicircular boards which had been used to enclose the junctions on previous occasions. It consisted merely of two straight boards hauled over the joint and splice, with the iron rod and leaden plummet attached to the centre. In hoisting it out from the side of the ship, however, the leaden sinker broke short off and fell overboard. There being no more convenient weight at hand, a 32 lb. shot was fastened to the splice instead; and the whole apparatus was quickly dropped into the sea without any formality—and, indeed, almost without a spectator—for those on board the ship had witnessed so many beginnings to the telegraphic line that it was evident they despaired of there ever being an end to it.

[1] Such as, "I hope you are all well." "Very well, I thank you." A touch of irony characterised one, however, when the *Gorgon* asked the *Niagara* if she had any coal to spare, the reply—this time by word of mouth—came, "None at all. I think the *Agamemnon* could give you some, as she can't have burned much since she left!"

The stipulated 210 fathoms of cable having been paid out to allow the splice to sink well below the surface, the signal to start was hoisted, the hawser cast loose, and the *Niagara* and *Agamemnon* start for the last time at about 1 p.m. for their opposite destinations. The announcement comes from the electrician's testing-room that the continuity is perfect, and with this assurance the engineers go on more boldly with the work. In point of fact the engineers may be said to be very much under the control of the electricians during paying out; for if they report anything wrong with the cable, the engineers are brought to a stand until they are allowed to go on with their operations by the announcement of the electricians that the insulation is perfect and the continuity all right. The testing-room is where the subtle current which flows along the conductor is generated, and where the mysterious apparatus—by which electricity is weighed and measured as a marketable commodity—is fitted up. The system of testing and transmitting and receiving signals through the cable from ship to ship during the process of paying out must now be briefly referred to. It consists of an exchange of currents sent alternately every ten minutes by each ship. These not only serve to give an accurate test of the continuity and insulation of the conducting wire from end to end, but also to give certain signals which it is desirable to send for information purposes. For instance, every ten miles of cable paid out is signalised from ship to ship, as also the approach to land or momentary stoppage for splicing, shifting to a fresh coil, etc. The current in its passage is made to pass through an electro-magnetometer, an instrument used by Mr. Whitehouse. It is also conveyed in its passage at each end of the cable through the reflecting galvanometer and speaking instrument just invented by Prof. Thomson; and it is this latter which is so invaluable, not only for the interchange of signals, but also for testing purposes. The deflections read on the galvanometer, as also the degree of charge and discharge indicated by the magnetometer, are carefully recorded. Thus, if a defect of continuity or insulation occurs, it is brought to light by comparison with those received before.

For the first three hours the ships proceeded very slowly, paying out a great quantity of slack; but after the expiration of this time the speed of the *Agamemnon* was increased to about five knots, the cable going at about six, without indicating more than a few hundred pounds of strain upon the dynamometer. Shortly after four o'clock a large whale was seen approaching the starboard bow at a great speed, rolling and tossing the sea into foam all round; and for the first time we felt a possibility for the supposition that our second mysterious breakage of the cable might have been caused after all by one of these animals getting foul of it under water. It appeared as if it were making direct for the cable; and great was the relief of all when the ponderous living mass was seen slowly to pass astern, just grazing the cable where it entered the water—but fortunately without doing any mischief.

All seemed to go well up to about eight o'clock; the cable paid out from the hold with an evenness and regularity which showed how carefully and perfectly it had been coiled away. The paying-out machine also worked so smoothly that it left nothing to be desired. Thus far everything looked promising. But in such a hazardous work no one knows what a few minutes may bring forth, and soon after eight o'clock a damaged piece of the cable was discovered about a mile or two from the portion paying out. Not a moment was lost by Mr. Canning, the engineer on duty, in setting men to work to cobble up the injury as well as time would permit; for the cable was going out at such a pace that the damaged portion would be paid overboard in less than twenty minutes, and former experience had shown us that to check either the speed of the ship or the cable would, in all probability, be attended by fatal results. Just before the lapping was finished Professor Thomson reported that the electrical continuity of the wire had ceased, but that the insulation was still perfect. Attention was naturally directed to the injured piece as the probable source of the stoppage, and not a moment was lost in cutting the cable at that point, with the intention of making a perfect splice.[1] To the consternation of all, the electrical tests applied showed the fault to be overboard, and in all probability some fifty miles from the ship. Not a second was to be lost, for it was evident that the cut portion must be paid overboard in a few minutes; and in the meantime the tedious and difficult operation of making a splice had to be performed. The ship was immediately stopped, and no more cable paid out than was absolutely necessary to prevent it breaking. As the stern of the ship was lifted by the waves a scene of most intense excitement followed. It seemed impossible that the junction could be finished before the part was taken out of the hands of the workmen. The main hold presented an extraordinary scene. Every one stood in groups

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[1] In connection with the above, an extract from Bright's diary will serve to fill up some gaps:—

"29th July, Greenwich time, 10 p.m. Signals ceased from *Niagara*. Professor Thomson reported loss of continuity, with insulation good. To ascertain whether fault was at the piece of cable which was about to be lapped, the cable was sprung open at this point and the gutta-percha wire pricked, and the part in the ship found good; pricked again nearer stern, found good inside ship.

"No indication of fracture during the time. It was then cut about ten turns from the outgoing part, and the test showed the loss of continuity to be far from the ship—probably more than forty miles, but decidedly less than 200.

"Joint made again as quickly as possible, and tested. Want of continuity and good insulation still experienced. When one turn off joint, commenced veering out again. Ship's time, 9.5 p.m. Splice paid over safely. Same results. Strong current came. On testing, 'earth' found about middle of cable, and on currents again coming it was concluded that the cable had been cut on board the *Niagara*.

"Signals then sent and received regularly, and showed 1,200 or 1,300 miles in circuit.

"*Note.*—This trouble might have been avoided had complete speaking arrangements been made."

about the coil, watching with great anxiety the cable as it slowly unwound itself nearer and nearer the joint, while the workmen worked at the splice as only men could work who felt that the life and death of the expedition depended upon their rapidity. But all their speed was to no purpose, as the cable was unwinding within a hundred fathoms. As a last and desperate resource the cable was stopped altogether, and for a few minutes the ship hung on by the end. Fortunately, however, it was only for a few minutes, as the strain was continually rising above two tons, and it would not hold on much longer. When the splice was finished the signal was made to loose the stoppers, and happily it passed overboard in safety.

When the excitement, consequent upon having so narrowly saved the cable, had passed away, we awoke to the consciousness that the case was yet as hopeless as ever, for the electrical continuity was still entirely wanting! Preparations were consequently made to pay out as little rope as possible, and to hold on for six hours in the hope that the fault—whatever it should prove to be—might mend itself before cutting the cable and returning to the *rendezvous* to make another splice. The magnetic needles on the receiving instruments were watched closely for the returning signals; when, in a few minutes, the last hope was extinguished by their suddenly indicating dead earth, which tended to show that the cable had broken from the *Niagara*, or that the insulation had been completely destroyed. Nothing, however, could be done. The only course was to wait until the current should return or take its final departure. It actually *did* return—with greater strength than ever; and in three minutes every one was agreeably surprised by the intelligence that the signals had again appeared at their regular intervals from the *Niagara*.[1] It is needless to say

[1] Later on it was made clear that this mysterious temporary want of continuity—accompanied by an apparent variation in the insulation—was due to a defect in the more or less inconstant sand battery used aboard the latter vessel.

what a load of anxiety this news removed from the minds of every one; but the general confidence in the ultimate success of the operations was much shaken by the occurrence, for all felt that every minute a similar accident might again occur.[1]

For some time the paying-out continued as usual, but towards the morning another damaged place was discovered in the cable.

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[1] This unpleasant incident regarding the continuity was never forgotten to the last, and forbade all to indulge in sanguine expectations, even when prospects seemed perfect. One of those representing the Press wrote: "The sailors, who are somewhat in the dark as to the scientific definition of the term 'continuity,' believe it to be at the bottom of all the trouble, and credit it even with vindictive qualities. 'Darn the continuity,' said an old 'salt,' after what was to him a highly scientific—but, to his audience of messmates, a rather foggy—dissertation on the subject of cable-work. 'Darn the continuity; I wish they would get rid of it altogether. It has caused a jolly sight more trouble than the business is worth. I say they ought to do without it, and let it go. I believe they'd get the cable down if they didn't pay any attention to it! You see,' he went on, 'I was on the last exhibition (*expedition* he meant, but it was all the same—his messmates did not mistake his meaning) and I thought I'd never hear the end of it. They were always talking about it; and one night when we were out last year it was gone for two hours, and we thought that was the end of the affair, and we should never hear of it again. But it came back, and soon after the cable busted. Now, I tell you what men, I'll never forget that night, I tell you. We all felt we had lost our best friend. After that I have never heard the word "continuity," or "contiguity," or whatever it is, mentioned, but I was always afraid something was going to happen. And that's a fact.' This was conclusive on the minds of the majority of his hearers. However, a number were of opinion that it was all right, and at the risk of being considered humbugs—asserted their belief that whatever might be said against the continuity they couldn't do without it, and that, on the contrary, it was because it was gone all the trouble had occurred."

Yet, fortunately, there was time to repair it in the hold without in any way interfering with the operations, beyond slightly reducing the speed of the ship for a few moments. Observations made at noon on Friday showed that we had made good ninety miles from the starting-point since the previous day, with an expenditure of 135 miles of cable. During the latter portion of the day the barometer fell considerably, and towards the evening it blew almost a gale of wind from the eastward, dead ahead of our course. As the breeze freshened, the speed of the engines was gradually increased; but the wind more than increased in proportion, so that before the sun went down the *Agamemnon* was going full steam against the wind, only making a speed of some four knots.

During the evening top masts were lowered, and spars, yards, sails, and, indeed, everything aloft that could offer resistance to the wind was sent down on deck. Still the ship made but little way, chiefly in consequence of the heavy sea; and the enormous quantity of fuel consumed showed us that if the wind lasted we should be reduced to burning the masts, spars, and even the decks, to bring the ship into Valentia. It seemed to be our particular ill-fortune to meet with head winds whichever way the ship's head was turned. On our journey out we had been delayed and obliged to consume an undue proportion of coal for want of an easterly wind, and now all our fuel was wanted because of one. However, during the next day the wind gradually went round to the south-west, which, though it raised a heavy sea, allowed us to husband our small remaining store of fuel.

At noon on Saturday, the 31st of July, observations showed us to be in lat. 52°23′ N., and long. 26°44′ W., having made good 120 miles of distance since noon of the previous day, with a loss of about 27 per cent. of cable. The *Niagara*, as far as could be judged from the amount of cable she paid out—which was signalled at every ten miles—kept pace with us, within one or two miles, the whole distance across. During the afternoon of Saturday the wind again freshened. Before nightfall it blew nearly a gale of wind, and a tremendous sea ran before it from the south-west, which made the *Agamemnon* pitch and toss to such an extent that it was thought unlikely the cable could hold through the night. Indeed, had it not been for the constant care and watchfulness exercised by Mr. Bright and his two energetic assistants, Mr. Canning and Mr. Clifford, it could not have been done at all. Men were kept at the wheels of the machine to prevent their stopping (as the stern of the ship rose and fell with the sea), for had they done so the cable must have parted.[1] During Sunday the sea and wind increased, and before the evening it blew a smart gale. Now, indeed, were the energy and activity of all engaged in the operation tasked to the utmost. Mr. Hoar and Mr. Moore, the two engineers who had the charge of the relieving wheels of the dynamometer, had to keep watch and watch alternately every four hours, and while on duty durst not let their attention be removed from their occupation for one moment; for on their releasing the brake every time the stern of the ship fell into the trough of the sea entirely depended the safety of the cable, and the result shows how ably they discharged their duty. Throughout the night there were few who had the least expectation of the cable holding on till morning, and many lay awake listening for the sound that every one dreaded to hear—viz., the gun which should announce the failure of all our hopes. But still the cable—which, in comparison with the ship from which it was paid out and the gigantic waves among which it was delivered,

[1] The paying-out apparatus was roped in, with a notice placed conspicuously, reading thus: "No one here except the Engineers' Watch." This was certainly laconic; but if any other than the privileged few made his way inside the sacred ground, the marine who stood close by informed him he must leave. That was not all, however; for if under the impression that he was at liberty to talk to the operator in charge of the dynamometer, he was soon made aware of the absurdity of such an idea by another inscription to the effect that no conversation was allowed with that particular party.

was but a mere thread—continued to hold on, only leaving a silvery phosphorescent line upon the stupendous seas as they rolled on towards the ship.

With Sunday morning came no improvement in the weather. Still the sky remained black and stormy to windward, and the constant violent squalls of wind and rain which prevailed during the whole day served to keep up—if not to augment—the height of the waves. But the cable had gone through so much during the night that our confidence in its continuing to hold was much restored.[1] At noon observations showed us to be in lat. 52°26′N., and long. 23°16′W., having made good 130 miles from noon of the previous day, and about 350 from our starting-point in mid-ocean. We had passed by the deepest sounding of 2,400 fathoms, and over more than half of the deep water generally; while the length of cable still remaining in the ship was more than sufficient to carry us to the Irish coast, even supposing the continuance of the bad weather should oblige us to pay out nearly the same amount of slack cable as hitherto. Thus far things looked very promising for our ultimate success. But former experience showed us only too plainly that we could never suppose that some accident might not arise until the ends had been fairly landed on the opposite shores.

One of the expedition made some notes in the present-tense-story, which are reproduced here as indicative of the feelings indulged in about this time by those on board:—

The cable is the absorbing subject of conversation. We hardly dare ask ourselves if we shall lay the line the whole distance—it seems too much to hope for—and we dread to think of the future. We count each day, not by hours, but by minutes. The sound of the machinery has become as familiar to us as

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[1] A note in Bright's rough diary says: "8 a.m., insulation reported better than ever."

that of our own voices; and when it is drowned in any other noise, we listen with eagerness to hear it again. The barometer is consulted hourly, and its variations watched with a jealous eye, for we can now appreciate how much depends on the weather. The sight of that thread-like wire battling with the wind and sea produces a feeling somewhat akin to that with which you would watch the struggles of a drowning man whom you have not the power to assist. There is a strong undercurrent of confidence, though we are still some way from the end. A kink in the cable, or a hole running through the gutta-percha into the conductor—a tiny hole, such as you could not force a hair through—would render the labour of months utterly unavailing. That group of sailors near the cook's galley are engaged in an animated discussion on the all-prevailing topic. One of the number is trying to persuade his messmates that it is impossible to lay it, but they lend him rather unwilling ears. Altogether the cable is getting into better repute, and specimens of it are more highly prized than they were before. Nothing is thought of during the day but the cable, and I believe two-thirds of the crew don't *dream* of anything else. Some of us are unreasonable enough to wish that things were still better, and that we were once more at home and amongst our friends—in fact, that this terrible struggle between hope and fear were at an end. Then our thoughts turn to the scene of wild excitement ashore when it is learnt that the "impracticable enterprise" has, after all, succeeded—that is to say, if everything continues to go well to the finish.

To continue in the words of *The Times* correspondent:—

During Sunday night and Monday morning the weather remained as boisterous as ever. It was only by the most indefatigable exertions of the engineer upon duty that the wheels could be prevented from stopping altogether as the vessel rose and fell with the sea; and once or twice they did come completely to a standstill, in spite of all that could be done to keep them moving. Fortunately, however, they were again set in motion before the stern of the ship was thrown up by the succeeding wave.

During the afternoon of the latter day an American three-masted schooner, which afterwards proved to be the *Chieftain*, was seen standing from the eastward towards us. No notice was taken of her at first; but when she was within about half a mile of the *Agamemnon* she altered her course, and bore right down across our bows. A collision, which might prove fatal to the cable, now seemed inevitable; or could only be avoided by the equally hazardous expedient of altering the *Agamemnon's* course. The *Valorous* steamed ahead and fired a gun for her to heave to, which, as she did not appear to take much notice, was quickly followed by another from the bows of the *Agamemnon*, and a second and third from the *Valorous*. But still the vessel held on her course, and as the only resource left to avoid a collision, the course of the *Agamemnon* was altered just in time to pass within a few yards of her. It was evident that our proceedings were a source of the greatest possible astonishment to them, for all her crew crowded upon her deck and rigging. At length they evidently discovered who we were and what we were doing, for the crew manned the rigging, and dipping the ensign several times they gave us three hearty cheers. Though the *Agamemnon* was obliged to acknowledge these congratulations in due form, the feelings of annoyance with which we regarded the vessel—which was so near adding a fatal and unexpected mishap to the long chapter of accidents which had already been encountered—may easily be imagined. To those below—who of course did not see the ship approaching—the sound of the first gun came like a thunderbolt, for all took it as a signal of the breaking of the cable. The dinner tables were deserted in a moment, and a general rush made up the hatches to the deck; but before reaching it their fears were quickly banished by the report of the succeeding gun, which all knew well could only be caused by a ship in our way or a man overboard.

Throughout the greater part of the same day the electrical signals from the *Niagara* had been getting gradually weaker, until they ceased altogether for nearly three-quarters of an hour. Then Professor Thomson sent a message to the effect that the signals were too weak to be read, and in a little while the deflections returned even stronger than they had ever been before. Towards the evening, however, they again declined in force for a few minutes.[1] With the exception of these little stoppages, the electrical condition of the submerged wire seemed to be much improved. It then became known for the first time that the low temperature of the water at the immense depth improved considerably the insulating properties of the gutta-percha, while the enormous pressure to which it must have been subjected tended to consolidate its texture and to fill up any air bubbles or slight faults in manufacture which may have existed. The weather during that night moderated a little; but still there was a very heavy sea on, which endangered the wire every second minute.

About three o'clock on the following (Tuesday) morning all on board were startled from their beds by the loud booming of a gun. Every one—without waiting for the performance of the most particular toilet—rushed on deck to ascertain the cause of the disturbance. Contrary to all expectation, the cable was safe; but just in the grey light could be seen the *Valorous*, rounded to in the most warlike attitude, firing gun after gun in quick succession towards a large American barque, which, quite unconscious of our proceedings, was standing right across our stern. Such loud and repeated remonstrances from a large steam frigate were not to be despised; and evidently without

[1] In connection with the above, Bright's diary says: "August 2nd, 1.40 p.m., Professor Thomson reports no regular signals from the *Niagara* for three terms of the usual ten minutes. Currents come, but no intelligible signals according to the arranged methods. It is possible they may be earth currents."

It subsequently transpired that the trouble had been due to a fault in the *Niagara's* ward-room coil. As soon as the electricians discovered this, and had it cut out, all went smoothly again.

knowing the why or the wherefore, she quickly threw her sails aback and remained hove to. Whether those on board her considered that we were engaged in some filibustering expedition or regarded our proceedings as another British outrage upon the American flag it is impossible to say; but certain it is that —apparently in great trepidation—she remained hove to until we had lost sight of her in the distance.

Tuesday was a much finer day than any we had experienced for nearly a week, but still there was a considerable sea running, and our dangers were far from passed; yet the hopes of our ultimate success ran high. We had accomplished nearly the whole of the deep portions of the route in safety, and that, too, under the most unfavourable circumstances possible. There was, therefore, every reason to believe that unless some unforeseen accident should occur, we should accomplish the remainder. Observations at noon placed us in lat. 52°26′N., long. 167° 40′W., having run 134 miles since the previous day. About five o'clock in the evening the steep submarine mountain which divides the steep telegraphic plateau from the Irish coast was reached; and the sudden shallowing of the water had a very marked effect upon the cable, causing the strain and the speed to lessen every minute. A great deal of slack was paid out [1] to allow for any greater inequalities which might exist, though undiscovered by the sounding line. About ten o'clock the shoal water of 250 fathoms was reached. The only remaining anxiety now was the changing from the lower main coil to that upon the upper deck, and this most dangerous operation was successfully performed between three and four o'clock on Wednesday morning.

Wednesday was a beautifully calm day; indeed, it was the first on which any one would have thought of making a splice since the day we started from the *rendezvous*. At noon we

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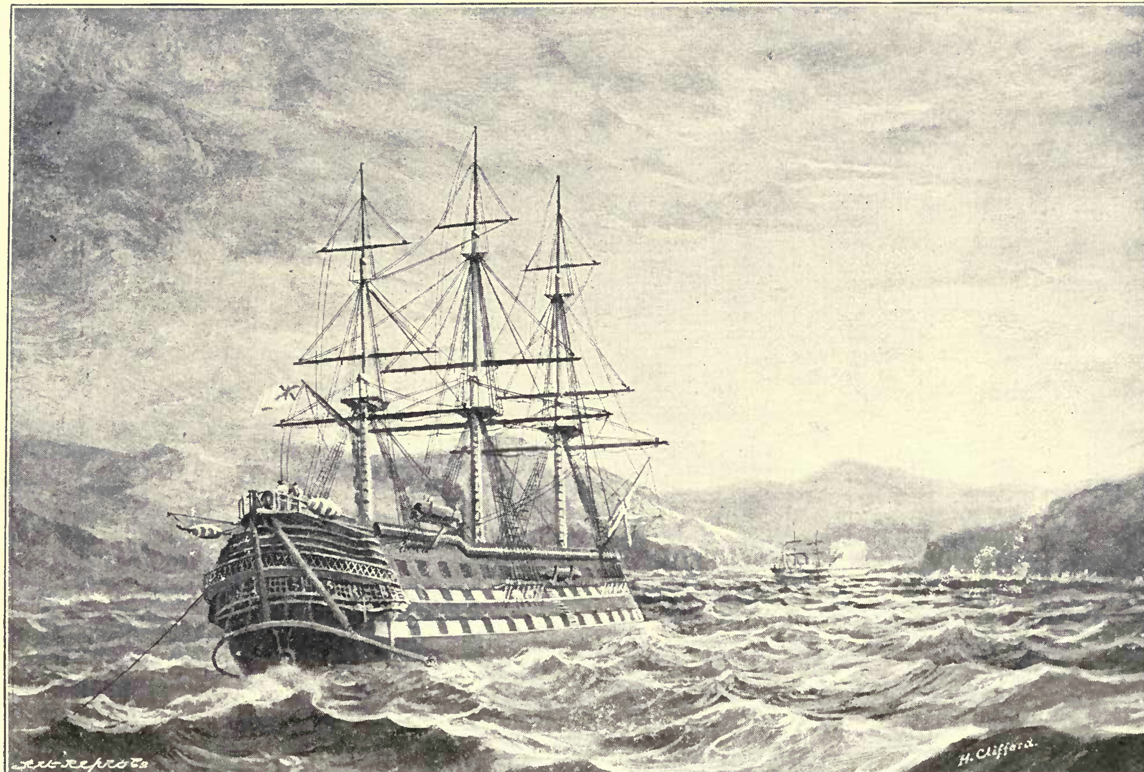
[1] The amount of slack paid out had already been almost ruinous. Luckily its continuance was not necessary, or we could scarcely have reached Ireland with the cable on board.

were in lat. 52°11′N., long. 12°40′2″W., eighty-nine miles distant from the telegraph station at Valentia. The water was shallow, so that there was no difficulty in paying out the wire with hardly any loss by slack; and all looked upon the undertaking as virtually accomplished. At about one o'clock in the evening the second change from the upper deck coil to that upon the orlop deck was safely effected, and shortly after the vessels exchanged signals that they were in 200 fathoms water. As night advanced the speed of the ship was reduced, as it was known that we were only a short distance from the land, and there would be no advantage in making it before daylight in the morning. At about twelve o'clock, however, the Skelligs Light was seen in the distance, and the *Valorous* steamed on ahead to lead us into the coast, firing rockets at intervals to direct us.

By daylight on the morning of Thursday, the 5th, the bold and rocky mountains which entirely surround the wild and picturesque neighbourhood of Valentia rose right before us at a few miles' distance. Never, probably, was the sight of land more welcome, as it brought to a successful termination one of the greatest—but at the same time most difficult—projects which was ever undertaken. Had it been the dullest and most melancholy swamp on the face of the earth that lay before us, we should have found it a pleasant prospect; but as the sun rose behind the estuary of Dingle Bay, tinging with a deep soft purple the lofty summits of the mountains which surround its shores, and illuminating the masses of morning vapour which hung upon them, it was a scene which might vie in beauty with anything that could be produced by the most florid imagination of an artist.

No one on shore was apparently conscious of our approach, so the *Valorous* went ahead to the mouth of the harbour and fired a gun. Both ships made straight for Doulas Bay—the *Agamemnon* steaming into the harbour with a feeling that she had done something—and about 6 a.m. came to anchor at the side of Beginish Island, opposite to Valentia. As soon as the inhabitants became aware of our impending arrival there was



H.M.S. "AGAMEMNON" COMPLETING THE FIRST ATLANTIC CABLE.

a general desertion of the place, and hundreds of boats crowded round us, their passengers in the greatest state of excitement to hear all about our voyage. The Knight of Kerry was absent in Dingle, but a messenger was immediately despatched for him, and he soon arrived in Her Majesty's gunboat *Shamrock*.

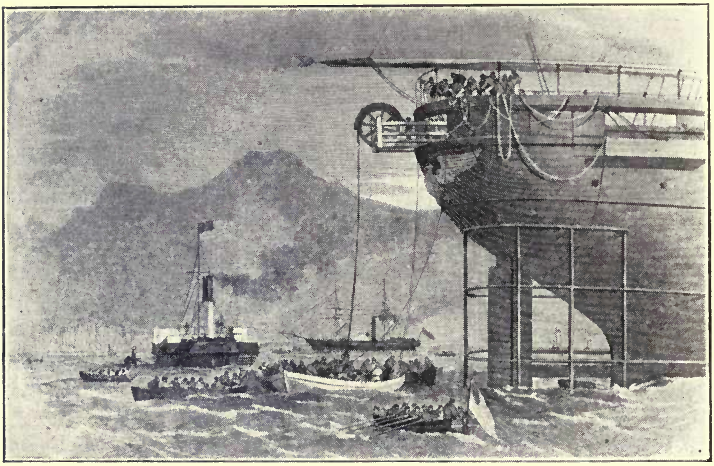
A short time after our arrival a signal was received from the *Niagara* that they were preparing to land, having paid out 1,030 nautical miles of cable, while the *Agamemnon* had accomplished her portion of the distance with an expenditure of 1,020 miles, making the total length of the wire submerged 2,050 geographical miles. Immediately after the ships cast anchor the paddle-box boats of the *Valorous* were got ready, and two miles of cable coiled away in them for the purpose of landing the end. But it was late in the afternoon before the procession of boats left the ship, under a salute of three rounds of small arms from the detachment of marines on board the *Agamemnon*.

Progress was very slow, in consequence of the stiff wind which blew at the time ; but at about 3 p.m. the end was safely brought on shore at Knight's Town, Valentia, by Mr. Bright, to whose exertions the success of the undertaking is attributable. Mr. Bright was accompanied by Mr. Canning and the Knight of Kerry. The end was immediately laid in the trench which had been dug to receive it. Afterwards a royal salute—making the neighbouring rocks and mountains reverberate—announced that the communication between the Old and the New World had been completed.

The cable was taken into the electrical room by Mr. Whitehouse and attached to a galvanometer, and the first message was received through the entire length now lying on the bed of the sea. It will, in all probability, be nearly a fortnight before the instruments are connected at the two termini for the transmission of regular messages.

It is unnecessary here to expatiate upon the magnitude of the undertaking which has just been completed, or upon the great political and social results which are likely to accrue from it ; but there cannot fail to be a feeling of universal admiration for the courage and perseverance which have been displayed by Mr. Bright,[1] and those who acted under his orders, in encountering the manifold difficulties which arose on their path at every step.[2]

In contradistinction to the heavy seas and difficulties the *Agamemnon* had to contend with, her consort, the *Niagara*,



U.S.N.S *NIAGARA* COMPLETING THE CABLE AT THE AMERICAN END

experienced very quiet weather; and her part of the work

[1] In the Institution of Civil Engineers' obituary notice of Charles Bright the following lines are of some interest in this connection: "The enormous amount of energy and resource required for the organisation and fitting out of such an expedition in those early days can only with difficulty be comprehended. The details of such an undertaking are indeed massive, and reflect the very highest credit on the abilities of the late Sir Charles Bright, who (on this occasion, as on others) showed himself to be a man of extraordinary energy and power, and endowed with perseverance under difficulties —qualities which enabled him to bring this never-to-be-forgotten undertaking to a successful issue."

[2] *The Times*, Wednesday, August 11th, 1858.

was comparatively uneventful [1]—with the exception of the fault near the bottom of the ward-room coil, which has already been referred to. This was detected during the operations on the night of August 2nd, but was removed before it was paid out into the sea at a depth of two miles. About four o'clock the next morning the continuity and insulation was accordingly restored ; and, says Mullaly, " all was going on as if nothing had occurred to disturb the confidence we felt in the success of the expedition."

A little later the same chronicler remarks :—

> Confidence is growing stronger, and there is considerable speculation as to the time we shall reach Newfoundland. The pilot who is to bring us into Trinity Bay is now in great repute, and is becoming a more important personage every day. His opinion is solicited in regard to the weather, as he is supposed to know something about it in these latitudes. He is also particularly catechised on the navigation of the bay and the formation and character of the coast. We are really beginning to have strong hopes that his services will be called into requisition, and that in the course of a few days more we shall be in sight of land.

Again, when nearing the end, Mullaly describes in stirring language the various icebergs—some a hundred feet high—which they met with.

Shortly after entering Trinity Bay, Newfoundland, the *Niagara* was met by H.M.S. *Porcupine,* which had been sent out from England at the very beginning of the 1858 expedition to await her approach and render any assistance that might be required. The *Niagara* anchored about 1 a.m on

[1] *The Story of the Atlantic Cable.*

August 5th, having completed her work; and during the forenoon of that day the cable was landed in a little bay, Bull Arm,[1] at the head of Trinity Bay, when they "received very strong currents of electricity through the whole cable from the other side of the Atlantic."[2] The telegraph house at the Newfoundland end was some two miles from the beach, and connected to the cable by a land line.

Section II

The Celebration

On landing at Valentia, Charles Bright at once sent the following welcome message to his Board, which was forthwith passed on to the Press:—

Valentia, *August 5th.*

Charles Bright, to the Directors of the Atlantic Telegraph Company.

The *Agamemnon* has arrived at Valentia, and we are about to land the end of the cable.

The *Niagara* is in Trinity Bay, Newfoundland. There are good signals between the ships.

We reached the *rendezvous* on the night of the 28th, and the splice with the *Niagara* cable was made on board the *Agamemnon* the following morning.

By noon on the 30th, 265 nautical miles were laid between the ships; on the 31st, 540; on the 1st August, 884; on the 2nd, 1,256; on the 4th, 1,854; on anchoring at six in the morning, in Doulas Bay, 2,022.

The speed of the *Niagara* during the whole time has been

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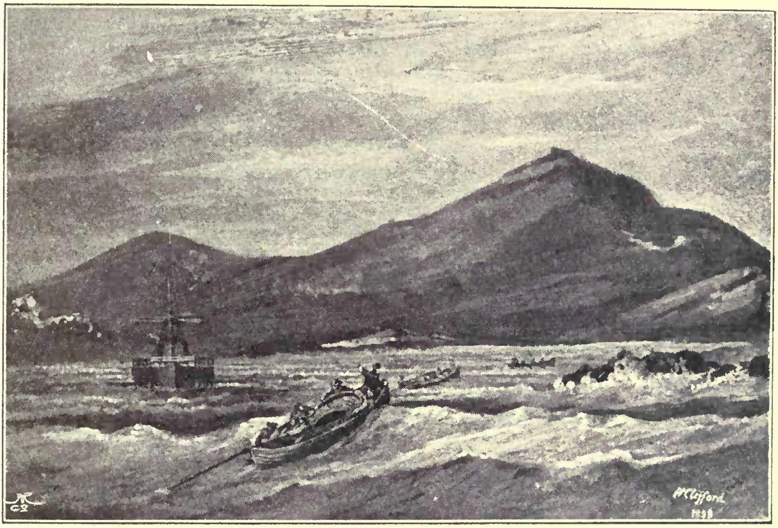
[1] This spot had been selected on account of its seclusion from prevailing winds, and owing to the shelter it afforded from drifting icebergs.

[2] Engineer's log, U.S.N.S. *Niagara.*

nearly the same as ours, the length of cable paid out from the two ships being generally within ten miles of each other.

With the exception of yesterday, the weather has been very unfavourable.[1]



LANDING THE IRISH END OF THE CABLE

In the afternoon of Thursday, August 5th—as already described in *The Times* report—Charles Bright and his staff brought to shore the end of the cable, at White Strand Bay, near Knight's Town, Valentia, in the boats of the

[1] *The Times*, 2nd edition, August 5th, 1858.

Some days later Charles Bright sent in his official report, setting forth fully the main features of the expedition. Here the maximum depth was shown to be 2,400 fathoms—nearly $2\frac{1}{2}$ statute miles—and the average slack paid out somewhere about 17 per cent. This report (reproduced in *The Times*) was given in full as Appendix 9 to Vol. I. of the original biography.

Valorous, welcomed by the united cheers of the small crowd assembled.

As soon as his work was completed, Charles Bright sent his wife a telegram couched in these laconic terms: "Atlantic cable laid. Signals received both ways."

All England applauded the triumph of such undaunted perseverance, and the engineering and nautical skill displayed in this victory over the elements. The Atlantic Telegraph had been justly characterised by Professor Morse as the "great feat of the century," and this was re-echoed by all the Press on its realisation. The following extract from the leading article of *The Times*, the day after completion, is an example of the comments upon the achievement:—

Mr. Bright, having landed the end of the Atlantic cable at Valentia, has brought to a successful termination his anxious and difficult task of linking the Old World with the New. Since the discovery of Columbus, nothing has been done in any degree comparable to the vast enlargement which has thus been given to the sphere of human activity.[1]

The rejoicing in America, both in public and private, knew no bounds. The astounding news of the success of this unparalleled enterprise, after such combats with storm and sea, "created universal enthusiasm, exultation and joy, such as was, perhaps, never before produced by any event, not even the discovery of the Western hemisphere. Many had predicted its failure—some from ignorance, others

[1] For the rest of this "leader" see Appendix *9b* to Vol. I. of the original biography.

simply because they were anti-progressives by nature. Philanthropists everywhere hailed it as the greatest event of modern times, heralding the good time coming of universal peace and brotherhood."

In Newfoundland, Mr. Field, with Captain Hudson, of the *Niagara,* Captain Dayman, of H.M.S. *Gorgon,* and Commander H. C. Otter, of H.M.S. *Porcupine,* together with Mr. Bright's assistant engineers, Messrs. Everett and Woodhouse, and the electricians, Messrs. de Sauty and Laws, received the heartiest congratulations and welcome from the Governor and Legislative Council of the Colony. Whilst acknowledging these congratulations, Mr. Field remarked: "We have had many difficulties to surmount, many discouragements to bear, and some enemies to overcome, whose very opposition has stimulated us to greater exertion."

It was a curious coincidence that the cable was successfully completed to Valentia on the same day, in 1858, on which the shore end had been landed the year before. [1]

Charles Bright, with Messrs. Canning and Clifford, and the rest of the staff—including Professor Thomson, and the other electricians—were absolutely exhausted with the

[1] Moreover, it was exactly one hundred and eleven years to a day since Dr. (later Sir William) Watson had astonished the scientific world by sending an electric current through a wire two miles long, using the earth as a return circuit.

It is also worthy of note that the first recorded feat of telegraphy was executed by order of *King Agamemnon* to his queen, announcing the fall of Troy, 1084, years before the birth of Christ, and that the great feat which we have narrated was carried out by the great *ship Agamemnon,* as we have here shown.

incessant watching, apart from the anxiety that attended their arduous work. Valentia proved a haven of rest for these "toilers of the deep."

But a series of banquets had to be faced.

Soon after his duties at Valentia were over, Bright made his way to Dublin. Here he was entertained by the Lord Mayor and civic authorities of that capital on Wednesday, September 1st. On this occasion Cardinal Wiseman, who was present, made an eloquent speech; and the following account of the proceedings (from the *Morning Post*) may be suitably quoted:—

The banquet given on Wednesday, the 1st, by the Lord Mayor of Dublin, to Mr. C. T. Bright, engineer-in-chief to the Atlantic Telegraph Company, was a great success. The assemblage embraced the highest names in the metropolis—civil, military, and official. Cardinal Wiseman was present in full cardinalite costume.

The Lord Mayor, in proposing the toast of the evening, "The health of Mr. Bright," dwelt with much eloquence on the achievements of science, and paid a marked and merited compliment to the genius and perseverance which, in the face of discouragement from the scientific world, had succeeded in bringing about their great accomplishment, the laying of the Atlantic telegraph. His lordship's speech was most complimentary to the distinguished guest, Mr. C. T. Bright.

Mr. Bright rose, amidst loud cheers, to respond. He thanked the assemblage for their hearty welcome, and said he was deeply sensible of the honour. He next commented upon the value of this means of communication for the prevention of misunderstanding between the Governments of the Great Powers, and then referred to the services of the gentlemen who had been associated with him in laying the cable, with whom he desired to share the honours done him that night. (Mr. Bright was warmly cheered throughout his eloquent speech.)

Mr. Bright then proposed the health of Mr. Cyrus Field, acknowledging in warm terms the services of this gentleman in the great project.

Referring next day, in a letter to his wife, to these proceedings, Bright said :—

The Cardinal came in tremendous costume, just like *Kean* in *Henry VIII*, with a large jewelled cross round his neck, and an immense sparkling ring of office on his white hand, which contrasted strongly with his red face and dress. However, I found him a very pleasant man, full of scientific knowledge and interest in the Atlantic line. He pressed me to come to see him in London.

I hope you thought my speech a good one! I was glad to have a public opportunity of shaming the "Yankees" by proposing Cyrus Field's health.

Charles Bright was honoured with knighthood within a few days of his landing.

As this was considered a special occasion—apart from ordinary periodic honours—and as the Queen was at that time on her famous and important visit to the Empress of the French at Cherbourg, it was arranged that the ceremony should be performed there and then, at Dublin, by His Excellency the Lord Lieutenant of Ireland (the Earl of Eglinton), in Her Majesty's name. [1]

With reference to this, Bright wrote to his wife the day before :—

[1] The following spring Charles Bright was duly "presented" at Court (by Lord Eglinton), in connection with his knighthood.

The Lord Lieutenant having expressed a wish to see me, I had an interview with him this morning. He intimated his desire to confer upon me—on behalf of Her Majesty—the honour of knighthood, which ceremony is to be performed to-morrow, after which I dine with him to meet a large party of the noble folks of the land, and then I shall be glad to get home and have a little quiet with "Lady Bright."

Bright was but twenty-six years of age at the time, being the youngest man who had received the distinction for generations past—and no similar instance has occurred since. It was, moreover, the first title conferred on the telegraphic profession, and remained so for some years.

With Professor Thomson and other colleagues Sir Charles was right royally entertained in Dublin, Killarney, and elsewhere, the Lord Lieutenant taking a prominent part in the celebrations.[1] Indeed, in Ireland generally, where he had been previously known for years as the engineer of the "Magnetic" Company—whose wires he had extended throughout the length and breadth of the Emerald Isle—warm greetings were unbounded.

A few days later, on the occasion of the grand banquet given in his honour at Killarney by the nobility and gentry of Kerry, His Excellency the Lord Lieutenant, after some prefatory remarks, thus referred to him and the cable[2]:—

[1] It was just previous to one of these at the Vice-Regal Lodge that opportunity was taken to perform the ceremony of "knighting" Bright. At the dinner afterwards he sat next to the then Duchess of Manchester, who reminded him that an ancestor of his had married Lady Lucy Montagu—one of the Duke's family—of previous days.

[2] *Daily News*, August 20th, 1858.

When we consider the extraordinary undertaking that has been accomplished within the last few weeks; when we consider that a cable of about 2,000 miles has been extended beneath the ocean—a length which, if multiplied ten times, would reach our farthest colonies and nearly surround the earth; when we consider it is stretched along the bed of shingles and shells, which appeared destined for it as a foundation by Providence, and stretching from the points which human enterprises would look to; and when we consider the great results that will flow from this great work, we are at a loss how sufficiently to admire the genius and energy of those who planned it, or how to be sufficiently thankful to the Almighty for having delegated such a power to the human race, for whose benefit it is to be put in force. (Cheers.) And let us look at the career which this telegraph has passed since it was originally discovered. At first, it was rapidly laid over the land, uniting states, communities and countries, extending over hills and valleys, roads and railways; but the sea appeared to present an impenetrable barrier. It could not stop here, however; submarine telegraphy was but a question of time, and the first enterprise by which it was introduced was in connection with an old foe—and at present our best friend—Imperial France. (Hear, hear.) The next attempt which was successful was the junction of England and our island, which was carried out by the same distinguished engineer whose name is now in the mouth of every man. (Hear, hear.) Other submarine attempts followed: the telegraph paused before the great Atlantic, like another Alexander, weeping as if it had no more worlds to conquer; but it has found another world, and it has gained it—not bringing strife or conquest, but carrying with it peace and goodwill. (Applause.) I feel I should be wanting if I did not allude in terms of admiration to the genius and skill of the engineer, Sir Charles Bright, who has carried out this project and brought it to a successful termination. (Applause.) It is not necessary, I am certain, to call attention to the diligence and attention shown by the crew of the *Agamemnon*—(cheers)—

because I am sure there is no one here who has not read the description of the voyage in the newspapers. The zeal, courage and enterprise exhibited were only to be equalled by the skill with which it was carried out. I believe there was only a difference of twelve miles between the two ends of the cable when it came to the shore. There are some questions with regard to the date at which the work was effected, to which I wish to call attention. It was on the 5th August, 1857, that this enterprise was first commenced under the auspices of my distinguished predecessor, who I wish was here now to rejoice in its success—I mean only in a private capacity. (Cheers and laughter.) It was on the 5th August, 1858, it was completed, and it was on the 5th August, more than 300 years ago, that Columbus left the shores of Spain to proceed on his ever-memorable voyage to America. It was on the 5th August, 1583, that Sir Hugh Gilbert, a worthy countryman of Raleigh and Drake, steered his good ship the *Squirrel* to the shores of Newfoundland, and first unfurled the flag of England in the very bay where this triumph has now taken place—(applause)—and it was on the same 5th of August that your Sovereign was received by her imperial friend amidst the fortifications of Cherbourg, and thereby put an end to the ridiculous nonsense about strife and dissension. (Applause.) Let the 5th August be a day ever memorable among nations. Let it be, if I may so term it, the birthday of England. (Applause.) Among the many points which must have given every one satisfaction, was the manner in which this great success was received in America. (Hear, hear.) There appears to have been but one feeling of rejoicing predominant amongst them; and I cannot but think that that was not only owing to their commercial enterprise—which they shared along with us—but also to the feelings of consanguinity and affection which I am sure we share, though occasionally disturbed by international disputes, and by differences caused by misrepresentations or hastiness. It must still burn as brightly in their breasts as in ours. (Applause.) I trust that, not only with our friends across the Atlantic, but with every civilised nation, this great triumph of science will prove the harbinger of peace, goodwill, and friendship; and that England and America will not verify the first line of the stanza—

> Lands intersected by a narrow firth
> Abhor each other,

but that they will, by mutual intercourse, arrive at the last line of that stanza, and, "like kindred drops, be mingled into one." (Warm applause.)

After the various functions in Ireland celebrating the laying of the cable had been exhausted, Bright was glad to have the opportunity of returning to his family at Harrow Weald, for the first time since the successful completion of the work.

Section 12

The Working of the Line

As previously shown, two descriptions of instruments were used on board the ships for testing and working through whilst laying the cable. These were the detector of Mr. Whitehouse and Professor Thomson's reflecting apparatus. The process of testing consisted in sending from one to the other vessel alternately, during a period of ten minutes, first, a "reversal" every minute for five minutes,[1] and then a current in one direction for five minutes. The results were observed and recorded on board both ships. There was also a special signal for each ten miles of cable paid out between the vessels.

When the splice was made on the 29th July, 72° deflec-

[1] This is usually described as a current first in one direction, and then in another, though, perhaps, not strictly accurate, technically.

tions were obtained on the *Agamemnon* from seventy-five cells of a sawdust Daniell's battery on board the *Niagara*, which had given 83° on entry. On arrival at Valentia at 6.30 a.m. on August 5th, the deflection on the same instruments (detector and marine galvanometer being both in circuit as before) was 68°; while the sending battery power on the *Niagara* had fallen off at entry to $62\frac{1}{2}°$ through the marine galvanometer on board that vessel.

The figures quoted show that, taking into account the certain diminution in electro-motive force of the "sawdust" battery employed, the cable had considerably improved by submersion, the insulation being even greater than that recorded before laying, when the cable was reported as perfect.

When Charles Bright and his staff had accomplished their part of the undertaking on August 5th, the cable was handed over to Mr. Whitehouse, the electrician of the Company, and his assistants. It was then reported to be in perfect condition.[1] Mr. Whitehouse, however, after taking charge of the line, found difficulty in working it with his special induction apparatus,[2] but appears to have made no report to the Board for some time. No information arrived at headquarters except some telegrams stating that signals were highly satisfactory, and that the adjustment of instruments was progressing.[3] More than a week passed,

[1] *The Story of the Atlantic Cable.*

[2] Besides being fully described in the pages of *The Engineer* at the time, some of Mr. Whitehouse's apparatus may now be seen at Messrs. Elliott Brothers, the famous instrument makers.

[3] *The Transatlantic Submarine Telegraph*, p. 33, by George Saward, Secretary to the Atlantic Telegraph Company.

during which Mr. Whitehouse continued his ineffectual efforts to work with the induction apparatus; and then Professor Thomson's reflecting galvanometer—that had worked so well during the voyage—was again inserted, with ordinary Daniell cells, in the circuit.

Thus, communication was resumed, the first clear message being received from Newfoundland on August 13th, 1858, and on the 16th the following message was got through from the directors in England to the directors in America[1]:—

Europe and America are united by telegraph. "Glory to God in the highest, on earth peace, good-will toward men."[2]

Then followed:—

From Her Majesty the Queen of Great Britain to His Excellency the President of the United States.

The Queen desires to congratulate the President upon the successful completion of this great international work, in which the Queen has taken the greatest interest.

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[1] There had been a considerable delay in getting the apparatus ready at Newfoundland; and, unfortunately, they adhered to alternating electro-magnetic apparatus there, in conjunction with a relay. The result was that supreme difficulty was experienced throughout in working the line this way. On the other hand, at Valentia they once reported: "We are now receiving from Newfoundland accurately, at the rate of 100 words per hour." Indeed, nearly all the really successful working was effected by the Thomson "marine galvanometer," at a speed up to five words per minute, as compared with 1·75 per minute with the other apparatus.

[2] With reference to this and some of the following cablegrams, Sir D. Brewster wrote (in the *Edinburgh Review*) at the time: "It is impossible to read, without emotion, these messages which breathe—from the earliest to the latest—the ardent wish that peace and good will should reign between hitherto unfriendly nations, born of the same blood, speaking the same tongue, and rejoicing in the same faith."

The Queen is convinced that the President will join with her in fervently hoping that the electric cable, which now already connects Great Britain with the United States, will prove an additional link between the two nations, whose friendship is founded upon their common interest and reciprocal esteem.

The Queen has much pleasure in thus directly communicating with the President, and in renewing to him her best wishes for the prosperity of the United States.

The message was shortly afterwards responded to as follows :—

WASHINGTON CITY.

The President of the United States to Her Majesty Victoria, Queen of Great Britain.

The President cordially reciprocates the congratulations of Her Majesty the Queen on the success of the great international enterprise accomplished by the skill, science, and indomitable energy of the two countries.

It is a triumph more glorious, because far more useful to mankind, than was ever won by a conqueror on the field of battle.

May the Atlantic Telegraph, under the blessing of Heaven, prove to be a bond of perpetual peace and friendship between the kindred nations, and an instrument destined by Divine Providence to diffuse religion, civilisation, liberty, and law throughout the world !

In this view will not all the nations of Christendom spontaneously unite in the declaration that it shall be for ever neutral, and that its communications shall be held sacred in passing to the place of their destination, even in the midst of hostilities ?

JAMES BUCHANAN.

Throughout the United States the arrival of the Queen's message was the signal for a fresh outburst of popular enthusiasm.[1]

Mr. Henry Field wrote in his description:—

The next morning, August 17th, the city of New York was awakened by the thunder of artillery. A hundred guns were fired in the City Hall Park at daybreak, and the salute was repeated at noon. At this hour flags were flying from all the public buildings, and the bells of the principal churches began to ring, as Christmas bells signal the birthday of One Who came to bring peace and good-will to men—chimes that, it was fondly hoped, might usher in, as they should, a new era.

> Ring out the old, ring in the new,
> Ring out the false, ring in the true.

That night the city was illuminated. Never had it seen so brilliant a spectacle. Such was the blaze of light around the City Hall that the cupola caught fire and was consumed, and the Hall itself narrowly escaped destruction. But one night did not exhaust the public enthusiasm, for the following evening witnessed one of those displays for which New York surpasses all the cities of the world—a fireman's torchlight procession. Moreover, several wagon-loads (each containing about twelve miles) of the cable left on board the *Niagara* were drawn through the principal streets of the city.

Similar demonstrations took place in other parts of the United

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[1] Whoever shall write the history of popular enthusiasm must give a large space to the way in which the advent of Atlantic telegraphy was received in the United States. Never did the tidings of any great achievement—whether of peace or war—more truly electrify a nation. In New York, the news was received at first with incredulity. No doubt the impression was greater, because it took every one completely by surprise. This undertaking had been looked upon as hopeless. Its projectors had shared the usual lot of those who conceive vast designs and venture on great enterprises, and their labours had been watched with mixed feelings of derision and pity.

States. From the Atlantic to the valley of the Mississippi, and to the Gulf of Mexico, in every city was heard the firing of guns and the ringing of bells. Nothing seemed too extravagant to give expression to the popular rejoicing.

The English Press were warm in their recognition of those to whom the nation were "indebted for bringing into action the greatest invention of the age," [1] and expressed their full belief that "the effect of bringing the Three Kingdoms and the United States into instantaneous communication with each other will be to render hostilities between the two nations almost impossible for the future."

And again:—"More was done yesterday for the consolidation of our Empire than the wisdom of our statesmen, the liberality of our Legislature, or the loyalty of our Colonists could ever have effected."

The sermons preached on the subject, both in England and America, were literally without number. Enough found their way into print to fill several large volumes. Never, indeed, had an event more deeply touched the spirit of religious enthusiasm.

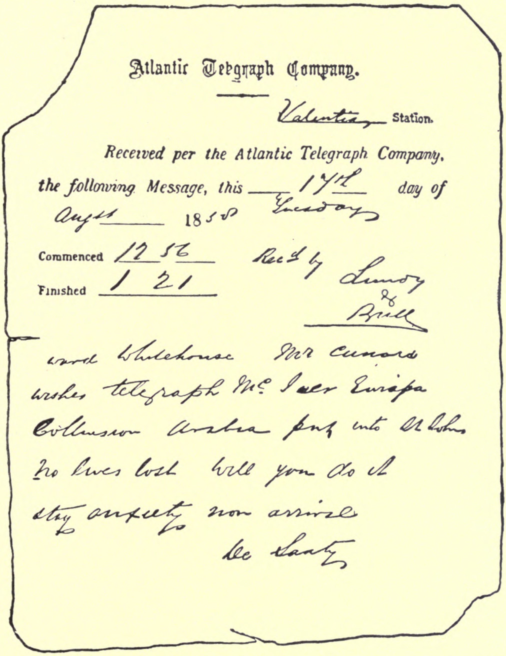
With further reference to the active life of the cable, the following communications have some interest:—

Three long congratulatory messages were transmitted: One on August 18th, from Mr. Peter Cooper, President of the New York, Newfoundland, and London Telegraph Company, to the Directors of the Atlantic Telegraph Company; another, from the Mayor of New York to the Lord Mayor of London, his reply in acknowledgment following.

[1] *The Times*, August 6th, 1858.

Two of the great Cunard mail steamers, the *Europa* and *Arabia*, came into collision on August 14th, while on their outward and homeward voyages. Neither the news nor the injured vessels could reach those concerned on both sides of the Atlantic for some days; but as soon as it became known in New York, a message was sent by the cable :—

Arabia in collision with *Europa*, Cape Race, Saturday. *Arabia*


Atlantic Telegraph Company.

Valentia Station.

Received per the Atlantic Telegraph Company, the following Message, this 17th day of August 1858 Tuesday

Commenced 12 56 Rec'd by Lundy & Brill
Finished 1 21

Ward Whitehouse Mr Cunard wishes telegraph McIver Europa collision Arabia put into St Johns no lives lost will you do it stay anxiety now arrive
De Sauty

FACSIMILE OF ONE OF THE FIRST MESSAGES RECEIVED THROUGH THE ATLANTIC CABLE

on her way. Head slightly injured. *Europa* lost bowsprit, cutwater stem sprung. Will remain in St. John's ten days from 16th. *Persia* calls at St. John's for mails and passengers. No loss of life or limb.

This first public *news* message showed the relief given by speedy knowledge in dispelling doubt and fear. Subsequently, messages giving the news on both Continents were transmitted, and published daily.

Further, as exemplifying the aid the cable afforded to our Government, we may mention two messages sent from the Commander-in-Chief, at the Horse Guards, on August 31st—owing to the quelling of the Indian Mutiny—cancelling orders sent by mail to Canada, thus :—

The first, to General Trollope, Halifax, ran as follows : "The 62nd Regiment is not to return to England." The other, to the officer in command at Montreal, ran thus : "The 39th Regiment is not to return to England."

From £50,000 to £60,000 was estimated by the authorities to have been saved in the unnecessary transportation of the troops by these two cable communications, which were delivered the same day that they were sent.

But the insulation of the precious wire had, unhappily, been giving way ; and the diminished flashes of light proved to be only the flickering of the flame that was soon to be extinguished in the eternal darkness of the waters. After a period of confused signals, the line ultimately breathed its last on October 20th, after 732 messages in all had been conveyed during a period of three months. The last word which the line uttered—and which may be said to have come beyond the sea—was "Forward !" The very day that the whole of New York rose up to do honour to the Atlantic Telegraph—when the roar of guns, the chiming of bells in the sacred spires, and the shouts of joy throughout the land might be heard o'er hill and dale, and when even London was about to do it honour—the throbs of this almost living thing were becoming visibly weaker, and fears began to prevail that it would shortly sleep for ever silent in its ocean grave.

The line had been subject to frequent interruption throughout. The wonder is that it did so much, when we consider the lack of experience at that period in the initial manufacture of deep-sea cables, the short time allowed, and the treatment the line received after being laid.[1]

An unusually violent lightning storm occurred at Newfoundland shortly after the cable had been laid. This was spoken of as a possible part cause of the gradual failure of the line; also a supposed "factory fault," masked by the tar in the hemp. There were, however, those who hinted at foul play. It was certainly singular that the cable should continue to work for several weeks and only show definite signs of sickness on the very day of the celebration in New York!

When all the efforts of the electricians failed to draw more than a few faint whispers—a dying gasp from the depths of the sea—there ensued, in the public mind, a feeling of

[1] It is extremely doubtful whether any cable, even of the present day, would long stand a trial with currents so generated and of such intensity.

In his work on the "Electric Telegraph" (p.348), the late Mr. Robert Sabine said: "At the date of the first Atlantic cable the engineering department was far ahead of the electrical. The cable was successfully laid—mechanically good, but electrically bad."

profound discouragement. And, then, as regards those officially concerned in the enterprise. What a bitter disappointment! Imagine Charles Bright's state of mind after all he had gone through, and after he had ultimately accomplished his part of the undertaking with complete success. In all the experience of life there are no sadder moments than those in which, after years of anxious toil, striving for a great object, and after a glorious triumph, the achievement that seemed complete becomes a wreck!

Still, young Bright had the satisfaction of knowing that he had (1) demonstrated the possibility of laying over 2,000 miles[1] of cable in one continuous length across the Atlantic Ocean at depths of two to three miles[2]; and (2) that by means of an electric current, distinct and regular signals could be transmitted and received through an insulated conductor—even when at such a depth beneath the sea—across this vast distance.[3]

[1] This was a length six times greater than had ever been previously laid, and at an average depth far in excess of anything before.

[2] He had also proved, amongst other things, that a ship could be hove to in deep water with a cable hanging on without the latter breaking.

[3] In his Presidential Address to the Institution of Electrical Engineers, in 1889, the late Lord Kelvin (then Sir William Thomson) said, in regard to the above work—

> "The first Atlantic Cable gave me the happiness and privilege of meeting and working with the late Sir Charles Bright. He was the engineer of this great undertaking—full of vigour, full of enthusiasm. We were shipmates on the *Agamemnon* on the ever memorable expedition of 1858, during which we were out of sight of land for thirty-three days. To Sir C. Bright's vigour, earnestness, and enthusiasm was due the successful laying of the cable. We must always feel deeply indebted to our late colleague as the pioneer in that great work, when other engineers would not look at it, and thought it absolutely impracticable."

Of course the gutta-percha coverings, as then applied in those early stages of submarine work,[1] cannot in any way be compared to the continual progress made in insulating methods and materials during the many years that have since elapsed.[2] But in 1856-57 the Atlantic Cable insulation was a great advance upon that applied to the wires of previous cables ; moreover, the conductor was a *strand* of copper, and much larger than anything before adopted.

It was to be regretted that owing to the precipitate orders given by the provisional committee of the subscribers to the memorandum of association of the Company—before even the Board had been formed, or Charles Bright appointed engineer—that his specification of a conductor nearly four times larger had not been worked to.[3] Bright's specification —had it been acted on—would have given six times the insulation, and more than treble the conductivity. Under such conditions it is highly improbable that strong currents would have been applied for the working of the line. Unhappily Professor Morse had, as we have seen, promulgated an opinion directly opposed to Charles Bright's practical knowledge.

[1] It was thought by some that the gutta-percha had let the water percolate in at the seams, and also that weak joints contributed to the ultimate failure of the line.

[2] *Submarine Telegraphs.*

[3] As previously stated, this heavier type of core was subsequently recommended to Government by Sir C. Bright, in 1860, for the Falmouth-Gibraltar cable, eventually used to connect Malta and Alexandria. It was also specified by Bright for the Second and Third Atlantic Cables of 1865 and 1866, and duly adopted, as may be seen further on.

Professor Morse's views ran thus :—

That by the use of comparatively small-coated wires, and of electro-magnetic induction coils for the exciting magnets, telegraphic signals can be transmitted through two thousand miles, with a speed amply sufficient for all commercial and economical purposes.[1]

A similarly incorrect theory was adopted even by Faraday (the greatest electrical scientist of the day), who, in a discussion on the proposed Atlantic Cable at the Institution of Civil Engineers, stated "that the larger the jar, or the larger the wire, the more electricity was required to charge it; and the greater was the retardation of that electric impulse, which should be occupied in sending the charge forward,"[2] thereby entirely disregarding the factor of conductor resistance. The Company were completely misled by this and by similar views entertained by Mr. Whitehouse. And so to a cable of comparatively small carrying power and poor insulation was set the task of withstanding electric currents of an intensity that would ruin any line ever laid, even now—fifty years later!

The cable, inadequately equipped as it was, would probably have worked—though slowly, of course—for years, had the battery power been limited to that which had been previously employed on the ships during the laying operations, in connection with Professor Thomson's highly sensitive mirror apparatus. Mr. Whitehouse, however,

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[1] Report by Professor S. F. B. Morse, LL.D., to the Provisional Committee of the Atlantic Telegraph Company.

[2] Professor Michael Faraday in *Proceedings of Inst. C.E.*, vol. xvi., p. 221.

connected his battery to fearfully intense induction coils in order to work his specially devised relay and Morse electro-magnetic recording instruments at the further end of the line. Moreover, finding difficulty in getting his appliances to act properly, he appears to have increased the power from time to time, up to nearly 500 cells—of a very potent type—during the first week of working, till the induction coils about *five feet* long yielded electricity that was estimated by the experts (who sat at a sort of coroner's inquest on the unhappy cable) to have an intensity of about 2,000 volts ![1]

Hence, when signalling was resumed by the comparatively mild voltaic currents, actuating Professor Thomson's instrument, a fault (or faults) had been already developed, necessitating a far higher battery power than had been employed during the continuous communication between the ships whilst paying out. The wounds opened further under the various stimulating doses ; the insulation was unable to bear the electrical strain ; and the circulation gradually ceased through a cable already in a state of dissolution.

[1] *The Story of the Atlantic Cable.*

Section 13

The Inquest

The great historical sea line having collapsed, some of the foremost of the electrical profession were called in to aid, first in determining the *nature* of the interruption, with a view to remedies if practicable ; then to elicit the *cause*. Mr. C. F. Varley,[1] the electrician of the Electric Telegraph Company ; Mr. E. B. Bright, Manager to the Magnetic Company ; and Mr. W. T. Henley, the well-known telegraph inventor, were severally requested by the "Atlantic" Company to examine and report in conjunction with Sir Charles Bright and Professor Thomson.

Resistance coils and apparatus for ascertaining the position of the fault, patented by the Messrs. Bright in 1852—as referred to in Chapter III—were employed, the result being that a serious leakage of electricity was indicated at a distance of about 300 miles from Valentia. There was clearly no fracture of the conductor, for excessively weak currents still came through in a fitful sort of way. According to the above location, the main leak through the gutta-percha envelope was in water of a depth of about two miles. At that time means had not been devised for grappling and lifting a cable from such depths.

As the result of tests made independently by Charles Bright and Professor Thomson, it seemed likely that the

[1] About this time, Mr. Varley became electrician to the Atlantic Company in succession to Mr. Whitehouse, who had retired, whilst Professor Thomson still remained scientific adviser to the Board of Directors.

Valentia shore end was especially faulty. Accordingly, it was under-run from the catamaran raft, previously used in 1857, for some three miles ; but on being cut at the furthest point at which it was found possible to raise the cable, the fault still appeared on the seaward side. The idea of repairs had, therefore, to be abandoned, and the cable was again spliced up.

The line being once more intact, efforts were made to renew signals by means of a large and improved magnetic telegraph devised by Mr. Henley, as well as by curb keys recently invented by the Brights. With the latter, currents of opposite character, and of given lengths, were transmitted, so that each signalling current was followed instantly by one of opposite polarity, which neutralised all that remained of its predecessor. The road was thus cleared for the succeeding signal.

All efforts, however, proved unavailing ; for signalling purposes the poor cable was defunct.

Having dealt with the nature of the interruption, we now come to the *cause*. It is first of all abundantly clear from the station diaries kept by the electricians at Valentia and Newfoundland—as well as by other irrefutable evidence—that when the laying was completed, and the cable ends were handed over to them from the ships on August 5th, all was in good working order.

Thus :—

"On the landing of the cable at Newfoundland some of them 'tasted' the current, and received a pretty strong shock, so strong that they willingly resigned the chance of repeating the experiment." On the same day, August 5th, Mr. Field telegraphed to the New York Associated Press: "The electrical signals sent through the whole cable are *perfect*." The station diary records the same. Again, on August 8th, the entry runs: "Good signals being received through the cable." On the 9th, Mr. de Sauty, the electrician, reports: "Receiving good, recorded signals from Valentia. *Perfectly satisfactory.*"

So much for the American end. On this side it was stated in the papers on August 5th, "good signals passing to and fro." Mr. Whitehouse, the chief electrician, reports on the 6th: "Electric communication is maintained perfectly." 7th: "The currents from Newfoundland are good, giving deflections of 60° on either side of the galvanometer, according as a positive or negative current is transmitted." On August 10th, Mr. Whitehouse telegraphed, "rate of transmission fully equals that obtained at Keyham, and the line works as well as it did before it was laid." [1]

With reference to the electrical working during laying operations, Mr. Whitehouse stated in his evidence before the Government Commission appointed in 1861 to enquire into the construction of submarine cables: "The signals were *very strong*: they made the *relay* speak out *loud*, so that *you could hear it across the room*. The battery power employed at the time at Newfoundland was seven twelve-cell sawdust batteries."

On board the ships during the submersion, only moderate charges of electricity were employed for signalling—some seventy cells of a very ordinary, and weak, form of voltaic battery. The use of these was continued at Valentia after landing, and worked the cable perfectly, though of course slowly compared with overhead land wires.

All the eminent electricians examined before the pre-

[1] *The Story of the Atlantic Cable.*

viously mentioned Parliamentary Committee were unanimous on this point[1]:— Mr. Cromwell Varley, F.R.S., declared his belief "that had a more moderate power been used, the cable would still have been capable of transmitting messages," and that "its faulty condition was no doubt due to the employment of large induction coils." Mr. J. W. Brett (a Director) stated that "the Board had clear evidence that the cable sustained injury by the use of very great power." Mr. Glass "was persuaded that the intense currents were finally the cause of the signals ceasing." Professor Hughes, the inventor of the well-known type-printing telegraph, declared that "the cable was injured by the induction coils, and that the intense currents developed by them were strong enough to burst through gutta-percha."

A member of the committee afterwards inquired whether it was the fact that those who had the misfortune to touch the cable at the time when the current was discharged from the induction coil received so severe a shock from it that they nearly fainted. It was admitted in reply, "that those who touched the bare wire would suffer for their carelessness, though not, if *discretion were exercised*, in grasping the gutta-percha only."

Professor Wheatstone expressed his opinion at the inquiry in question: "That the force of the induction coils must have been enormously greater than that of a battery of 400 elements, such as we subsequently employed at Valentia in the later signalling efforts." Further evidence was given to the same effect by other experts, and the

[1] "Joint Commission on Submarine Telegraph Cables."

Right Hon. J. Stuart-Wortley, M.P., the then Chairman of the Atlantic Company, in a deputation to Lord Palmerston in March, 1862, stated that "far too high charges of electricity were forced into the conductor. It was evidently thought at that time by certain electricians that you could not charge a cable of this sort too highly. Thus, they proceeded somewhat like the man who bores a hole with a poker in a deal board: he gets the hole, to be sure, *but the board is burnt in the operation.*"

Professor Thomson (afterwards Lord Kelvin), writing in 1860, expressed the following opinion anent the use of excessive power:—

The induction coils were superseded by Daniell's battery at Valentia after a few days' trial, though the rapidly failing line had seemed to prove them incapable of giving intelligible signals to the Newfoundland Station. Owing to the immediate introduction and continued use of my mirror galvanometer as a receiving instrument at Valentia, the signals from Newfoundland were sufficient during the three weeks of successful working of the cable. It is quite certain that, with a properly-adjusted mirror galvanometer at each end, twenty cells of Daniell's battery would have done the work required; and the writer has little doubt that if no induction coils and no battery power exceeding the above had ever been applied to the cable since the landing of its ends, *it would be now in full work day and night, with no prospect, or probability, of failure.*[1]

Summing up the *cause* of the catastrophe to the ill-used cable, it may be said (in engineering *parlance*) that "high-pressure steam had been got up in a low-pressure boiler."

[1] *The Encyclopædia Britannica*, 8th Edition, 1860. Article on "The Electric Telegraph," by Professor W. Thomson, F.R.S.

Section 14

Other Routes

It soon became evident that no fresh venture would take practical shape for several years. Seeing this, Sir Charles devoted himself to his other professional work connected with the Magnetic Telegraph Company, and subsequently to the accomplishment of further cable enterprises, of which the first line to India was the chief. This —as will be seen subsequently—was superintended and laid by him, for Government, in 1864.

It was not, however, as it turned out, long before he became interested in another big Atlantic project. The failure of the first line after a short period of working, and the slow rate at which messages were capable of being passed through its conductor, naturally deterred capitalists from providing the means for another line of such length, in deep water.

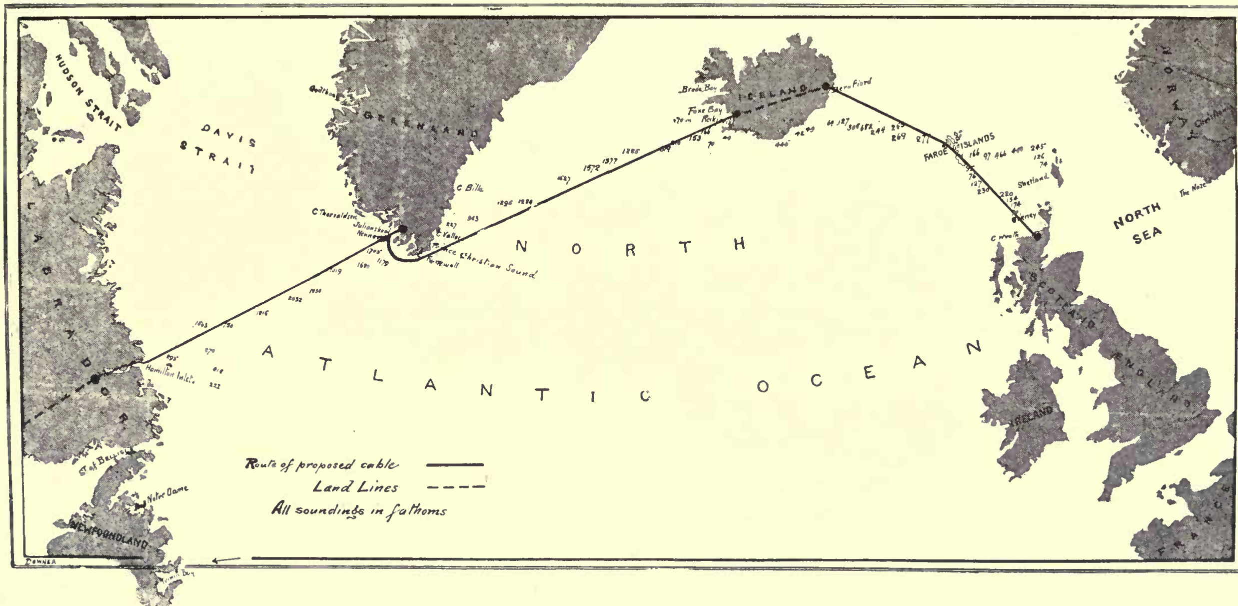
But there was an alternative route between this country and America, by which the transmission of the electric current could be sub-divided into four comparatively short circuits: namely—from the extreme north of Scotland to the Faröe Islands, thence to Iceland, from there to the southern point of Greenland, and so to Labrador or Newfoundland. Although this route looks much longer on the map, it is not really so; and the earth's curvature is less in those northern regions than between Ireland and Newfoundland. The distances—varying a little according to landing-places selected—were approximately :—

		Miles.
From	the North of Scotland to Faröe Islands .	225
,,	the Faröe Islands to Iceland . .	280
,,	Iceland to Greenland, S.W. Harbour .	700
,,	Greenland to Labrador . . .	550
	Total	1,755

From the electrician's point of view, these sub-divisions were extremely favourable, as compared with the great continuous length entailed by an Atlantic cable between Ireland and Newfoundland. Then again, the soundings, except for a section between Greenland and Labrador, did not yield anything approaching the more southern depths.

But against these palpable advantages there was the engineering objection—which at first seemed insurmountable —that the Greenland coast was bound up by ice for a considerable part of the year, in addition to the risk of injury to the cable from the grounding icebergs. There was also the probable difficulty of obtaining a trained staff to work a line when laid to such inhospitable regions. Having regard, however, to the anxiety exhibited by many to get to the North Pole, and to remain for years in the coldest Arctic regions, this did not present an insuperable obstacle.

This bold project—with a route across the coldest and iciest regions of the Atlantic—had been originally brought to the notice of the Danish Government by Mr. Wyld, the geographer, even before the Atlantic Telegraph Company had been established. It was reintroduced in a different form by Colonel T. P. Shaffner, an American electrician of some note. Colonel Shaffner, who had been



THE NORTH ATLANTIC TELEGRAPH PROJECT, 1860 a pioneer of telegraphs in the Western States, published his opinion early in 1855 against so long a circuit as the direct Atlantic line in the following words: "I do not say that a galvanic, or magnetic, electrical current can never be sent from Newfoundland to Ireland; but I do say that, with the present discoveries of science, I do not believe it practicable for telegraphic service."[1] In this, of course, he proved to be mistaken; nevertheless, he made a strong case for the series of short stages geographically afforded by the North Atlantic deviation. After the 1858 cable had ceased working, to back up his belief in the advantages of the route—which he characterised as having "natural stepping-stones which Providence had placed across the ocean in the North"—he actually chartered a small sailing vessel; and, *with his family on board*, put forth from Boston on August 29th, 1859, for the purpose of making the preliminary survey. He landed at Glasgow in November of that year; and there and then presented to the public the results of an arduous journey which so few had gone through up to that time.

On the voyage Colonel Shaffner sounded the deep seas to be traversed between Labrador and Greenland, and between Greenland and Iceland. He found a firm supporter in Mr. J. Rodney Croskey, of London, who advanced the "caution" money to the Danish Government for the concessions requisite in the Faröes, Iceland, and Greenland.[2]

[1] *The Story of the Atlantic Cable.*

[2] Mr. Croskey also subsequently found the bulk of the capital for the exploring expeditions.

Colonel Shaffner had been on terms of friendship for some years with Sir Charles Bright and his brother, who had both contributed a good deal to his *Telegraph Manual,* published in the United States. Thus, after this preliminary work, he and Mr. Croskey discussed the matter with Sir Charles, who soon recognised its feasibility, and entered heartily into the project as its technical adviser.

The first point was to convince the public that there were no insuperable difficulties in the way, by further surveys and soundings of a detailed character, so as to ascertain the inequalities of the bottom, as well as the materials of which it was composed.

In the course of the spring of 1860, Colonel Shaffner read a paper on the proposed North Atlantic Telegraph to the members of the Royal Geographical Society, the result being that much assistance was offered by those present, including Earl de Grey, Sir Roderick Murchison, and the Secretary, Dr. Norton Shaw. On May 15th, Lord Palmerston granted an audience to an influential deputation, headed by the Right Hon. Milner Gibson, M.P., and four other members of the House of Commons, to solicit the assistance of Government, in sending out ships and officers to make the necessary official survey, for ascertaining the practicability of the proposed route. The Premier appeared to fully appreciate the advantages of the north-about scheme, and in a short time the Admiralty were directed to despatch an expedition for the purpose of making the requisite survey. The Admiralty selected for this duty Captain McClintock, R.N.,[1] an officer of great experience

[1] Later Admiral Sir Leopold McClintock, K.C.B., LL.D., F.R.S.

in the navigation of the Arctic seas, and H.M.S. *Bulldog* was placed under his command. This distinguished officer was directed to take the deep-sea soundings, and he sailed from Portsmouth on his mission in June, 1860. In the meantime, the promoters of the enterprise purchased the *Fox*—the steam yacht formerly employed in the search for Franklin—and fitted her out with a view to making surveys of the proposed landing-places. The *Fox* was placed under the command of Captain Young,[1] of the mercantile marine, an officer well known for his distinguished labours under McClintock in the Franklin search. At the same time, Dr. John Rae, an intrepid Arctic explorer, volunteered his services to join the *Fox*, in charge of the overland expeditions in the Faröe Isles, Iceland, and Greenland. Colonel Shaffner, as concessioner, also accompanied the *Fox* expedition, to take part in the surveys.

Before the departure of the *Fox*, which sailed on July 18th, 1860, Her Majesty the Queen, the Prince Consort, and other members of the Royal Family honoured the enterprise by a visit to that vessel, while lying off Osborne, and showed a lively interest in the details of the expedition. After the royal visit, Sir Charles Bright, with other promoters and friends, saw the party off with many hearty good wishes.

On the return of the expedition, Sir Leopold McClintock reported to Sir Charles, favouring the route as perfectly practicable, pointing out that the ice would not really prove a difficulty, and strongly approving of the original intention of a land line across Iceland to Faxe Bay, "as

[1] Now Sir Allen Young, C.B.

by so doing you will avoid the only part of the sea where submarine volcanic disturbances may be suspected."

The results of the voyages of H.M.S. *Bulldog* and the steam-yacht *Fox* were brought before a crowded meeting of the Royal Geographical Society on January 28th, 1861, when Sir Leopold McClintock gave the first public account of his submarine survey along, and in the vicinity of, the proposed course of the cable. Then followed an exhaustive paper by Sir Charles Bright, giving a synopsis of Captain Young's report on his voyage in the *Fox*—including the examination of various estuaries and harbours—so as to enable a decision to be arrived at as to the best landing-places, the climatic conditions, etc. From both sets of soundings it was shown that, as a rule, the bottom was of ooze. Dr. Wallich, the naturalist of the expedition, had brought up brightly coloured star-fish from depths of over a mile, whereas it had previously been believed that nothing could possibly live under such an enormous pressure of water. In concluding his paper, Sir Charles made the following remarks :—

Having thus presented to the Society some of the most valuable and interesting portions of Captain Young's report, I have only to observe that the result of the recent survey has been to remove from my mind the apprehensions—which I previously entertained in common with many others—as to the extent and character of the difficulties to be overcome in carrying a line of telegraph to America by the northern route.

Prior to the despatch of the surveying expedition, we had no knowledge of the depth of the seas to be crossed, with the exception of the few soundings obtained by Colonel Shaffner in 1859, and our information as to the nature of the shores of Greenland in regard to the requirements of a telegraphic cable was equally small.

These points are of vital importance to the prospects of the North Atlantic route, and the survey has placed us in possession of satisfactory particulars respecting them. The soundings taken by Sir Leopold McClintock will be a guide in the selection of the most suitable form for the deep-sea lengths of the cable, while the data furnished by Captain Young will direct the construction of the more massive cables to be laid in the inlets of the coast.

It is not necessary to determine upon the precise landing-places, and other details in connection with the enterprise, at the present time. But the promoters of the undertaking have received ample encouragement from the survey to warrant them in proceeding with their labours with renewed vigour and confidence. When they have achieved that success which their perseverance and energy deserve, I am sure they will always gratefully remember that their endeavours at the stage of their operations which is now under discussion would have been very much less productive of good results but for the patriotic foresight of Lord Palmerston in ordering the *Bulldog* on her late successful service. We must also be most thankful for the assistance of Sir Leopold McClintock, Captain Young, Dr. Rae, and the Commissioner appointed to accompany the *Fox* by the Danish Government, whose patience and devotion to their self-imposed work has been beyond all praise. Nor can those interested in this important undertaking forget the great help rendered to them by the Royal Geographical Society.[1]

Then came a highly instructive paper by Dr. Rae. He gave a number of interesting particulars of his land surveys, the population, price of food, wages, etc. He also described the ride of the *Fox* party across Iceland, whilst making important suggestions as to the route for the land line with a view to avoiding the geysers. These papers were

[1] Bright's paper, as above, is given in full in Appendix 12 to Vol. I. of the original biography.

followed at the next meeting of the Geographical Society by an exhaustive discussion, at which Lord Ashburton, Admiral Sir Edward Belcher, Captain (afterwards Rear-Admiral) Sherard Osborn, R.N., C.B., Mr. John Ball, F.R.S., and various gentlemen of Arctic expedition fame, spoke favourably of the project.[1]

At this time, however (1861), there was still too much discouragement owing to the stoppage in working of the first Atlantic cable, and the yet more disastrous failure of the Red Sea and Indian lines, besides the loss of other cables in the Mediterranean. Moreover, there were those who continued to fear the ice-floes ; and in the end, the public did not respond sufficiently. Thus, after all, what came to be styled the "Grand North Atlantic Telegraph" project—which had been worked out with so much trouble and expense—was never actually realised.

Another scheme which attracted some attention about the same time was described as the "South Atlantic Telegraph." This was for a very long length of cable between the south of Spain and the coast of Brazil, touching at Madeira, the Canary Islands, Cape de Verde Isles, Don Pedro and Fernando de Noronha Island on the way—and stretching out to the West Indies and the United States.

Then there was a project—concerning which Sir Charles was also consulted—for a cable on an intermediate route

[1] It was here that Sir William Fothergill Cooke took occasion to express the pride he felt in Sir Charles having been—so to speak—a pupil of his ; and he expressed himself similarly at various times in public.

from Portugal to the Azores, and thence to America, *via* Bermuda and the Southern States.

Being, however, to a great extent foreign in their scope, these latter schemes found little favour with those in our country who were by way of promoting such enterprises.[1]

SECTION 15

The 1865 *and* 1866 *Cables*[2]

Though their cables had ceased to work, the Atlantic Company was kept afloat by the promoters, whilst Mr. Lampson as vice-chairman, and Mr. Saward as secretary, were doing all that could be done to keep its objects constantly before the public, in the hopes of raising fresh funds.[3]

In 1862 the Government were prevailed on to despatch H.M.S. *Porcupine* to further examine the ocean floor 300 miles out from the coasts of Ireland and Newfoundland respectively.

It took a considerable time to get together the full amount of capital required for another Atlantic cable ; this, indeed, could only be done gradually. The great civil war in America stimulated capitalists to renew the undertaking. One of the main advantages adduced was—on this occasion, as

[1] *Submarine Telegraphs.*

[2] It should be observed that a considerable interval of time occurred between the events just dealt with and those forming the subject of the present section of this chapter. It was thought best to depart from order of date here and tell the story of early Atlantic Telegraphy in a consecutive manner. The intervening period is accounted for, so far as our object is concerned, in subsequent chapters.

[3] *Submarine Telegraphs.*

before—the avoidance of misunderstandings between the two countries. Another—intended by Mr. Cyrus Field as a special inducement to his fellow-countrymen—was the improvement of the agricultural position of the United States, by extending to it the facilities, already enjoyed by France, of commanding the foreign grain markets. On this account, the project was warmly supported by the Right Honourable John Bright, M.P., and other eminent "Free Traders."

Mr. Field, however, met with as little success in obtaining pecuniary support in the States as he had in connection with the previous line. His brother, Mr. H. M. Field, writes:—

The summer of this year (1862) Mr. Field spent in America, where he applied himself vigorously to raising capital for the new enterprise. To this end he visited Boston, Providence, Philadelphia, Albany, and Buffalo, to address meetings of merchants and others. He used to amuse us with the account of his visit to the first city, where he was honoured with the attendance of a large array of "the solid men of Boston," who listened with an attention that was most flattering to the pride of the speaker addressing such an assemblage in the capital of his native State.

There was no mistaking the interest they felt in the subject. They went still further; they passed a series of resolutions, in which they applauded the projected telegraph across the ocean as one of the grandest enterprises ever undertaken by man, which they proudly commended to the confidence and support of the American public. After this they went home feeling that they had done the generous thing in bestowing upon it such a mark of their approbation. *But not a man subscribed a dollar!*

In point of fact, as before, the cable of 1865—as well as that of 1866—was provided for out of English pockets. Let us now substantiate this statement by a cursory glance at events. Mr. Thomas Brassey, M.P., was the first to be appealed to in this country, and he supported the venture nobly. Then Mr. Pender [1] was applied to, and here also substantial aid was forthcoming. Both these gentlemen had joined the Board of the Telegraph Construction and Maintenance Company which had just been formed (in April, 1864), as the result of amalgamation of the Gutta-Percha Co. and Messrs. Glass, Elliot & Co.

Shortly after the first Atlantic cable was laid, Messrs. Glass, Elliot & Co. availed themselves of the services of Mr. Canning and Mr. Clifford, whose engagements on Charles Bright's staff for the "Atlantic" Company had ceased. Thus, with an additional staff of electricians, they had placed themselves in a position to undertake direct contracts for laying, as well as manufacturing, submarine telegraphs. They had, indeed, carried out work of this character in the Mediterranean during the year 1860; and on the amalgamation of the two businesses above mentioned into a limited liability company, their position was still further strengthened.

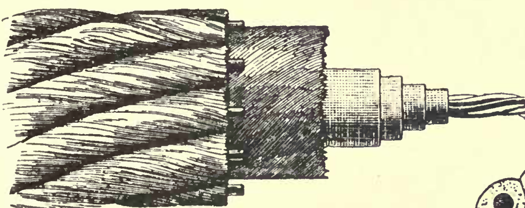
The capital raised for the new cable by the Atlantic Telegraph Company was £600,000; and by agreeing to take a considerable proportion of their payment in "Atlantic" shares, the contractors, now the Telegraph Construction Company,[2] practically found more than half of this amount. It will be seen that the new cable was to be an expensive one as compared with that of 1857–58. It was the outcome

[1] Afterwards Sir John Pender, G.C.M.G., M.P.

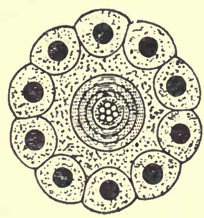
[2] This firm had previously (as Glass, Elliot & Co.) been selected to undertake the entire work.

of six years' further experience, during which several important lines—dealt with in subsequent pages—had been laid. It also followed upon the exhaustive Government inquiry already alluded to.

The actual type, adopted on the recommendation of Sir Charles Bright, was much the same in respect to the conductor and insulator [1] as that which Sir Charles had suggested for the previous Atlantic line, on which occasion, it will be remembered, his recommendation was not followed. The armour provided for the present insulated and yarn-



THE MAIN CABLE



served heart, or core, was precisely similar to Sir Charles' Government specification of May, 1859, for the proposed cable from Falmouth to Gibraltar. It consisted of a combination of iron and hemp, each wire being enveloped in manilla yarns. The object of encasing the separate wires in hemp was (1) to protect them from rust due to exposure to air and water, and (2) to reduce the specific gravity of

[1] 300 lb. copper to 400 lb. gutta-percha per nautical mile. Bright was also specially consulted regarding the estimates, besides drawing up the specification.

the cable, with a view to rendering it more capable of supporting its own weight in water. This form of cable—bearing a stress of about eight tons [1]—was considered by most of the authorities at that period to perfectly fulfil the conditions required for deep-sea lines.[2]

It was determined that this time the cable must be laid in one length (with the exception of the shore ends), by a single vessel.[3] There was but one ship that could carry such a cargo. This ship was the *Great Eastern*—the conception of that distinguished engineer, Isambard Kingdom Brunel. She was in course of construction, by the late Mr. Scott Russell, at the time of the first cable, and Charles Bright had joined with Brunel in his regrets that she was not then available. An enormous craft of 22,500 tons, she did not prove suitable at that time as a cargo boat; and the laying of the second Atlantic cable was the first piece of useful work she did, after lying more or less idle for nearly ten years. It is sad to think of the way this poor old ship was metaphorically passed from hand to hand. Even at this period, three separate companies had already been formed one after another to work her. As promoter and chairman of one

[1] The increased breaking strain here afforded over that of the first Atlantic line was partly due to the great improvements made in the manufacture of iron wire during the interval.

[2] Experience has since taught us, however, that such a type lacks durability, owing to the rapid decay of the hemp between the iron wires and the sea. When the hemp has once decayed a bundle of loose wires are left, which by exposure all round soon become seriously reduced and weakened. Moreover, this pattern was found afterwards to be unsuitable on account of a broken wire being liable to stab the insulation—an accident which could scarcely happen to a close-sheathed type.

[3] *The Story of the Atlantic Cable.*

of these, Mr. Gooch, C.E. (afterwards Sir Daniel Gooch, Bart., M.P.), took an active part in arranging that she should be chartered for this undertaking. Hence it was that he became a prominent party in the enterprise, with a seat on the Board of the Telegraph Construction Company.

In main principles, the apparatus for paying out the cable was similar to that previously adopted on the *Agamemnon* and *Niagara*.[1] There were, however, several modifications introduced, as the result of the extra experience gained during the seven years' interval. The main point of difference was the further application of jockeys, in a more complete form. All the machinery for the present undertaking was constructed and set up by the famous firm of engineers, Messrs. John Penn & Son, of Greenwich.

As soon as the full length of cable had been manufactured, and shipped from the Greenwich Works, the *Great Eastern*, under the command of Captain (afterwards Sir James) Anderson,[2] left the Thames on July 23rd, 1865, and proceeded to Foilhommerum Bay, Valentia. Here she joined up her cable to the shore end [3] which had been laid

[1] This general similarity is referred to in the complete account of the 1865 and 1866 machinery, given by Mr. Elliot (afterwards Sir George Elliot, Bart,, M.P.) in the course of a paper read before the Institution of Mechanical Engineers in 1867.

[2] Captain Anderson had the reputation of possessing great skill in the handling of a ship. He was at the time in the service of the Cunard Steamship Company, by whose permission he joined the expedition.

[3] This—somewhere near thirty miles in length—had been made by Mr. W. T. Henley, of North Woolwich. It had an additional outer sheathing of iron strands, each strand being composed of three stout wires, bringing the weight up to as much as twenty tons per mile.

a day earlier by s.s. *Caroline*, a small vessel chartered and fitted up for the purpose. The great ship then started paying out as she steamed away on her journey to America, escorted by two British men-of-war, the *Terrible* and the *Sphinx*.

On behalf of the contractors—the Telegraph Construction and Maintenance Company—Mr. (now Sir Samuel) Canning was the Engineer in charge, with Mr. Henry Clifford as his chief assistant. As we have seen, both these gentlemen had been engaged with Sir Charles Bright on the first Atlantic expedition, and had had much experience, alike in cable work and mechanical engineering. There was also on the engineering staff of the contractors, Mr. John Temple (formerly Bright's secretary and assistant engineer), as well as Mr. Robert London. Mr. C. V. de Sauty served as chief electrician, assisted by Mr. H. A. C. Saunders, and several others. By arrangement with the Admiralty, Staff-Commander H. A. Moriarty, R.N., again acted as the navigator of the expedition. Captain Moriarty was possessed of great skill in that direction—a fact which had been made clear in the previous undertakings.

Though acting as Consulting Engineer to this enterprise, Sir Charles Bright did not accompany the expedition. As will be seen in a subsequent chapter, he was at the time deeply engaged in political matters. Indeed, his visits to Greenwich had been of late largely associated with the General Election. These visits terminated in his being returned for that borough ; but the Atlantic Telegraph Company was represented on board by Professor Thomson and Mr. C. F. Varley, as electricians, the former acting mainly as scientific expert in a consultative sense. Both Mr. Field and Mr. Gooch accompanied the expedition, the former as promoter of the scheme, and the latter on behalf of the *Great Eastern* Company. Representing the Press, there were also on board Dr. W. H. Russell,[1] the well-known correspondent of *The Times*, as the historian of the enterprise; and Mr. Robert Dudley, an artist of repute, who produced several excellent pictures of the work in its different stages, as well as articles for the *Illustrated London News*.

Inasmuch as Bright was not on board, a detailed account of the trip is not attempted here. It suffices to say that several mishaps occurred during the laying. A number of unsuccessful attempts were made to recover the cable after it had been broken in deep water when endeavouring to haul back a fault. Ultimately the ships had to return home, on August 11th, without completing their work.

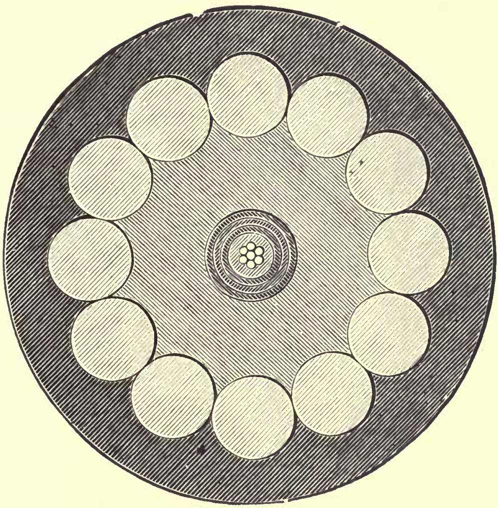
Second and Successful Attempt, 1866.—The results of the last expedition, disastrous as they were from a financial point of view, in no wise abated the courage of the promoters. During the heaviest weather the *Great Eastern* had shown exceptional "stiffness"; whilst her great size and manœuvring power (afforded by the screw and paddles combined) seemed to show her to be the very type of vessel for the kind of work in hand. The newly-designed picking-up gear, it was true, had proved insufficient; but with the paying-out machinery no serious fault was to be found.

[1] Later Sir William Howard Russell, LL.D.

The feasibility of grappling in mid-Atlantic had been demonstrated, and they had gone far towards proving the possibility of recovering the cable from similar depths.

The Atlantic Telegraph Company was amalgamated with a new concern, the Anglo-American Telegraph Company, which was formed, mainly by those interested in the older business, with the object of raising fresh capital for the new and double ventures of 1866. The ultimate capital of this Company amounted (as before) to £600,000. In raising this, Mr. Field first secured the support of Mr. (afterwards Sir Daniel) Gooch, M.P., chairman of the Great Western Railway Company, who promised, if necessary, to subscribe as much as £20,000. On the same conditions, Mr. Brassey expressed his willingness to bear one-tenth of the total cost of the undertaking. Ultimately, the Telegraph Construction Company led off with £100,000, this amount being followed by the signatures of ten directors interested in the contract (as guarantors) at £10,000 apiece. Then there were four subscriptions of £5,000, and some of £2,500 to £1,000, principally from firms participating in one shape or another in the sub-contracts. These sums were all subscribed before even the prospectus was issued, or the books opened to the public. The remaining capital soon followed. The Telegraph Construction Company, in undertaking the entire work as contractors, were to receive £500,000 for the new cable in any case ; and if it succeeded, an extra £100,000. If both cables came into effective operation, the total amount payable to them was to be £737,140.

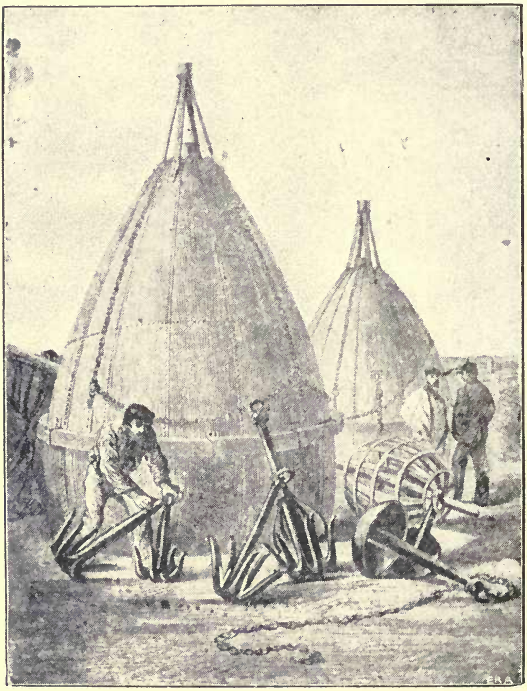
It was now proposed not only to lay a new cable between Ireland and Newfoundland, but also to repair and complete the one lying at the bottom of the sea. A length of 1,600 miles of cable was ordered from the contractors. Thus, with the unexpended cable from the last expedition, the total length available when the expedition started would be 2,730 miles, of which 1,960 miles were allotted to the new cable, and 697 to complete the old one, leaving 113 miles as a reserve. The new main cable was similar to that of the year before. The shore-end type determined on



HEAVY SHORE-END CABLE

in this case was of a different description. It had only one sheathing, consisting of twelve contiguous iron wires of great individual surface and weight ; and outside all a covering of tarred hemp and compound. The part of this cable which was intended for shallow depths was made—in accordance with Bright's recommendation—in three different types. Starting from the coast of Ireland, eight miles of the heaviest was to be laid, then eight miles of the intermediate, and lastly fourteen miles of the lightest type, making thirty miles of shoal-water cable on the Irish side. Five miles of shallow-water cable of the different types named were considered sufficient on the Newfoundland coast.

For the purpose of grappling the 1865 cable, twenty miles of rope were manufactured, which was constituted of forty-



BUOYS, GRAPNELS, MUSHROOMS—AND MEN

nine iron wires, separately covered with manilla hemp. Six wires so served were laid up strand-wise round a seventh, which formed the heart, or core, of the rope. This rope would stand a longitudinal stress of thirty tons before breaking. In addition, five miles of buoy rope were provided, besides buoys of different shapes and sizes, the largest of which would support a weight of twenty tons. As on the previous expedition, several kinds of grapnels were put on board—some of the ordinary sort, and some with springs to prevent the cable surging and thus escaping whilst the grapnel was still dragging on the bottom: others, again, were fashioned like pincers, to hold (or jam) the cable when raised to a required height, or else to cut it only, and so take off a large proportion of the strain previous to picking up.[1]

The testing arrangements had been perfected by Mr. Willoughby Smith in such a way that insulation readings could be continuously observed, even whilst measuring the copper resistance, or while exchanging signals with Valentia. Thus there was no longer any danger of a fault being paid overboard without instant detection. On this occasion, also, condensers were applied to the receiving end of the cable, having the effect of very materially increasing the working speed.

On June 30th, 1866, the *Great Eastern*—steaming from the Thames, followed by the *Medway* and *Albany*—arrived at Valentia, where H.M.S. *Terrible* and *Racoon* were found, under orders to accompany the expedition. The *Medway* had on board forty-five miles of deep-sea cable in addition to the American shore-end.

The principal members of the staff acting on behalf of the contractors in this expedition were the same as in that of the previous year: Mr. Canning was again in charge, with Mr. Clifford and Mr. Temple as his chief assistants. In the electrical department, however, the Telegraph Construction

[1] *Submarine Telegraphs.*

Company had since secured the services of Mr. Willoughby Smith as their chief electrician, whilst he still acted in that capacity at the Wharf Road Gutta-Percha Works. Mr. Smith, therefore, accompanied the expedition as chief electrician to the contractors. Captain James Anderson and Staff-Commander H. A. Moriarty, R.N., were once more to be seen on board the great ship, the former as her captain, and the latter as navigating officer. Professor Thomson was aboard as consulting electrical adviser to the Atlantic Telegraph Company,[1] whilst Mr. C. F. Varley was ashore at Valentia as their electrician. Sir Charles Bright was at this period serving on certain committees of the House of Commons, as alluded to further on; but his partner, Mr. Latimer Clark, took up his quarters on board to personally represent the firm of Bright and Clark as consulting engineers to the Anglo-American Telegraph Company, Mr. J. C. Laws and Mr. Richard Collett being respectively at the Valentia and Newfoundland ends representing the same firm. Mr. Glass, the managing director of the Telegraph Construction Company, was ashore at Valentia for the purpose of giving any instructions to his (the contractor's) staff on the ship, whilst Mr. Gooch and Mr. Field were on board the *Great Eastern* as onlookers and watchers of their individual interests.

On July 7th the *William Cory*—commonly known as the *Dirty Billy*—landed the shore end in Foilhommerum Bay, and afterwards laid out twenty-seven miles of the intermediate cable. On the 13th, the *Great Eastern* took the end

[1] Though financially wrapped up with the new "Anglo" Company, the "Atlantic" continued in existence till as late as 1874.

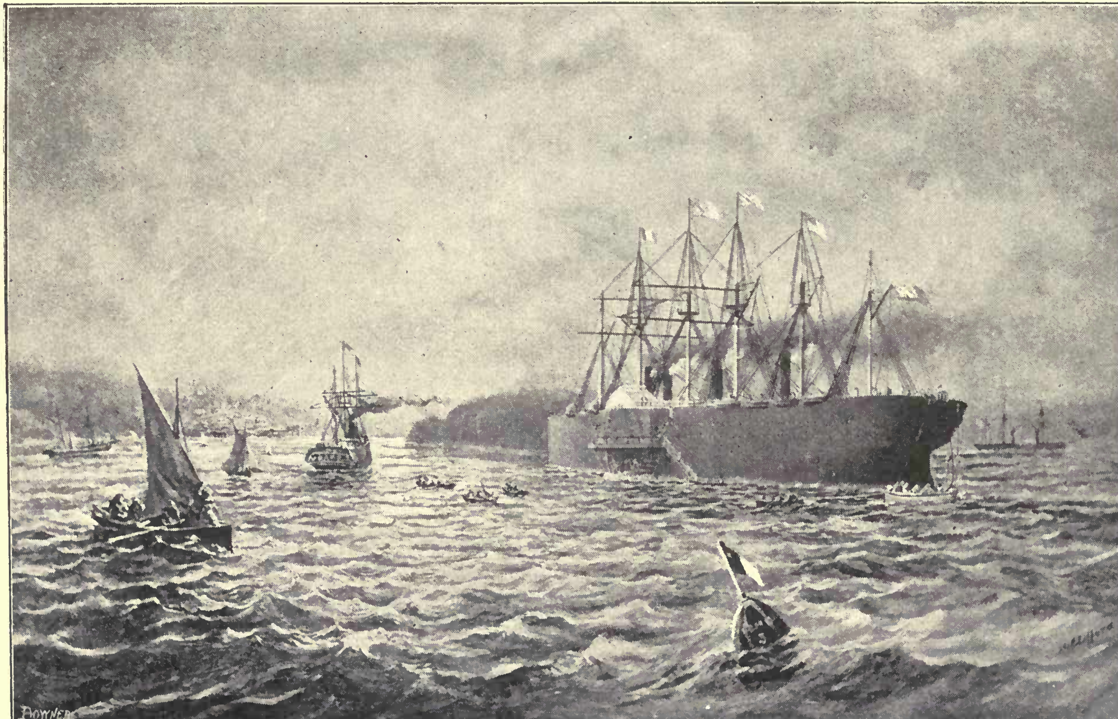
on board, and, having spliced on to her cable aboard, started paying out. The track followed was parallel to that of the year before, but about twenty-seven miles further north. There were two instances of fouls in the tank. These were both due to broken wires catching neighbouring turns and flakes, and thus drawing up a whole bundle of cable in an apparently inextricable mass of kinks quite close to the brake drum. In each case the ship was promptly got to a standstill, and all hands set to unravelling the tangle. With a certain amount of luck, neither accident ended fatally; and, after straightening out the wire as far as possible, paying out was resumed. Fourteen days after starting, the *Great Eastern* arrived off Heart's Content, Trinity Bay, where the *Medway* joined on and landed the shore-end, thus bringing to a successful conclusion this part of the expedition. The total length of cable laid was 1,852 nautical miles, average depth 1,400 fathoms. After much rejoicing[1] during the coaling of the *Great Eastern*, the Telegraph Fleet once more put to sea, on August 9th.

Recovery and Completion of 1865 *Cable.*—It now remained to find the end of the cable lost on August 2nd, 1865, situated about 604 miles from Newfoundland, to pick it up, splice

[1] These rejoicings were at first somewhat dampened by the fact that the cable between Newfoundland and Cape Breton (Nova Scotia) still remained interrupted, and that consequently the entire telegraphic system was not even now complete. However, in the course of a few days this line was repaired, and New York and the rest of the United States and Canada were put into telegraphic communication with Europe.

on to the cable remaining on board, and finish the work so unfortunately interrupted the year before. On August 12th, the *Great Eastern*, accompanied by s.s. *Medway*, arrived on the scene of action, where they joined H.M.S. *Terrible* and s.s. *Albany*, these vessels having left Heart's Content Bay a week in advance to buoy the line of the 1865 cable and commence grappling. The plan decided on was to drag for the cable near the end with all three ships at once. The cable, when raised to a certain height, was to be cut by the *Medway*, stationed to the westward of the *Great Eastern*, so as to enable the latter vessel to lift the Valentia end on board.

After repeated failures and many mishaps, the cable was hooked on August 31st by the *Great Eastern* (when the grapnel had been lowered for the thirtieth time), and picking up commenced in a complete calm. When the bight of cable was about 900 fathoms from the surface, the grappling rope was buoyed. The big ship then proceeded to grapple three miles west of the buoy, and the *Medway* another two miles, or so, west of her again. The cable was soon once more hooked by both ships, and when the *Medway* had raised her bight to within 300 fathoms of the surface she was ordered to break it. The *Great Eastern* having stopped picking up when the bight was 800 fathoms from the surface, proceeded to resume the operation as soon as the intentional rupture of the cable had eased the strain, which, with a loose end of about two miles, at once fell from 10 or 11 tons to 5 tons. Slowly but surely, and amid breathless silence, the long-lost cable made its appearance at last—for the third time—above water, a little before one o'clock (early morn) of September



S.S. *GREAT EASTERN* COMPLETING THE SECOND ATLANTIC CABLE

2nd. Two hours later the precious end was on board, and signals were exchanged with Valentia.[1]

The recovered end was spliced on to the cable on board, and the same morning the *Great Eastern* started paying out about 680 nautical miles of cable towards Newfoundland. On September 8th, when only 13 miles from the Bay of Heart's Content—just after receiving a summary of the news in *The Times* of that morning—the tests showed a fault in the line. The mischief was soon found to be on board ship; and the faulty portion having been cut out, paying out again proceeded, finishing the same day at eleven o'clock in the forenoon. The *Medway* immediately set to work laying the shore-end, and that evening a second line of communication across the Atlantic was completed. The total length of this cable, commenced in 1865, was 1,896 miles; average depth, 1,900 fathoms.

The main feature and accomplishment in connection with the second and third Atlantic cables, of 1865 and 1866, was the recovery of the former in deeper water than had ever been before effected, in the open ocean; just as in the first (1858) line it was the demonstration of the fact that a cable could be successfully laid in such a depth, and worked through electrically.[2]

It should be mentioned that Professor Thomson's reflecting apparatus for testing and signalling through a long submarine line had been considerably improved since the first

[1] *Submarine Telegraphs. The Story of the Atlantic Cable.*
[2] *The Story of the Atlantic Cable.*

cable. In illustration of the degree of sensibility and perfection attained at this period in the appliances for working the line, the following experiment is of striking interest: Mr. Latimer Clark—who went to Valentia to test the cable on behalf of Messrs. Bright & Clark—had the conductor of the two lines joined together at the Newfoundland end, thus forming an unbroken length of 3,700 miles in circuit. He then placed some pure sulphuric acid in a lady's silver thimble, with a fragment of zinc weighing a grain or two. By this primitive agency he succeeded in conveying signals twice through the breadth of the Atlantic Ocean in little more than a second of time. The deflections were not of a dubious character, but full and strong, the spot of light traversing freely over a space of 12 inches or more, from which it was manifest that an even smaller battery would suffice to produce somewhat similar effects. This speaks well for the electrical components assigned to the two lines, and for the arrangements adopted in working them. It also shows the benefit derived from seven years' extra experience in manufacture, backed up by the previously-mentioned exhaustive Government inquiry thereon.

Notwithstanding the dimensions of the core, these cables were worked slowly at first—at a rate of about eight words per minute. This was, however, steadily increased as the staff became more accustomed to the apparatus up to fifteen and even seventeen words per minute, with the application of condensers.

Unfortunately both these lines broke down a few months later, and one of them again during the following year.

The faults were localised [1] with great accuracy from Heart's Content by Mr. F. Lambert, on behalf of Messrs. Bright & Clark. Unlike the 1858 line, however, these last cables had not been killed electrically; and being worthy of repairs, they were maintained for a considerable time.

On the return of the 1866 Expedition, a banquet was given to the cable layers by the Liverpool Chamber of Commerce as soon as the *Great Eastern* was once more safely moored in the Mersey.

The following account from *The Times* will be of some interest here:—

The decorations assumed an emblematic character, and were peculiarly appropriate to the event which was being celebrated. From the centre of the room there hung the grapnel by which the previous line was recovered from the bed of the ocean, a piece of the cable itself, and the grapnel chain. Then around the room were two lines of the cable supported by gilded grapnels, a profusion of sea-weed being entangled about the lines. The principal mirrors were surmounted by trophies of flags: those over the mirror at the rear of the President consisting of English and American flags, and those over the principal side mirrors being flags of all nations.

A line of telegraph was extended from the British and Irish Magnetic Telegraph Company's Office, at the Liverpool Exchange, to the banqueting room; and as a practical illustration of the working of the cable, a message was despatched to Washington, besides communications by the telegraph being read from Newfoundland.

The chair was occupied by the Right Hon. Sir Stafford

[1] The above location was performed by a method based on Charles Bright's patent of 1852, already referred to.

Northcote, Bart.,[1] President of the Board of Trade. The following were amongst the invited guests : The Right Hon. Lord Stanley, M.P., Secretary of State for Foreign Affairs ; the Right Hon. Lord Carnarvon ; the Right Rev. the Lord Bishop of Chester ; the Right Hon. W. E. Gladstone, M.P. ; Sir Charles Bright, M.P., original projector of the Atlantic Cable, and engineer to the Anglo-American Telegraph Company ; Professor W. Thomson, electrical adviser to the Atlantic Telegraph Company ; Mr. Latimer Clark, co-engineer with Sir C. Bright ; Mr. R. A. Glass, managing director to the Telegraph Construction Company (contractors) ; Mr. Samuel Canning, engineer to the contractors ; Mr. Henry Clifford, assistant engineer to the contractors ; Mr. Willoughby Smith, electrician to the contractors ; Captain James Anderson, commander of the *Great Eastern* ; Mr. William Barber, chairman of the Great Ship Company ; Mr. John Chatterton, manager of the Gutta-Percha Works ; Mr. E. B. Bright, Magnetic Telegraph Company ; Mr. T. B. Horsfall, M.P. ; and Mr. John Laird, M.P.

After proposing toasts to Her Majesty the Queen, to the President of the United States, and to the Prince of Wales, the Chairman (Sir S. Northcote) again rose amidst applause and said it was a maxim of a great Roman poet that a great work should be begun by plunging into the middle of the subject. He would therefore do so by proposing a toast to the projectors of the Atlantic Telegraph, Sir Charles Bright and Mr. Cyrus Field, Mr. J. W. Brett having since unfortunately died. When they came in after years to relate the history of this cable, they would find many who had contributed to it ; but it would be as impossible

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[1] Afterwards the first Earl of Iddesleigh, G.C.B.

to say who were the originators of the great invention as it was to say who were the first inventors of steam. He begged to couple with the toast the name of Sir Charles Bright, as, perhaps, the foremost representative from all points of view, up to the present time. (Applause.) The greatest honour is due to the indomitable perseverance and energy of Sir C. Bright that the original cable was successfully laid, though—through no fault of his—it had but a short useful existence. (Great cheering.)

Sir Charles Bright, M.P., after acknowledging the compliment paid to the "original projectors" and to himself personally, said that the idea of laying a cable across the Atlantic was the natural outcome of the success which was attained in carrying short lines under the English and Irish Channels, and was a common subject of discussion among those concerned in telegraph extension prior to the formation of the Atlantic Telegraph Company.

About ten years ago the science had sufficiently advanced to permit of the notion assuming a practical form. Soundings taken in the Atlantic between Ireland and Newfoundland proved that the bottom was soft, and that no serious currents or abrading agencies existed; for the minute and fragile shells brought up by the sounding-line were perfect and uninjured.

There only remained the proof that electricity could be successfully employed through so vast a length of conductor. Upon this point, and the best mode of working such a line, he had been experimenting for several years. He had carried on a series of investigations which resulted in establishing the fact that messages could be practically passed through an unbroken circuit of more than two thousand miles of insulated wire—a notion derided at that time by many distinguished authorities. Mr. Wildman Whitehouse—who subsequently became Electrician to the Company—had been likewise engaged. On comparing notes later, it was discovered that they had arrived at similar conclusions, though holding somewhat different views. His (Sir C. Bright's) calculations, using other instruments, led him to believe that a conductor nearly four times the size of that adopted would be desirable, with a slightly thicker insulator. It was this type which the new cables just laid had been furnished with.

In 1856, Mr. Cyrus Field—to whom the world was as much indebted for the establishment of the line as to any man—came over to England upon the completion of the telegraph between Nova Scotia and Newfoundland. He then joined with the late Mr. Brett and himself (Sir C. Bright) with a view to extending this system to Europe, and they mutually agreed to carry out the undertaking.

A meeting was first held in Liverpool, and in the course of a few days their friends had subscribed the necessary capital. So that in greeting those who had just returned from the last expedition—Mr. Canning, Mr. Clifford, Captain Anderson, and other guests of the evening—Liverpool was fitly welcoming those who had accomplished the crowning success of an enterprise to which at the outset she had so largely contributed. (Applause.)

The circumstances connected with the first cable would be in the recollection of every one ; and although the loss was considerable, the experience gained was of no small moment. A few months after the old line had ceased to work, their chairman (Sir S. Northcote) consulted him on behalf of the Government as to the best form of cable for connecting us telegraphically with Gibraltar ; and he (Sir C. Bright) did not hesitate to recommend the same type of conductor and insulator which he had before suggested for the Atlantic line. This class of conductor in the newly-laid Atlantic cable appeared likely to give every satisfaction, he was happy to say ; and the mechanical construction of the cable—also the same as that he had previously specified for the Gibraltar line—appeared to have admirably met some of the difficulties experienced in cable operations.

The credit attached to these second and third Atlantic cables must mainly rest with the Telegraph Construction Company (formerly Messrs. Glass, Elliot & Co.) and their staff, inasmuch as in this case the responsibility rested with them throughout. The directors—including Mr. Glass, Mr. Elliot, Mr. Gooch, Mr.

Pender, Mr. Barclay, and Mr. Brassey—deserved the reward which they and the shareholders would no doubt reap.

To Mr. Glass—upon whom the principal responsibility of the manufacture devolved—the greatest praise was due, for his indomitable perseverance in the enterprise. Then the art of insulating the conducting wire had been wonderfully improved by Mr. Chatterton and Mr. Willoughby Smith, so that, nowadays, a very feeble electrical current was sufficient to work the longest circuits—an enormous advance on the state of affairs nine years previously.

Again, they must not forget how much of the success now attained was due to Professor Thomson and his delicate signalling apparatus, the advantages of which have, since 1858, been more firmly established. Mr. Varley had also done much useful work since becoming electrician to the "Atlantic" Company. Moreover, he (Sir C. Bright) hoped the active services of his partner, Mr. Latimer Clark, would not be lost sight of.

It was satisfactory to find that the cables were already being worked at a profit. This would doubtless be quadrupled within a short period, when the land lines on the American side were improved. (Hear, hear, and applause.)

With this commercial success—combined with the improvements introduced into submarine cables, and the power of picking up and repairing them from vast depths—there was a future for submarine telegraphy to which scarcely any bounds could be assigned. A certain amount had already been done; but China and Japan, Australia and New Zealand, South America and the West India Islands, must all be placed within speaking distance of England. When this has been accomplished—but not till then—telegraphic engineers might take a short rest from their labours and ask with some little pride—

Quæ regio in terris nostri non plena laboris?

(Loud Applause.)

Then followed speeches from Lord Stanley, the American Consul (on behalf of Mr. Cyrus Field) and others.

Honours were subsequently bestowed on some of the various gentlemen immediately concerned in these ultimately successful undertakings of 1865 and 1866.

As a natural sequence other Atlantic cables followed—first of all in 1869 that hailing from France—until now the North Atlantic ocean alone is spanned by as many as sixteen in working order.[1] Sir Charles Bright acted in a consulting capacity—where not actually as engineer—to practically all of those of a pioneer order which came within his lifetime.

[1] *Submarine Telegraphs. The Story of the Atlantic Cable.*

CHAPTER VI

The Mediterranean Cables

SHORTLY after the laying of the 1858 Atlantic Cable, the attention of Government had been directed to the importance of establishing direct lines of telegraphic communication between Great Britain and her dependencies.

Gibraltar was the first point considered and decided upon. Thus, in the House of Commons on July 28th, 1859, Sir W. Gallwey asked the Secretary of the Admiralty "what experiments were being made before risking the sum voted for the Gibraltar Cable." Lord Clarence Paget replied that "Experiments were in progress on behalf of the Board of Trade, by those eminent engineers, Sir Charles Bright and Mr. Robert Stephenson, with a view to testing the composition of the outer coverings of telegraphic cables."[1]

In conjunction with Mr. Stephenson, Charles Bright drew up a report on the subject. Bright was also independently consulted regarding the proposed line by the late Right Hon. Sir Stafford Northcote, Bart., M.P.,[2] as President of the Board of Trade. Eventually, at the request of Sir S.

[1] *The Times*, July 29th, 1859.

[2] Afterwards the first Earl of Iddesleigh, G.C.B.

Northcote, Bright sent in a detailed report, estimate, and specification to the Treasury.[1] The conductor and insulator recommended by Sir Charles were the same as he had ineffectively suggested for the First Atlantic Cable—and were both of much greater dimensions than anything previously done, consisting, in fact, of nearly 400 lb. copper per mile to the same weight of gutta-percha covering.

This core was forthwith ordered by Government, and manufactured at the Wharf Road Gutta-Percha Works, in accordance with Bright's specification. The outer covering ultimately decided on by Sir Charles was exactly the same as was afterwards adopted for the second and third Atlantic lines of 1865 and 1866—a combination of iron and hemp—with a view to meeting the exigencies of cable operations in deep water. The cable was constructed at Messrs. Glass, Elliot & Co.'s factory towards the end of 1859.

Subsequently, the Government decided to use the above to connect Rangoon with Singapore for the purposes of a more rapid communication with China. The war with that country having, however, come to an end before the cable was completed, the necessity for this line was lessened. Thus, its destination was changed a third time; and it finally came into use as a link with Egypt—one of the stages on the road to India. The cable was laid in three shallow water sections, i.e., Malta-Tripoli, Tripoli-Benghazi, and Benghazi-Alexandria. Perhaps the most remarkable

[1] For correspondence and Report see *Parliamentary Blue Book* respecting "The Establishment of Telegraphic Communication in the Mediterranean, and with India," 1859; also Appendix 2 of Vol. II, of the original biography.

feature in regard to this line is the fact that laying operations were always suspended at nightfall.[1] Notwithstanding the dimensions of the core provided, it could not be worked at a higher speed than three words per minute, on account of the instrument adopted—i.e., the Morse Recorder.

As we shall see later, these cables were subsequently replaced in 1868 by a direct line from Malta to Alexandria, when Sir Charles acted both as engineer and electrician.

The Balearic Islands connected with Spain

We must now go back in our narrative, as the undertaking we are about to describe was carried through a year previous to that just referred to.

For a number of years, from 1855, the deep waters of the Mediterranean had proved a sort of *bête noire* to cable layers. In 1860, however, Sir Charles Bright broke the spell for a time, by successfully laying an important series of cables for the Spanish Government—viz., between Barcelona and Port Mahon, Minorca, 180 miles; Minorca to Majorca, 35 miles; Majorca to Iviça, 74 miles; and Iviça to San Antonio, Spain, 76 miles—in all 365 nautical miles. These cables were submerged in great depths, that between Barcelona and Port Mahon being 1,400 fathoms deep. They were manufactured by Mr. W. T. Henley. The sections between the three islands contained two conductors, each protected by eighteen outer wires, and weighed 1 ton 18 cwt. to the nautical mile; and the two to the mainland were single

[1] This was, it is believed, on the score of difficult navigation.

wire cables, cased with sixteen wires, weighing a ton and a quarter per nautical mile.

Sir Charles fitted out a vessel—the s.s. *Stella*—for laying these lines. The work was carried out with great expedition. On August 29th, 1860, Bright laid the Minorca to Majorca section, completing the shore end and connections next day. The 31st saw the shore end and connections made at the opposite end of the island; and the following day the cable was laid between Majorca and Iviça, the landing portion being carried out on September 2nd. Rough weather delayed operation for two days; but on the 5th Iviça island was put into telegraphic communication with the Spanish mainland at Javea Bay, alongside Cape Antonio.

The remaining section to be laid was that between Barcelona and Minorca—a distance of about 100 miles. Sir Charles mentions in his diary, relating to the laying of this last length: "Weather very bad, and ship pitching and rolling much."

After laying the shore end at Javea Bay, and making the connections with the Spanish land lines, he went on to Barcelona to complete the longest section—180 miles—thence to Port Mahon, Minorca; but here he met with considerable delay, first by a fault a long way down the main coil, which "rendered it necessary for the cable to be turned over into the after hold to get down to the defect—hands to work day and night."[1] Then, on September 15th, when ready to start, there came a message from

[1] From Sir C. Bright's diary.

the Spanish Government, from Madrid, to "detain the *Stella* until the arrival of Señor d'Oksza," the Director of Telegraphs. This gentleman was of Polish origin, his full name being Count Thaddeus Orzechowski, which he had thoughtfully abbreviated for business purposes.[1]

After waiting till September 17th, it began blowing heavily till the 21st, when Bright's diary states :—

6 a.m., steam up, ready to leave, but it appears the *Bonaventura* (Spanish gunboat to accompany the *Stella*) was not informed yesterday, and cannot leave this morning. Weather fine.

Saturday, September 22nd.—5 a.m., steam up, but delayed in lifting anchor by the chain of a brig fouling ours. 6.45, steaming out of harbour. 10 o'clock, all ready for starting, but *no current through cable*! Found that Spaniards had *cut* the cable and *led it up a pole on shore*! 11.55 a.m., started paying out.

At 1.55 next morning, when in 1,300 fathoms, Sir Charles enters :—

Drum stopped; brakesman asleep; found Suter doing Bank's work, having been up all the time himself in the hold. Luckily it was seen to in time.

The latter part of the line was laid in a heavy sea, and there were several troubles from broken outer wires; but the laying to Port Mahon was successfully finished at night.

These cables worked well for many years.

[1] Some twenty years later Sir Charles was again associated with Count d'Oksza in connection with cables from Spain to the Canary Isles, as will be seen in subsequent pages.

CHAPTER VII

1860-1863

Proposed Permanent Exhibition in Paris

DURING the early part of 1860, Bright was actively engaged on a project brought to him by some leading Frenchmen, headed by Prince Napoleon, with a view to establishing a permanent universal exhibition in the building erected in the Champs Elysées for the recent exhibition. Although a large amount of space was applied for by important English, French, and German firms, it was not enough to make it a success, or justify the promoters—or Sir Charles—in carrying out the scheme.

At the beginning of 1860—as well as previously—Charles Bright's time was largely taken up in furthering telegraphic extensions to Hanover, Denmark, the Channel Islands, and Normandy, on behalf of the "Magnetic" and "Submarine" Telegraph Companies, who had a mutual working arrangement. The first of these cables started from the coast of Norfolk, and Sir Charles erected a special land line from Cromer to connect it with London. At that time there was a great deal of prejudice against overhead wires, from an artistic standpoint. Thus, every effort was made to render the work as sightly as possible. The poles were furnished with handsome finials, and were painted green, so as to be pleasant to the country eye, with a few feet of white at the bottom to warn vehicles by night. But still these posts did not meet with the approbation that was desired from suburban villa residents; and the song of the wires appears to have acted as an irritant rather than otherwise! The rustics—who, like most of our country folk, had an innate dislike to anything novel—seem to have supposed this humming to be occasioned by the passage of the messages!! On one occasion, when Sir Charles was inspecting part of the new work near Norwich, he noticed that the "ganger" —a powerful man who rejoiced in the *sobriquet* "Hulks" —had one side of his head much bruised. "Hulks" explained that on putting up a pole opposite a villa, "the old gent came out of his front garden with a spade and caught me a clop on the head with it, so I just twisted his collar till his tongue came out, and then we was quite friendly-like!"

The cable from Cromer to Hanover was 280 miles in length. It contained two conductors, and weighed three tons to the mile. The line to Heligoland and Denmark was 350 miles long, with three conductors, and was four tons per mile in weight. The "Magnetic" Company subscribed a considerable amount of the capital for these lines, on account of the large accession of traffic brought on their land wires in connection with the North of Europe.

Many have been identified by some peculiar characteristic or other; but it is doubtful whether any one has ever been traced on a journey by his love of pickles, except Sir Charles—for whom they possessed a special attraction through life. Sir Charles had arranged to accompany the above Anglo-Continental Cable Expeditions in the "Magnetic" Company's interests, and was going down from town with Mr. Henry Clifford, who, with Mr. (afterwards Sir Samuel) Canning, ultimately laid the cables on behalf of Messrs. Glass, Elliot and Co. Somehow they missed one another, and Clifford arrived alone at Norwich. He made inquiries at the principal inn whether Sir Charles had arrived. Whereupon an obtuse, old-fashioned waiter said there had been some gentlemen, but they didn't leave their names. When cross-questioned as to their appearance, he said he thought several were tall, and perhaps fair. Failing information, Mr. Clifford sat down to cold beef. On asking for the mixed pickles, the ancient waiter replied: "Well, a party, what lunched here just now, finished the bottle, but I'll send out for some more."

"Oh, indeed; was *he* tall and fair?"

"Yes, sir; and he drove away to Cromer."

"All right," said Clifford to himself, "Sir Charles has gone on"; and so it was.

In November of the same year (1860) Mr. (now Sir) W. H. Preece read a paper before the Institution of Civil Engineers, on "The Maintenance and Durability of Submarine Cables in Shallow Water." One of the main purports of this paper was to point out the supreme importance of thoroughly surveying the bottom along the route proposed for a cable. Though the suggestion was somewhat scornfully received, the same point had been dwelt on by Sir Charles Bright in his evidence before the Government Committee on the Construction of Submarine Cables, a year previously.[1]

Bright argued that :—

> An extremely close search should be made before telegraphic cables were lowered into unknown depths and laid across submarine hills, gorges, and valleys, the irregularity of whose forms as existing between the points hitherto sounded, might prove to be enormous.

He further asserted that :—

> A full and proper submarine search was almost as essential a preliminary to a rational scheme of laying down a telegraphic cable, as a survey of the outlines of land was for an engineer before he could accurately define the best and safest route to be followed by a railroad.

The result of Mr. Preece's contentions and of Charles Bright's statements[2] is that, nowadays, cables are designed to suit every depth and every bottom ; moreover, the operation of laying a cable in a permanent manner has become a comparatively simple affair.[3]

Another feature of Mr. Preece's paper was a review of the relative merits of light and heavy sheathed cables. Bright

[1] See *Blue-Book.*

[2] Mr. Preece's remarks were directed in particular to the rocky bottoms of shallow water, whilst Sir Charles' had reference to the precipices which deep water undertakings have to cope with.

[3] This, however, was not destined to be so, as regards great depths, for some years ; for it was not till 1872 that the Thomson steel wire sounding apparatus was introduced, thereby rendering a close and accurate deep-sea survey practicable where it was not before.

spoke strongly against a slight armour for rough bottoms or where the cable is liable to disturbances, from one cause or another, in shallow depths. He also argued against the various proposals for a cable without any iron sheathing for deep waters. His contention was that though such a cable might be readily picked up when new, it would soon fail to have sufficient strength for the purpose.[1]

In the early part of 1861 Sir Charles and his family moved to a town house, 12, Upper Hyde Park Gardens—afterwards forming a part of Lancaster Gate.

Retirement from Engineership to the Magnetic Telegraph Company

About this time it became clear to Charles Bright that a large professional business was open to him in connection with the various submarine telegraphs then in contemplation, and that in a consulting capacity he could turn time to a more profitable account than he could possibly do as the active Engineer-in-Chief to the British and Irish Magnetic Telegraph Company, the network of whose lines was now fairly complete. Accordingly, he relinquished the latter post, and became Consulting Engineer instead.[2] A banquet was given in his honour by the directors and executive staff of the Company. This formed an occasion for the presentation of some handsome plate,

[1] A full report of Sir Charles's remarks on this occasion were embodied in Appendix 4 of Vol. II. of the original biography.

[2] This position he held up to the time of the acquisition of the telegraphs of the United Kingdom by the State in 1870.

in addition to an illuminated testimonial, similar to one he had previously received from the Atlantic Company.

Before quitting the subject of Bright's association with the "Magnetic" Company, it is thought that a few further reminiscences may be of interest here. When his Atlantic Cable work was complete, Sir Charles resumed engineering charge of the Magnetic system. Soon afterwards he was confronted with a serious trouble in connection with their main underground lines, stretching from Dover to London, and thence to Birmingham, Manchester and Liverpool, with extensions to Scotland and Ireland. As already described, they were laid in 1851 and 1852, and although carefully protected in troughs and covered with tarred yarn, their insulation was rapidly deteriorating by the gutta-percha becoming desiccated. This was found to occur in a more striking manner wherever laid past oak plantations, from some chemical action of the roots upon the ground. Fortunately, by the amalgamation with the "British," the Company was possessed of the former's Act of 1850, which provided powers to erect post lines along the highways. None of the other companies had been able to obtain this privilege, and it was said that the clause, when passed by the Committee and the House, was supposed by them to refer to "testing posts!" However, it proved the salvation of the Magnetic Company; for the price of gutta-percha had about doubled in the interval, and they could not have afforded to lay new underground wires. As it was, there was the difficulty of turning the old gutta-percha wires to sufficient account to pay for the new overhead system.

This was the problem that Sir Charles had to solve. He approached the Gutta-Percha Company, who had originally supplied the many thousand miles of gutta-percha-covered wire to the Company, and who at this time had nearly a monopoly of the business; but their able and astute manager, Mr. Samuel Statham, would make no bid for the old wire that at all satisfied the requirements. So Sir Charles set to work to strip the gutta-percha from the copper conductors, and by warming it up to convert it into saleable lumps for ordinary manufacture; for though much of its insulating power was lost, it was still quite good for a number of trade purposes. He first tried having the material sliced off; but this proved tedious and expensive. He then had the wires drawn through the rollers used for making steels for the crinoline, at that time in fashion with ladies. The rollers were set to the exact diameter of the copper wire, and the gutta-percha being compressed fell off on each side as it passed through. It was then made up into lumps and sold. In this way it realised more than double the price originally offered by Mr. Statham, who therefore, not wanting competition in the gutta-percha market, bought the whole lot! Thus the Magnetic Company were enabled to reconstruct their lines out of the amount secured for the old wires. Substituting the one system for the other naturally involved much consideration and care. The most defective sections had to be completed first, and the change made to the new wires bit by bit. But this arduous undertaking was so carefully arranged by Sir Charles and his able assistants, that no interruption occurred to the heavy business of the Company throughout the kingdom.

Partnership with Mr. Latimer Clark

A little later Charles Bright joined in partnership with Mr. Latimer Clark, M.Inst.C.E., a gentleman of great experience and high repute in telegraph work. He had been for several years the engineer of the Electric and International Telegraph Company. There was something singularly appropriate in this union of the engineers of the two largest telegraphic companies in existence, both individuals possessing, moreover, great inventive ingenuity. Sir Charles Bright and Mr. Clark had both favoured heavy cables for shallow water in contrast to other engineers, who had employed light cables in small depths.

As consulting engineers, the firm of Bright & Clark became at once associated with nearly all the big submarine cable undertakings that followed.

The Formulation of Electrical Standards and Units

In this same year (1861) an important paper[1] was con-

[1] The object of this paper was to point out the desirability of establishing a set of standards of electrical measurement, and to ask the aid and authority of the British Association in introducing such standards into practical use. Four standards or units were considered necessary:—

(1) The unit of electro-motive force, or tension, or potential.

(2) The unit of absolute electrical quantity, or of static electricity.

(3) The unit of electrical current, which should be formed by the combination of the unit of quantity with time. Such, for example, as the flow of a unit of electricity per second.

(4) The unit of electrical resistance, which should be the same unit as that of current:—viz., a wire which would conduct a unit of electricity in a second of time.

The necessity of the adoption of some nomenclature was also pointed out, "in order to adapt the system to the wants of practical telegraphists." See B.A. Report of Manchester Meeting, 1861.

tributed by Sir Charles Bright and his partner, on electrical standards, units, and measurements, to the British Association for the Advancement of Science. This formed the sequel to a letter addressed by Bright to Prof. J. Clerk Maxwell, F.R.S., some months previously, on the whole question of electrical standards and units. Upon the paper above alluded to being read, Professor William Thomson[1] obtained the appointment of a committee with the object of determining a rational system of electrical units, and to construct an equivalent standard of measurement. The members were: Professors Williamson, Wheatstone, Thomson, Miller, Clerk Maxwell, Dr. Matthiessen and Mr. Fleeming Jenkin. These were joined by Sir Charles Bright, Dr. J. P. Joule, Dr. Esselbach, Messrs. Balfour Stewart and C. W. Siemens. Later on Prof. G. C. Foster, Messrs. D. Forbes, C. F. Varley, Latimer Clark and Charles Hockin were added to the strength of the committee.[2]

The first of the British Association reports of 1862 may be said to have been the signal for a great advance in the

[1] Referring to this paper some years later, Lord Kelvin (then Sir William Thomson) said: "I may mention that a paper was communicated to the British Association in 1861 by Sir Charles Bright and Mr. Latimer Clark, in which the names that we now have, with some slight differences, were suggested; moreover, a complete continuous system of measurement was proposed, which fulfilled most of the conditions of the absolute system in an exceedingly useful manner. To Sir Charles Bright and Mr. Latimer Clark, therefore, is due the whole system of nomenclature in electrical units and standards; we are consequently very greatly indebted to them in the matter." (See "Thomson on Electrical Units of Measurement," *Proc. Inst. C.E.*, 1883.)

[2] See *Reports of Electrical Standards*, edited by Fleeming Jenkin, F.R.S.

methods of testing submarine lines electrically. The work of the committee lasted eight years, and was not entirely finished until the close of the year 1869. As the result of its labours, we have the system of electro-magnetic absolute units from which are derived the ohm, ampère, farad, volt, and coulomb, being a system of nomenclature suggested by Sir C. Bright and Mr. Latimer Clark in their paper of 1861.[1] This system was confirmed by an International Congress, in 1881, at which every civilised nation was represented. The creation of these standards has substituted perfectly definite and identical quantities for the many arbitrary units formerly in general use among electricians, has introduced precise definitions in all questions of electrical measurements, and has, indeed, rendered immense service, both to the electrical industry and to science generally.

During the year 1861, Sir Charles and Mr. Clark were largely engaged upon experiments on gutta-percha-covered wire, mainly with a view to determining the influence which temperature had upon the insulating value of the gum. An exhaustive series of tests was carried out, and a comprehensive table of definite and reliable results compiled therefrom. These were supplemented by a curve and table of co-efficients, which are given in Bright's paper on " The

[1] In introducing the above nomenclature for electrical standards and units, Sir Charles and his partner enshrined the names and memories of some of our greatest and earliest electrical *savants* in the every-day words employed by electricians throughout the world in such a way as to honour them in perpetuity. It now remains for the revered name Kelvin to be turned to similar account.

Telegraph to India,"[1] reproduced in the Appendices to Vol. II of the original biography. In these experiments the wire was subjected to water at temperatures varying from freezing point to over 100° Fah. The results obtained gave a law, which forms the basis of present-day practice, for arriving at the electrical resistance independent of temperature influence. This law pointed to an enormous increase in value on a cable being submerged in the cold water (a few degrees above freezing point), at the depths of the ocean.

Corresponding investigations were made subsequently regarding the effect of pressure on the insulation in order to arrive at the difference after submergence at the bottom of the sea; and here again a satisfactory formula was attained. A similar improvement was revealed, where cables are laid at great depths, and also where time has a maturing effect upon the insulation.[2]

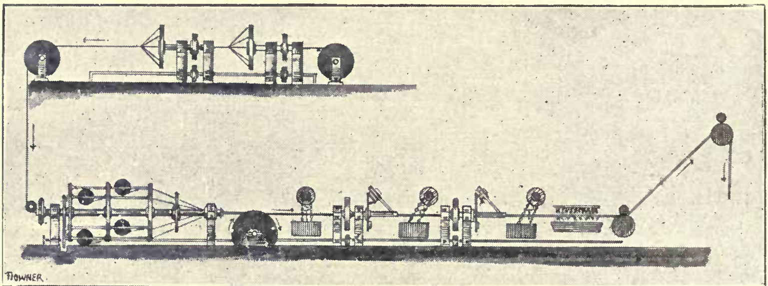
In 1862, Sir Charles Bright took out patents in connection with the outer coverings of submarine cables. By this invention two layers of hemp or other yarn are wound round the sheathing wires in opposite directions, each layer being saturated with a preservative adhesive compound of bitumen and tar. It was thought that the layers of yarn and bituminous composition so applied would effectually check

[1] "The Telegraph to India, and its Extensions to Australasia and China," by Sir Charles Tilston Bright, M.P., M.Inst.C.E. *Minutes Proc. Inst. C.E.*, vol. xxv. (1865).

[2] For further particulars, see a paper on "The Physical and Electrical Effect of Pressure and Temperature on a Submarine Cable Core," by Charles Bright, F.R.S.E., M.I.E.E. *Journal Inst. E.E.*, vol. xvii.

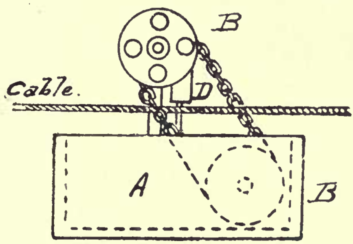
the oxidation of the iron wires—by acting as a more or less waterproof, and even air-tight, casing; and so it proved. It was soon found that such an outer cover also behaved as an excellent binder for the sheathing wires, and in holding them in place avoided the trouble caused by broken wires getting adrift.

Previously, in 1858, Mr. Latimer Clark, Mr. Frederick Braithwaite, and Mr. George Preece had collaborated in a patent—of which Mr. Clark was the main author—for a covering of hemp and asphalte for retarding the decay of



THE CABLE-COVERING APPARATUS

the zinc coating the iron wires. The cable itself was drawn through hot asphalte heated up by charcoal fires. This plan was tried on a short cable to the Isle of Man in 1859. It, however, gave a good deal of trouble during manufacture, the insulation becoming seriously damaged by the process: as a result no further use was made of that particular method of protection. On the other hand, Sir Charles Bright's system generally commended itself. It was at once adopted in the construction of the Pembroke and Wexford (Irish) cable, and has been in universal use ever since. Though, after an extensive series of experiments, Bright arrived at an improved composition, the main feature in his device was the method of application. Here, instead of the cable passing through the hot compound, the latter, whilst yet plastic, is poured over it in streams by an elevator from a tank. Furthermore, inasmuch as this process is performed simultaneously with the laying on of the hemp, or jute, yarns—by having the shaft of the compound apparatus geared to the rest of the cable machine—the delay of the double manufacture is saved. Moreover, by Bright's device, in the event of a stoppage the supply of compound



A is a steam-jacketted tank, with molten, bituminous compound; *B B*, the elevator—usually an endless chain worked with pulleys—dipping into the tank. The cable passes under the chain, from which the compound drops, by gravity, in a continuous stream, into the inclined chute *D*, and so on to the cable.

to the outside of the cable is immediately and automatically arrested, thereby avoiding damage to the insulation—as in the case of the hot compound continuing to flow over the cable. A part of Sir Charles' method consisted in the cable being finally—at one and the same operation—drawn between semi-circular rollers under a stream of cold water. By this, the coating is thoroughly pressed into all the interstices of the yarns and wires, rendering the outside surface hard, even, and smooth—thereby reducing the co-efficient of friction during cable-laying or recovery operations. The success attending this process—subsequently included in every submarine cable specification—was so great that up to the time of the expiry of Bright's patent it had yielded nearly £30,000 to Sir Charles and his partner.

The same patent also included an improved apparatus for curbing the currents sent into a cable for signalling purposes. This was an arrangement whereby the superabundant (remaining) part of each charge communicated to the line was to be neutralised, thereby overcoming the effect of inductive retardation to the signal following after—in fact clearing the line so as to increase the working speed of the cable.

CHAPTER VIII

The Telegraph to India

SECTION I

Retrospect and Preparations

IN 1862 Sir Charles Bright was called upon by Government to carry out another important achievement of his life—the first successful and permanent telegraph to India, and the pioneer cable, electrically speaking.

Let us take a glance at the situation at the moment. In the first place it was considered that the Governments of England and India should be brought into the speediest possible method of communication. It was, indeed, thought that in this era of the telegraph the countries could not any longer be allowed to be separated by thirty days of postal service, when, by the agency of the wires, but a few hours need divide them. The imperative necessity for electric communication between this country and the greatest of her dependencies had actually been felt for years, not only by Government—on political grounds—but by the great mercantile community whose enormous business was dependent upon our Eastern possessions. So urgently was this desired—and, after the Mutiny, so essential was the telegraph deemed to be for the preservation of our position—that in 1858 the Red Sea and India Telegraph Company had been formed (with a guarantee from Government on a capital of £800,000) to lay a line from Suez down the Red Sea to Aden, and thence to Karachi, with intermediate stations at Kassiri, Suakin, Hillainich and Muscat.

Messrs. R. S. Newall & Co. were the contractors for the construction and laying of this line, Messrs. Gisborne & Forde the engineers, and Messrs. Siemens & Halske the electricians. Though for a very different depth and bottom, the type of cable adopted was somewhat similar to that of the first Atlantic line. The route was not sufficiently surveyed by soundings, and the cable was too slightly made for the purpose. It was once spoken of as being "like running a donkey for the Leger!" Being laid taut, and here and there across reefs, although messages were transmitted through each separate section they broke down in a few days, and were never worked together in one continuous length as originally intended.[1]

A new Company was formed in 1862 for restoring communication and working the lines of the "Red Sea" Company. This was called the Telegraph to India Company, to which Sir Charles acted as technical adviser; and his report on the subject is given in Appendix 6 of Vol. II of the original biography.

Though the cables broke down, the land line from Alex-

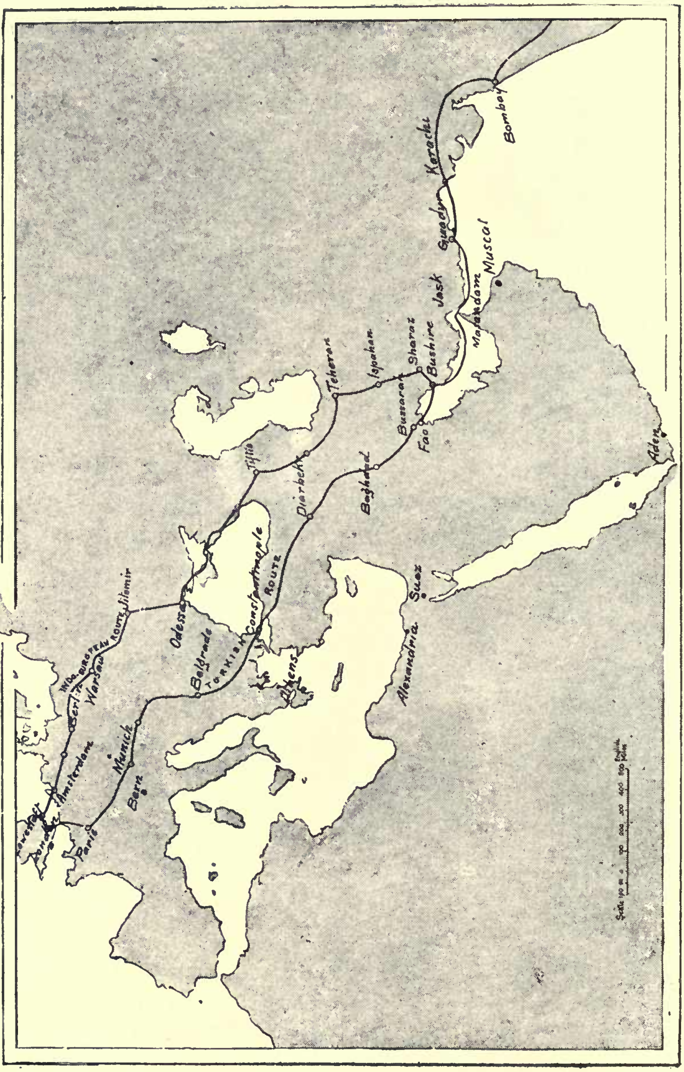
[1] For further particulars of this cable, see *Submarine Telegraphs*; also *Old Cable Stories Retold*, by F. C. Webb, M.Inst.C.E., *The Electrician*.

andria to Suez was worked by the Telegraph to India Company for a number of years. Subsequently, however, it was transferred, with the Egyptian concessions, to the British Indian Submarine Telegraph Company, on the latter's formation in 1870. The Telegraph to India Company was then voluntarily wound up, after paying a fairly regular dividend of 3 per cent.

Under the somewhat hasty, and perhaps careless, conditions agreed to by Government with the "Red Sea" Company, the interest on the outlay became a charge on the country (till 1908) to the extent of £36,000 per annum. This failure was naturally a heavy blow to submarine telegraph extension, and a great discouragement to the authorities. Yet the demand for the Indian Telegraph became more and more pressing. The want was no longer merely confined to commercial or political interests: it was eminently national. The Turkish Government were constructing a land line between Constantinople and Baghdad, *via* Scutari, Angora, Diarbekir, and Mosul; and an agreement was come to by Her Majesty's Government with the Sublime Porte for special wires, as well as for the extension of the telegraph overland from Baghdad to the Shat-el-Arab at the head of the Persian Gulf.

Partly at the instance of the late Sir Henry Rawlinson, K.C.B., it was at first proposed to erect a land line along the Mekran coast of the Persian Gulf; but Lieutenant-Colonel Patrick Stewart, R.E.,[1] who had been especially

[1] The "Pat Stewart" of Mutiny fame.



THE TELEGRAPH TO INDIA

despatched to Persia regarding the matter, reported against its practicability, on reaching England in the summer of 1862. Meanwhile Mr. Latimer Clark had returned after fully investigating the condition of the damaged and unworkable cable between Suez, Aden, and Karachi. Mr. Clark's investigations went to show that it was impossible to put any of the sections into working order.

In view of these authoritative reports, the Government, together with the India Council, determined upon laying a submarine cable between the mouth of the Shat-el-Arab—the river uniting the Tigris and Euphrates in their flow into the Persian Gulf—and Gwadur (or Chubar), the most westerly point to which it was then found practicable to extend the Indian land telegraphs. It was afterwards resolved—in consequence of the workmen on the Mekran land telegraph being molested by the natives—to extend the submarine cable from Gwadur to Karachi, thereby avoiding the vandalism of barbarous and then unconquered tribes. It was determined to divide the line into sections, with a station at Gwadur on the Mekran coast, another near Cape Mussendom on the Arabian coast, at the entrance to the Gulf, and a third at Bushire, on the coast of Persia.

Notwithstanding the previous careful surveys by the officers of the Indian Navy—the character, as well as the depth, of the bottom being of so much importance in regard to the permanence of a submarine cable—a special survey was made during 1862, by Lieutenant (now Captain) A. W. Stiffe, of what was then called the Bombay Marine. On the whole, the bed of the Persian Gulf was found to be quite favourable to the deposition of a cable.

The Indian Government arranged to assist the Turks in connection with the erection of the land line between Baghdad, Bussorah, and the mouth of the Shat-el-Arab, and also agreed with the Persian Government—after a survey by Major Goldsmid[1]—for the construction of an alternative land line from the Turkish frontier to Ispahan, Teheran, Shiraz, and Bushire on the Persian Gulf, where

SIR CHARLES BRIGHT
(*Age* 32)

connection would also be made with the cable. Besides these junctions a cross line was to be made to provide against interruption, linking Baghdad with Teheran *via* Khanakain.

The Government appointed Colonel Stewart as director

[1] Of the Madras Staff Corps, and afterwards Major-General Sir F. J. Goldsmid, K.C.S.I., C.B.

of this great length of line. They also appointed Messrs. Bright & Clark the engineers for the construction, electrical testing, and laying of the cable, Sir Charles Bright undertaking the personal supervision of the entire work.

Section 2

The Design, Construction, and Testing of the Persian Gulf Cable

Shortly after Colonel Stewart had come over to England, an order for the core was placed with the Gutta-Percha Company, of Wharf Road, whilst the contract for the rest of the manufacture fell to Mr. W. T. Henley, of North Woolwich.

The Persian Gulf was one of the greatest habitats of the teredo. This little "auger worm" likes, and lives on, woody matter, besides having an affection for yarns and gutta-percha. Indeed, it appears to regard the submarine cable as a sort of private larder provided for its immediate use. The outer spiral wires of a cable are sure to open out slightly under the strain of laying, leaving small crevices, of which this boring worm takes advantage. He then works his way through the yarn and gutta-percha, to the copper conductor—thus creating an electrical leak through the hole bored in the insulation of the cable. The teredo was, in fact, at that time the deterrent of telegraphs in warm climates. With a view, then, to defeating the ravages of this objectionable little creature, Sir Charles Bright added a proportion of powdered silica (made by grinding calcined flints) to the outer covering compound already referred to. This addition was found to effectually damage the boring tool of the teredo, and thus frustrate his incursions.[1]

We now come to the improvements introduced in the conductor of this line. In the earliest submarine cables the copper conductor was formed of solid wire, as in subterranean lines ; but in later years the use of a strand of seven copper wires had been introduced, it being seen that a weak spot in a single wire would interfere with the working of the line, while it was not likely that seven separate wires would develop flaws at the same point. A stranded conductor had, however, the disadvantage of presenting a greater surface for a given weight (and resistance) of copper than the solid wire ; thus the retardative efforts of induction were proportionately increased.

To obviate the latter defect, a conductor built up of segmental copper bars, with an outer embracing tube, was adopted for this cable. To quote Sir Charles' words : "The result of experiments upon this form of conductor, compared with a strand made of the same copper and of the same gauge, showed that the new device preserved equal mechanical properties, coupled with the best form for electrical requirements."[2] Less inductive retardation represented greater speed of message transmission through the conductor of the cable, thereby imbuing it with a higher earning power.

[1] For further particulars, *vide* Note on "Telegraphic Communication between England and India : its Present Condition and Future Development," by Charles Bright, F.R.S.E. M.I.E.E. (*Society of Arts Journal*, vol. xlii).

[2] *The Telegraph to India*, by Sir Charles Tilston Bright, M.P., M.Inst.C.E. (*Mins. Proc. Inst. C.E.*, vol. xxv., 1865–6).

The new segmental conductor weighed 225 lb. to the nautical mile. It gave a good deal of trouble—not to say expense—in construction [1]; for instance, even when drawn down to wire, the joints entailed were very numerous.

Special care was taken to ensure the purification of the copper used. The lowest limit of specific conductivity allowed for the copper was 76, what was then known as "pure galvano-plastic copper" being taken at 100. The mean conductivity of the whole line was thus raised to nearly 90 per cent. In many of the older submarine cables, which were laid before this point had received attention, the conductivity had come out as low as 30 and 40.

Let us now turn our attention to the insulation of the conductor. In testing this during manufacture certain novel precautions were taken. The apparatus was much more delicate than any hitherto employed for the purpose, and the testing of joints was first carried out on this occasion. The joints made in the insulating material during manufacture, and in the finished core, had always been the subject of considerable anxiety to those engaged in the supervision of submarine telegraphs, as although the loss on a single joint might be so small as hardly to affect the tests obtained upon a considerable length, yet dearly-bought experience had shown that the defect might contain within it the seeds of a serious fault hereafter.

Then, again, it was on this enterprise that condensers were employed for the first time in cable testing. These were

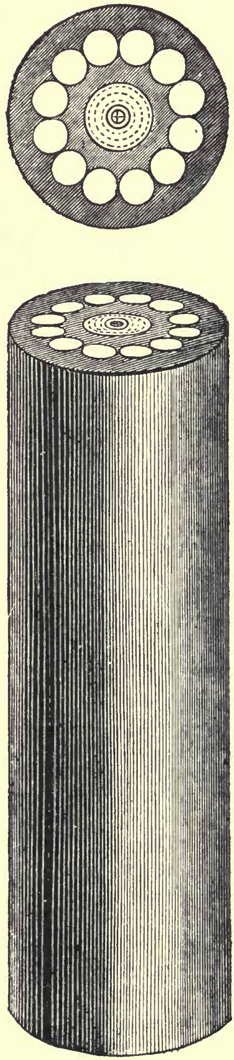
[1] The result is that we now adopt modifications of this principle for the conductors of our ocean cables—as, for example, the excellent device of the late Sir William Siemens.

formed of plates of mica, coated on each side with tinfoil, and having a standard capacity equal to that of one mile of the Persian Gulf core. These were found very permanent in practice, and most convenient for use. The measurements were taken after one minute's electrification, by observing the swing of the suspended needle of a galvanometer, and the extreme variations in the several coils did not exceed 8 per cent. above or below the average capacity. From the above data it was easy to ascertain the inductive capacity of any portion of the cable with great accuracy. Thus, in one interruption which occurred during the laying of the cable—from the copper wire having broken within the gutta-percha—whereas the distance of the fault was calculated at 92·33 miles off, it actually proved to be 92·4 miles distant.

During the manufacture of the core, advantage was taken of the facilities afforded at the Gutta-Percha Company's works for trying a series of experiments as to the effect of temperature upon the conducting power of gutta-percha and india-rubber. It had long been known that the resistances of these substances varied greatly with changes of temperature; but the exact law had not hitherto been satisfactorily determined.

The manufacture and testing of the entire line was under the personal supervision of Sir Charles Bright. The testing of the core at the Gutta-Percha Company's works was carried out, with every precaution which skill and experience could suggest, by Mr. J. C. Laws (the senior of Messrs. Bright & Clark's staff), assisted by Mr. Frank Lambert. These gentlemen—who had previously served Sir Charles on the Atlantic expeditions—were also to look after the electrical welfare of the line during submergence.

As has frequently been stated, this was the first cable which passed through a complete system of electrical testing during the various stages of manufacture. It must be remembered, however, that it was almost the earliest undertaking of the sort following after the suggestion of Sir Charles and his partner at the British Association for definite electrical units and standards and a proper system of nomenclature. It was, indeed, the first occasion on which the core was tested in separate (three-mile) lengths under water; and a wholly unprecedented degree of insulation was obtained.



THE
PERSIAN GULF CABLE
(*Main type*)

The external protecting coats, already referred to, were then applied. In the end this constituted one of the most efficient and durable cables ever devised, and considerably excelled anything up to that time.

The total weight of the cable was four tons per nautical mile. For the shore-end portions, the sheathing wires were materially larger, bringing the weight up to eight tons. Some of this contained two insulated conductors, to enable one sheathing to do service for the circuit each way at an intermediate station.

The completed cable subsequently received a coating of whitewash to prevent sticking, and was then coiled away into tanks under cover and filled with water, the tests being continued at periodic intervals till the cable was shipped.[1] The immediate superintendence of this branch of the work was carried on, under Sir Charles' directions, by Mr. F. C. Webb, M.Inst.C.E.,[2] assisted by Messrs. Thomas Alexander, J. E. Tennison Woods, T. Brasher, T. B. Moseley, and other members of Messrs. Bright & Clark's staff.

The manufacture of the core was commenced by the Gutta-Percha Company in February, 1863, and the 1,450 miles of cable, weighing nearly 7,000 tons, was completed by Mr. Henley on November 10th. This formed by far the heaviest length ever carried in a submarine telegraph expedition.

It was coiled into five large sailing vessels and a small steamer. In addition to machinery for laying the line, these vessels were all fitted with iron tanks, in which

[1] This was the earliest occasion on which all the above routine was gone through, though now matters of common practice.

[2] Mr. Webb had been connected with many important cable undertakings, including the First Atlantic. He was now the chief of the engineering staff of Messrs. Bright & Clark.

the cable was coiled, besides a small engine and a Gwynne's pump for filling and emptying the tanks. The ships were severally in charge of Messrs. E. Donovan, E. D. Walker, T. B. Moseley, J. E. T. Woods and J. P. E. Crookes as electricians, who kept up tests of the cable on each ship during the voyage round the Cape to Bombay. Some interesting observations were taken of the currents produced by the action of the earth's magnetism on the coils of cable at each roll of the vessel. These were most evident in the higher latitudes, became invisible at the equator, and were in the reverse direction in the southern hemisphere. In rough weather they were sufficiently powerful to interfere seriously with the measurements of the conductivity of the copper wire.

Accompanied by Colonel Patrick Stewart, R.E., Captain Colvin Stewart (a younger brother), Dr. Esselbach, Mr. Hirz and Mr. Mance,[1] Sir Charles Bright proceeded to the scene of action by the overland route to Bombay towards the end of November (1863).

[1] Afterwards Sir H. C. Mance, C.I.E., M.Inst.C.E., Past President of the Institution of Electrical Engineers.

Section 3

Laying the Cable

An outline of the work to be done will form the best preliminary here. Karachi was the sea terminus of the existing Indian telegraph system (to Bombay, Calcutta, Madras, and other main towns) at the north-west corner of the great peninsula. Fāo, at the head of the Persian Gulf, was the sea terminus of the Turkish telegraph system, connected with the systems of Continental Europe and, through them, with England. Karachi is distant from Fāo about 1,250 miles. It was intended to join the two by submarine cable laid in four sections, in round numbers as follows: Karachi to Gwadur, 300 miles; Gwadur to Mussendom 400 miles; Mussendom to Bushire, 400 miles; Bushire to Fāo, 150 miles. The first section to be laid was that from Gwadur to Mussendom; and the ships immediately engaged were to *rendezvous* on February 4th, at the former station, whence operations would commence.

As soon as a portion of the telegraph fleet arrived at Bombay, Sir Charles and Colonel Stewart, R.E., joined them by embarking on the steamer *Coromandel*, the flag-ship of the expedition.

The following letter from Charles Bright to his wife about this time gives an idea of the way the time was passed after reaching India (on December 10th), whilst waiting for the ships:—

Bombay, *December 28th*, 1863.

. . . I write this without having yet heard from you since the letter I got at Marseilles. . . .

I keep very well. The climate is delightful. . . . I have had one trip into the interior since I wrote by last mail, to a place called Matherau, about sixty miles hence, where I went with an old schoolfellow, Baker,[1] who found me out here. He has a bungalow there, and I stayed a couple of days with him. It was harder work, though, than I had expected, but well worth the trouble.

First, I went to a place called Narel by train; then I had to get on horseback and ride nine miles up hill. At the top, about 2,000 feet above the sea, is an extraordinary range of mountains, with the most wonderful view I have ever seen in the extent of country they command. All the hillsides are covered with trees and beautiful wild shrubs and flowers, with bridle paths winding about in every direction. It is much cooler there than here, and in the hot season numbers of people go to live there as a sanatorium.

Bombay itself has little to recommend it, but the people are very hospitable. On Christmas Eve I dined with the Governor,[2] but on Christmas Day I was at the hotel—not the place I should have chosen.

For the last week I have been very busy, owing to the first of our ships, the *Marion Moore,* having arrived. (They are very slow here in getting work done.) You will be glad to hear that the cable in her is all in excellent order. I expect to get off in a few days to commence work. I shall write before leaving, but the letter will not go till the next mail, about a fortnight hence.

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[1] When Mr. Baker came to call on Bright, the latter did not recognise him at first. Baker then reminded Sir Charles that they had been interrupted in a fight when at school, whereupon Charles said, "Let's finish it now!" If they *had,* the prospects would have been very different; for though Baker was the bigger boy as schoolfellows, it was now all the other way, the subject of our biography standing 6 ft. 1 in. in his boots.

[2] The late Sir Bartle Frere, G.C.B., G.C.S.I.

My movements are rather uncertain, and it is probable that you may not get any letter by the mail following the next, as I shall most likely be on the Mekran coast without any means of sending a letter; but it is also possible that I may come back here, as we have an extra steamer which I can use for the purpose, if my plans then require it. . . .

The above was followed up a few days later by the following :—

BOMBAY, *January 1st*, 1864.

. . . I did not get your letter of the 2nd until the 30th, the mails being delayed and very late. Captain Dayman, of H.M.S. *Hornet*, an old Atlantic friend of mine (he took the soundings in 1857 in the *Cyclops*, and commanded the *Gorgon* afterwards in our trip in 1858), is going to Aden about some risings of the Arab tribes between there and Mocha, and I take this chance of writing.

I have not much fresh information as to my doings or movements to communicate, except to tell you of the delight my dearest's letter gave me after waiting so impatiently for it, as I have spent my days principally at the Government dockyard here, and on board the *Marion Moore*, since I wrote.

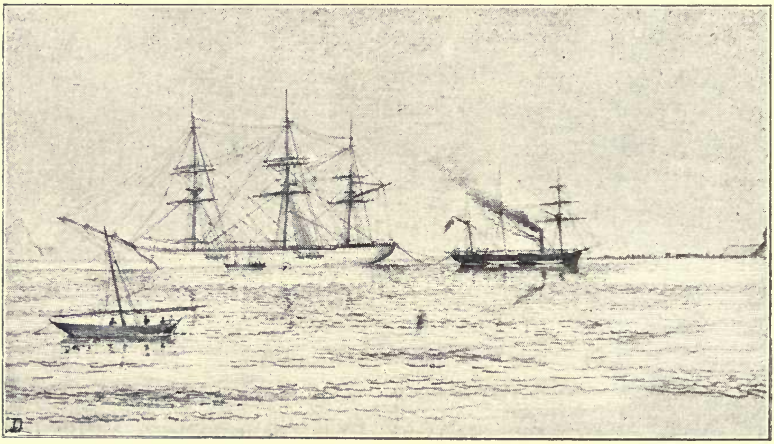
I don't find folks work so well, either at the head or foot of departments, here as in England, and I have been very savage at the delays I find in getting things done. The climate, I suppose, has its effect on people after a long stay, or else they don't like working between Christmas and the new Year. Whatever the cause, I am still more aggravated to find that there is general holiday from to-day (Friday) to Tuesday next. This has delayed me so much that I shall now probably await the arrival of the second ship, the *Kirkham*, which left on September 11th, and ought to be here in a few days.

This will be a great saving of time ultimately, as I shall have the two ships towed on to the scene of action together, but I am so tired of Bombay—having seen nearly everything and everybody—that I am eager to get off, and to work. The day I got your letter I had an engagement to go to the Governor's, to meet the Ranee Begum of Bhopal at a sort of evening levée, so I had only just time to read your dear letter and be off, leaving my business letters and Robert's to be read afterwards ; and the newspapers sent me from the office (which I read with great appetite) kept me afterwards till past four, having got back from the Governor's at half-past twelve. The party at the Governor's was full of interest to me—much more so than his dinner-party before, which was subdued and ceremonial—a bad feature in dinner-parties.

Her Royal Highness the Begum is, of course, looked upon as a great personage, for she stuck to us throughout the Mutiny, while all her relatives were against us. She has, therefore, been made a *Knight* of the Star of India. To look upon, she is a little dried-up, brown, loud-voiced thing. When I was presented to her exalted Majesty, she shook hands very cordially ; and, as Sir Bartle Frere translated her lingo, said "she knew all about me, and about telegraphs too !" so I did not think it needful to give her any further information on the two subjects. She had some important Indian personages with her. Her son-in-law, the Maharajah of something or another, was a great swell, with gold headpiece, gold-cloth clothes, but no shoes or stockings (according to the native custom here), and his feet and ankles did not look a good finish. A lot of meaner stars—male and female—of the native sort, made up the suite.

The room, a very grand and well-proportioned one, was filled up with ladies in full dress, and officers of every kind and colour of uniform, which made the scene quite amusing to me, if only from its novelty. . . .

On the *Marion Moore* and *Kirkham* reaching Bombay with sufficient cable for the section between Gwadur and Mussendom, Bright took charge ; and, after erecting the machinery on deck for paying out the cable, they were towed to Gwadur by the *Zenobia* and *Semiramis*, two powerful paddle-wheel steamers of the Government. They anchored after seven days' cruise, and were joined by H.M. Gunboat *Clyde*, and also found the rest of the fleet awaiting them, a few days in advance of the appointed time. Gwadur is a small Beloochee town erected on a sandy isthmus between two very lofty and precipitous sandstone ranges. The inhabitants are neither Arab, Persian, nor



CABLE-LAYING IN THE PERSIAN GULF
(*From a sketch by Sir Charles Bright*)

Beloochee, but seem to be a mixed race, possessing few of the distinctive qualities of either but their colour, their dirt, and their general dislike of work.

Having landed the shore end, Sir Charles commenced on February 4th, 1864, laying the cable towards Mussendom, on the Arabian side of the Persian Gulf, from the *Kirkham*, in tow of the *Zenobia*, the screw-steamer *Coromandel* (with Colonel Stewart on board) piloting the course.

The expedition skirted along near the mountainous cliffs which bound the Mekran coast, and for the purposes of description we will now follow the records of an eye-witness, Mr. J. E. Tennison Woods, who acted as special correspondent to the *Daily Telegraph* :—

[1] Nothing could exceed the perfect regularity with which the arrangements acted. The cable uncoiled itself with absolute freedom from the hold, and the bituminous covering, instead of proving an embarrassment on account of its sticking together, was found to be a positive advantage in keeping the cable from springing out of its place, and in preventing the wires—which occasionally get broken in passing over the drum—from escaping and fouling the machinery, a species of accident not uncommon in paying out cables unprovided with such protection.

There are always considerable difficulties attendant upon paying out cable from a ship towed by a steamer. In the first place, it is impossible to stop the ship's way, alter her course, or, indeed, to do anything in case of an emergency, without going through the laborious—and, at best, very uncertain—method of signalling either by lamps or flags. This difficulty was to a great extent overcome by an ingenious adaptation of the Morse alphabet (as used by all the telegraph companies) to semaphore and lamp signals. At night it was effected with a bull's eye lantern, the shutter of which is carried on the end of a small lever. The duration of time the light is exposed is made to represent the "dot" and "dash" of the Morse code. With such skill and rapidity were these instruments used on board both the *Kirkham* and *Zenobia* that the most complicated messages were exchanged by flashes of light between the steamer and the ship in tow, at the rate of some twenty words a minute ; whereas by means of the Marryat code it would be next to impossible

[1] *Daily Telegraph*, article on "The Anglo-Indian Electric Line," March 10th, 1864.

to transmit a message of twenty words in less than half an hour.[1] The system of testing adopted during the submersion by Mr. Laws, the chief electrician, and his assistant, Mr. Lambert, was so perfectly contrived that hardly a minute elapsed during which the line was not under electrical examination.[2] The test for insulation was kept on constantly, the current being reversed on the ship every half-hour. For testing the continuity of the conductor a condenser was charged from the cable end every five minutes, and then discharged, thus giving a slight and sudden deflection on the ship's galvanometer.[3] Thus the least fault or injury occurring during the process of submersion would be detected before it was too late to remedy the defect. Everything, indeed, went so smoothly that Sir Charles Bright and his assistant engineers had little to do but to see that the already perfect arrangements were adhered to. The cable was paid out at from $5\frac{1}{2}$ to 6 knots—a rate just sufficiently in excess of that of the ship to allow the line to accommodate itself to the inequalities of the bottom.

The *Kirkham* finished paying out her portion of the cable on the morning of February 6th, when near Jask. The most troublesome part of the business—the transfer of the staff, cable hands, stores and apparatus of the *Marion Moore*—was then successfully carried out at sea, and the laying continued across the entrance to the Persian Gulf.

[1] This was the first cable expedition on which Morse Flag and Lamp signalling were made use of by day and night respectively.

[2] On this occasion the Thomson marine galvanometer was used for the first time. Previously, in connection with the Atlantic Cable, Professor Thomson had introduced his mirror speaking instrument; and as it was also—indeed mainly—used for testing it was more often termed a galvanometer.

[3] The above plan, with modifications, is in very general use during cable-laying operations in the present day. It originated with this expedition.

Says the *Daily Telegraph* correspondent:—

[1] By daylight on the morning of the 9th the lofty mountains of the Arabian coast could be seen towering high above the morning mist, apparently, though not in reality, close to the ships.

The ships continued to approach the land, but no opening in what appeared to be an unbroken line of cliffs was visible, until when within hardly more than 100 yards of the shore the narrow entrance to Malcolm's Inlet came in sight. After passing through this natural portal, the ships of the squadron steamed up the inlet, enclosed and hemmed in on all sides by lofty and precipitous rocks several thousand feet in height. The points of land overlapped each other so as to form a series of lakes, which might vie with the wildest parts of the Highlands for savage beauty. As the vessels proceeded, shotted guns were fired—alike to inform the Arabs of our approach, and to let them know that the ships were not defenceless. Nothing could exceed the strange effect of these artillery discharges, reverberating from rock to rock with the sound of thunder; each gun seemed magnified by the echo into a broadside.

About noon the vessels arrived at the head of the inlet, and, the water being very deep, anchored within a short distance of the shore. Several days were occupied in erecting a land line across the peninsula, and in selecting a suitable place for the erection of the tents for a temporary station here. After this, on February 13th, the end of the cable was landed at this, the hottest region on earth, and electrical communication opened with Gwadur, distant by cable 370 miles.

The line proved to be in splendid order, and capable of transmitting messages at the rate of twenty-five words per minute—a speed quite unprecedented in a submarine cable of such length. The first message transmitted was to Sir

[1] "The Anglo-Indian Electric Line."—*Ibid.*

Charles Bright himself, conveying the news from England of the birth of his son Charles. It ran thus:—From Mr. Walton,[1] Karachi, 4th February, 3.7 p.m., to Sir Charles Bright, Gwadur. I send you the following from *The Times* of 2nd January, in case it may interest you.

> On December 25th, at 12, Upper Hyde Park Gardens, Lady Bright, of a son."

After this, communication was maintained with Bombay and the rest of India throughout the laying of each cable section.

H.M.S. *Sinde*—with Colonel Goldsmid, who had surveyed the Mekran coast—and the *Clyde* arrived on the 13th. The *Zenobia* then left with the *Marion Moore for* Bombay. Colonel Stewart, Sir Charles Bright, and Colonel Disbrowe, the Political Resident (or Agent) at Muscat, remained at Mussendom, to arrange difficulties with the Arabs, pending the arrival of the *Tweed* and *Assaye* with 735 miles of cable to continue the work. More than a month was spent here, the Arabs giving a good deal of trouble throughout. In the words of Colonel Goldsmid: "Even the fishermen were reluctant to bestow their friendly offices on comparative strangers without at least the guarantee of some substantial return for the privilege they considered they were granting."[2]

One of the expedition, in corresponding for *The Times of India*, wrote with regard to the experiences off Mussendom:—

[1] Mr. H. Izaak Walton was the Director of the Mekram Coast Telegraphs.

[2] See *Telegraph and Travel*, by Sir F. J. Goldsmid, C.B., K.C.S.I. (Macmillan & Co., 1874).

It seems very doubtful whose territory this barren country is in. Even the inhabitants do not appear to know, some speaking of a Sheik named Ben Suggar, of Ras el Kymer, as their rightful ruler, while others look upon the head of their villages as "without superiors on earth," and responsible to God alone !

The Arabs soon began to flock off to the ships in very original-looking boats, and became most pressing and troublesome in their familiarities ; but as it was highly important to secure good-will for the sake of the electricians, signallers, and others who were to be on shore in charge of the "repeating" station, they were treated with the utmost kindness, and no effort was spared to propitiate them by presents of rice, sugar, coffee, etc.

Evidently they do not understand the meaning of *quid pro quo* : for when asked to assist in landing stores, pitching tents, and building one or two wooden huts, though promised liberal payment in money or food for doing so, they showed no alacrity to close with the offer. The old plan of paying a few rogues well to watch the rest has succeeded perfectly hitherto, the charge of all the stores landed having been entrusted to about a dozen Arabs. The policy thought best is to secure the goodwill of the leading men by making it their interest to treat our people well. Great difficulty is, however, experienced in finding out who are the real chiefs, for the local politics are most intricate ; and every now and then the knots into which they get are so complicated that the sword is deemed the only means of solution !

Here we will again quote the *Daily Telegraph* [1] : —

The aspect of the place accorded well with the known character of its inhabitants, who are wild and savage in the extreme. These intricate and tortuous passages—running as they do into the very centre of the mountain fastnesses—are indeed well calculated to shelter and protect the desperate hordes of pirates who inhabited them a few years ago under the chief of Ras el Kymer, the Sultan Ben Suggar. What the inhabitants were

[1] "The Anglo-Indian Electric Line."—*Ibid.*

then, so they are now in disposition. They are no longer open pirates, because piracy does not pay. The unremitting vigilance of the Indian navy ships has rendered that occupation even more precarious than the uncertain pearl fishery. But these men are truculent and fierce, and—following out their old traditions—would always rather bully for an advantage than obtain it in any other way.

From the first they showed strong signs of objection to the expedition ; but shortly after the arrival a curious incident occurred. A crowd of these ruffians had assumed a threatening attitude on the landing of Sir Charles with but a small escort. Having, however, read that Freemasonry was current among the Arabs, and being a member of the craft, it occurred to him to try them with a well-known sign. They exhibited some astonishment for a moment ; but on its repetition several answered the sign, and at once became warm friends, though their demonstrations of fraternal affection involved some slightly unpleasant hugging with not over fragrant " brothers " !

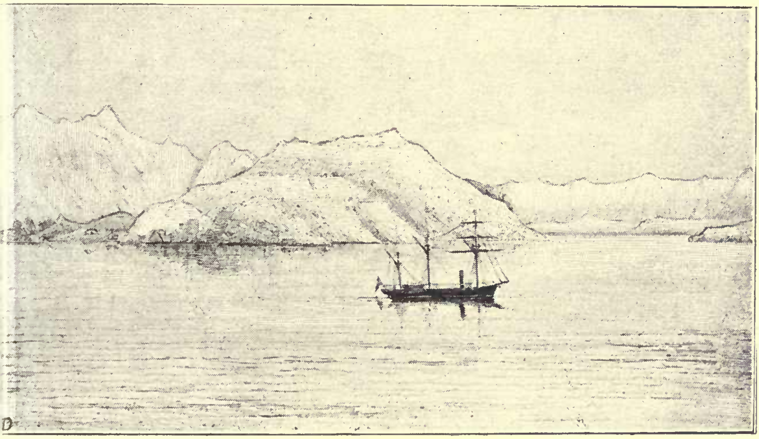
There can be no doubt that when, as in this instance, the masonic signs, symbols and fellowship are found established in the desert wilds of the East, the craft is much more widely spread over the globe than most people—even Freemasons—have believed. At all events it proved a good thing to voyage with, in a very out-of-the-way and queer place—a couple of thousand miles or so from what we deem civilisation. The same masonic formula being current among a most truculent race of predatory Arabs, in the far south-east corner of Arabia, is certainly a striking instance of the widely-spread character of Masonry.

This curious demonstration of brotherly love did not, however, extend beyond Sir Charles, and as time wore on—while waiting for the other cable ships, which did not arrive for several weeks—the suspicions of the tribes increased, and their attitude became more and more hostile. They probably thought from the continued presence of the three ships of war that some permanent annexation was intended. So it was considered desirable to make some slight demonstration of the power (or rather powder) at command. The gunboat *Clyde* was therefore told off for target practice with her guns at the face of a rock close by the landing-place. The smashing effect upon the cliff of this pounding immediately mollified the people, and modified their views as to their powers of resistance. They had probably never heard a cannon fired before, but showed themselves now quite capable of recognising *force majeure.*

But even when matters were arranged later by Colonel Stewart and Colonel Disbrowe, it was a case of much "back-shish." A sort of "durbar," or reception of chiefs, and distribution of presents was held. On this occasion the chiefs—or pretended chiefs—attended in all the glory of such state vestments as they were possessed of, and, after considerable chatter, filed out apparently satisfied with what they had received. Those who had come first were, however, shortly succeeded by another batch of claimants. But it was remarked that they came in wearing identically the same gorgeous robes of office as their predecessors had displayed; and in the hurry of changing outside, the "borrowed plumes" didn't fit some, making their appearance ridiculous, and—to say the least—considerably diminishing the dignity of their "get-up!" They were evidently sent in by the real " head men " with the deliberate intention of ascertaining whether by this means still more blackmail could not be extracted ; one was indeed recognised as the boatman of a sheik ! When accused by the interpreter of so flagrant an act of impersonation, they " stormed " and seemed extremely vexed at the failure of their attempt to " spoil the giaours "—though not one whit ashamed at the detection of their trick. They shambled off crestfallen—with much wagging of beard and jaw !

Of course the tribes had to be propitiated by presents and promises of periodical payments for safeguarding the staff and stations after the expedition had left ; but it required considerable knowledge and tact to deal with the right headmen, and yet not to give more than absolutely necessary—difficult points to decide with such ruffians, who were quite disposed to " slit throats " on small provocation. Notwithstanding the amicable relations thus temporarily established with the shore " ruffs," it was decided not to leave the staff and stores at their tender mercies on the mainland, after the squadron was withdrawn. A station was therefore established on a small rocky island nearly a mile from shore, in Elphinstone Inlet, and about a quarter of a mile long. Two armed hulks, the *Euphrates* and *Constance*, were then moored off the island, and the gunboat *Clyde* was left on guard.

On March 18th, the expedition started for Bushire on the Persian side of the Gulf, the cable being laid from the *Tweed* in tow of the *Zenobia*. Some very rough weather was encountered, and at one time it was doubtful whether Sir Charles would not be driven to cut and buoy the cable. The steamer was only able to tow the ship at a speed of two knots, but they managed to pull through till the storm abated. Afterwards the paying out was transferred to the sailing ship *Assaye*, and by daylight on March 23rd the snow-capped mountains—some 12,000 feet high, behind Bushire—shone in the morning sun. The anchorage was



ELPHINSTONE ISLAND AND TELEGRAPH STATION
[*From a Sketch by* SIR CHARLES BRIGHT]

reached shortly afterwards, the 430 miles laid from Mussendom being in splendid order. After a close inspection by Bright, in conjunction with Colonel Stewart, the exact spot for landing the cable was determined, and the section satisfactorily put through on March 24th.

A propos of the arrival in Bushire, the *Daily Telegraph* correspondent wrote [1]:—

[1] "The Anglo-Indian Electric Line."—*Ibid.*

It is curious what changes and vicissitudes a place will see in the course of a very few years. It is not quite seven years since that these same ships anchored in the very same place for the purpose of landing the British force destined for the siege of Bushire during the Persian war. Although their present mission was so different, it was evident that the inhabitants did not feel at all certain of our pacific intentions, for it was some time before any boats came off. Those that did, for a long time kept clear of the *Assaye,* she having been one of the vessels most actively employed in the destruction of the Persian batteries in 1857—as many a patched and torn plank in her deck testifies.

The town of Bushire itself does not appear to have suffered commercially from the English bombardment. The ruined buildings and fortifications still remain unrepaired, but the material prosperity of the place has augmented manyfold.

After the landing of the second shore end, the squadron started on the morning of March 26th for Fāo—some 150 miles distant—at the far end of the Persian Gulf, where the mouths of the great rivers Euphrates and Tigris converge.

Considerable difficulty occurred in landing the shore end of the cable at Fāo, and connecting it with the floating station moored off the entrance to the Tigris, owing to the shallowness of the water and extent of deep mud banks.[1] When the ship had got in as far as was possible there were still some six to eight miles of these mud banks between her and the beach. Thus the cable could only be landed in comparatively flat-bottomed vessels. To assist in this work the *Comet,* of the Bombay Marine Service, was requisitioned. To make room for the cable, she had to disem-

[1] This was, in fact, the most arduous feature of the whole expedition.

bark her guns and coal, this operation occupying as much as fourteen days. The work was commenced on April 5th, after several days had been occupied by Sir Charles and Colonel Stewart in exploring the locality, so as to determine the course to be pursued.

[1] About five miles of cable, weighing some twenty tons, were distributed among ten of the largest boats belonging to the fleet. When something like four miles had been paid out, the boats grounded. Though there was very little water there was a great depth of mud, of about the consistency of cream. There was no use in hesitation, the cable must be landed at any risk, so Sir Charles Bright set an example to his staff and the men, and was the first to get out of the boat and stand up to his waist in the mud. This example was followed by all the officers and men —upwards of a hundred in number—who were soon wallowing in the soft yielding slush up to their chests, but still dragging the end of the cable with them.[2]

The progress through such a material was necessarily slow—half swimming, half wading. It was impossible to rest for a moment without hopelessly sinking below the surface; yet no one thought of abandoning the cable. Though it was only two o'clock when the party left the boats, it was nearly dark before the last man reached the shore. Several sank so deeply in places when attempting to stand upright on approaching the beach that they were compelled—as the only practical mode of progression—to throw themselves down and crawl like turtles. All were grimed with mud, and nineteen out of twenty were nearly naked, having left or abandoned almost every article

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[1] *The Times.*

[2] Some idea of this performance may be gathered from our illustration—which appeared in the *Illustrated London News* at the time—from a sketch made by an eye-witness, in which Sir Charles is shown directing operations on the left.

of their clothing in the effort to reach the shore. But in spite of obstacles the cable was landed.

Just as the troubles of the landing party appeared to be over, it was found that the ships of the expedition, which were waiting to receive them in the Tigris, lay at the other side of a mud bank—only a little less fluid than that which had just been passed,

LANDING THE CABLE IN THE MUD AT FĀO
(From the *Illustrated London News*)

and four miles in extent! To make matters worse, a thunder-storm, truly tropical in its violence, was raging; and the tide, which washes the banks, was rapidly rising. The party, however, made a dash for it, and all succeeded in reaching the ships, with the exception of one of the Lascars, who was overwhelmed by the mud and tide, and sank before assistance could reach him. The remainder were much exhausted—some, indeed, having to be carried by their companions. Even when the solid part of the bank was reached, the cable had to be cut into mile and a half lengths, carried on the backs of several hundred Arabs, and then joined up again.

As an instance of the kindly thoughtfulness always evinced by Sir Charles towards his colleagues, on the shore trenchings being finished, Sir Frederick Goldsmid says, in his interesting book,[1] alluding to Captain Bradshaw[2] and himself—" When the superintending officers returned to their tent in the afternoon, they found half a dozen of champagne, a huge joint of wild hog, and the following letter in pencil—

" COROMANDEL,"
April 9th.

MY DEAR GOLDSMID,—

I send a very solid piece of wild boar and some champagne for you and Bradshaw to drink good luck to the cable with, as you cannot be here. We are going to have a salute and dress ships at noon. Hurrah ! !

Yours sincerely,
C. B.

In the book referred to, Sir Frederick Goldsmid says much about the days passed on the monotonous sea shore and amid the dilapidated out-buildings at Fāo, or Fava, a place barely existing but for the Indo-European Telegraph station.

Swamps, flats, ditches ; here and there a dwarf tree or shrub ; men and things disturbed and exaggerated by a marvellous mirage. Such was indeed the scene at the mouth of the Shat-el-Arab and Khor Abdullah. The fort itself was an old tumble-down mud building, rising from a swamp, used mainly as a burial ground.

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[1] *Telegraph and Travel.*

[2] Captain Bradshaw (afterwards Vice-Admiral Richard Bradshaw, C.B.) was serving as a surveying officer, and had accompanied the expedition on one or other of the pilot vessels.

His diary will also be of some interest here in connection with a visit to this fort. He says :—

By aid of a canoe we make our way into the fort ; but on striking off to seaward get into a muddy dilemma. One or two of us take off shoes and stockings and plunge in. All very well, so far as it goes, for the soft mud ; but not so for the hard-baked soil, which cuts unmercifully into the feet. Walk some four miles and get well out to sea, facing our old anchorage, and seeing the ships about seven miles off in the Khor Abdullah. Sir C. B. and Colonel S. out the furthest, but all have a pretty good spell.

A fault in the Bushire-Fāo cable presented itself soon after it had been laid ; only the very feeblest signals could be got through, and these only at intervals. This pointed to a break, or partial break, in the conductor, though testing perfectly up to the time of submergence. It was supposed afterwards—based on the tests made by Mr. Laws—that the conductor must have been broken [1] during the construction of the cable, the broken ends remaining in contact when the cable was submerged. The reduction of temperature, in contracting the copper, would then have sufficed to separate the broken ends, and so interfere with electric continuity.

Sir Charles effected a repair of the defect with a rapidity and certainty which Colonel Stewart justly described as "an excellent instance of the thorough efficiency with which the work has been performed." [2] Colonel Stewart adds :

[1] As it happened the conductor in this section was a solid wire, being made before the adoption of the segmental type. It, therefore, had not the advantages of greater pliability and immunity from complete interruption.

[2] Lieut.-Colonel Patrick Stewart to Secretary to Government. Bombay, June 11th, 1864.

" The position of the fault was calculated and laid down with a nicety which has never been surpassed. The course of the cable was so accurately defined by the surveying officers, and the vessels sent on the repairing trip so skilfully navigated, that the buoy intended to show the presumed position of the fault was actually laid down by the *Zenobia* within less than a quarter of a mile of its true position."

" This defect of manufacture was responsible for the only hitch experienced during the whole of the operations."

The remaining section of the cable between Gwadur and Karachi was afterwards successfully laid by Mr. F. C. Webb, with Messrs. Woods, Alexander, and Moseley, out of the *Assaye* and *Cospatrick*, during April and May, in the absence of Sir Charles Bright. The latter went to Baghdad with Colonel Stewart, R.E., and Major Champain, R.E.,[1] for the purpose of endeavouring to arrange for the completion of the land line from Fāo, which had been interfered with by the Montefic Arabs. On this subject Colonel Stewart reported to the Indian Government as follows :—

So much having been completed, it remained—in accordance with the original programme—to extend the submarine line from Gwadur eastward to the frontier of British possessions at Ras Mooaree (Cape Monze), some twenty miles west of Karachi. We thereby rendered the vitally important link between the Indian system of telegraphs on the one side and those of Turkey and Persia on the other, more secure than would have been possible had the efficiency of the whole chain of communication

[1] Afterwards Sir John Underwood Bateman-Champain, K.C.M.G., Director-in-Chief of the Indo-European Telegraph Department.

been permitted to depend on a land line passing through such a country as that between Karachi and Gwadur.

In the meantime, however, it was absolutely necessary for me to proceed at once to Baghdad regarding the completion of the line between Bussorah and Baghdad, and the introduction of certain essential reforms in the system of maintaining and working the telegraph to the westward of the latter city. I was, therefore, obliged to make special arrangement for superintending the laying of the Gwadur-Karachi cable during my absence. Fortunately, the qualifications of Mr. F. C. Webb, the senior of Sir Charles Bright's engineering staff, were such that there was no need for hesitation in entrusting him with this duty. At the same time I was enabled to take advantage of Sir C. Bright's offer to accompany me to Baghdad, and to secure the advantage of his experience, while considering with Colonel Kemball the various proposals for effecting improvements in the Turkish telegraphs.

An idea of the travellers' experiences can, perhaps, be best gathered from Sir Charles' letter to his wife a short time after their arrival at Baghdad.

BAGHDAD,
April 25th, 1864.

. . . I have come up here from the gulf with Colonel Stewart and Major Champain after getting all the important part of the cable laid most satisfactorily. The land lines hereabouts are not as satisfactory, but time will get them right. The Turks are very tiresome people to deal with, and never keep their engagements.

You will have heard of the laying of the cable. I have written very fully about all that to Clark at the office, and have asked him to give it to Robert for you to read, as you will like to do so, and the repetition of it would be a rather long affair. . . . After laying the cable to the head of the Gulf, and having a desperately hard job, I came up here, as all the land communication between this and the Gulf is at a standstill through the Turks and Arabs fighting together—a very great drawback to us—and the Turks, as usual, are in the wrong, and won't give way. The river Tigris, through which we come, is not very interesting, except from the associations connected with this part of Mesopotamia.

At Korna—where the Tigris and Euphrates joining form one river, the Shat-el-Arab—is situated the supposed site of the Garden of Eden. Everybody here assures us it is the very garden, so we landed and examined it. It is full of the usual palm trees, dates, roses, etc., which we find everywhere here, and a dirty Arab village and ruined mosque, with a single minaret, of some pretensions as regards taste, standing. Bussorah, a little below Komeh, is a good-sized town. If you took Johnnie to any day performance at Drury Lane I see you would have a scene of the port of Bussorah in *Sinbad the Sailor*, and probably another of Baghdad. All the old stories in the *Arabian Nights* are taken from this part of the country, which was once the richest and greatest in the world.

A little above Komeh is Ezra's tomb on the banks of the river. Here he lived and died after taking the Jews back from the Babylonian captivity. Baghdad—where I am writing in an old-fashioned room looking direct over the river—is a large city, something like Cairo. There are several large mosques and long rows of shops under cover, in the bazaar. Still, the general effect is similar to the Lowther Arcade, but low, dirty, nasty smelling and unpaved. This bazaar is quite full of people of all kinds—some dressed in colours, some nearly naked: I saw one man quite so.

Everybody pushes and shouts, so that it is impossible to go there except on horseback, which, as it is only a few feet wide, adds to the confusion. Fancy half a dozen men on horses riding through Burlington Arcade full of people! Everything is done here by Europeans, or persons of any importance, *on horseback*; and the same in Persia, as there are no carriages anywhere—or, indeed, roads wide enough for them.

To-night I go to dine with the Pasha, in state, with all our party. To-morrow he dines here with Colonel Kemball, the British (Political) Resident, whose guests we are, and who, I must say, treats us exceedingly well—providing rooms, horses, attendants in uniform and armed to go out with us, and feeding us sumptuously.

It is rather a treat to get ashore for a bit and lie down in a real bed after being "penned up" on board ship in a narrow, close berth—not long enough for my unmanageable legs—for three months at a stretch.

I so like to read all you tell me of yourself and the bairns. I am longing to get home, and hope to catch the mail of May 24th from Bombay. . . .

I shall take a long rest and be very idle when I return till the shooting begins. . . .

Then I shall probably want to go to the South of France to look at our mines there before the winter sets in. . . .

PS.—I have had some good deer and boar-shooting on the river-banks and on Tomb Island, but it is too hot for much exercise.

We will now return to the laying of the last section—from Gwadur to Cape Moaree, near Karachi—which was fully reported on by Mr. F. C. Webb, who was left in charge of operations.

During this part of the work a most exciting incident occurred, which was described as follows in *The Engineer*:—

Whilst paying out cable on the evening of April 4th, with very little warning, the ships were struck by a tremendous squall from the W.N.W., accompanied by rain, lightning, and a fearful quantity of fine sand, which enveloped everything in the most solid darkness. So intense was the obscurity, that the *Assaye* was driven nearly on to the *Zenobia*; and although she was close under the bows of the *Assaye* not a vestige of her lights could be perceived. Just before the total eclipse, as the squall came, the message, " Webb to Carpendale " : " Don't get blown into deep water " was sent, and then all signalling was at an end, and everything total darkness. Both ships " broached to " and headed in for the land in spite of their helms being hard up. The full force of the wind came on them thus, right on the beam. The awning of the *Assaye* was caught underneath by the wind, and carried away with a report like a gun—snapping all the heavy iron stanchions to which the ridge-chains were secured, and dashing chains, etc., down on deck, fortunately without doing any injury to life or limb. The paying-out machinery was completely buried in the wreck. It is, indeed, a wonder that nothing happened to the cable, seeing that for some time the ridge-chain was actually resting on the drum of the brake, which was revolving at the rate of forty-five revolutions a minute. This was a pretty good test for the mechanical arrangements, which continued to act as perfectly as if the ships had only been going three knots—instead of eight and a half.[1]

While laying the cable from Gwadur, a number of joints failed through air-bubbles developing, and these had to be replaced.

On May 16th, this last section (about 250 miles) was completed in the presence of Sir Charles Bright and Colonel Stewart, who had come in the *Coromandel* from Baghdad, leaving Major Champain to attend to further matters there.

A land line, twenty-four miles long, had previously been erected from Cape Monze to Karachi, and communication over this—the final link of the Persian Gulf cable system—was thus established.

A banquet was held to celebrate the successful completion of the work.

[1] *The Engineer*, August 12th, 1864.

After this Bright left Karachi for Bombay in the *Coromandel,* with Colonel Stewart and staff.

On May 24th, Sir Charles left in the P. & O. steamer *Behar,* homeward bound, accompanied by Mr. Laws and the rest of his staff, with the exception of Mr. F. C. Webb, who remained to carry out final arrangements for the working of the line.

Lastly, on June 24th, Colonel Stewart sailed for Constantinople, after all the various vessels, except the *Amber Witch,* had been discharged from Government employ.

Section 4

The Land Line Connecting Links

Bright reached home during the last week of June, only to find his wife in a poor state of health.

Within a few weeks the family went to a riverside cottage at Datchet for entire rest and change, the effect of which was highly beneficial. Here the time was mostly spent in boating on the Thames, in which Sir Charles was accompanied by his brother Edward and other friends.

Very soon, however, there began to come disquieting news regarding the working of the line between Europe and the cables which had just been laid under Bright's immediate supervision.

It was expected that the Turkish land line between Baghdad and the head of the Persian Gulf would have been completed simultaneously with the submersion of the cable; but a considerable part of the broad tract of country—400 miles in extent—between the ancient city of the Caliphs and the miserable village of Shat-el-Arab (at the junction between the Tigris and Euphrates) is inhabited by predatory Arab tribes, incessantly quarrelling one with another and mutually defying the Turks, their nominal masters. *Backshish*—in the form of subsidies—was the only way to quiet these rapacious vagabonds. It was not until the commencement of 1865 that their state of chronic revolt against the Turkish Government could be put an end to, and the line carried through.

The arrangements eventually made by Major Champain with the sheiks of the troublesome Montefic tribes, for safeguarding the land line between Fāo and Baghdad, were based on the rule of procedure often employed with eastern doctors, who only get "feed" while their patient is well. As described by Captain Huish:—

At every six miles an Arab guard was employed, who was paid 15*s*. or 16*s*. per week, but this pay was stopped if anything happened to the telegraph. Thus, in addition to the exercise of his ordinary marauding propensities, this Arab received a handsome income; and the guards took care that their brother Arabs did the telegraph no harm.

The distance through the Turkish dominions was from Constantinople to Baghdad 1,550 miles, and thence to Fāo 400 miles; and it may be added that the portion most easily maintained was that which passed through this country of the Bedouin Arabs.

To the intense grief of Sir Charles Bright, and all taking part in the carrying through of this great international undertaking, Colonel Patrick Stewart, R.E., died shortly afterwards of malarial fever while on a special mission near Constantinople. He did not survive even to witness the actual opening to the public of the entire Indo-European line, to the accomplishment of which he had so largely contributed and for which he had just been made a Companion of the Bath.

As expressed by *The Times*: "Stewart had been largely instrumental in bringing Sir Charles Bright's wondrous sea cable to the head of the Persian Gulf, where it was joined to the land line at Fāo under his supervision. With Sir C. Bright, he shared the honour due for this great achievement." Referring to Colonel Stewart in his paper on "The Telegraph to India,"[1] Bright said: "By his death the country has lost an accomplished and fearless officer, unsurpassed in zealous devotion to his duties, and rarely equalled in administrative capacity."

Colonel Stewart was succeeded by Colonel Goldsmid; but on the latter receiving a special political appointment, Major Champain received promotion and became the Director General of the Indo-European Government Telegraphs. He had had a considerable experience with the Persian Telegraph system.

It was not until the end of February, 1865, that arrangements had been so far organised as to permit of the line to India being opened for the transmission of public messages, since which it has been in daily operation, carrying a large traffic between India and Europe. It was soon found, however, that the connecting wires through Turkey and between Karachi and the main Indian lines at

[1] *Mins. Proc. Inst. C.E.*, vol. xxv.

Bombay were very badly managed. Whilst a speedy service was established on the four sections of cable, messages between India and England frequently occupied many days in transit over the land lines. This was partly due to the inefficient staff of half-castes at first employed in India. It was also partly due to the carelessness and indolence of the Turks, who often allowed their wires to be out of order for days together. The extent of Turkish apathy may be judged when it is stated that messages were frequently so changed in their order of transmission that those sent days after others would arrive first ! This came about from their being filed as they arrived one after another at an intermediate station, and when sufficiently accumulated sent on, those at the top (the last received) being dealt with first ! Endeavours were soon made to arrange for through Turkish wires worked by English operators ; but so jealous was the Sultan's Government of interference that this reform did not receive the necessary sanction.

With regard to this, *The Times* said :—

Advices just received from Baghdad and Beyrout describe the causes of delay in the transmission of intelligence through the telegraph to India, the submarine portion of which in the Persian Gulf was recently completed by Sir Charles Bright. It appears that seventy miles of the line from Bussorah to Baghdad are incomplete, and cannot be constructed on account of the distracted state of the intervening country, the Arabs having revolted against their Turkish masters. The Porte undertook to construct this portion of the telegraph through the Pashalic of Baghdad ; but, in consequence of hostility from the Arabs, not a Turk, it is said, dare venture into the district unless protected by a strong military force.

Notwithstanding the above weakness in the system, the cable at once proved a commercial success to the Government; and the traffic materially increased after Major Champain and a staff of "sappers" erected lines a year later through Persia from Bushire, so as to connect up with the already existing Russo-European system at Tiflis. In later years the Persian Gulf cable had a fresh feeding string; for in 1868 the Indo-European Telegraph Company was formed "for promoting a more speedy and reliable line of communication between England and India than that hitherto permitted by the Turkish State land lines." This line passes through Germany and Lower Russia, a good traffic being picked up as far as Teheran, in Persia, where it joins the system of the Indo-European Telegraph Department of the Indian Government.

Between 1864 and 1869 the Persian Gulf line was earning at the rate of £100,000 per annum; this, moreover, under the disadvantages of a bad land-line connection through Turkey. At the time it had the monopoly of telegraphic communication with India, and it made the best of it. These halcyon days came to an end when the Eastern and Associated Companies arrived on the scene.

SECTION 5

Retrospection and Reminiscences

Sir Charles Bright's paper [1] dealing with the whole subject of this chapter, and giving a complete account of the undertaking, was read before the Institution of Civil Engineers [2] on November 14th, 1865, and four evenings were occupied in its discussion. This paper won for Sir Charles the Telford Medal.

It was generally agreed that here was the first instance of any great length of cable being completely and lastingly satisfactory. Even after an interval of thirty-five years, the Persian Gulf cable is acknowledged to have been the first case in which the real requirements of a cable had been thoroughly appreciated and put into practice. Apart from the uninterrupted success attending the laying of the four sections, a vast advance had been made in the design, manufacture, and testing, upon anything hitherto achieved; and to the novelties and improvements introduced therein the result may be largely attributed. With the laying of the Persian Gulf cable—forming the first telegraphic connection between the United Kingdom, Europe and India—the science of the construction and laying of submarine telegraphs had been pretty definitely worked

[1] "The Telegraph to India and its Extension to Australia and China," by Sir Charles Tilston Bright, M.P., M.Inst.C.E. (vide *Mins. Proc. Inst. C.E.*, vol. xxv); also Appendix 2 of Vol. II. of orginal biography.

[2] Sir Charles had lately been elected a full member of this Institution when thirty—the youngest age possible.

out, and no very striking departure in general principles has since been introduced; indeed, the end of the pioneer stage may be said to have been reached at this juncture, giving rise to a new era in submarine telegraphy. As a result of the various precautions taken on the Persian Gulf line, it was in 1889 reported by the chief technical officer of the Indo-European Government Telegraphs[1] to be "one of the best ever made." Mr. Possmann at the same time reported that "the gutta-percha insulation is in excellent order, after submersion under most trying conditions for no less than thirty years." Now—when we consider the countless myriads of boring worms in that hot sea, and the fact that they have a great weakness for yarn and gutta-percha—we can the better appreciate what this means, and the value of the improvements introduced in the design of the cable.

For personal recollections of Sir Charles Bright in connection with the Indian Telegraph Expedition, the following graceful tribute from the pen of Mr. F. C. Webb—his chief engineering assistant—may here be reproduced. It appeared in the *Electrical Engineer* on the occasion of Sir Charles' death, and ran thus:—

I can recollect many little traits of character that struck me suddenly at the time, and that showed me he had a kindly heart. I remember once when, in my zeal for pushing on the work of fitting out the five ships for the Persian Gulf cable, I

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[1] *Official History of the Persian Gulf Telegraph Cables.* By Julius Possmann, Engineer and Electrician. 1889.

pressed Sir Charles to take some violent steps against Mr. Henley. "No," said Sir Charles, "I won't do that. Because we have the power of giants, that is no reason why we should use it!" I was silent for some time. I accepted the rebuke; and I hope I have since acted on his words, which showed a kindly and considerate heart.

Then again, I remember how Sir Charles used to whisper to me when we were paying out cable from the *Marian Moore* at night. "Come down below," he said; "my servant is opening a tin of Bath chaps"; and down we went, and I never enjoyed anything in the Persian Gulf so much as these little *impromptu* suppers to which Sir Charles was wont to invite me.

Once, I recollect, when we arrived on board the P. & O. steamer off Suez, we were absolutely starving; but so *Medes and Persian*-like were the laws of the P. & O. Company then, that as dinner was over, we could *not get a scrap to eat.* Sir Charles was always a model of discipline, and would not even raise his voice on the subject; but determined to suffer hunger in silence so as to show an example to his impatient and excitable assistant. We paced the deck in silent hunger for some time; then Sir Charles suggested that we should discuss quietly what we should *like* to have for dinner. I immediately fell into the idea. "Julien soup," I exclaimed. "No," said Sir Charles, in a grave tone, "half a dozen oysters, and a glass of Chablis." "Good," I said; "I see you understand the matter better than I do, Sir Charles. But still," I said in a pensive way, "Julien soup *would not* be bad on empty stomachs like ours; however, I waive the point, and accept the oysters, such as they are." "Let us go on to the fish," said Sir Charles, as we paced the deck faster and faster in the deepening twilight. "*Filet de soles au gratin* is a favourite dish of mine, Sir Charles. Would you mind me having that?" "Certainly, my dear fellow, by all means; but I must have some cod and oyster sauce to follow." "*Tête de veau en tortue* is not bad when you are nearly starving, and the stomach is in a weak state." "That is true," said Sir Charles, "but *petits pates à la Victoria* are not to be despised;" and so we went on, pacing the deck until we were obliged to " turn in " awfully hungry. I dreamt about that dinner, of course, all night, and then I awoke to a ship's boy bringing me a cup of P. & O. ship's coffee ; and I suppose that every telegraph engineer or electrician knows, to his own cost, what P. & O. morning coffee is. If they don't know, I advise them not to try to. I believe the P. & O. have reformed since then, so enough of that story ; but I shall *never* forget it.

Let me think again.

Once, when we were turning some cable over into a gunboat, about two miles off Bushire, a mistake, between myself and a young clerk, had been made as to the number of revolutions of the machine that was measuring the cable being transhipped to the gunboat. The mistake was discovered, and I was in consternation. We were shipping into the gunboat enough to land five shore ends. Sir Charles grasped the situation in a second, and instead of blowing me up (which " blowing up " I should probably have passed on to the real culprit, a poor harmless clerk), simply said in the coolest manner, " I will go ashore, Webb, and carry all the critics with me."

I could find in my memory, if I had time, many another little anecdote which would show the kindly feeling that existed in the heart of Sir Charles Bright. He always showed an unusual consideration towards all who worked under him, and had a genial word for every one—entirely irrespective of position.

CHAPTER IX

Politics and Parliament

FOR some time before the dissolution of Parliament in 1865 Sir Charles was approached by influential members of several constituencies as to becoming a candidate, but none of these attracted him. When making holiday in Wales, however, he heard that Mr. W. Angerstein, one of the sitting members for Greenwich, proposed contesting the county instead; and, after some deliberation, he consented to "stand" for the vacant Greenwich seat, being known to many in connection with the Atlantic cable and other important lines—most of which had been constructed at Greenwich. Many of his old staff and cable hands lived there, thus his name was almost a "household word."

As a first step, Bright sounded Mr. Charles Curtoys, an old telegraphic associate, who had long resided at Charlton, where he was a churchwarden. Mr. Curtoys took an active part in political matters, being chairman of the local Conservative Association, of which Mr. A. D. Wilson was the energetic secretary. Now though Sir Charles was a Liberal, he was moderate in his views, and by no means a Radical.[1]

[1] He was, in fact, what would to-day be called a Liberal Unionist.

Thus Mr. Curtoys at once favoured the idea of his candidature, and this gentleman's influence led to promises of support from an imporant section of the local Conservatives. As soon as his willingness to contest the seat was noised abroad, the moderate section of the Liberal party united in urging him to do so.

After expressing his political opinions at considerable length, and after going through the usual "heckling," he was adopted as candidate by acclamation in conjunction with the sitting member, Alderman Salomons.

Sir Charles Bright's address to the electors read as follows :—

To the Electors of the Borough of Greenwich

Gentlemen,—

Having received a requisition from many of the Electors of your Borough, inviting me to become a Candidate for your representation in Parliament at the ensuing election, I feel pride in accepting the invitation, and I have now the honour of soliciting your suffrages.

My political principles are, I believe, in unison with those of the majority of your large body.

I am well contented with the position of our country compared with that of foreign nations ; and attribute it to the superiority of its constitutional government. I am an earnest advocate of an Extension of the Electoral Franchise—conceived in the spirit of the Reform Bill of 1832, and applied to the present advanced condition of the population—so as to call into exercise more of the enlightened intelligence of the country.

In regard to the question of Voting by Ballot, I see no reason to think that it can be necessary for the protection of the independence of the British Voter to resort to a secret use of his rights.

While I am desirous of ensuring, by proper legislation, the maintenance of the fabric of the National Church, I am no less anxious to exempt from the payment of rates for such purposes all those who—from conscientious scruples—are opposed to the present system, thus removing all grounds of complaint against the Church of England, of which I am a sincere member.

With reference to the various social subjects that affect the welfare, comfort and independence of the people, and with respect to our relations with foreign states, by which the interests of the nation at large are influenced, many opportunities will be presented to me for affording to the electors the fullest information they may require as to my views on these and other public questions.

If you do me the honour of returning me as your representative, I shall take my seat as an independent supporter of the present Government, whose general measures have been fraught with so much proved benefit to the commercial and financial condition of the country.

I have the honour to be, Gentlemen,

Your faithful servant,

CHARLES T. BRIGHT.

1, VICTORIA STREET, WESTMINSTER.

Greenwich was in those days one of the most unwieldy boroughs existing, comprising the three towns of Greenwich, Woolwich, and Deptford, besides Plumstead, Charlton, Blackheath, and Lewisham, thus forming an exceedingly extensive and varied electorate to canvass. It was, in fact, the largest Metropolitan borough at that period. It has since been carved into three separate boroughs, but at that time a small army of paid canvassers, with a number of sub-committee rooms—mostly in public-houses—had to be engaged.

Many meetings and speeches were, of course, necessary, the latter requiring considerable cogitation as regards choice of subject, seeing that the shade of opinion varied not a little between Deptford on the one hand and Woolwich on the other. However, Sir Charles went through with it, never letting the grass grow under his feet. His speeches were duly reported at considerable length by the *Kentish Mercury* and other provincial papers. It would be impossible to reproduce these, but a report in *The Times* of one of them may be taken as a sample, and so is given here :—

ELECTION INTELLIGENCE

GREENWICH

A large meeting was held on Wednesday night at the Lecture Hall, Greenwich, to hear an exposition of the political views of Sir Charles Bright, whose address as a candidate for the seat about to be vacated by Mr. Angerstein, M.P., was published nearly a month since. Mr. W. Jones was called to the chair, and, after some preliminary remarks,

Sir Charles, who was received with great applause, referred to the extension of the franchise. The indifference which had existed for some time on this subject was now at an end, and a settlement would doubtless be arrived at during the coming Parliament. The present system of household qualification had many advantages—that of simplicity among the number ; but it failed to bring in many persons mentally and morally suited to exercise the franchise, even of a class who might be considered above the standard intended to be drawn. Men, whatever their station and intelligence, living with their parents, were excluded, and practically also lodgers. It was further complained—and apparently with much reason—that artisans were left out of thepresent system altogether ; in some boroughs, no doubt, a certain number were included, as in Greenwich, where many skilled mechanics were on the muster-roll; but the number could not be taken, at the extreme, as more than 10 per cent. of the whole, and the trading part of the community enjoyed the lion's share of the electoral power. Let them consider the position of that class. It was a third part of a century since the passing of the Reform Bill, and what gigantic strides had been made everywhere in that period. Railways, telegraphs, the penny post, and a crowd of improvements had been introduced, most important in their influence on the habits of the people. Nor had the political world been idle. In that time had occurred the abolition of slavery, as well as the repeal of the corn laws and navigation laws. The poor law had been reformed, as well as the criminal law, by which the punishment of death had been abolished for forgery, larceny and other crimes previously subject to the extreme penalty. Taxes upon knowledge had been removed, and many other liberal and progressive measures had been carried out. One wheel of the machine had, however, been stationary—the distribution of the voting power of the people—and this in the face of the admitted increase of education and habits of frugality everywhere. He would not inflict any statistics upon them to establish this, for it was incontestable; but he pointed to the late distress in Lancashire, arising from the sudden stoppage of the staple manufacture of the country, and the manly, uncomplaining, thoughtful conduct of the operatives during a long season of misfortune. On the grounds of education and intelligence, he, therefore, considered that the time had arrived for a re-consideration of the limits imposed upon the electoral scale thirty-three years since, and for a suitable downward extension of the franchise. To what extent and by what means should such an extension be made? It was considered by some that every man of sound intelligence and years of discretion had an inherent right to the suffrage, and some had also argued that women were entitled to it. Let them consider if that would be just. There were about a million of voters at present, and these would, of course, be placed at once in a minority by such a scheme being carried out. The chief business of Parliament was to determine the amount, mode of collection, and expenditure of taxes; and would be clearly unfair to those who paid the greatest part of the taxes, to commit these functions to a majority composed of those who paid the smallest part. They would, to use the words of a distinguished writer, "have every motive to lavish, and none to economise," and any voting power exerted by them in regard to funds to which they did not contribute would be contrary to all principles of free government. It was true that everybody paid taxes, to some extent, indirectly. But this was very different to a tax levied directly; and it would, at all events, be to the interest of indirect tax-paying voters to make sure that whatever increased expenditure they might carry by their votes, it should not be paid for by any increased taxation upon the tea or sugar, or other duty-paying articles, consumed by themselves. This might be met, no doubt, by some general system of direct taxation; but any change of that kind, even if the revenue could be so well collected, must necessarily be carried out by slow degrees, and they had to deal with things as they existed. There were also many glaring anomalies in the present distribution of the representation which it was, to his mind, almost as important to have corrected as to widen and deepen the limits of the franchise. That Honiton, with a population of 3,300 and 269 electors, or Portarlington, with 2,500 people and 106 electors, should each return the same number of members as Liverpool or Manchester was obviously a defect; and a majority in a division might not represent a tithe of population and property for which the minority appeared. Let them imagine the difference of property paying taxes if that qualification was to be regarded instead of population, in Liverpool, compared with Honiton. He did not, however, advocate an absolutely rigid system of numerical representation, but for the correction of many existing anomalies, which were comparable with Weymouth having four members before the Reform Bill. He considered that a complete and maturely considered plan should be carried, for rectifying the present deficiencies in the scheme of voting. It should comprise an extension of the suffrage both in counties and boroughs. It should also provide for revision of the representation, and ought to be sufficiently comprehensive to settle the question for another third part of a century. He would like also to see an extension of the present class of voters; and had no objection to what had been unreasonably sneered at as fancy franchises—such as that every person who paid income tax should have a vote, whether a householder or not.

He had stated in his address that he considered the vote by ballot unnecessary and unsuited to British institutions. A vote was not the private property of the voter, which he could sell or dispose of as he wished; it was a public trust, and should be publicly exercised. The well-known argument taken from the use of the ballot in clubs had been made use of to him by an elector. But in a club no sort of trust was involved, and the members had a positive right to express their opinions as to admitting a candidate for membership into their Society or not, and there was no sort of obligation to publish the fact or the reasons.

In respect to church rates, while the Church and State were united, the right of the latter to tax members of the Church for the support of the fabric could not be disputed. It was very different with those who did not take part in her services, or concur in her formularies. To Nonconformists the payment of church rates was a positive injustice. He would give his most earnest support to any system which might be devised for relieving them from this grievance, and at the same time the parish churches from falling into decay. Failing this—for the reasons he had given, as well as because as a member of the Church of England he was desirous that there should be no sense of injustice on the part of others—he would vote for the abolition of church rates, feeling sure that the gap would be filled up by the voluntary support of her members.

After some remarks upon the foreign policy of the Government and the distribution of the burdens of taxation during the last few years, Sir Charles stated that if elected he should take his seat as an independent supporter of Lord Palmerston's Govern ment—not necessarily following it in every groove, or pledging himself to vote with it on every question, but generally supporting liberal and progressive measures.

After an animated discussion—several speakers addressing the meeting at once—and a number of questions being put to the candidate upon the Permissive Bill, capital punishment, and other public topics, a resolution was proposed to the effect that the meeting having heard the political sentiments of Sir Charles Bright, was of opinion that he was a fit and proper person to represent the borough in Parliament, and pledged itself to support him at the forthcoming election.

An amendment, to the effect that the views of other supposed candidates should be heard before giving any pledge in favour of Sir Charles Bright, was rejected by an overwhelming majority—only twenty-five hands being held up in its favour.

The original motion was then put and carried by acclamation.

Bright was ably supported in Greenwich and Blackheath by his old friend, Mr. John Penn, the famous engineer, and father of the late Member for Lewisham. During a part of the canvassing period, Sir Charles was the guest of Mr. Penn at The Cedars, Lee, a pretty place through which the South-Eastern Railway runs. Another energetic and distinguished member of his general electioneering committee was the late Sir E. J. Reed, K.C.B., M.P., F.R.S., at one time Naval Constructor to the Admiralty. Sir Charles also shared, with Sir J. Heron-Maxwell, a partial support from the landed interest in the person of Sir Thomas Maryon-Wilson, Bart., of Charlton House, where he stayed more than once.

Bright was further supported at a number of the meetings by an elderly man with a name sounding somewhat like Hobart, who used to make his way from the crowd in front on to the platform in working garb—sometimes coatless, with his shirt sleeves tucked up. He had a great "gift of the gab," and interspersed workmen's jokes and sayings, which always evoked cheers and kept the crowd thoroughly entertained. He would wind up somewhat as follows :—

"Now, 'ere's Surr Charles. He's a real good working man he is. If his hands ain't horny, his head's hard for work, aye, and soft for us working men, and the work of his brain has given lots of good employment, and lots of good pay to heaps of us around about here. And he's a thorough sailor, like many more of us."

This style of advocacy always led to warm applause. It turned out that he was a paid speaker ; and, as far as was known, had not himself done a stroke of work for years—preferring rather to live by his tongue ! We see more of this nowadays than was experienced at that time.

But some of Sir Charles' actual cable hands also came forward, referring to him as the real working man's candidate, and speaking of his having "shared grub with them"—which was, more or less, true—on board ship, etc. Some boatloads of these used to come over from Henley's and Silver's Telegraph works, on the other side of the river, to take part in the meetings, besides most of the hands from the Telegraph Construction Company's Greenwich works, with whom he had had so much to do in connection with the Atlantic cable.

There were five candidates for two seats: Alderman Salomons, the old sitting member; Sir John Heron-Maxwell, a strong Tory ; Sir Charles Bright ; Captain Douglas Harris, professedly Liberal ; and Mr. Baxter-Langley, an "advanced" Radical.

In the result, the voters showed their preference for moderate men by returning Alderman Salomons, the old member, at the head of the poll, Sir Charles being second with 3,678 votes, or a majority of 1,237 over Sir J. Heron-Maxwell, whilst Captain Harris and Mr. Baxter-Langley were "nowhere." At the declaration of the poll, Sir Charles Bright and Alderman Salomons addressed an immense crowd from the hustings, and were received with the usual enthusiasm which accompanies success.

Sir Charles—considerably the youngest of all the candidates—was the only man who had ever succeeded for the first time at a Greenwich parliamentary election.

On his entry into Parliament Sir Charles did not join the ranks of the too voluble members. He seldom spoke, but when he did, his speech was concise and to the point, and dealt with subjects he knew thoroughly. In fact, he never got up on his legs without having something useful to say.[1] He voted consistently, and was scarcely ever absent from a division.

Sir Charles always did his best for his constituents. Among other matters, he joined with Mr. Otway, M.P.

[1] This remark applies equally as regards the scientific meetings connected with his profession. Sir Charles was, indeed, essentially a man of action rather than of words—or papers. Nevertheless, he was once characterised in print as "an engineer who could talk the leg off an iron pot !"

for Chatham, in repeatedly urging upon the Tory Government the need of some improvement in the wretched pay (about fourteen shillings per week) then doled out to the dockyard labourers—remembering, as he told his constituents, the advice of President Lincoln: "If you keep on pegging away, some good may come."

The subject of this biography could, however, speak at length—and well, too—when occasion demanded it. His addresses at meetings in Kent sometimes extended to two or three newspaper columns; but then, of course, on such occasions the whole region of current politics had to be traversed.

CHAPTER X

1865–1869

DURING 1865 the Aëronautical Society[1] of Great Britain was founded by Sir Charles Bright—in conjunction with the Duke of Argyll and Mr. James Glaisher—with the object of fostering and developing aeronautics and aerology; and to this matter he gave much careful attention, notwithstanding his arduous professional and political engagements.

The Inquiry into the Construction of Submarine Telegraphs

Aroused by the failure of the Red Sea line—the losses of which amounted to more than half a million sterling, and to which a continuous Treasury guarantee had been given—the Government, before undertaking further responsibility, had resolved some years previously to thoroughly investigate the entire question of submarine telegraphy, and appointed a committee for the purpose.

This Committee, with Captain Galton, R.E.,[2] in the chair, representing the Board of Trade, devoted twenty-two sittings

[1] Afterwards the Balloon Society.

[2] Then of the War Office, and afterwards Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.

to questioning engineers, electricians, professors, physicists, seamen, and manufacturers, who had taken part in the various branches of submarine work, and whose knowledge or experience might throw light on the subject. Investigations were instituted concerning the structure of all cables previously made or in course of manufacture, and the quality of the different materials used, as to special points arising during manufacture and laying, on the routes taken, on electrical testing, and on sending and receiving instruments, speed of signalling, etc. Eminent scientists and engineers, including Professor Wheatstone, Professor Thomson, Sir Charles Bright, Mr. R. S. Newall, Mr. R. A. Glass, Mr. Wildman Whitehouse, Mr. Latimer Clark, Mr. Samuel Canning, Mr. C. W. Siemens, Mr. Willoughby Smith, Mr. C. F. Varley, and Mr. F. C. Webb made known to the Committee the science and practice of cable making and laying.

The finding of this Committee was published by order of the Government, as also the reports of the meetings and descriptions of the experiments, together with papers and drawings sent in by the experts who were consulted, the whole being included in the form of a Parliamentary Blue Book—the result of work which will ever be considered a model of scientific investigation.[1]

[1] Referring to this Blue Book, Sir Charles, in his Presidential Address of 1887 to the Institution of Electrical Engineers, remarked : "I consider it to be the most valuable collection of facts, warnings and evidence which has ever been compiled concerning submarine cables, and that no telegraph engineer or electrician should be without it, or a study of it. It is like the boards on ice marked 'Dangerous' as a caution to skaters. The succinct report of the Committee at the beginning of the book, which is, of course, based on the evidence obtained, should especially commend itself."

Second and Third Atlantic Cables, 1865-66

As has been already mentioned, benefiting by the evidence and conclusions of this exhaustive inquiry, coupled with the experience gained in the various lines since the First Atlantic Cable, at last (in 1865) another Trans-Atlantic line came to be embarked upon. As we have seen, this, and yet another, was in the end successfully carried out, the type of cable advised by Bright being the same as that which he (Sir Charles) had recommended in 1859 for the then proposed connection with Gibraltar.

To celebrate the Atlantic cables a great banquet was given at the instigation of Mr. Cyrus Field, when that gentleman was in London. It was held at the Palace Hotel, and was graced by many distinguished personages in the political and scientific world.

Besides the subject of this biography, the company included the Right Hon. James Stuart Wortley, M.P., Mr. Thomas Brassey, M.P., Mr. Samuel Gurney, M.P., Mr. R. W. Crawford, M.P., Sir Daniel Gooch, Bart., M.P., Sir George Elliot, Bart., M.P., Mr. Charles Edwards, M.P., Mr. W. C. Romaine, C.B., Captain Mackinnon, R.N., M.P., Captain (afterwards Rear-Admiral) Sherard Osborn, R.N., C.B., Captain Richards (afterwards Rear-Admiral Sir George Richards, K.C.B., F.R.S.), Professor Sir Charles Wheatstone F.R.S., Sir Charles Fox, Captain Galton, R.E. (afterwards Sir Douglas Galton, K.C.B., F.R.S.), Mr. W. T. Henley, Captain Sir James Anderson, Sir Samuel Canning, Mr. John Chatterton, Mr. Willoughby Smith, Mr. Henry Clifford, Mr. Richard Collett, Mr. W. Shuter, Mr. H. Weaver, Mr.

T. H. Wells, Mr. William Barber, Mr. Charles Burt, and Mr. J. C. Parkinson, besides Mr. John Walter and Dr. W. H. Russell, both of *The Times* newspaper.

In the course of the proceedings Mr. Field said :—

Ladies and gentlemen, we have here to-night a gentleman who was one of my earliest friends in the Atlantic Telegraph, and who, for the distinguished part he took in the expeditions of 1857 and 1858, was knighted by Her Majesty. He is now a member of the House of Commons. I hope we shall hear from Sir Charles Bright.

Sir Charles Bright, M.P., rose and said :—

Mr. Field, ladies and gentlemen, I was not expecting to be called upon as a member of the House of Commons this evening, for the occasion upon which we have met together, and the recollections it has brought up, made me lose sight of myself for the time being in any other capacity than that of an engineer.

We have had a most able expression of the kindly feeling and goodwill which in reality exists between us in this country and that great nation which is uppermost in our minds to-night, and we have also heard something about the possibilities, or contingencies, of difference between us. Well, I for one do not think there is any likelihood of our being very long in an unfriendly position towards each other while such a communication as that which we have witnessed in this room continues in operation [1]; for while the electric telegraph is a most deadly instrument in times of war, I regard it as the most effective engine that statesmen can have in their hands for maintaining peace between nations. (Hear, hear.)

The changes which an earlier invention of the telegraph would

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[1] A wire had been led into the room, in connection with the Atlantic cable, by which various messages were sent to the States and replies received during the evening.

have made in the history of events in the world can hardly now be followed out, and there is room for a treatise to be written by some ingenious person upon the occurrences which would not have happened if telegraphs had been there to prevent them. We need not go far for an example. If we look back at the lamentable war between England and the United States at the beginning of this century we find that certain Orders in Council, which were obnoxious on the other side of the Atlantic, were actually withdrawn or cancelled at the very time that war was declared on their account by the American Government. So, too, at the end of many wars, it has happened that thousands of lives have been sacrificed through the tardiness of communication; as, for instance, the battle of Toulouse[1]—after peace had been settled between France and England—which would have had no place in history if electricity had then been trained to our service.

That the story of our suppression of the Sepoy revolt in India, in 1857, would have been a much longer one but for the telegraph is fully recognised; and, in connection with this, I remember a circumstance at a much earlier date, which was, at the time, almost prophetic. When the telegraph between London and Southampton was opened, in 1843, the meeting of the British Association was being held at the latter place. Lord Palmerston, who was a landowner in the neighbourhood, took an active interest in the proceedings, and, in referring to the telegraph, he said that the time might come when, supposing a mutiny broke out in India, the Government would telegraph instructions to the Governor-General in Calcutta as to the steps to be taken to repress it.

And this reminds me, gentlemen, that while we are celebrating the beginning and completion of the Atlantic Telegraph, there remains yet a good deal for us to do. England must have a more perfect communication with her Eastern Colonies—we must have an independent line of our own to India, and onward to

[1] An uncle of Sir Charles, Major Henry Bright, in command of the Royal Irish Fusiliers (87th Regt.), was shot dead when leading his men in this battle.

Australia and China. (Cheers.) There are men at this table who have done great things, but there is ample work in the future. I hope that we may all meet together, at no very distant time, to congratulate ourselves upon the success of further labours, when the seas shall cover wires communicating like nerves between every great centre of thought and action in the world.

I should get too enthusiastic and make a long story of it were I to attempt to describe the extent to which I expect submarine telegraphy will be carried in the time even of this generation; and I will therefore resume my seat, thanking you again for your kindness in coupling my name with a toast at such a triumphant banquet as this. (Prolonged cheers.)

Later on, the following cable message was received from Professor Samuel Morse, LL.D., in America :—

Greeting to all met to perform an act of national justice. May this divine attribute ever be the companion of the telegraph in its true mission of binding the nations of the entire world in bonds of peace! Special greeting to Cyrus Field, Sir Charles Bright, and Sir William Thomson, as also to Cooke, Wheatstone, and Whitehouse.

Hooper's India-Rubber Cables

Almost from the earliest days of submarine telegraphy the question of adopting india-rubber for insulating the conductor had been a subject of consideration. Mr. C. V. West—in connection with Messrs. Silver and Co.—was probably one of the first champions of india-rubber for this purpose. He had not only proposed to lay an india-rubber insulated cable to France before the Channel line was laid, but actually submerged short experimental lengths in Portsmouth Harbour and elsewhere about that time.

Then again, Mr. (afterwards Sir C. W.) Siemens had devised a special form of india-rubber coating for submarine wires, and considerable lengths were made by his firm at an early date.

But in all the foregoing the india-rubber, more or less pure, was subject to serious deterioration by change of temperature and general conditions. It was not, indeed, until the late Mr. William Hooper conceived the idea of applying the system of vulcanization to india-rubber-covered wires, that very practical success was met with in this direction. Mr. Hooper's first patented process had come out in 1859, followed by improvements in 1860, 1863, and 1868.

The strong point about india-rubber as an electrical insulator was its high resistance and low inductive capacity compared with gutta-percha. But its manufacture was a less simple matter from first to last; and much credit is due to the late Mr. Hooper for developing the art to the extent he did. Shortly before this he had submitted specimens of the core made by the Hooper material and process to various eminent engineers, electricians, and chemists for their opinion. Besides being reported on by Sir Charles and his partner, Mr. Latimer Clark, its qualities were also testified to by Sir William Thomson, Sir Charles Wheatstone, Mr. Wildman Whitehouse, Dr. Miller, Dr. Frankland, Mr. C. F. Varley, Professor Fleeming Jenkin, and Mr. F. C. Webb, but the report of Messrs. Bright and Clark was of a specially exhaustive character.[1]

Thus, about this time, Hooper's core came into high repute.

[1] The full report is embodied in Appendix 13 to Vol. II of the original biography.

It was adopted for river crossings in India, and when, shortly afterwards, an additional cable was determined on for the Persian Gulf, Hooper's core was selected for the submarine portion of the line.[1]

Improvement of Communication with India and the East.

Perhaps one of the most important matters which Sir Charles Bright took up in Parliament was the improvement and acceleration of the mail and telegraphic communication with India and the East. Indeed, ever since he had laid the Indian cables, he had been indefatigable in his endeavours to improve the land line connecting links.

It will scarcely be realised now that in 1866 the contract speed of the Peninsular and Oriental mail steamers was only 8½ knots in vessels of 800 tons; and that the Australian mails were taken on from Point de Galle *once a month* at the same speed *in 600 tonners.*

But the telegraph service was still more indifferent; for although the cable laid by Sir Charles in 1864, between Fāo, at the head of the Persian Gulf, and Karachi, was worked well and quickly by the trained English staff, yet, owing to the crass ignorance and indolence of the Turkish staff between Constantinople, Baghdad, and Fāo—coupled with the inefficiency and venality of the half-castes em-

[1] India-rubber core is probably better suited for underground lines in tropical climates than gutta-percha. It is also proof against the teredo and other submarine borers.

All the india-rubber core as used in the present day for electric light mains, torpedo cables, etc., is manufactured on the principle of Hooper's process. It is also still adopted for cables laid in certain teredo-ridden waters.

ployed by Government on the Indian side—messages constantly took a week, and sometimes letters dispatched from England at the same time were delivered first! Besides this, the messages were mostly incorrect and often mutilated by the apparently intentional omission of parts. As for the Turks, they would often from sheer apathy allow their apparatus, or wires, to be out of order for days together rather than devote an hour or two to repairs. Notwithstanding constant complaints and urgent representations from all sides, the Turkish Government were so jealous that they would not allow a land wire between Constantinople and Fāo to be worked by English operators, though the traffic was even then at the rate of £100,000 per annum.

With a view to remedying this state of things, Mr. R. W. Crawford, M.P. for the City of London, and Sir Charles Bright took up the cudgels. Thus in the House of Commons, on February 27th, 1866, an important discussion was initiated by Mr. Crawford on the wretched working of the land lines in Turkey and India connecting up the 1,300 miles of cable laid in the Persian Gulf in 1864. He was followed by Mr. Horsfall; and Sir Charles contributed his quota, as follows:—

Sir C. Bright, having been practically engaged in the construction and laying down of the portion of the line under discussion, hoped the House would permit him to add the expression of his regret that a line with which much pains had been taken, and which had cost much money, should have occasioned such disappointment.

He took it for granted that the Turkish Government was desirous of carrying out the convention; but so little interest did the Turks feel in the matter that the line between Bussorah and Baghdad was delayed for a year, owing to some miserable local squabble, and operations in the Turkish dominions had been retarded ever since. The working of the Indian line had been described as "the most wretched in the world." He had met a gentleman waiting as long as seven days at Bombay for a telegram, and he had himself been obliged to wait for two or three days for a message between Karachi and Bombay—a distance of 500 miles. It would be difficult to exaggerate the importance of this line in a political sense, and while it was working so badly it would be impossible to extend our telegraphic system through to Australia and China. (Hear, hear.[1])

To obviate so serious an impediment to prompt and accurate communication, he (Sir C. Bright) wished to call attention to the importance of carrying a second line from England, by direct submarine cable to Gibraltar and Malta, to connect up the existing Malta and Alexandrian cable and the Egyptian land lines; thence by a cable to Aden and Bombay, so as to avoid the delays, and errors arising from transmission at the hands of those working the present land route, comprising half-educated half-castes, Turks, Austrians, etc., who all combine in mutilating and mangling the plain English of our messages. (Applause.)

Finally, he (Sir C. Bright) wished to point out that by what was known as the Turkish route a message was liable to be dealt with by no less than ten administrations before passing into British hands—a matter which the honourable gentleman ventured to think required our serious consideration and a speedy remedy. (Cheers.)

Mr. Moffatt, Mr. Childers (for the Government), and Mr. Ayrton continued the discussion, which led to the appointment of a Select Committee on "East India Communications," of which Sir Charles proved one of the most active members. The other members of the Committee were:—

[1] *The Times*, February 28th, 1866.

Mr. Crawford (in the chair), Lord Stanley, Lord Robert Montagu, Sir Henry Rawlinson, Admiral Seymour, Mr. John Laird, Mr. (afterwards the Right Honourable Sir James) Stansfield, Mr. Acton Ayrton, the Right Honourable Hugh Childers,[1] Mr. T. M. Weguelin, Mr. Charles Turner, Mr. H. J. Bailie, Mr. G. Moffatt, and Mr. Charles Schreiber, whilst at a later period Mr. Ward Hunt (the Chancellor of the Exchequer) and Sir James Fergusson were added.

The sittings extended from March 13th, 1866, till July 20th, and culminated in an exhaustive Report, with a Blue Book of nearly 700 pages. Some sixty witnesses were examined, commencing with the principal postal and other Government officials (Mr. Frederick Hill, the Contract Secretary, and others), together with the chiefs of the Indian Telegraphs—Col. Frederick Goldsmid, Col. D. J. Robinson, R.E., Gol. Richard Strachey, R.E., Major J. U. Bateman-Champain, R.E., besides Capt. James Rennie, C.B., and Mr. W. T. Thornton of the India Office. All of these gave valuable information as to the mail and telegraph service.

The tardiness of letters and gross telegraphic irregularities were testified to by many merchants of eminence, including Messrs. Henry Nelson, representing Crawford, Colvin & Co., Charles Shand, W. H. Crake, Patrick Campbell of the Oriental Bank, Robert Gladstone, G. McMicking of Ker, Bolton & Co.; C. J. Robinson, and John Green, of Ralli

[1] Mr. Childers was at that time representing Pontefract, near which Badsworth Hall—an old seat of the Bright family—is situated. As a fellow Yorkshireman, as well as for other reasons, he and Sir Charles had much in common and were close friends.

Brothers. They were all unanimous in condemning the existing state of things; as were the Hon. R. Grimston (Chairman of the Electric Telegraph Company) and Sir James Carmichael (Chairman of the Submarine Telegraph Company), who pointed out that the public blamed their companies—to whom the messages were originally handed—for the misdeeds of the Turks and Indian "half-castes." Sir Macdonald Stephenson, Chairman of the Telegraph to India Company, with Mr. Latimer Clark, C.E., furnished important details about the cause of failure of the early cable from Suez to Bombay in 1859, on the £800,000 of whose capital the Government had, too hastily, given a subsidy.

With reference to the question of providing speedier steamers and the cost of an accelerated service, Mr. Joseph d'Aguilar Samuda, M.P.—perhaps the highest living authority on shipbuilding, and a friend of Sir Charles'—put in most valuable evidence, making many suggestions that were shortly afterwards carried out. As regards through cables and their construction, all requisite knowledge was imparted to the Committee by such experts as Mr. H. C. Forde, C.E.; Mr. R. A. Glass, Managing Director of the Telegraph Construction Company; Mr. C. W. Siemens, C.E.; and Prof. Fleeming Jenkin, C.E.

Throughout this prolonged inquiry Mr. Crawford, the Chairman, and Sir Charles were in constant attendance. After the Chairman, Bright was, perhaps, the most active at the many meetings, taking part, as he did, in the examination of a large proportion of the witnesses.

With reference to the mails, the Committee strongly recommended increased expenditure for more frequent services, and an additional speed of about two knots which was shown to be practicable. In view of the then approaching completion of the main railway system in India, they also recommended that Bombay should in future be the principal port of call.

The following were the recommendations arrived at by the committee, in regard to the telegraph side of the inquiry [1] :—

(1st) That, having regard to the magnitude of the interests —political, commercial and social—involved in the connection between this country and India, it is not expedient that the means of intercommunication by telegraph should be dependent upon any single line, or any single system of wires, in the hands of several foreign governments, and under several distinct responsibilities, however well such services may be conducted as a whole, in time of peace.

(2nd) That the establishment of separate lines, entirely or partially independent of the present line through Turkey, is therefore desirable ; and, in that view, that means should be taken for improving the condition and facilitating the use of the lines of telegraph which connect the Persian system with Europe.

(3rd) That, with the view to better security against accident in time to come, the communication by the way of the Persian Gulf should be doubled, either by the laying of a second submarine cable, or by continuing the land line from Karachi and Gwadur to Bunder Abbas, and thence, under arrangements with the Government of Persia, to Ispahan, by way of Kerman and Yezd.

(4th) That the scheme for establishing a direct communication between Alexandria and Bombay, by way of Aden—on the principle of a line practically under one management and

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[1] Report on "East India Communications," Parliamentary Blue Book, 1866, p. viii.

responsibility, between London and the Indian Presidencies in the first instance, and afterwards with China, Japan and the Australian Colonies—is deserving of serious consideration and such reasonable support as the influence of Her Majesty's Government may be able to bring to its aid.[1]

(5th) That considering the great outlay of guaranteed railway capital already incurred in the establishment of the telegraph on the several lines of railway in India, it is expedient that means should be taken for affording the public the utmost benefit attainable from that expenditure. It is suggested that this could be effected either by the Government of India sanctioning the use of the wires of the companies by a public company willing to rent the privilege on equitable terms, or by such an organisation of the several independent companies as will establish a unity of system, and bring the use of the lines fairly within reach of the public.

(6th) That the magnitude of the interests involved in the trade of this country with China and Australia, and the rapidly increasing development of the colonies, render it desirable that arrangements should be made to bring these communities within the reach of telegraphic communication with Europe.

(7th) The Committee also finally urge upon the Indian authorities the absolute necessity in the meantime of improving their internal arrangements, so as to remove all risk of delay in the transmission of messages from Karachi to the interior.

Extension to the Far East

Shortly after he had laid the Indian cables and the connecting links were in some sort of working order, Sir Charles began to urge the question of extensions to Australia on the one hand and China on the other.

He commenced the public ventilation of the subject in

[1] This suggestion of Sir Charles Bright was afterwards realised in the present vast system of the Eastern Telegraph Company.

what has become a somewhat recognised fashon—i.e. by writing a letter to *The Times* on the subject. Just as Charles Bright had been an original projector of the Atlantic cable, so also in this matter he was the first in the field. The result was that his letter met with some opposition from an anonymous writer. The lines which Sir Charles advocated have, of course, since been laid without any conspicuous difficulties being met with [1]; and it is somewhat amusing in the present day to read the sort of objections that were then raised by "C." and others.

In the course of this correspondence—as well as in his Institution of Civil Engineers' paper [2] later—Charles Bright pointed out that owing to the already existing land-line system of the Indian telegraph, when the Persian Gulf and Mekran coast cables were laid, electrical communication existed as far eastward as Rangoon. He then drew attention to the fact here, in the House of Commons, and at the Select Committee on "East India Communications," that "there would be no difficulty in selecting a cable route with a favourable bottom from Rangoon, at a short distance from the coast, to Singapore." He further pointed out that "between Singapore and Hong-Kong a cable could be readily carried in shallow water, touching at Saigon; or the connection with China may be effected by crossing the peninsula and laying a cable across the Gulf of Siam." Sir Charles then went on to say that to effect the same object a land line of telegraph was possible from Rangoon through Bur-

[1] They now form a part of the system of the Eastern Extension, Australasia and China Telegraph Company.

[2] *Inst. C.E. Proc.*, vol. xxv.

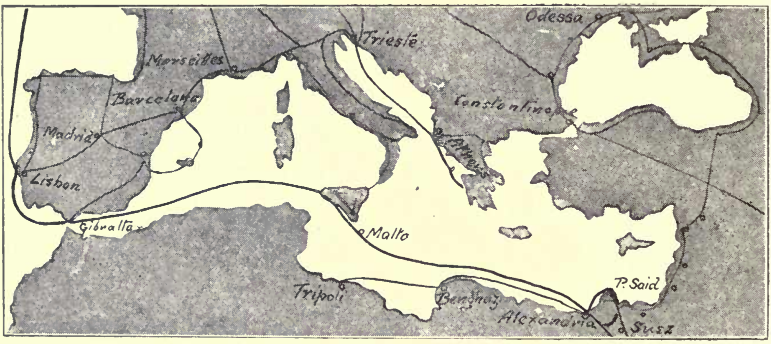
mah and Western China; "but," he added, "in uncivilised countries, communication by the aid of submarine cables, whenever practicable, is far more reliable." Bright then said: "Proceeding southwards from Singapore towards Australia, the first section, to Java, can be laid in shallow water, and hence to Timor. Indeed, with the exception of a short distance to the south of the latter island—as yet not surveyed by soundings—the remaining link to Australia can certainly be laid in shallow water." Finally, Sir Charles remarked: "The Australian telegraphs already extending between Adelaide, Melbourne, Sydney, Brisbane, and Port Denison—a distance of about 2,400 miles—are being pushed on northwards from the latter place towards the Gulf of Carpentaria. As the whole of the intermediate country is being rapidly occupied by settlers, there will be little difficulty in completing the link between the Australian telegraph system and the landing point of the cable." [1]

The first Company promoted with a view to putting these views into effect was the Oriental Telegraph Company, at the instance of Mr. Charles Edwards, M.P., and his associates of the Telegraph Construction Company. Sir Charles was asked to act as technical expert in connection with this project. It was, however, subsequently abandoned in favour of others of a less ambitious character.

[1] The full *Times* correspondence—as well as articles in *The Observer* and *Saturday Review* on the same subject—are given in Appendix 15 to Vol. II of the original biography.

The Anglo-Mediterranean Cable

The first was that of the Anglo-Mediterranean Telegraph Company, formed in 1868 for the purpose of providing a direct and thoroughly efficient line of telegraph to Egypt. With this view a contract had been entered into for the purchase of certain lines through Italy, etc., and short lengths of cable which formed a connecting link with the French continental lines in communication with the Submarine



TELEGRAPHIC COMMUNICATION TO THE EAST, 1868

Company's system. Then, besides taking over the old Malta and Alexandria cable of 1861, the Company undertook to establish fresh communications between Malta and Alexandria, by means of a direct deep-water cable of about 900 miles across the Mediterranean. This was found necessary owing to the constant failure of the old line between these points, which had been laid on a bad bottom in shallow water, touching at intermediate points along the north coast of Africa.

The new cable was laid with complete success. The Telegraph Construction and Maintenance Company were the contractors, whilst Sir Charles acted in the double capacity of engineer and electrician to the "Anglo-Mediterranean" Company. This line gave every satisfaction afterwards as regards its working. The core was composed of copper conductor = 150 lb. per nautical mile, and gutta-percha dielectric = 230 lb. per nautical mile. The speed obtained was ninteen words per minute.

The above afterwards formed the European end of that vast world-wide system of electro-metallic nerves to the East and Far East, now owned by the "Eastern" and "Eastern Extension" Telegraph Companies.[1]

Bright went out on the expedition. He journeyed overland to join the ship at Marseilles, being busily engaged over parliamentary matters up to the last moment. From Marseilles he proceeded a day later to Messina, and there the first boat was taken for Malta, which was reached on September 23rd, 1868. Here Bright spent two days with the Governor (Sir Patrick Grant, G.C.B.) and also visited the telegraph station. The following day the expedition started from Malta on the work of laying a direct cable to Alexandria, which, as before stated, was performed without hitch; the completion being effected on October 4th. That evening we find Sir Charles dining with the Consul-General, the following day visiting Cairo, and afterwards the Pyramids with Mr. Douglas Gibbs[2] and other friends. After staying for three days in and about Cairo, for a fair, a religious fête,

[1] Vide *Submarine Telegraphs*.

[2] Formerly of the Electric Telegraph Company. Mr. Gibbs was representatve in Egypt of the cable system.

and other social functions of interest, Charles Bright and his party returned to Alexandria in time to catch the P. & O. boat *Manilla,* for Marseilles. From there Sir Charles journeyed direct to Paris, which he left the same day by the tidal train for home.

In connection with this new Mediterranean link, it may be mentioned that Bright—in collaboration with Mr. A. S Ayrton, M.P.—arranged a concession with the Austrian Government for a system of cables between Trieste, Ragusa, Corfu, and Malta, which afterwards culminated in the system of the Mediterranean Extension Telegraph Company, and was eventually merged with others.

British Indian Lines

The next great cable project with which Sir Charles was associated (beside his brother Edward, who acted as Secretary) was that of the British Indian Submarine Telegraph Company. This was the outcome of the previously referred to Anglo-Indian Telegraph Company which had been formed in 1867 for the purpose of establishing direct telegraphic communication to India, by means of submarine cables, instead of relying upon land lines to the Persian Gulf, and a cable thence as heretofore. The "Anglo-Indian" Company, however (which had acquired the Egyptian landing rights of the "Red Sea" Company, and had secured as their engineers Sir Charles Bright and Mr. Latimer Clark), failed at the time to raise sufficient capital for carrying out the entire enterprise. This long and important line between Suez and Bombay was ultimately manufactured and laid a year later by the Telegraph Construction Company.

British Indian Extension, etc., Lines

Next we have the extensions of the above lines. These extensions were to start from the Indian telegraph system to Penang, hence to Singapore. From the latter there were to be two branches, one towards Australia via the Straits Settlements, and the other up to Hong-Kong and other Chinese ports in which England was commercially interested. The line was afterwards further extended to Japan. This scheme was, in fact, the outcome of Sir Charles' original project, as set forth in *The Times*, in his paper on "The Telegraph to India," in the House of Commons, in Parliamentary Select Committees, and elsewhere. Besides the Oriental Telegraph Company previously referred to, another, entitled the Anglo-Australian and China Telegraph Company —of which Messrs. Bright & Clark and Messrs. Forde & Jenkin had undertaken to act as engineers—had been formed several years before. But it was left for the combined forces of the newly formed British-Indian Extension Telegraph Company, the China Submarine Telegraph Company, and the British-Australian Telegraph Company—at a time when more faith prevailed in submarine telegraphy —to realise the project; and from what has been said it will be seen that it was only in the nature of things that Sir Charles should have become the engineer to the above undertakings. In this capacity he was partnered by Mr. Latimer Clark and Mr. H. C. Forde.

All these lines (entailing an enormous length of cable) were eventually laid with complete success within three years by the contractors, the Telegraph Construction Company.

Marseilles, Algiers and Malta Line

It was about this time that the Marseilles, Algiers, and Malta Telegraph Company was founded. This project —viz., the telegraphic connection of these important Mediterranean ports by means of a cable touching the Algerian coast at Bona—was also successfully accomplished. One of the objects of these scheme was to avoid the necessity of English messages going through the Italian lines, which were worked so badly—or, indeed, any other land wires than those of France.

Falmouth, Gibraltar and Malta Cable

A few months later the Falmouth, Gibraltar, and Malta Telegraph Company was formed, to complete a direct submarine communication by telegraph between Great Britain and her Eastern possessions. Thus our fortresses at Gibraltar and Malta—as well as our fleets—would be in ready communication with the home Government ; and our messages to and from the East would no longer be dependent upon the goodwill or political condition of any continental nation ; besides that, the ordinary interruptions common to land wires were avoided. As we have seen before, the Government had such a link in mind several years previously, and Sir Charles had even been requested to draw up a specification for the cable ; but it was decided that owing to the existing continental land lines, other submarine communications were more urgent. It was for the same reason that the Falmouth, Gibraltar and Malta Company was preceded by the flotation of concerns for laying cables to India and the Far East. As the result of pressing advances on the part of the Portuguese Government, this cable was ultimately taken into Carcavellos, Lisbon, on its way to Gibraltar. The starting-point chosen for it eventually was not Falmouth but Porthcurnow, a quiet spot about ten miles from the Land's End—the Company leasing a land line between there and London. For the purposes of this last contract, Sir Charles and Mr. L. Clark stood in the position of engineers to the Company, whilst Mr. Edward Bright was the first Secretary.

All the above-mentioned schemes were put into effect during that peculiarly busy telegraphic period characterising the end of the seventh and the beginning of the eight decade of last century. The cables were, in each instance, laid by the Telegraph Construction Company, although owing to the great pressure of business at that firm's works, the manufacture of certain portions was undertaken by Mr, Henley.

Rival Schemes

Quite a number of rival companies were "floated" about the same time for effecting telegraphic communication with the East, Far East, America and other parts of the world—some effective, some otherwise. The schemes, however, we have dealt with were those which were actually carried out, or with which Sir Charles was associated.

In some of these rival projects it was proposed to adopt a cable without any iron sheathing. This was notably so in the case of the Direct English-Indian and Australian Submarine Telegraph Company's proposed line, of which Sir William Thomson and Mr. C. F. Varley [1] were the consulting electricians, but this project never took a practical shape —indeed, notions of cables of this stamp were soon afterwards entirely abandoned.

The "Eastern" Companies

Some two years later the four companies owning the cables on the direct route to India were amalgamated into the now world-famous Eastern Telegraph Company. These companies and their cables (already referred to) were the so-called "Falmouth, Gibraltar, and Malta"; the "Marseilles, Algiers, and Malta"; the "Anglo-Mediterranean," and the "British-Indian." To all of these Sir Charles Bright acted as consulting engineer. Their amalgamator and successor, the "Eastern" Company, now possesses by far the largest and, from a national point of view, the most important telegraphic system in the world. It was promoted under the chairmanship of Mr. Pender (afterwards Sir John Pender, G.C.M.G., M.P.), with Lord William Hay (now Marquis of Tweeddale) as vice-chairman; and Sir James Anderson [2] became the general manager.

[1] Mr. Varley had always been a great advocate for unsheathed cables, just as Charles Bright had been opposed to them.

[2] Succeeded, since his death in 1893, by Mr. (now Sir) John Denison Pender, K.C.M.G., the present managing director.

This consolidation having been accomplished, in the following year the Eastern Extension, Australasia and China Telegraph Company was formed for absorbing those companies which owned the extension lines to the further side of India, the Straits Settlements, China, and Australia, previously alluded to. The companies thus incorporated were the "British-Indian Extension," the "China Submarine," and the "British-Australian." The board of this amalgamating company was an equally strong combination to that of the "Eastern" Company—being, in fact, very similarly composed.

Parliamentary Life

A short time after Charles Bright had been elected member for Greenwich, Lord Palmerston's death took place and Earl Russell became leader of the Liberal party.

In February, 1868, Bright questioned the Secretary of the Treasury as to the Government's proposed Bill to acquire the Telegraphs, with a view to keeping the "Magnetic" and other Companies advised; and on the subsequent introduction of the measure by Mr. Ward Hunt, the then Chancellor of the Exchequer, he found its clauses were of a very confiscatory nature and obviously unfair to those who had developed the business and run all the risk. In combination with Mr. Milner Gibson (afterwards Lord Houghton) he, therefore, opposed the second reading, and caused its postponement. This resulted in reasonable terms being arranged in the interval between the Government and the companies.

About the same time, Sir Charles also associated himself with Sir Thomas Fowell Buxton, Mr. Ayrton, Mr. John Locke and Mr. John Hanbury—all fellow-members of the House of Commons—in strenuously advocating the equalisation of poor rates in the Metropolitan parishes. He pointed out that in the East and South-East districts of London, possessing the poorest population—and where naturally there was a greater proportion of paupers—the rates under the existing system were, most unfairly, the heaviest.

This session closed Sir Charles' Parliamentary career; for he was so closely engaged professionally that it became impossible to devote the requisite time to politics. Moreover, it was a very expensive borough in many ways, partly on account of its wide range at that period. It had, indeed, already cost Sir Charles over £4,000, and he had experienced many pecuniary losses of late. As a matter of fact, at the actual moment he was unable to return from Havana, where he was engaged—as we shall see further on—in the submersion of a cable between Cuba and Florida, which was destined afterwards to form the connecting link (devised by him) for bringing the West India Islands and the East and West Coast of South America, into communication with the United States, Europe, etc.—indeed, with the rest of the civilised world.

Thus, although strongly urged by his constituents at Greenwich to come forward at the dissolution at the end of 1868, he felt obliged to decline. This he did in the following terms, as taken from *The Times* of October 10th, 1868 :—

The following is the copy of a letter just received from Sir C. T. Bright, M.P., in which he declines being put in nomination again as a representative for the borough of Greenwich:—

MALTA, *September 25th.*

MY DEAR SIR,—

I have been detained in the West Indies longer than I expected owing to a mishap with the telegraph cable which I have been engaged in laying, and now I find that it will be necessary for me to return there after completing some business in the Mediterranean. As you were deputed by the meeting of Liberal electors prior to the last election to communicate to me the resolution, passed in my favour, I think I may ask you to be kind enough to make it known to the gentlemen who took part in that meeting —and through them to the electors in different parts of the borough—that I do not feel warranted in soliciting at the next election the suffrages of so populous a constituency as it has now become, with a prospect of a session of unusual labour and unequalled moment to the interests of the people, unless I could devote the whole of my time to the trust which I undertook. I beg you will also do me the favour—should you be present at any meeting which may be held by the Liberal electors regarding the course to be pursued at the ensuing election—of expressing my deep gratitude for their warm-hearted support and forbearance to me during the time that I have enjoyed the honour of being one of the representatives of the borough. With many thanks to you personally for the trouble you have taken regarding my position towards the borough on several occasions,

I am, very truly yours,

CHARLES T. BRIGHT.

D. BASS, Esq.

Sir Charles often characterised the House as "one of the pleasantest clubs going." He made many friends, one of the most agreeable—though only a distant connection—being the "Tribune of the People," John Bright, with whom there ensued many a pleasant game of billiards and interchange of thought at the Reform Club when temporarily out of reach of the "whips." There were, too, several civil engineers in Parliament at the time—to wit, Mr. Robert Stephenson, Mr. J. d'Aguilar Samuda, Sir Daniel Gooch, etc.—with all of whom Sir Charles was naturally intimate.

Sir Charles also made many other Parliamentary friends. Amongst them were Sir Julian Goldsmid, Bart. (afterwards chairman of the Submarine Telegraph Company), Mr. Samuel Gurney (formerly chairman of the Atlantic Company); Sir John Lubbock, F.R.S. (now the Right Hon. Lord Avebury); Lord William Hay (now Marquis of Tweeddale, a promiment spirit in submarine cable administration); Mr. (now Sir John) Aird; Sir Edmund Lechmere, Bart.; Vice-Admiral Sir J. C. D. Hay, Bart.; Mr. Bernhard Samuelson; Alderman (afterwards Sir James) Lawrence, and his brother, Alderman (afterwards Sir William) Lawrence; Mr. Charles Edwards (partner in Messrs. Glass, Elliot & Co.); Mr. George Traill; The Right Hon. George Sclater-Booth (afterwards Lord Basing); and his neighbour Sir John Kelk, in whose company he (Bright) usually returned home when the House rose at night.

Whilst the prestige and interest of representing a great Metropolitan borough was considerable, the subject of this memoir soon found that it was not exactly a bed of roses, and he sometimes expressed the wish that he had been returned for the Land's End, or John o' Groats, whence a constituent could not interview him so readily. He found himself incessantly pressed with deputations or applications about every conceivable fad or want appertaining to his enormous and particularly varied constituency. Not a chapel could be built, a bazaar opened, a "sing-song" be held, nor a regatta started, without a requisition on his purse, or a desire being expressed for his personal presence. Even the sweeps

LITTLE SUTTON, CHISWICK

on May Day, the boys on oyster eve, and the guys of November, all claimed him as their own—the onus of refusal resting on his shoulders.

Gladstone was at the moment in the unique position of being Prime Minister-elect without a seat, having just been defeated for West Lancashire. Accordingly, Sir Charles mentioned to the right honourable gentleman that he intended retiring, and suggested that he (Mr. Gladstone) might be disposed to stand in his stead.

Besides being the youngest knight since the middle ages, Bright was also for some years the youngest member of the House of Commons.

About the same time as his retirement from the House of Commons, the family left their town house for a new home near Chiswick. During the interval of removal, rooms were taken in Maddox Street; and Sir Charles went down to Winchester for some days to see his eldest son, John, at the school. Another note in his diary indicates a visit to the Chinese Ambassador, but without any further particulars.

At this period Bright dissolved his partnership with Mr. Latimer Clark. The firm of Bright and Clark had done much for the pioneering and extension of submarine telegraphy during the period of its existence.

CHAPTER XI

West India Cables

Section I

The Florida-Cuba Line

OUR narrative has now reached what proved to be the most trying period of Sir Charles' active life. This represented the most arduous piece of work it has ever been the lot of man to carry through in the whole history of submarine telegraphy—partly due to the irregularities of the sea bottom round about the coral-reefed islands of the West Indies, and partly to the unhealthy climate in these regions. In the end a number of the staff died, and others were invalided home.[1] Bright himself had at one time to succumb; but the work was stuck to, and eventually carried through.

First of all, in 1868, Sir Charles undertook the laying of a cable to connect Havana (Cuba) with the American telegraph lines of the United States,[2] via Key West and

[1] The landing of several of the cables entailed wading through pestiferous mud, undisturbed for ages past.

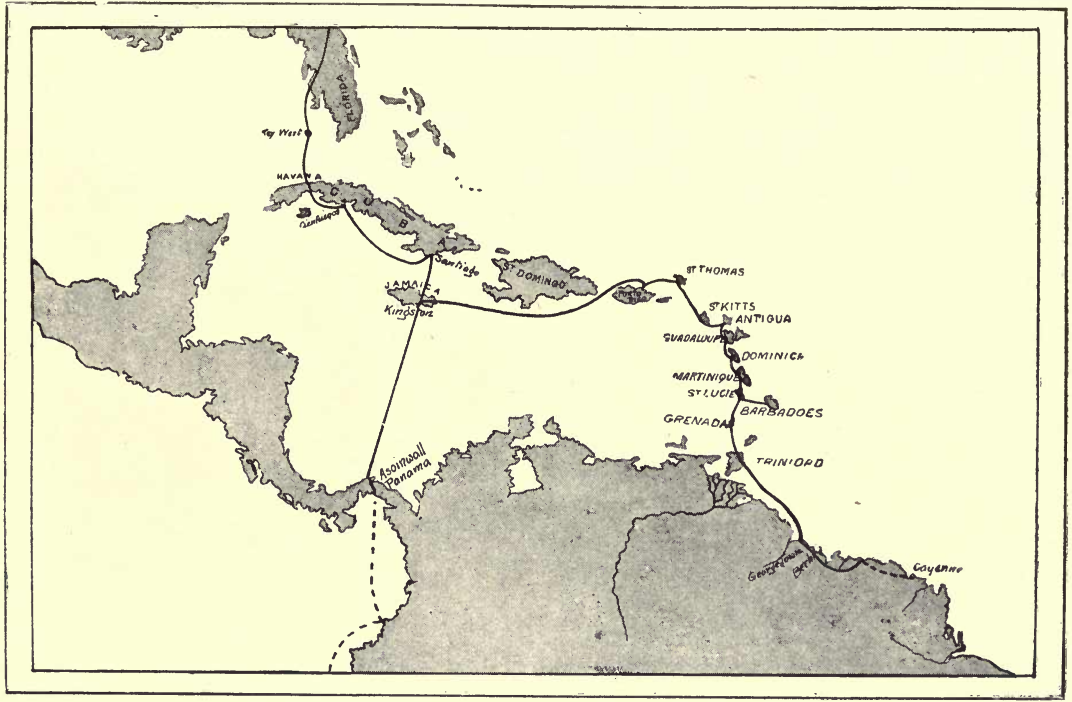
[2] Worked by the Western Union Telegraph Company—by far the largest land-line system in the world.

Punta Rassa on the west coast of Florida. This formed but the commencement of a vast submarine system which he had had for some time in view—for linking into the world's telegraphs the whole series of West Indian Colonies. These included islands belonging to England, Spain, France, and Denmark—as well as Central America—

SIR C. T. BRIGHT
(*Age* 37)

at Colon, Panama, and Georgetown, Demerara. The foregoing comprised twenty separate cables, each upwards of 700 miles in length, and laid in water 1,000 to 2,000 fathoms deep. Moreover, land lines had to be erected on or across various islands, the whole network extending to over 4,000 miles.[1] This grand scheme was enlarged in

[1] This formed by far the greatest length connected with any single enterprise. Altogether some thirty-six shore ends were landed in a highly malarious climate, with a scorching sun overhead.



ROUTE FOR THE WEST INDIAN CABLES

order to include a festoon of cables on the east right along the whole coast of Brazil and thence to Buenos Ayres—a distance of 4,140 miles; while on the west side of the South American Continent Bright proposed to connect Panama southwards with Ecuador, Peru, and Chili, involving some 3,080 miles of cable; and northward along the Pacific coast, to embrace Mexico—another 1,590 miles. These projects altogether amounted to nearly thirteen thousand miles, and were eventually all carried out in what was a comparatively short time under the particular circumstances. They entailed, however, a vast amout of labour and pecuniary risk—not to mention several years spent in cable laying, coupled with serious loss of health on the part of Sir Charles.

The cable between Florida and Havana was made by the India-Rubber, Gutta-Percha and Telegraph Works Company at Silvertown,[1] for the International Ocean Telegraph Company of America, and was laid by Sir Charles from the s.s. *Narva,* which he joined in the States, whence he sailed on November 21st. Shortly after his arrival on the scene of action, and after laying the above cable, Sir Charles penned the following letter to Lady Bright:—

HAVANA, *January 8th,* 1869.

. . . On arriving here on Sunday I got all ready for starting,

[1] This firm had originated, as Messrs. Silver & Co., (shortly after the introduction of vulcanising india-rubber) as a general india-rubber manufactory, but being converted in 1864 into a limited liability company, its sphere of operations was extended to all sorts of telegraph work. Previously it had only covered quite short lengths of wire (with india-rubber) for Mr. C. V. West and others.

and next day went out to grapple before daylight ; but, after two casts, the picking-up machine—made in New York—broke down, and I have been very busy ever since trying to get it right again. With the appliances I have for doing it, the job is very tedious and excessively vexatious.

It has been blowing too hard for the last two days to do anything in the way of grappling, so I do not lose time. When it is fine I shall get hold of it very soon, I expect, and shall then return as quickly as possible.

I shall not telegraph by what steamer I leave, as I don't want to be bothered with business for a few days after I get back, but shall wire "Yours of Wednesday or Saturday (as the case may be) received," by which you will understand that I leave by the steamer on that day of the week after my message. . . .

He subsequently picked up and repaired the line in question—the first Havana cable—which had been laid in 1867 by Mr. F. C. Webb, who had the misfortune to lose no less than sixteen of his assistants and seamen from yellow fever during the work, besides being nearly shipwrecked when out of course off Cape Hatteras. The repairs were very difficult owing to the strong current of the Gulf Stream between the islands of Cuba and Key West ; but after weeks of grappling in about a mile depth of water — with a storm intervening — Sir Charles completed the work.

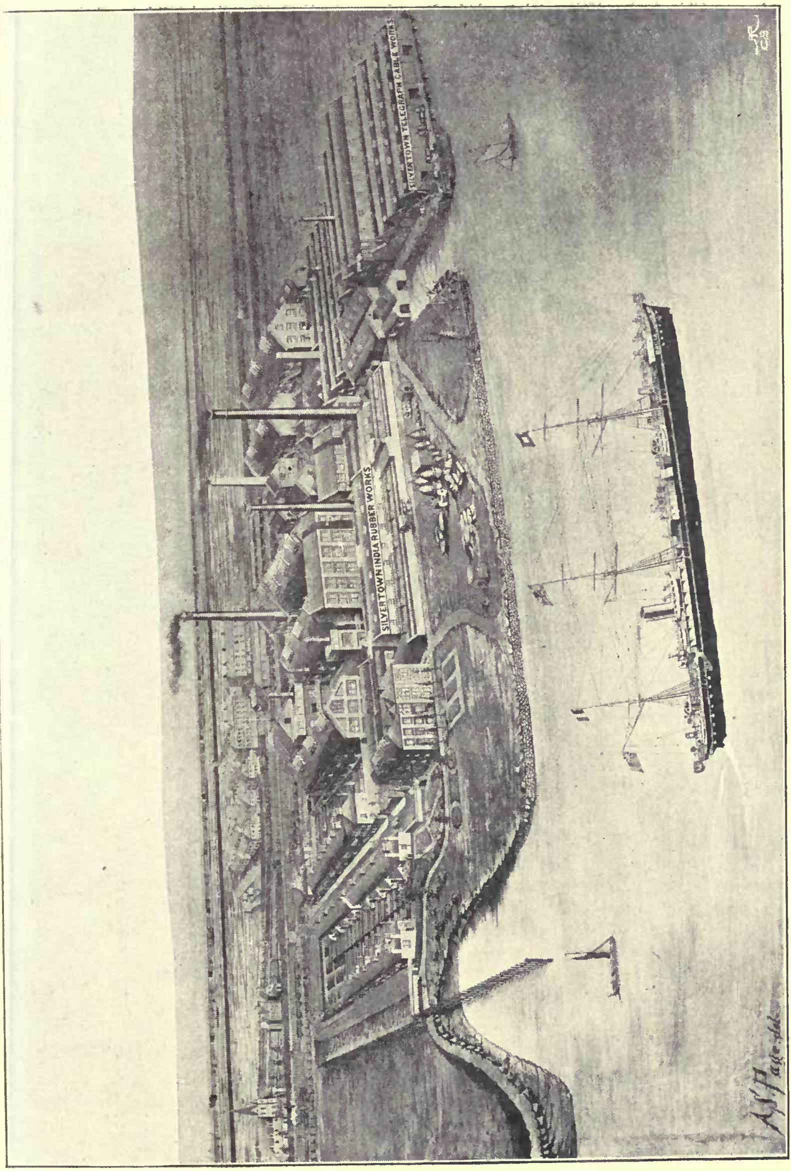
In connection with this success he was the recipient of an elaborate illuminated testimonial in acknowledgment from the International Ocean Telegraph Company.

SECTION 2

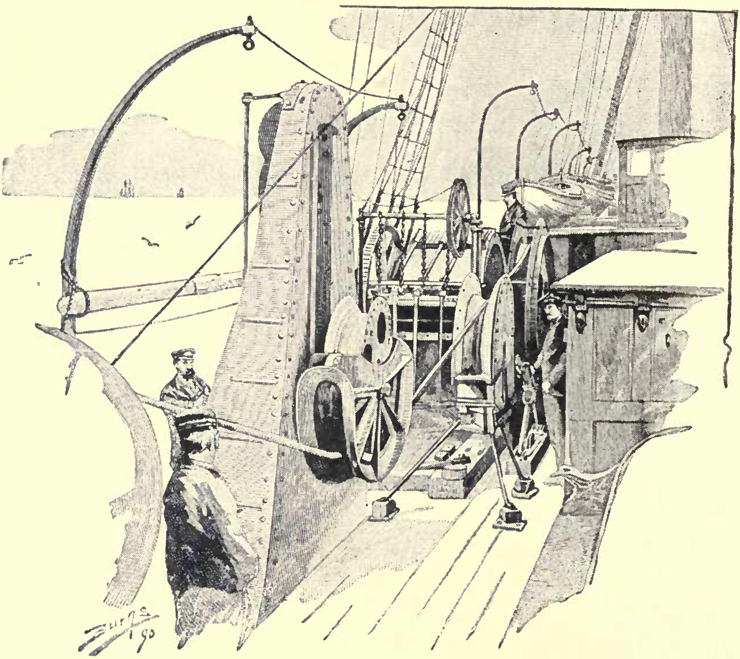
Preparations and Manufacture of Island Links

On his return home, we find Sir Charles joining forces with General William F. Smith, President of the "International Ocean" Company, and Mr. Matthew Gray, the able Managing Director of the "India-Rubber Company" of Silvertown, for the purposes of the West Indian telegraph extensions. The preliminary negotiations and arrangements occupied considerable time. Concessions—and, in many cases, subsidies—had to be obtained from the authorities of the various colonies and then ratified by their Governments, ere the great scheme could be laid before the public. Two companies, the West India and Panama Telegraph Co., and the Cuba Submarine Telegraph Co., were then formed, mainly by Sir Charles and his brother Edward among their "Magnetic" friends. The capital thus raised was about a million sterling.

For the purposes of this undertaking, Bright took over and fitted the *Dacia*, a screw steamer of about 2,000 tons burthen, with special machinery of his design. After having her cut in half and increased in length by 40 feet—to provide room for a large additional cable tank amidships—she was also strengthened by a broad iron belt on her sides from stem to stern. Sir Charles bestowed special care on her paying-out gear and even more on her picking-up apparatus, which latter is about the most efficient of its kind ever put on board a cable ship. The great feature in the gear was that it had a large margin of power, and therefore,



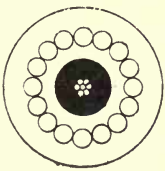
TELEGRAPH SHIP *DACIA*, OFF THE SILVERTOWN WORKS showed no tendency to jerkiness under a heavy strain, such as is liable to cause rupture of the cable. In fact, its perfection was such that it might be likened to the certain, yet elastic, action of an elephant's trunk, in gently and steadily drawing up the grappling rope when raising a lost cable to the surface. The *Dacia*, and her gear,



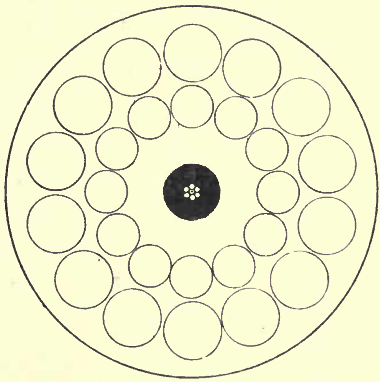
BRIGHT'S CABLE GEAR ABOARD T.S. *DACIA*

has since done as much useful work as any telegraph ship, and has probably done more repairs than any vessel afloat.

The type of cable specified by Sir Charles was similar to that which had proved such a success in the heated waters of the Persian Gulf, the patent outer protective wrappings with Bright & Clark's compound being applied; but the copper conductor was stranded instead of segmental, weighing 107 lb. per mile, while the gutta-percha weighed 166 lb. per mile. There were as many as four types, made to suit the various depths. These consisted of very heavy shore ends weighing 16 tons per mile; intermediate of 5 tons per mile; and deep sea of $2\frac{1}{2}$ tons for depth up to 700 fathoms, and, for beyond that depth, 1 ton 12 cwt. The general character



THE MAIN CABLE



THE "SHORE-END"

of the main cable was undoubtedly well chosen,[1] as the "open jawed" types adopted for the Atlantic cables of 1865 and 1866 were already showing signs of deterioration.

The whole of the 4,000 and odd miles, weighing nearly 10,000 tons, were made at Silvertown by the India-Rubber Company between the latter part of 1869 and the summer of 1870, under the constant supervision of Sir Charles and a highly-trained staff, who afterwards went out to assist

[1] This form has been adhered to ever since—partly on account of its characteristic durability, and partly on the score of immunity from marine borers and fish attacks.

on the expedition. These consisted of Mr. J. R. France (who had previously acted as engineer to the Submarine Telegraph Co.); Mr. Leslie C. Hill, a prizeman of University College, who had been engaged in the laying of the French Atlantic cable; Mr. Robert Kaye Gray (son of Mr. Matthew Gray, and now engineer-in-chief of the Silvertown Company); Mr. E. March Webb (afterwards chief electrician to the same firm); Mr. Percy Tarbutt, subsequently a highly successful mining engineer; Mr. F. L. Robinson, in charge of correspondence and accounts (now Secretary to the West Coast of America Telegraph Company); and others.

The cable was shipped on the s.s. *Dacia*, on the s.s. *Suffolk*, a twin-screw bought by the companies to be stationed in the West Indies as a repairing ship; and on three large sailing vessels chartered and fitted for the purpose. These were supplemented during the laying work by the s.s. *Titian* and s.s. *International*. A small steam-launch was also built to go out with the *Dacia*. She was christened the *Beatrice*, after Sir Charles' youngest daughter, now well known as a portrait painter.[1]

Sir Charles Bright sailed for New York about the middle of March, leaving Mr. France, the chief of his staff, to represent him during the remainder of the manufacture, shipment and voyage out, until he (Bright) joined the expedition on the scene of operations. The object of Sir

[1] This is a notable instance of taste running through a family, for Sir Charles—and, indeed, most of his children—had always shown a predisposition for the pencil, and even for the brush, as was shown in the original biography.

Charles' mission was to meet General Smith—with whom he stayed for some time to discuss business—before making his way to Havana.

The great expedition left the Thames in the summer of 1870.

On June 7th a message reached London from Baltimore as follows: "Steamship *Dacia* total wreck, on outer north reef Bermuda. Sir Charles Bright on board. Three saved." This created a terrible sensation at first, on account of the many lives on board—apart from the steamer and her cargo, which were insured for about £300,000. Those connected with the companies knew it must be a falsehood, as the Bermudas were fully a thousand miles out of her course. As a matter of fact, on the very day this supposed disaster was published, the *Dacia* reached the West Indies, as may be seen from the following letter written by Charles Bright to his wife, after he had joined the vessel:—

JAMAICA, *June 25th*, 1870.

. . . The *Dacia* did not arrive at St. Thomas, our *rendezvous*, till the 7th of this month.

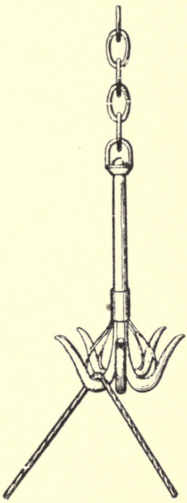
I left in her the same day for San Juan, Puerto Rico, where we arrived on the 8th and left next day. My birthday was celebrated on board the *Dacia* that evening by dressing the ship with lamps. On coming into Kingston on the 13th, the pilot ran us on to a mud bank, and I had to take out some of the cable forward to lighten the ship. It is very slow work uncoiling cable, so we did not get off till last night. The mail steamer which takes this also ran ashore, but she got off last night. I expected she would have some damage to repair, but she is coaling now and is to leave shortly—so I must hurry through my letter-writing.

Tell Robert I have received his letter and will write soon, but have as much as I can do just now; moreover, the engine is running over my head taking the cable back into the ship, and the thermometer stands at 90°! . . .

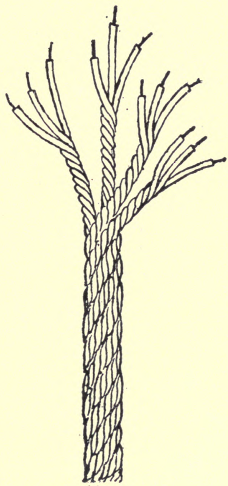
About this time H.M.S. *Vestal* (Captain J. E. Hunter, R.N.), which had been specially detailed by the Admiralty to render any assistance possible, arrived on the scene. A little later, accompanied by her five consorts, the *Dacia* started off on her work. Sir Charles, however, met with quite unlooked-for difficulties; for, although all the cable was said to have tested perfectly when shipped in the Thames, yet, on and after reaching the West Indies, serious faults developed. These had, of course, to be cut out, involving constant turning over from one tank to another, as set forth in Bright's diary. Thus great delay ensued with nearly every section, and in some instances the faults only showed themselves on submersion. The above defects occurred in the gutta-percha (mainly in the joints) and were occasioned by minute gas-bubbles forming between the layers, and bursting through—either from the weight of the coils in the tanks, or from the pressure of the water at the bottom of the sea. A large number had to be removed. Though all were but tiny punctures—like the prick of a pin—they were sufficient to cause serious loss of insulation, which would have gone from bad to worse had they not then been repaired. Sir Charles and all the staff were greatly tried by these quite unexpected troubles. Nothing of the kind had ever occurred during the laying of the cables in the Persian Gulf or in other hot climates.[1]

[1] Anent this, Bright's diary contains the following note: "I had not seen a bad joint in a completed cable for a long time."

The result was most disastrous to the expedition. Over and over again, when some of these faults had been got at and removed—after expending many days in turning over cable from one tank to another—and as a start was being made for submerging a new section, at the last moment another joint would give way, and the turning over had to be renewed. It generally occurred towards the bottom of



GRAPNEL IN OPERATION



GRAPPLING ROPE

the coil in the tank—where the greatest pressure existed—and this meant recommencing the tedious process of clearing perhaps several hundreds of miles to get at it! In this way week after week was taken up, rendering the undertaking more trying than ever to all engaged, in so broiling a climate.

On two occasions further trouble arose by the cable parting in deep water during the operation of recovering faults that had passed overboard. One case like this unfortunately occurred—midway between Colon and Jamaica—when it had not been possible to take observations for a couple of days. This entailed months of grappling before the end could be found. The other was on the long section of nearly seven hundred miles, between Puerto Rico and Jamaica; and—although only about thirty miles off land—was in very deep water and on such a rough and rocky coral bottom that about forty grapnels and several grappling ropes were broken, and weeks passed before the cable could be recovered. It was a very different task to the comparatively easy grappling for the Atlantic lines, where the cable hook is readily drawn along the surface of the ground through soft ooze.

Sir Charles had calculated on completely finishing his task—vast as it was—within a year; but it took him a good deal longer in the end. He suffered very heavily by these terrible and unlooked-for delays, which immensely increased the cost of the work. Still, though so heavy a loser both in pocket and health, he bore it all throughout with equanimity; and, although greatly discouraged by this untoward turn of affairs, he and his brother Edward—who eventually joined him—stuck to it till every section was complete and in perfect order.

The scheme of the Panama and South Pacific Telegraph Company in connection with the West Indian system at Panama—for cables down the west coast of South America—was ultimately abandoned.

During the manufacture of this Panama and South Pacific cable, the late Lord Sackville Cecil—half-brother to the

Premier of that time—acted for Sir Charles in his absence abroad. He had been a pupil of Sir Charles', and electrically tested this cable up to the time its manufacture ceased.

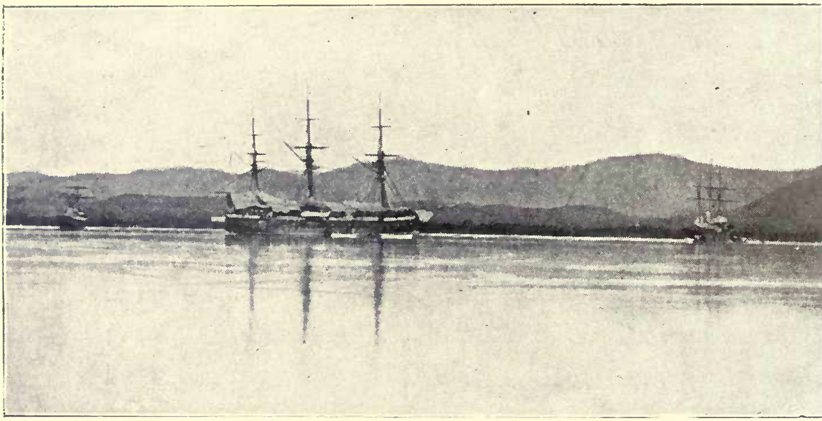
Section 3

Laying the Cables

Operations were commenced at the beginning of July (1870) from the terminus of the International Ocean line. This point was to be the junction connecting Cuba and the American United States Telegraph system with the whole of the West Indies and Colon for Panama.

The first sections to be laid were those of the Cuba Submarine Telegraph company along the south side of that island—the " Pearl of the Antilles," from Batabano (already connected by two land lines with Havana) to Cienfuegos, and thence on to Santiago. The latter portion was laid without much difficulty, in tolerably deep water ; but the first part from Batabano proved exceedingly troublesome, as the shallow and narrow channels of approach were composed of tortuous passages amidst coral reefs and rocky islets for some forty-five miles. Batabano is the southern terminus of a short railway across the narrow part of Cuba from Havana. It was of the greatest importance, both to the Government and the mercantile community, that a reliable line of telegraph should thus be established with Cienfuegos, a large port, and still more with Santiago, the second city of this vast and prosperous country. The existing land lines through the wild interior worked badly at all times ; but these were also constantly interrupted by the "Cubanos"—creoles, or born inhabitants, of the island—who were, proverbially, in a state of chronic revolt against the Spaniards' rule.

While the channels to Batabano were being further sounded, Sir Charles went to Havana, accompanied by Señor Lopez—an elderly gentleman especially attached to the expedition—in order to arrange various matters with the



H.M.S. *VESTAL* WITH T.S.S. *DACIA* AND *SUFFOLK* OFF THE CUBAN COAST

authorities. The Señor, who was a friend of Sir Charles' in England, was an excellent negotiator and interpreter, besides being closely related to the then Governor, General Lopez. Sir Charles and the Señor were received with the greatest consideration by the various dignitaries, and, while there, were made honorary members of the "Cercle Espanol." This Club is worth describing, as the building at that time—strange as it may seem—constituted by far the largest club-house in the world; the "Carlton" and "Reform" rolled into one club would not equal it in size. There were twenty-three billiard tables occupying part of one floor, the Club being built in quadrangle form. The luncheon and dining accommodation was on a very large scale. There was an immense library, an extensive well-fitted gymnasium, and a superb ball-room. The latter had two side rows of marble pillars and intermediate tropical palms, tree ferns, and flowers, which formed a sheltered promenade of no mean order. While Sir Charles and Señor Lopez were in the Club an attack was made upon it by a party of the "Cubanos," and some lively revolver shooting took place in the streets, until the disturbance was quelled by the authorities.

As the result of the survey, many more shoals were revealed than had hitherto been thought of. To avoid these would have involved a detour of 360 miles, as they extended far out to sea. Thus Sir Charles had to employ "sugar flats," towed by a light-draught Spanish gunboat, the *Alarma*; and as a heavy type of cable was necessary, the work—entailing much manual labour—became very trying, especially as each short section had to be jointed. Concerning this, Sir Charles remarks in his diary :—

> Working in boats under a burning sun knocks up the men very soon, and the joints take very long to make, as we are out of ice [1] and cannot get any more without going to Batabano and telegraphing for it to Havana—whence to Batabano there is only one train a day, and that in the early morning.

On the first completion of this section, Charles Bright wrote home to his wife as follows :—

[1] This, or some cooling mixture, is always necessary for subsequently handling a gutta-percha joint in tropical climates.

BATABANO, ON BOARD "SUFFOLK."
July 30th, 1870.

. . . I have had a very tough job getting seventy-five miles of cable laid over shallow water, and got aground again in this ship. The place is full of shoals. The charts are good for nothing, and the pilots only used to very small ships. This is the biggest ship that has ever been here.

I am very well, though having an anxious piece of work—almost a labour of Hercules in its complication—but I think I am better when I am hard at it! Am busy now testing the cable we have laid, as there is a small fault near shore here which I have come back to take out, so must stop writing. . . .

But after the laying of this troublesome and exhausting section was effected, Sir Charles had to go back no less than three times to cut out faults that showed themselves.

The following letter, written about this time to Lady Bright, serves to recount some of the above troubles :—

S.S. "SUFFOLK," OFF BATABANO,
August 19th, 1870.

. . . I wrote you from this (blessed) place on the 30th July, and never hoped to see it again. After no end of trouble to get the cable right then, owing to the shallow water, rocks, squalls, and troubles of every kind (including getting the *Suffolk* aground half a dozen times, but luckily without getting a rock through her bottom), we at last finished, and went to the other end of our lines, about seventy-five miles off ; but we had not been paying out long from the *Dacia*—and in fact, had just got in deep water —when another fault showed itself. It was half-past four in the morning, and I was luckily on deck to stop the ship at once. On testing we found the fault near this end! Was not that vexing, after spending three weeks in these abominable waters, to have to come back and do all the work over again? I have only a few ounces of patience left, out of, I should think, many tons which I must have brought from Jamaica !—but I have got it all right again, and leave to-morrow morning for the *Dacia* off Diego Perez to join on to the deep sea, and go on paying out.

I have not had a letter from you of later date than June 15th, nor have I seen an English paper for months ! We might as well be in the Pacific Ocean as on the south side of Cuba for getting any English news. I can give you very little news of myself except that which you will like best to know, that I am well, and *no one* on the sick list on either of the ships. I am always particular about the ships having plenty of ventilation. At Cienfuegos, when we were there, there was yellow fever, cholera, and small-pox all at once raging in the town ; so I put the town in quarantine, and would not let any one have liberty to go ashore—in fact I only went four times myself, which I was obliged to do on business.

You will all have gone to the seaside, I think. For myself, I don't want to see the sea for ever so long again. . . .

Eventually the Cuban line was in complete operation on September 2nd, and a little later Sir Charles opened the telegraph office to the public.

As a slight return for all the attention paid him in the island of Cuba, Sir Charles gave a picnic party when near Havana : an excursion was made to a beautiful hill, from which lovely views were obtainable.

The *Dacia* and the rest of the fleet arrived at Santiago on August 27th. While at this picturesque seaport—approached by a long narrow entrance between cliffs—Sir Charles and his staff were hospitably received, on several occasions, by Mr. F. W. Ramsden, the British Consul, and Mrs. Ramsden, who did everything to make their temporary visits pleasant.

On the first visit a strong shock of earthquake occurred at night, shaking the hotel in which they were quartered. Every one bolted downstairs and into the street in their sleeping attire ; but the quickest of all was Señor Lopez, though stout and about seventy years of age. He flew down the stone stairs taking two or three at a bound, arriving outside in the scantiest of raiment—mainly pyjamas—lengths in advance of Sir Charles, who started before him. The Señor knew what an earthquake out there sometimes meant ! The streets were full of residents, many absolutely *in puris naturalibis*, as is very much the custom at night in that warm climate. Only a few minor buildings were, however, wrecked on this occasion. Regarding this a Jamaica newspaper [1] reported as follows :—

The earthquake at Santiago on Sunday last was a serious affair. At nine a.m., during High Mass, a terrific shock was felt, shaking the foundations of houses in the city. The people in the Cathedral and from all the dwelling-houses rushed out in great numbers, almost undressed, and perfectly terror-stricken. The shrieks were heard on board the vessels of the Expedition, fully a mile from the shore. A second shock followed, producing renewed consternation on land. Boats from the Expedition were sent on shore to offer any assistance that might be requisite. A few buildings were thrown down.

The same journal describes the general proceedings about this time in these words :—

The Cable Expedition

The *Dacia, Vestal, Suffolk,* and two Spanish gunboats in Santiago, arrived there on the 27th with cable working beauti-

[1] *The Jamaica Gleaner*, September 10th, 1870.

fully. Telegrams from London daily. Festivities, balls, serenades, dinners, picnics, in honour of the expedition. Sir Charles Bright presented with freedom of the city. No other instance like this in Santiago since conquest. Expedition will probably leave Santiago on Saturday for Holland Bay. Five steamers will form the expedition.

In a subsequent number this paper reported as follows :—

SANTIAGO DE CUBA,
August 28th, 1870.

There were great rejoicings here over the cable success ; the whole harbour has been grandly illuminated last night in honour of the event. In all directions fireworks are shooting in the air. The enthusiasm in favour of Sir Charles Bright has been at its height. Fourteen hundred volunteers marched in procession, and then chartered steamers and sailed round the *Dacia* in honour of the expedition. They presented a brilliant array of lights. The foreigners gave "God save the Queen," with thrilling effect, and simultaneously uncovered at the playing of the tune.

The *Dacia, Suffolk*, and H.M.S. *Vestal* were gorgeously illuminated during this imposing ceremony. The enthusiasm of the people of Santiago knew no bounds General Valmaseda and 2,000 citizens visited the *Dacia* in order to present their voluntary congratulations to Sir Charles Bright.

August 30th.—The rejoicings over the success of the cable still continues. Private families in groups have caught the enthusiasm, and are paying their respects in person. Every public body in Cuba has addressed Sir Charles Bright. Clergymen of the United States have been entertained on board the *Dacia*. Mr. Ramsden, the British Vice-Consul, gave a dinner to-day ; and, in response, the city gave a grand dinner.

The festivities are likely to last for several days.

September 1st.—The Cuban shore-end from Batabano was laid yesterday morning. The inhabitants turned out, General Valmaseda and the officials were up at 5 a.m. to see the splice made.

The clubs enthusiastic.

There was even a regatta in honour of the expedition.

The fleet was decorated throughout with bunting.

And later this journal announced:—

On the 5th, the Governor of Santiago gave a banquet to Sir Charles Bright. Complimentary speeches were made in honour of the expedition.

On Thursday, the Spanish *Circulo* gave a picnic in the country, to which Sir Charles and his officers were invited. The country house and its approaches were brilliantly illuminated in the evening.

On Friday, General Valmaseda gave a grand ball to commemorate the successful laying of the cable.

On Saturday, the British Consul, Mr. Ramsden, gave an evening party; and on Sunday afternoon, thousands of persons from the city visited the fleet.

During this period the Franco-German War was in full swing. Sir Charles had occasion to exercise a little tact in this connection—even so far away as the West Indies—as may be gathered from the following report in the *Jamaica Gleaner* aforesaid:—

The French vessel of war *Talisman* arrived at Santiago de Cuba, it is said in search of the Prussian gunboat *Meteor*. The Prussian Consul applied to Sir Charles Bright to forward a telegram to Havana to the Consul-General. Sir Charles, not liking to interfere in any way with the neutrality of nations, applied to the Consul-General for advice; and was informed that Spain being a neutral Power, they would not like to give advantage to either party. Sir Charles therefore politely declined to permit the cable to be used for this purpose, and the French steamer *Talisman* immediately put to sea.

The laying of the "Cuba" Company's lines being at last brought to a successful issue, the "West India and Panama" series of cables had to be tackled. Continuing in the route, the first section of this system to be laid was naturally that from Santiago (Cuba) to Holland Bay, on the north-east coast of Jamaica.

Whilst all the preceding festivities were going on, preparations were being made for the laying of these future sections by the turning over of great lengths of cable from one tank to another in order to remedy a sticky condition which had proved a great source of trouble in paying out.[1] Indeed, it was only owing to this being necessary as soon as the Cuban lines were completed—and partly on account of faults in the insulation—that social entertainments as above described could be given time for.

The Cuba-Jamaica cable was laid after some trouble (starting on September 13th), but without any incident of special or novel interest. The shore end was landed near Plantain Garden Harbour, in Holland Bay, and the final splice effected on September 15th.

Almost immediately on arrival, the Vicar of St. Thomas', Morant Bay, several miles off—boarded the *Dacia* and presented the following address to Sir Charles. This is reproduced as being characteristic of wordy elaboration such as "gentlemen of colour" are prone to—especially when

[1] The above stickiness of the outer compound and a want of lime are matters noted in Sir Charles Bright's diary as entirely novel experiences, such as he had never before met with in laying cables in the Persian Gulf, or other tropical climates.

associated with the pulpit or bench. The exact meaning of some of the phrases and passages is sometimes difficult to decipher. Maybe, however, in this very touch of mystery lay the charm of the address to those members of the Vicar's flock who attached their names to this well-meant "masterpiece of English literature."

PARISH OF ST. THOMAS,
MORANT BAY, JAMAICA.

To Sir Charles Bright, of the Telegraph Expedition, etc.

HONOURABLE SIR,—We, the inhabitants of the Parish of St. Thomas, desire very respectfully to thank you, for your presence in our midst, not only as a distinguished individual, but connected as you are with the discovery of a science, hitherto unknown among the ancients, but, confining its Mystic achievements to the select few of the present generation, among whom, you, Sir Charles Bright, bear a conspicuous part, and also for the Company's selection of our Seaboard at Holland Bay as the vehicular channel of communication with the Metropolis of the world.

That, notwithstanding the difficulties and calamities through which we have recently passed, yet, it is our firm belief, that St. Thomas will, in the good providence of God, be the Pioneer in leading on Jamaica to ultimate beneficial results. For within the brief period of five years of her political reconstruction, Capitalists, men of genius, commercial men, and an enterprising galaxy of Scientific men, have, with a wonderful combination, spent more money for the development of the resources of the Island than has been done during any former Government.

Thanks for the name of "Saint Thomas," and to our worthy Governor, Sir John Peter Grant, and his official and lay associates in the legislative Council of Jamaica. Thanks to our beloved "Queen Victoria," and her Constitutional advisers, for conferring on us "Crown Government," and delivering us from the yoke of oppression and wrong. An official, of limited perception of our geographical importance, willing to pay homage to his constituents rather than to his employers, very recently published in his " Report " on education that the inhabitants of St. Thomas could not worthily be contrasted with either of the parishes of Manchester and Saint Elizabeth in point of mental culture and the development of civilisation, in ignorance, too, that superior men of genius, enterprise, and benevolence, selected this parish for the introduction and importation of a new method of abcedarian instruction in " Telegraphy," the letters of which will never be deciphered by the pharisaical declamation of the Reporter, and which will—and in all probability may—be taught by one of the many rustics employed in connection with the Company's works and offices, and which will cause the inhabitants of Manchester and Saint Elizabeth to hide their diminished heads in the clefts of the rocks in their mountain fastness.[1]

And we fervently pray that He who first diffused the genius, by the inspiration of His Spirit, into the minds of men in its incipient conception of " Telegraphy " for the good of mankind, will, with the knowledge thus conferred, abundantly provide the means for its furtherance, to the remotest parts of the earth, with a large marginal surplus for compensation to those who labour and struggle with the gigantic undertaking.

And we further pray that the time may soon come when the shores of " Africa " will be visited by " Telegraphy," and that as a continent with her varied Nationality, contribute her share in the disbursement of the general outlay, and the knowledge of the " Lord " cover the earth as the waters of the mighty deep

With profoundest respect, we are, Sir Charles,

Your obedient, humble servants,

* * *

(Here followed a number of signatures representing the congregation of St. Thomas', Morant Bay.)

The next day Sir Charles landed the shore ends for the

[1] It is not every day that one falls upon so long a sentence as the above !

cable to Colon (Panama) and Puerto Rico respectively, and at 11.30 that night the telegraph fleet proceeded to Kingston, which was reached at 9 a.m. the following morning.

Here, again, it was necessary to feed the "laying" vessels with a further supply of cable, to the extent of nearly 700 miles, from the ships holding the reserve stock, before further work could be proceeded with. This meant spending several weeks at the chief town of our principal West Indian colony; and, when once the programme became known, it was a signal for more festivities ashore.

The whole town had been in a state of feverish excitement the day before, as soon as the inhabitants had satisfied themselves as to the working of the cable to Cuba, which (by means of the connecting land-line across to Holland Bay) put them into telegraphic communication for the first time with the American United States, the Mother country, and the whole of Europe. Many had journeyed to Port Royal in order to see the first of the telegraph squadron and offer greetings.

Whilst the expedition was at Kingston, Bright spent most of his time ashore attending to various business, whilst his orders—in the way of cable transference—were being carried out on the ships. First of all he opened the new telegraph office there. Then he had to call on a number of people on official matters, all more or less connected with the welfare of the cable systems.

Then various dinners had, in a similar way, to be given and received.

Sir Charles had a real pleasure in getting ashore again, if only to get into touch with home matters once more—by telegraph as well as through the newspapers.

Soon after landing, an address was presented to him which was thus reported in the local journals :—

Address to Sir Charles Bright

At eleven o'clock on Wednesday a deputation from the Royal Society of Arts waited upon Sir Charles Bright at the Telegraph Station, to present him an address from the Society on the successful laying of the telegraph cable to Jamaica. The Hon. Secretary read the address, as follows :—

Sir,—We, the undersigned, Members of the Council and General Members of the United Royal Agricultural Society and Society of Arts, Manufactures, and Commerce, of this Island, deem it our peculiar duty and privilege to welcome you to our shores, and to thank you in the name of the inhabitants of this ancient and loyal Colony, for the benefits—Social, Political, Scientific, and Commercial—likely to result from the great work you have lately so satisfactorily accomplished in connecting this country by Electric Cable with Europe, America, and the Neighbouring Islands.

In recognition of your important services the Society has unanimously elected you an Honorary Member—a position we hope you will do us the honour to accept. And we beg that you will receive our cordial congratulations and good wishes to yourself, and for the further success of this great enterprise, destined, in its completeness, to link together the Nations of the Earth.

Dated at Kingston, Jamaica, this 28th day of September, 1870.

Sir Charles, in reply, said he felt very highly honoured by the bestowal of membership, especially coming from such high quarters. These addresses, when presented to engineers, are looked upon as of very great value, and are prized as much as the glittering stars on the breasts of some. He thanked the Society heartily for the high honour conferred upon him. Sir Charles then invited the deputation to visit the operating room, when messages were sent to Holland Bay and speedily replied to. Sir Charles desired the operator to ask Holland Bay to send a few lines, which was done accordingly.

The address to Sir Charles was accompanied by a beautiful cabinet-box of photographs of all the islands, the box being entirely made from native wood. This gift was greatly appreciated, and was always prized by Bright in after years.

A number of private dances were also given, amongst other festivities, by the leading people of Kingston and round about, as well as aboard H.M.S. *Vestal*. Then finally, we find the following extract in the *Jamaica Despatch* :—

On Thursday night last a grand subscription ball was given in this city in honour of our distinguished guest, Sir Charles Bright.

Thus ended the festivities, and on the following day (October 11th) Sir Charles left Kingston in the *Vestal* for Colon, the transference of cable having got sufficiently advanced to allow of making further preparations for the subsequent sections.

Colon was reached on the 16th inst., and the Consul-General at once boarded the *Vestal*.

Across the isthmus between here and Panama a land telegraph already existed. The connection to it by the cable to Panama was one full of importance ; for the traffic and mails from the whole of the western coasts of the entire South and Central American continent concentrate at Panama. The next day (October 17th) Bright left that ship to go round Manzanilla Bay to select the landing-place for the cable. On the same evening a banquet was given by the town to Sir Charles, at which another flow of speeches occurred.

Bright had previously received a special request to unveil the statue of Christopher Columbus, which had just been erected there at the instance of the Empress Eugènie. This he arranged to do the following day.

That same afternoon saw the arrival of the *Dacia* with all the necessary cable on board. On the next day Sir Charles had to journey to Panama on official business, and that evening he dined with President Correoso. This was on October 20th, and Bright notes in his diary that on the 21st he visited H.M.S. *Zealous* with Admiral Farquhar On the 22nd Sir Charles returned to Colon (or Aspinwall, as it is sometimes called) by special train; and that evening the American Consul paid him a visit aboard the *Dacia*.

And now a sad story must be recorded. Since Sir Charles left Kingston he found that sickness had occurred amongst his "shipmates"—cable hands and sailors—for'ard. Several had to be sent to hospital, and one had ultimately died of yellow fever. Though frequently having to go (and remain) ashore himself, Bright had done his best to prevent the rest of the ship's company from doing so. However, for the purposes of landing the cable, this could not be avoided entirely. Moreover, the landing spot was often—by force of circumstances—situated in the midst of a malarial district, besides being unhealthy in other respects,[1] and to make matters worse the ship's doctor had resigned !

On October 23rd, the ships went round to the bay selected for landing the cable, but a heavy swell from the north-east prevented work.

Sir Charles notes in his diary for the next day as follows :—

Monday, October 24th, 5 a.m., weather moderating ; ordered steam. 8.30 a.m., got into position for landing S.E. ; moored to wharf and buoy by stern.

The heavy shore end had to be landed on a mud bank and dragged to the cable-house through a pestiferous swamp forming part of the neighbouring lagoons. The result was that Sir Charles and others employed in the work caught malarial, or "chagres," fever. This had just previously killed one of the two doctors of that fever den, whilst the other had been invalided home to the States ; thus, the outlook—in the strictest sense—was not a bright one[2] ; in fact a general depression ensued which Sir Charles had to do his best to check. But there was a vast amount more trouble and sadness in store.

The shore end having been landed, paying out towards Jamaica was started on at 3 p.m. the same day (October 24th).

The following *facsimile* reproduction of a few lines in

[1] It may be mentioned here that, in addition to lime-juice, Sir Charles had doses of quinine regularly dispensed to all on board. The sailors at first objected. He had it, however, mixed with their rum ; so that they had to absorb the quinine, or leave the "grog !"

[2] As a further instance of the pestiferous character of the climate, it was a saying that during the building of the Colon-Panama Railway "every sleeper represented a man who had died on the work."

Sir Charles' diary for this day, concerning the course, is given as an example of how he attended to everything of importance himself—

> Direct magnetic course
> N by E $\frac{1}{3}$ E
> First 25 m steer 1 point
> E to counteract Easterly
> current
> After that straight for
> the Point, allowing for
> current as may be found
> necessary.

This diary—neatly kept notwithstanding the anxieties and grief caused by the nature of his work, and sickness and death amongst his staff—serves to illustrate his patience and fortitude under adverse circumstances, besides giving an idea of the life, routine and troubles associated with cable work. His notes appear to have been usually entered in the dead of night, between watches, and at moments when least liable to disturbance. They were drawn up with uniform precision and neatness throughout the expedition.

[1] *October* 25, 8 a.m.—Laid 79 miles. Light breeze, smooth sea. Midnight, laid 162. Wind freshening. . . .

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[1] The four hours' recurring records of speed of ship, cable laid, strain, barometer, etc., are in most cases omitted from these diary extracts.

October 26, 4 a.m. . . . Blowing fresh from southward and westward, ship pitching a good deal. 8 a.m., changed to No. 1 tank. In changing, the bight fouled a piece of spare cable at the bottom of the tank, but got clear.

The *Californian*, Liverpool steamer, passed at 0.50 p.m., and reported her position at noon—then being about five miles astern of our position.

(N.B.—None of the calculations, either of *Californian*, *Dacia*, or *Vestal*, agreed with one another. All the calculations are by "dead reckoning," it being too thick for noon observations.) 4 p.m. laid 240 miles. . . .

October 27, 6.55 a.m.—Finding a fault outside ship, made fast hawser from bow sheave to cable at stern and let go; but the warp parted, in roughish weather, and we lost the cable.[1]

Heavy storm with thunder and shifting squalls.

Put down large conical buoy with blue flag.—buoy No. 2.

Estimated distance from Colon 320 miles, cable paid out 367. Weather too bad to do anything.

At 3 p.m., Seaton, 2nd foreman, died of fever; buried at 8 p.m. Did the best we could in the way of a funeral service at sea.

Friday, October 28.—Blowing fresh. Heavy swell, but looking better. Could do nothing in morning, drifting to W. Buoy bearing S. 82, E., showing a 2 knot westerly current.

Lowered grapnel in afternoon with 1,200 fathoms of rope and 30 fm. 1 in. chain.

Saturday, 29th.—The buoy not in sight. Blowing strong from E.S.E., sea moderating. Riding to grappling rope. In afternoon weather bright and clear, commenced heaving in on line. Sighted buoy from top gallant yard ¼ point on starboard bow, apparently adrift.

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[1] Owing to the lack of recent observations it ultimately took many weeks to recover and complete the above section, as will be seen in these pages.

4 p.m., picked up buoy and let go another with two mushroom anchors, 3 and 4 cwt. respectively.

9 p.m., in position for grappling again ; lowered grapnel.

October 30 (Sunday).—Grappling all day, from last night's position.

7 a.m.—Ship's head N.E. by E., rope leading well ahead. Light breeze from E. $\frac{1}{2}$ N. Foresail and topsail set, going with wind and current.

11 p.m.—Wind freshening, and grappling rope leading further ahead.

11.50.—Strain increasing, and dynamometer wheel rising and falling violently.

October 31, 4.20 a.m.—Commenced heaving in, strain increasing suddenly on starting engine and going back, or stopping ; appears to be fast on rock. 4.45, put on slow motion. 5.10, strain up suddenly.

5.15 a.m.—Grappling rope parted between dynamometer and bow-sheave ; end struck Captain Dowell, who was by the bow sheave, and knocked him down insensible, but no cut. 5.30, Dowell better ; wind increasing and sea getting up.

Lost 800 fathoms rope, 7 swivels, 30 fathoms $\frac{7}{8}$ inch chain, 2 large swivels and fittings, and 1 large grapnel.

10.30 a.m.—*Vestal* some miles S., fires a gun, went to her, and at 11.30 sighted buoy. . . . Took long time to get buoy on board, owing to heavy sea and wind. . . . Lost chain and grapnel ; end of buoy rope chafed by rocks.

November 1.—Grappling all day. Blowing fresh, heavy sea. 10 a.m., *Vestal* signals she is short of coal, and will have to return to Port Royal.

10.30 a.m.—Too much to the West for the cable. Began taking in ropes. Having only 60 tons of coal on board, and requiring 40 to reach Kingston, decided to return to take in coal. Started at 1.15 p.m. Heavy sea, blowing hard. . . .

November 3.—Heavy sea. Ship rolling a good deal.

November 4.—Blowing hard, heavy sea. Only 100 miles run at noon since yesterday.

November 5.—Wind moderating. Land of Jamaica just in sight in the morning. 0.40, took pilot on board, who says it is the worst weather they have had for 25 years, and that everybody looks for a hurricane.[1] 2.30 p.m., Gillespie died of fever. 6 p.m., buried Gillespie at sea off Jamaica.[2] 8 p.m., H. Mitchell died of fever. Midnight, buried Mitchell at sea off Jamaica.

Sunday, November 6.—Anchored in Kingston harbour at 8 a.m., and sent the sick men to hospital.

November 7.—At Blundell Hall; sent convalescent hands to Bellevue; coaling *Dacia* at wharf.

Soon after landing, Sir Charles penned the following to Lady Bright. Foreseeing that his wife was sure to hear—probably in an exaggerated form—the sad tidings,he thought it best to tell her himself how things were, if only to allay worse apprehension.

KINGSTON, JAMAICA,
November 7th, 1870.

I know that a short letter will be better than none. I have two of yours to reply to. I am writing against time. Am quite well. Lost end of Colon cable, which will give me some trouble; the particulars you will find in the enclosed paragraph. It was bad weather, and a squall came on during a ticklish operation with the cable. . . .

I cannot write much. I am pestered from day to night with somebody or something turning up. Am sorry to say I have had much trouble with sickness on board the *Dacia:* buried three of my cable hands, one a foreman, on our voyage from Colon to Jamaica. I suppose you would hear of it from some

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[1] This meant much, for the Caribbean Sea is often subjected to very disturbed conditions.

[2] Owing to the Captain's illness, Sir Charles had on several occasions to read the burial service over his late "shipmates."

one else, and most likely made worse than it has been. I have cleared the men out of the ship, and sent some to hospitals, and some to the mountains. All going on well now, but fear I shall lose one or two more. . . .

This sad and depressing story is best continued by extracts from the diary—necessarily in a somewhat matter-of-fact form, as follows :—

November 8.—Richardson (jointer) died in Kingston Hospital of fever. Commenced cleaning and fumigating *Dacia*.

November 9,—Whittingstall (foreman) died in the hospital of fever. Buried Richardson at 5 p.m.

November 10. 9 a.m.—Whittingstall buried. Rose died in hospital of fever.

November 11.—Welham died of fever at the hospital. 5 p.m., Rose buried.

Having in mind the trouble which the cable had given, and the serious losses by death, Sir Charles had foreseen—even before starting on this last section—that he would require additional assistance. Accordingly, before leaving Colon, he had sent a " cable " to his brother Edward requesting him to come out to help him. Sir Charles now determined that under prevailing conditions it would be best to get on with the other sections for the present.[1] Moreover, his brother had " wired " in reply to say he was coming out by the first mail ; so the first thing to be done (after shifting some cable between the ships) was to take the fleet to St. Thomas, the *rendezvous* and starting-point for future operations.

[1] This decision was made partly in order to get to more healthy surroundings—with a view to checking further sickness—as well as on account of the bad weather here just at that time of year.

With these lines of explanation we will now return to Bright's records.

November 15.—Started transferring cable from *Bonaventure.*

November 19.—Finished transferring cable

November 20 (Sunday).—Nothing done.

November 21.—Sent *Dacia* to St. Thomas, accompanied by *Suffolk.*

I started for San Domingo City, Puerto Rico, on board *Vestal.* Sr. Lopez with me, also Mr. James Gutteres.[1]

November 25, 10 a.m.—Anchored off San Domingo. H.M.S. *Yantic* here. Went on board and then on shore with Captain Irwin. Called on the English Consul and the Secretaries for War and Finance, the President being away. Left in the *Vestal* at 5 p.m.

November 28.—Arrived at St. Thomas in the evening.

November 29.—*Dacia* arrived this afternoon with the *Suffolk.* Found that Robert Jackson had died on board the former on 26th inst., and was buried at sea the following day.

November 30.—Erecting testing-house at landing-place, etc.

December 5.—*Seine* with Edward on board being long overdue, got the Danish authorities to despatch the *Eider* to search for her

December 6.—*Eider* returned without any news of *Seine.*

1 p.m., went on board *Suffolk* with staff. 1.10, weighed anchor and went round to landing-place in Gregorie Bay. 3.55, got end of cable ashore for the St. Thomas-Puerto Rico section, and returned to *Dacia.* Mr. France's connection with the expedition came to an end to-day.[2]

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[1] Mr. Gutteres was manager in the West Indies of the West India and Panama Company. He was associated with Sir Charles in the early days of the "Electric" and "Magnetic" Companies, and was a close friend to the last with the rest of his family.

[2] This gentleman had been the chief of Bright's staff, but, having other work in view at home, he, at this juncture, sent in his resignation, and returned to England by the next mail.

December 7.—Splice made in morning between "S.E." and "Intermediate." Bearings of splice—

David's Point, W.N.W.
Saba Island, S.W.$\frac{1}{2}$ W.

R.M.S. *Seine* arrived in afternoon.[1] Went on board and took Edward to *Dacia.*

Went out to the *Suffolk* and laid Puerto Rico section to abreast of Savana Island. At night, in getting end on board *Dacia*, with fresh wind and swell, the cable got jammed in the rocks at the bottom, and parted.

December 8.—Picked up cable in afternoon, and spliced on to cable on board *Dacia.*

December 9, 1.30 a.m.—Weather fine. Started paying out towards Puerto Rico.

2 p.m., buoyed cable (Cuba type) off San Juan de Puerto Rico.

3 p.m., went into harbour of San Juan (the capital of Puerto Rico) with *Vestal* and *Titian.*

December 10.—Went ashore. Got large flat to put shore end in; coiled 1,800 yards on board of her.

December 11, 6 a.m.—Went out, but had to come in again, weather being too bad.

11.25 a.m.—Weather having improved, started for buoy again.
0.30 p.m., mushroom in. Hauled in some slack and anchored.

Splice made during afternoon.

December 12.—Completed shore end to St. John's Bay, and slipped final splice.

Ball given to the expedition in evening by the municipality to celebrate the laying of this section.

December 13.—*Titian* alongside, but great difficulty in getting hands employed to transfer the cable.[2]

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[1] She had experienced a fearful gale for several days after passing the Azores, and only reached St. Thomas after the engineer had utilised the cinders and anything to spare that was at all burnable!

[2] Owing to sickness and deaths, Bright was obliged to have recourse to native labour.

Testing-house on shore finished.

December 15.—Finding the Spanish hands could not be got to coil the cable properly, determined to do it at St. Thomas. Left in *Dacia* at 5 p.m.

December 16, 9 a.m.—Arrived at St. Thomas; went ashore to testing-house and along land line.

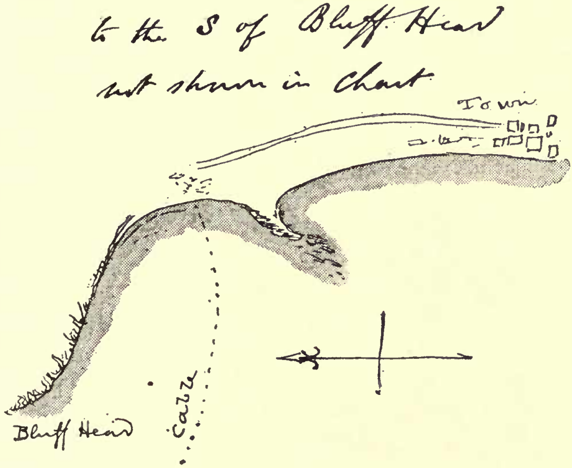
And now comes another break in the cable-laying operations, for whilst the *Dacia* is employed in taking in a fresh supply of cable from the *Titian* we find Sir Charles proceeding to some of the Leeward and Windward Islands in H.M.S. *Vestal*, on various official matters.

To extract again from his diary:—

December 17.—Left in *Vestal* at 5.30 p.m. for St. Kitts, Sr. Lopez with me. Mr. Gutteres also on board.

December 19.—Arrived at Basseterre, St. Kitts, at 0.30 a.m. Went ashore after breakfast and saw Mr. Wigley, the administrator, to arrange where the cable could be landed. Drove to Frigate Bay estate. Walked to a

bay without a name
on the N side of
Timothy's Hill —
Afterwards to landing at
other side (Basseterre side)
about 1½ m from the
proposed office in Treasury
Buildings
Landing to S. of a spit



(REPRODUCED FROM BRIGHT'S DIARY)

N.B.—No large timber to be got.

Left at 5.30 for Antigua.

December 20.—Arrived off St. John's Harbour, Antigua, and inspected Goat Hill Bay. Four miles of land line. Left at 6 p.m.

Night very dark. *Vestal* anchoring in shallow water near Hurst's Shoal, lost anchor and chain.

December 21.—Sweeping all day for lost anchor and chain.

December 22.—Left for Dominica.

December 23.—Arrived at Dominica in the morning. Saw Major Freeling, the Lieutenant-Governor of Dominica, about landing the cable; also Sir Benjamin Pine, the Governor of the Leeward Islands, now here.

Left in the afternoon for St. Pierre.

December 24.—Arrived at St. Pierre in the morning. Held meeting with the Chamber of Commerce and some deputies of the Council-General. Sailed for Barbadoes at night.

December 25 (Christmas Day).—Abreast of St. Lucia in morning.

December 26.—Arrived at Barbadoes and anchored in Carlisle Bay at 8 a.m.

Called on Governor Rawson.[1] Drove to N. end of bay by Pelican Point; then to S. end by Fort Charles. Afterwards called on General Munro.

Left for Guadeloupe in the afternoon.

December 29.—Arrived at Basse Terre, Guadeloupe, at 5.30 p.m.

Went ashore to see the Governor and discuss the telegraph question. Left at 10 p.m. for English Harbour.

December 30.—Arrived at English Harbour at 10 a.m. Went ashore, saw Mr. Vizard, and sailed for St. Thomas in the afternoon.

December 31.—Arrived at St. Thomas. Found *Dacia* still transferring cable from *Titian*. Mail in to-day.[2]

Sunday, January 1, 1871.—No work; service on board *Vestal*; called on Governor, Consul, etc.

January 2.—*Shannon* arrived from England with a new jointer on board.

January 3.—Having finished turning over cable during afternoon, set out (at 5.30) for Puerto Rico.

January 4, 8.30 a.m.—Arrived at San Juan de Puerto Rico. *Vestal* with us.[3] Mr. Latimer came on board. Went with Sr. Lopez to see the Governor.

January 5.—Transferring cable and getting ready for Puerto Rico-Jamaica section.

January 8.—Landed shore end near St. John's Gate, and buoyed end.

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[1] Afterwards Sir Rawson W. Rawson, K.C.M.G., C.B.

[2] By this mail Sir Charles received a letter which formed a curious and striking instance of Post Office zeal. It was a letter forwarded by the G.P.O., London, and addressed :—

"To Sir Charles Bright,
"England.
"(*If not there, try elsewhere*)."

[3] Sir Charles had returned to his quarters aboard the *Dacia* on last reaching St. Thomas.

January 9.—6.30 a.m.—Anchor up, and set on for buoyed end, cable on drum.

1 p.m., splice with shore end finished. Started paying out towards Holland Bay, Jamaica, a matter of nearly 700 miles.

January 10, 0.40 a.m.—Stopped ship owing to appearance of a fault, supposed to be in lead, but found to be in cable.

Rode to cable till daylight. 7.30 a.m., after effecting repair, went ahead easy. 8.30, stopped ship's engines. Took sounding, 32 fathoms, sand—about 1½ mile from land.

We will now leave the diary temporarily, and confine ourselves to a more general and less technical description. Sir Charles and his brother—who had joined the expedition by request—kept alternate watches in charge of the laying operations. The large cabin they occupied was immediately under the paying-out machine. When laying cable the rumbling noise of the apparatus acted as a lullaby to the one resting below; while, from habit, any stoppage of the machine at once roused the sleeper. This may well be understood when the fracture of a cable in deep water with a rough bottom probably meant an expense of many thousands of pounds and several months in its recovery.

H.M.S. *Vestal* went ahead as pilot, and the *Dacia* coasted along a few miles off Puerto Rico, under the lee of the island, with the sweet scent of orange and lemon trees wafted off during the night. At daybreak on the morrow (January 12th) they bore over towards San Domingo (and Haiti), past Saona Island, and across the great bay leading to Alta Vela, a rock resembling a "high sail." The trade wind from the east here blew heavily, and the sea rose so much that it was with difficulty that the speed of the *Dacia* could be kept low enough for safe "paying out," and yet at the same time avoid being pooped by the following waves. At night on the fourth day out, more than six hundred miles had been laid without any serious hitch ; but at daybreak —when Jamaica was already in sight—a fault showed itself, after having passed overboard. This it was, of course, necessary to recover. The depth was about, 1,200 fathoms—nearly a mile and a half. However, the fault was got on board once more, in safety, and cut out.

But, after the splice had been made, in passing the cable from the bows to the stern again, the cable parted, through getting foul of the propeller, owing to a strong current. Had it not been for an unfortunate, but excusable, error on the part of the navigating lieutenant of the *Vestal*—who mistook Cape Espada at the south-east end of San Domingo for the end of Saona Island, and thus piloted the *Dacia* many miles out of her true course—the cable would have been laid to within a few miles of Holland Bay, her destination, when the fault occurred and the accident took place. As it was, it required months of grappling and a very heavy outlay to raise the cable again, the bottom of the sea about here (off Morant Point) being a nest of volcanic ridges interspersed with coral walls. These latter had a way of breaking grapnels, and, occasionally, the still more precious grappling rope.

To return to Sir Charles' diary :—

January 15.—The cable having parted, Buoy No. 1 was at once lowered, and we then proceeded to prepare for grappling, whilst the *Vestal* left for Kingston.

5 p.m., grapnel down.

January 16, 17, 18, and 19.—*Dacia* grappling.

January 20.—The weather being bad, proceeded to Kingston harbour for provisions, as well as to effect lengthy repairs to ship and engines.

February 4.—Left Kingston for grappling ground.

February 6, 8 a.m.—On reaching supposed position of grappling ground the sea had got up too much to grapple; besides being too hazy to find buoy.

6 p.m., lowered grapnel.

February 7, 7 a.m.—Commenced heaving up. Found one prong of grapnel broken off and two straightened out. Too much sea for grappling.

February 8.—Strong breeze from N.E. Weather thick. No observation at noon.

5 p.m., wind and sea moderating. Put down grapnel in position.

February 10.—Have so far been unable to get a drift across the cable.

February 11, 9.30 a.m.—Picked up grapnel. Found prongs covered with chalk and coral.

3.40 p.m., lowered grapnel again.

February 12.—Blowing hard with rain. Too much sea for grappling.

February 15.—Grappling during day.

1 p.m., took line in. All the prongs of grapnel bent and scored by rocks.

February 17.—Lowered grapnel again.

February 18.—Too much sea for grappling, so left *Dacia* in *Vestal* for Kingston.

February 24.—After waiting for mails, returned in the *Vestal* to grappling ground.

February 25.—Stormy. Gale from E. Could not find *Dacia* or buoy.

February 26 (Sunday).—Met with *Dacia*. Too stormy to work. Went for shelter to Port Morant and put live stock and provisions on board. I rejoined *Dacia*.

February 27 and 28.—At Port Morant. Too rough to do anything.

March 1.—Out at daylight. Found buoy with staff broken short off.

March 2, 3, 4, and 5.—Too much sea for work.

March 6.—Grappling all night. At 10.40 a.m. strain rose to 10,000 and remained so. Began picking up.

1 p.m., grapnel inboard; four prongs completely straightened, but no cable!

Being short of coal, started for Port Royal, and remained outside all night.

March 8.—Commenced coaling from barque *Malta*.

March 9.—*Suffolk* in from St. Thomas. Commenced coaling her.

March 11.—*Suffolk* alongside to take over cable, grappling rope, etc., from *Dacia* for grappling.

March 12 to 23.—Coaling, transferring cable and repairs on board *Dacia* and *Suffolk*.

March 28.—First day on which weather has been at all fit for grappling after above changes. *Dacia* went out to grappling ground, but had to return to Port Morant for shelter.

April 1.—Joined *Dacia* at Port Morant.

April 2.—Set out for grappling.

April 3.—Had to take shelter again in Port Morant.

April 6.—Still blowing hard from N.E. Heavy sea outside.

The *Suffolk* being now available and ready for grappling work, Sir Charles, at this stage, determined to leave her with his brother, Mr. Rae, and half the cable staff, to continue the grappling for—and to complete—the lost Puerto Rico-Jamaica cable, whilst he went on with the laying of the remaining sections connecting up the long string of Leeward and Windward Islands.

Being short of staff—owing to sickness and the return home of Mr. France—Sir Charles Bright engaged the services of Mr. Henry Benest,[1] captain of a trading steamer belonging to Messrs. Nunes Bros.

The diary continues :—

April 7 (Good Friday).—Started at daylight in the *Dacia* for San Juan de Puerto Rico.

April 8.—At sea off the coast of Haiti. Weather fine. Sea calm.

April 9 (Easter Day).—Divine service on quarter deck. Fine.

April 10.—After a dead calm, it rained in torrents and blew fresh.

April 12.—Arrived at San Juan de Puerto Rico in morning. Tested Jamaica cable, and left at 6 p.m. for St. Thomas.

April 13.—Arrived at St. Thomas.

April 14.—Started transferring shore-end from No. 4 tank.

April 17.—Started transferring deep-sea cable from No. 3 to No. 4 tank.

April 19.—Commenced putting new tubes in ship's boilers.

April 22.—*Dacia's* crew "signed off" at British Consul's and a new crew shipped, only the officers, boatswain, and carpenter of the old crew re-shipping.[2]

April 23 (Sunday).—Liberty ashore.[3]

April 24 to 28.—Transferring cable.

April 29.—*Dacia's* old crew left by German mail steamer for Southampton.

April 30 (Sunday).—Boarded H.M.S. *Myrmidon*, and arranged

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[1] Now a telegraph engineer of great experience, in constant charge of the Silvertown Company's Cable expeditions.

[2] The period was over for which they had "signed on," and few cared to risk a longer stay in the midst of such ill-luck, with death constantly hanging over them. This loss of old hands, of course, made things all the more difficult for Sir Charles.

[3] This liberty to the new hands was, by reason of their agreements, unavoidable.

for her to accompany the *Dacia* as escort whilst laying the remaining sections. Came round Water Island in morning to splice on to shore-end. Anchored in Gregorie Bay. Making all ready for starting laying St. Kitts section.

May 1, 1871, 8.40 a.m.—Anchor up and jib set. Started paying out.

5.55 p.m.—Light off scale. 7.40, cut cable aft and passed it to bows—fault at sea. Picked up slowly all night, having to stop from time to time on strain becoming excessive, to get the cable clear. Cable came up with the outer covering torn off in some places and the wires abraded by rocks.

May 2.—Picking up slowly. Fault estimated at 22 miles off; by Blavier's test, 18 miles.

May 3, 9.55 a.m.—Sudden jerk on cable while coming up easily. Eventually it came up quite slack, after the dynamometer jumped. Found it had parted at the bottom, the end being torn to pieces by rocks. Two hundred and eighty-four fathoms came in after the break.

0.30 p.m., grapnel down on the bank, 28 fathoms. Grappling with 74 fathoms of lines, including 30 fathoms of chain.

1 p.m., bottom at 25 fathoms. 1.20., no bottom at 80. Hauled in grapnel. Three prongs broken.

2.15 p.m., put down grapnel, 66 fathoms of rope and 30 fathoms of chain. 5.50 p.m., picked up grapnel. Three prongs broken off, two broken in half.

6.25 p.m., lowered grapnel again, but strain very irregular, and picked up at 7.30 with all the prongs gone.

8.20 p.m., grapnel down again. 9.10, up; one prong broken.

9.33 p.m., grapnel down. 10.25, hooked cable. 10.40, bight of cable (intermediate) out of water. Buoyed St. Thomas end.

May 4, 1 a.m.—Commenced picking up sea-end of cable.

8.50 a.m., cable parted about a fathom inboard, coming in much chafed, and wires gone in places.

May 6, 4.40 p.m.—Started paying out again, and signalled *Myrmidon* "Steer E. by S. ½ S." 11.10 p.m., stopped for defect in cable.

May 7, 5.40 p.m.—Started paying out again towards St. Kitts. . . .

May 8, 10 p.m.—Nearing St. Kitts landing-place. Stopped engines. 10.30, let go anchor in harbour.

May 9.—Sent testing-house on shore. Went out with Captains Holder, R.N., and Dowell, to examine landing-place.

May 10.—House erected by Mr. Tarbutt and men.

Laid shore-end round Bluff Head, and completed St. Thomas-St. Kitts (or St. Christopher) section.

May 11.—Started transferring cable. Went ashore to see the Administrator.

May 18.—Mr. Matthew Gray arrived from England, accompanied by Admiral Dunlop; the former came on board, the latter went on to the Windward Islands.

May 24.—Schooner *Queen* came alongside to take in shore-end for Antigua section.

May 25, 5.40 a.m.—Started from Basse Terre with the schooner to land the Antigua shore-end.

3 p.m, shore-end landed. Sent Captain Dowell on board schooner to join the homeward mail, invalided; also the boatswain.

May 26, 3.25 a.m.—Started laying cable towards Antigua.

1.0 p.m., stopped for slight fault.

4.0, having cut out fault, resumed paying out.

5.0, buoyed end of cable off Antigua landing-place.

5.20, anchored in Goat Hill Bay.

May 27.—Put up testing-house. Landed shore-end and completed St. Kitts-Antigua section.

May 29.—Laid second shore-end (for Guadeloupe section) and buoyed it.

8.30 p.m., started laying towards Guadeloupe, so as to approach there at daylight.

May 30, 10 a.m.—Buoyed end of cable off Guadeloupe.

May 31.—Went into the country to see the Governor. Testing-house erected.

June 2, 6.30 a.m.—Up anchor. Commenced coiling cable in boats. Strong tide to N.W. delayed landing shore-end till 7.15 p.m.

June 3.—Tarbutt arrived from St. Kitts in schooner *Queen.*

6.45 p.m., spliced on to shore-end, and started paying out towards buoyed end of cable already laid from Antigua.

June 4, 11.13 a.m.—Reached buoy. 5 p.m, slipped final splice Antigua-Guadeloupe section.

6.30 p.m., anchored in St. John's Harbour for the night.

June 5.—Went to English Harbour to arrange about coaling there. Started transferring cable on board *Dacia*. Land line not finished yet.

June 6 and 7.—Transferring cable.

June 8.—*Dacia* taking in coal at English Harbour. Meanwhile I stayed at St. John's with Colonel Menzies.

June 9.—Rejoined *Dacia* at English Harbour.

June 11.—Left English Harbour in *Dacia* at 5 p.m.

June 12.—Arrived at landing-place at daylight. 3.30 p.m., shore-end for next section (to Dominica) landed.

June 13, 1.30 a.m.—Started paying out towards Dominica, so as to near there in daylight. 2.11 a.m., Saint's Island (the westernmost island) abeam.

5 a.m., Dominica in sight.

Noon, stopped paying out and buoyed end of cable.

1.10, anchored in 15 fathoms. Went in afternoon to select exact landing-place and arrange with the Acting-Governor about land-line.

June 14.—Testing-house sent on shore. Mr. Benest in charge of working party.

June 15.—Testing-house erected, and trench for shore-end dug.

June 16.—Anchor up first thing in the morning, and set on for landing-place.

Noon, shore-end landed, and started laying forward buoyed end.

4 p.m, final splice lowered, thus putting through Antigua-Dominian section. Back to anchorage off Government House.

June 17.—Transference and arranging of cable for next section commenced.

June 18 (Sunday).—Work continuing but very slowly, owing to the necessity of employing black labour. Tarbutt arrived in R.M.S. *Mersey* from Guadeloupe. Ball at the Governor's.

June 20.—Sent Currich to hospital. 4 p.m, landed shore-end for Dominica-Martinique section.

(N.B.—Message during day that part of Silvertown Works had been burnt down.)

June 24, 3.48 a.m.—Commenced paying out to Martinique. 11.20 a.m., close to Martinique. Stopped paying out.

In buoying end, the buoy got foul of the propeller (owing to strong current), and sank.

Went into anchorage, placing cutter to mark position of sunken buoy.

Went on shore to the hotel in afternoon. Admiral Dunlop there.

June 25.—Sent away steam launch and two boats to grapple for cable. Picked up, and buoyed end during day.

June 26.—Out in morning with *Dacia*. Landed shore-end; and put through Dominica-Martinique section, during day.

Arno arrived in evening. Admiral Dunlop and Mr. Gutteres go in her to Guadeloupe.

June 28.—Landed shore-end for cable to St. Lucia.

Déjeuner given at the hotel by the town. M. Borde, President of the Council, presided.

June 29, 1.40 a.m.—Picked up buoyed shore-end, and started laying towards St. Lucia. During night ship rolling and pitching a good deal whilst paying out cable.

1 p.m, off St. Lucia. Stopped paying out and buoyed cable. Went into harbour and anchored.

June 30.—Made all ready for landing shore-end in Cul de Sac Bay to-morrow.

July 1.—Landed shore-end, and joined on to D.S. at buoy, thus completing Martinique-St. Lucia section.

July 2.—Coaling all day.

July 3, 9.30 a.m.—Cast off from wharf in morning, and set on to Cul de Sac Bay.

4.30 a.m., landed shore end for St. Lucia-St. Vincent section. After buoying, returned to anchorage for English mail in the evening. Admiral Dunlop and Mr. Gutteres on board. Former goes on to Trinidad, latter to St. Vincent.

11 p.m., hove up anchor and set on for St. Vincent.[1]

July 4.—Anchored off Kingstown, St. Vincent, in 21 fathoms of water.

Went in launch to Greathead Bay, Cane Garden Bay, and Otley Hull Bay. Chose the latter.

July 7.—Landed shore-end; also landed and buoyed the Barbadoes shore-end.

July 8, 3.30 a.m.—Started laying back to St. Lucia. 8. am., in leaving the lee of the land and entering channel ship pitched very much.

4 p.m., entering Cul de Sac Bay. 6.30 p.m, slipped final splice with buoyed end and went into Castries Harbour.

July 9 (Sunday).—Lunched with Governor Des Voeux, and left in the evening for Forte de France, Martinique, to dock the *Dacia*.

July 10, 6.30 a.m.—Arrived at Forte de France. Went into docks.

3 p.m, went ashore with Mr. Gray and Sr. Lopez. Called on the Governor.

July 11.—Dock hands emptying dock and shoring ship.

Called on the *Directeur d'Interieur*. The Governor and party on board the *Dacia* in the evening looking at the cable and machinery.

July 12.—Dock hands still engaged on ship. Mr. Tarbutt arrived from St. Vincent.

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[1] Before laying the cable between St. Lucia and St. Vincent it was necessary to proceed to the latter to select the landing-place and make other preliminary arrangements.

Went to the country house of the Governor near Balata—six hours driving there, two hours back.

July 13.—Dock hands and crew engaged in scraping and painting ship.

To a dinner-party at the Governor's in the evening.

July 14, 15 and 16.—Scraping and painting ship.

July 17.—Commenced letting water in dock at 0.45 p.m. Dock full at 1.55.

2 p.m., started warping out. 4.30 p.m., anchored in harbour.

6.15 p.m., accounts settled. Cast off from buoys, and set on for Barbadoes.

July 18, 4 p.m.—Anchored off Bridgetown, Barbadoes.

July 19.—Called on Governor Rawson[1] and General Munro. Dined with the latter. The former pressed me to make a stay at Government House, but I fear that will be impossible.

Started taking over cable from *Benledi*.

July 30.—*Suffolk* arrived with Edward on board, besides a fresh supply of grappling rope and grapnels.

August 1.—Went with Edward and Gray to examine possible landing-places. Selected a site.

E.B. and self dined with the Governor.

4 p.m., got under way and set on for Demerara, to arrange for landing cable there.

August 5, 5 p.m.—Arrived off Georgetown, Demerara.

Went ashore to Beckwith's Hotel. Mr. Mason called.

August 6. Went to inspect the proposed landing-place.

August 7.—Mail day.

August 8.—Saw Babington.

August 9.—Looked at various other points for landing the cable.

August 10.—*Suffolk* in at 3 p.m.

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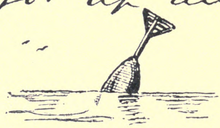
[1] Then Governor-in-Chief of the Windward Isles, with headquarters at Barbadoes, and afterwards Sir Rawson W. Rawson, K.C.M.G., C.B.

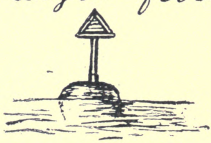
16th Having got shore end
ready for paying out went
to position 25 m from
Georgetown and anchored
there at 11 pm.

17th 6.45 am put buoy
on end of cable and
got up anchor



50 fm 7/8 in chain
& mushroom anch

7.10 am put a buoy on
the bight about a cables'
length from the end



7.30 am started paying
out. Course SSE to allow
for current – true course was

(REPRODUCED FROM BRIGHT'S DIARY)

be S.) Nothing in sight.

11.30, lightship bearing S.W., about 3 miles distant.

Noon, waited for tide. (High water at 5.38 p.m.)

3.50 p.m., resumed paying out up the river Demerara.

Soundings, 17 ft., and ship drawing 11 ft. 6 in. aft, 9 ft. forward.

5.12, cable end buoyed, and a can buoy put on bight. 5.15, returned to Georgetown.

N.B.—Admiralty chart 533 of Demerara River not reliable; several inaccuracies.

August 18.—As we could not get nearer than within 10 miles, arranged with the Governor for the use of the *Governor Mundy* schooner for landing the rest of the cable in the very shallow water. Had to get her cleared out and prepared for receiving cable.

August 20 (Sunday).—Cable all coiled in hold of schooner.

August 21.—Started at daylight landing shore-end from schooner (*Governor Mundy*), steamer *Stirling* assisting. Hard at it all day. Governor Scott with me during part of the work. 100 convicts assisting on shore cutting trench and hauling. Great difficulty in getting so heavy a cable [1] through the mud, about the consistency of cream. Knocked off work at dusk.

August 22, 9.20 a.m.—Landed end on Sophia Estate, 3 miles from Georgetown. During afternoon made splice with cable previously laid.

August 23.—St. Vincent-Barbadoes cable laid from *Dacia*.

August 24.—*Suffolk* laying cable further out from the buoy, ready for the *Dacia* to continue the section between here and Trinidad, after turning over cable.

August 25.—Went to Berbice (New Amsterdam), with Mr. Gray and Mr. Cox, to inspect the route of the land-line towards Surinam, which connects on to Cayenne.

6 p.m., arrived at Berbice. Went to Britton's Hotel.

After inspecting the land-line and station, the *Dacia* being well employed for some days taking in fresh cable,

[1] No less than thirty-five miles of the heavy shore-end type had to be laid—owing to the shallowness of the approach for a long distance, and the liability of ships anchoring over the route.

Sir Charles—whilst at Berbice—appears to have accepted an invitation from the genial head of the Colonial Police (Colonel Fraser) to accompany him on the Government schooner during a round of inspection, extending to a trip up the River Corentyn, where it was necessary to take to canoes paddled by natives.

Game was met with at first; but on getting higher up the river the nearly naked aborigines in the interior drove all the deer, etc., away. Some of the provisions having been capsized out of a canoe, it became necessary to shoot and cook the large lizards (iguana), which proved anything but bad eating. They are desperately ugly, with greenish brown wrinkled skins, forbidding snouts, and serrated backs: they taste, however, very like rabbit or fowl.

While on this expedition Sir Charles killed a tremendous boa constrictor (or *anaconda*) by a shot through the head. It was hauled up to the branch of a tree by a noosed rope, and was still wriggling the following day. None of the natives would go near it, but a negro servant was slung up and took the skin off, measuring 23 feet.

To return again to the diary:—

August 26.—Started in revenue schooner *Petrel*, at 3 p.m., accompanied by Messrs. Cox, Gray, and Godfrey. Anchored at Bannaboo, near the mouth of the Corentyn River, at night.

August 27.—Left at 11 a.m. with the rising tide.

August 28, 7 a.m.—Arrived at Orealla. Landed and went out on the Savannah shooting. Returned at 9; too hot. Went out again at 5 p.m. for an hour.

August 29.—Out at 5.30 a.m. Left in boats for Siparota at 2.50 p.m.; arrived there at 6.15. Swung our hammocks in the Indian lodges.

August 30.—Off in morning through the woods. Breakfasted in an Indian lodge six miles off. Got back to camp at night.

August 31.—Started at 10 a.m. in boats for the schooner. Beat two islands for deer on the way.

September 1.—Anchored off Phillips' (collector's) Station. Left at 9 a.m., and anchored for night at Three Sisters Island.

September 2.—Arrived off the police station at entrance to Corentyn River early in the morning. Had to wait for the tide till night for crossing the bar.

September 3 (Sunday).—Arrived off Georgetown in morning. Left with Mr. Gray in the French steamer *Guyane* for Trinidad (Port of Spain) in afternoon.

September 4.—Arrived at Port of Spain at 11 p.m., and went to Madame Pantin's Hotel.

September 5.—*Dacia* arrived in the morning. Edward, Captain Hunter, and Sr. Lopez came to the hotel.

September 6.—Called on Governor Longley. On board at noon. Busy there rest of day.

September 7.—Transferring cable.

(Mr. Gutteres informs me that the St. Thomas-St. Kitts cable has been damaged in the harbour of the latter place, during the recent hurricane, by ships dragging their anchors.)

September 8.—Mails made up for England. Sent home Benest, Baxter, and Lopez—all more or less invalided.

Left for Moruga (the proposed landing-place for the southern cable) at night.

September 9.—Passed through Serpent's Mouth in morning. Off Moruga at 2 p.m. Went ashore and examined landing-place etc.

Started back for Demerara at 5 p.m.

September 10 (Sunday).—Weather fine. Off Venezuelan coast. Divine service on quarter-deck.

September 11.—Arrived off the Demerara light-ship, and anchored near her at 10 p.m.

At this stage Bright's diary may be left, as the laying of the subsequent cables did not follow in ready sequence. It suffices, however, to say that within a month the remaining sections were laid. These connected up the islands of Trinidad, Grenada, and Barbadoes with the rest of the telegraphic system.

At Trinidad, the Demerara cable was landed at the south-east corner of the island ; while the continuing section northwards to Grenada was taken from Maccaripe Bay. The connection to Port of Spain (the capital) on the west side, was made by means of a long land-line. A great part of this was erected through a dense forest of more than fifty miles, which had to be cleared away by a small army of wood-cutters, for a width of at least forty feet, for a considerable distance.

On the completion of the various sections connecting up the Windward Islands and British Guiana, we find Sir Charles leaving for St. Thomas, which was reached on October 12th.

After at last bringing to a successful issue this chain of cables, Bright became so weak from recurrent attacks of malarious fever that his medical adviser peremptorily ordered him to England for some months at least. Thus, he very reluctantly took the mail from St. Thomas [1] a week

[1] He was, in fact, in so exhausted a conditon that he had to be carried on board the steamer.

The doctor had expressed himself strongly that he would not answer for his life if he stayed ; indeed, his health and constitution were seriously undermined, and he suffered the ill effects for the remainder of his life.

after his arrival there, leaving his brother, with Captain Edward Hunter, R.N.,[1] and Mr. Leslie Hill, to go on grappling for the lost cable between Jamaica and Puerto Rico, as well as that between Jamaica and Colon.

These West Indian cables have always given a deal of trouble, owing not only to the unfavourable character of the bottom, but also to frequent attacks at the hands—or, rather, at the *snouts*—of saw and sword-fishes, not to mention the teredo, previously referred to.

Section 4

Adventures and Reminiscences

The expedition was naturally greeted on the successful completion of each section with the greatest enthusiasm. Island after island was *en fête*, and a more hospitable race than the West Indian cannot be found.

It would be impossible to enumerate all the attentions shown to Sir Charles and the members of the Telegraph Squadron. The civil and military chiefs vied with one another in making pleasant the frequent intervals of perhaps weeks on shore that had to be spent while shifting cable from the depôt vessels to the laying steamers, fitting up the stations, and connecting with them the cables and necessary land-lines.

Jamaica, as the principal centre of the cables (from north, east, and south), was—for a considerable part of

[1] H.M.S. *Vestal* had been paid off, and thus the gallant Captain was available.

the enterprise—the main *rendezvous* for transhipping, coaling, and provisioning; so more was seen and experienced of that island and its inhabitants than of others. In the official circles frequent entertainments were given by the Governor, Sir John Peter Grant, aided by his able aide-de-camp, Major (afterwards Sir Owen) Lanyon, the son of Sir Peter Lanyon, an old Belfast friend of Sir Charles', as well as by the chief of the forces, Col. Sir Henry Johnston, Bart., and Sir John Lucie Smith, the Chief Justice of the island. Among the many leaders in the island who made time pass pleasantly for the members of the cable squadron were General Munro, the Commander-in-Chief, with Colonel Harman (afterwards Sir George Harman, K.C.B.) the Adjutant-General, and Col. Chesney, R.E. (later General Sir George Chesney, K.C.B., M.P.), Major W. W. Lynch, of the Queen's Royals, and Captain Gordon, R.A.

Section 5

The Griefs of Grappling

It now remained for Sir Charles' brother Edward, assisted by Capt. Hunter and Mr. Leslie Hill, to recover and "put through" the two lost cables—between Jamaica and Puerto Rico on the one hand and Jamaica and Colon on the other.

The following extracts from letters from Mr. Edward Bright by way of report to his brother indicate the difficulties to be contended with:—

PORT ROYAL, JAMAICA.
5th November, 1871.

. . . We started this afternoon, but have been absolutely stuck here by one of the engineers (4th) and an assistant not joining, added to the loss of poor Stephenson (2nd) . . . The 3rd engineer is drunk. Mr. Stoddart cannot, of course, take charge of the engines with one assistant; so we are in a fix, and shall probably lose a clear day by Wheeler being on shore. I have therefore wired you to send us *at once* a 2nd and 4th engineer.

Hilliard had previously written Glover's (by this mail) about a 2nd officer coming out. Arrange with Norwood's and Glover's. We must not let ourselves be stuck; that would be as bad as the old jointer business. Tarbutt is better to-day. . . .

KINGSTON, JAMAICA,
24th November, 1871.

. . . Since I last wrote I have no success to report, as we have had bad weather nearly every day, with too heavy a sea to grapple.

On the 6th, we grappled from 2 m. N. to 10 m. S. of the buoy, with a S.W. drift. Three prongs of grapnel injured.

7th and 8th.—Grappled from 18·5 lat. N., 75·37 long. W. Took two grapnels up at night, 3.30 a.m. Two prongs bent on after grapnel; sounded 960 fathoms, yellow mud $\left\{\begin{matrix}18\cdot3\\75\cdot37\end{matrix}\right\}$.

8th.—Continued grappling from $\left\{\begin{matrix}18\cdot\ 7\\75\cdot33\end{matrix}\right\}$ to $\left\{\begin{matrix}17\cdot57\\75\cdot44\end{matrix}\right\}$ with one large grapnel. Prongs slightly bent.

9th.—From S. to N. $\left\{\begin{matrix}17\cdot39\\75\cdot34\end{matrix}\right\}$, strain on at $\left\{\begin{matrix}18\cdot\ 0\\75\cdot37\end{matrix}\right\}$ Pick up.

10th.—Sounded 1,340 fms. shell sand $\left\{\begin{matrix}18\cdot\ 6\\75\cdot37\end{matrix}\right\}$, grapple from $\left\{\begin{matrix}18\cdot\ 9\\75\cdot34\end{matrix}\right\}$. Stuck at $\left\{\begin{matrix}18\cdot\ 2\\75\cdot45\end{matrix}\right\}$. Picked up. Chalk on chain and grapnel.

11th. — Grappled from $\begin{Bmatrix}18^{\cdot}\ 7\\75^{\cdot}35\end{Bmatrix}$. Went a long way to westward and picked up.

12th.—Too rough to grapple or sound.

13th.—Went into Port Morant.

14th.—Wind moderated. Put out in afternoon.

15th.—At buoy 6.30 a.m. Go 5 m. E. and 4 m. N. Broke sounding line; apparently very shallow, about 350 faths. Tried to grapple, but could not get ship S., owing to a westerly set of two knots. Grappled S. to N. from $\begin{Bmatrix}18^{\cdot}\ 3\\75^{\cdot}37\end{Bmatrix}$ to $\begin{Bmatrix}18^{\cdot}\ 7\\75^{\cdot}50\end{Bmatrix}$.

16th.—Grapnel down $\begin{Bmatrix}18^{\cdot}\ 5\\75^{\cdot}33\end{Bmatrix}$; obliged to take it up. Heavy sea, and half a gale. This state of affairs increasing, we went into Port Morant.

18th and 19th.—Wind still on.

20th.—Steamed to Narvasso. Wind still strong. Heavy swell. Got lost buoy from there (previously got one from Caymaros by schooner), so now three large buoys ready.

21st.—Went to Kingston. Strong wind and heavy sea.

We leave to-day after coaling. I have wired for more of Massey's deep-sea registers. Only one left, which had to be altered.

We have had to invalid Tarbutt. Chronic dysentery and liver complaint. He's very thin and ill. Do what you can to get him fresh work. . . .

To Sir Charles Bright,
London.

Once, when Captain Hunter and Mr. Bright were standing on the "bow baulks" of the *Dacia*, grappling for the Puerto Rico cable in deep water, the grapnel suddenly hitched on a rock; and before the ship could be checked a strain of over twenty tons came on the rope, which broke inboard close to the dynamometer with a shower of sparks. The end whirled overboard between them as they stood scarce a *foot apart,* but luckily without striking either one or the other.

As a further illustration of what had to be contended with, about forty grapnels were broken or bent in the recovery of this and the Colon cable, besides the loss of several grappling ropes.

As soon as Sir Charles' health had sufficiently recovered, he returned to this scene of trouble.

At the moment when the mishap first occurred to the Puerto Rico-Jamaica cable, Sir Charles and his brother made careful sketches of the outline and appearance of the Jamaica mountains in the distance, so as to give a clue to the bearings of the spot. This could not, however, be very accurately discriminated, though some angles were also taken. Had it been the era of the "kodak" the relations of the mountains and their slopes would have been so accurately defined as to have materially assisted the subsequent search.

The broken Colon-Jamaica cable had now to be taken in hand. It was, unfortunately, in very deep water. Moreover, considerable uncertainty existed as to its position; for it will be remembered that thick weather had prevented observations for some time prior to the mishap, while trying to recover a fault in deep water about 320 miles from Colon. Much rough weather was again experienced, the *Dacia* being frequently driven for refuge to the lee of Serrano and Roncador Cays, or to Old Providence Island, for days—and even weeks—together.

While engaged grappling for the Colon cable, the *Dacia* was caught in a violent cyclone, which came on suddenly and whipped her clean round in an incredibly short time—tearing the stay-sails to ribbons, clearing away the aft awning (which there was not time to furl), and taking the port quarter boat right out of the davits, which were bent into most curious shapes. However—except for pitching about those on board in a disagreeable sort of way—no actual harm was done.

In grappling it was the custom to attach a light chain with a long swab to the ring at the back of the grapnel. Thus, what was broken off the ground or rooted up by the prongs in front was enveloped by the swab as it rolled over and over, and a good idea of the nature of the bottom was thereby obtained. After the weariness of eight or ten hours' drifting without touching the cable, there was always something to look forward to when the hour or so of winding up had brought the grapnel on deck. First of all the state of the prongs was a matter of interest. Then there was its companion, the six-foot swab, enveloping *infusoria*, coral, and shells in its long tangles—collecting, like some octopus, whatever the prongs had detached.

A number of unique specimens were secured in this way, including many varieties of the lovely network-like lace of "Venus' bouquet-holder," or "flower basket" (*euplectella*), with numerous net coral cups, besides black coral and other varieties. The ooze consisted, as usual, of the microscopic skeletons of *infusoria, globigerinæ, diatomaceæ*, etc.

Apart from the vast difference in the climates, fishing for a cable in the soft ooze forming the so-called "telegraph plateau" at the bottom of the North Atlantic was child's play to the work entailed in recovering this line between the west end of Haiti and Holland Bay, Jamaica, where the bottom is mostly volcanic, and certainly one of the roughest in the world. The soundings, that had been made some five or ten miles apart, gave very little idea of the real state of things; for between one sounding and the next, perhaps half a dozen unknown declivities would be found to exist—and there was certainly no "telegraph plateau" in these parts.[1]

Section 6

Homeward Bound

On leaving Jamaica, the *International* proceeded to Santiago de Cuba. Here Sir Charles and his brother were cordially received by Consul and Mrs. Ramsden; and they then proceeded, *via* Batabano, to Havana. Before leaving, Sir Charles gave a picnic, some of the leading officials being invited. The scene selected for the picnic was a lovely plateau on a hill near Havana, shaded by the

[1] Bearing in mind that the Thomson steel-wire sounding apparatus had not then been introduced, the number of soundings taken compare favourably with what had been done elsewhere at this period.

luxuriant foliage of the island, and commanding a beautiful view.

Whilst in this neighbourhood, Charles Bright visited the tobacco plantations of Don Jose di Cabarga, a well-known manufacturer of the best Havana cigars, who had a special brand named "Sir Charles Bright regalias."[1] Perhaps the most curious sight here was a large enclosure with about a dozen detached cottages, given up to those slave-wives anticipating family increase. They were given no work to do, were looked after by a competent medical man, and had excellent food provided for them. Sir Charles and his brother had, of course, to allow themselves to be nominated as godfathers, and their names were given to a few of the already existing babies.

After a few days, the brothers took steamer to New Orleans. Thence they journeyed up the Mississippi in one of the "Palace Steamers." The lower part of the great river was quite uninteresting, mostly bordered by mud banks, into which the steamer every now and again had to poke its nose to receive bales of cotton—and passengers—and to discharge goods. The journey was not very pleasantly passed. The national games of "euchre" and "poker" were being played all about the saloon, and all night long; and as the players did not attempt to moderate their somewhat coarse voices, a lively time resulted for those in the state cabins.

At various points, very light railways with small trucks,

[1] After Sir Charles' return from the West Indies, "Don Jose" made a habit of sending him every year a case of these.

came down from the plantation villages—generally located on rising ground at a distance, so as to escape floods. It was notified that all passengers were expected to provide themselves with clench nails, in order to help to re-fasten the rails if any got loose on the trip! These light railways were nicknamed "huckleberry" lines, because, as hurry was unknown, the trains would pull up in the ripe season to let the negro women get out and pick the huckleberries here and there.

Every one knows what "skimming dishes" the creek steamers are, often drawing only a few inches of water; but the skipper, being "on the burst" with Mississippi yarns, asserted that in one very shallow "bayou" there was a "stern-wheeler" so light that a heavy dew on the grass was enough for it to pass over!

Our travellers were glad to go on by rail from Vicksburg in a Pullman car, though on one of the worst-made lines they had ever met with—a sort of corduroy road through forests and round spurs of mountains. They had happily secured a special compartment at the very tail of the train, which afforded fine views. The train oscillated so much that the voyagers were soon literally rocked to sleep!

The smallest incident was a relief from the monotony of the Mississippi. At one point they were roused by a plaintive but subdued howl of "Hi! Boss! Boss!!" accompanied by a faint odour, not unlike singed india-rubber. On going out to the rear division where the stove was, the cry was found coming from the large "grille" that surrounded it. On opening the lattice door a little nigger boy tumbled out half-grilled and fainting; but a douche of water revived him. He turned out to be a "stow-away" who had crept in there with the double object of warmth and concealment; but as the train went on, the draught increased the heat, till at last he was forced to cry out, being half-roasted alive. It was arranged with the conductor to take the lad to his destination—and without cooking him any more.

On arriving at New York in February, 1873, suitable thick garments required to be bought "ready-made." Each pair of trousers had a deep pocket behind, the explanation of its use in these parts being that it was customary for every man to carry a bowie knife.

The trip was prolonged into Canada, and the Niagara Falls were seen in their extraordinary winter mantle of ice and snow. The Falls were passed under with icy "stalactites" of eighty to one hundred feet hanging over the ledge. It was a great change from the 85° of the West Indies, the temperature being down to 30° below zero, or 62° of frost.

After returning to New York, Sir Charles and his brother had an uncommonly rough passage home in the White Star mail steamer *Atlantic*. This happened to be her final voyage before being wrecked.

And here ends the story of the West Indian cable expeditions—the last expedition which Sir Charles accompanied or took an active part in.

CHAPTER XII

1873–1874

SHORTLY after Sir Charles Bright's final return from the West Indies in 1873, the family took up quarters in a new town house at South Kensington—No. 20, Bolton Gardens.

About this time Sir Charles embarked on a book on electrical and telegraphic matters. It was, however, set on one side shortly after. Up to his last days, he expressed an intention of completing this work; but, like many other busy men, he never found an opportunity of realising his hopes, or, indeed, of doing much literary work of any sort. The fact is, though writing extremely concise and clear reports and addresses, his characteristic ability lay more in the direction of carrying out practical work. He was not one of those engineers who have contributed largely to the literature of their subjects, being indeed, a man of actions rather than of words.

He had, however, a more complete collection of electrical literature than was contained in any individual library. Sir Charles' library contained many works not included in the famous collection of the late Sir Francis Ronalds, afterwards presented to the Institution of Electrical Engineers. Moreover, he had kept up, from the very beginning, a collection of press-cuttings referring to telegraphy, or electrical matters generally. This collection has since been continued by the author, the twelfth bulky volume having now been reached. Probably no similar collection can be seen elsewhere.

Bright had only been home a short time when he became interested with Count d'Oksza—a prominent Spanish gentleman [1] to whom we have already referred—in a project for telegraphically uniting Spain with her Canary Island possessions and with extensions down the West African Coast.[2] This eventually culminated in the formation of the Spanish National Telegraph Company—promoted by the Silvertown Company—with subsidies from the Spanish and French Governments, whose system extends as far as the latter's colony of St. Louis, in Senegal. The extension to the Cape was afterwards carried out, with the help of subsidies from the French, Portuguese and British Governments, on the condition that the cable landed at some of their respective colonies *en route*. These sections were partly laid by the Silvertown Company, and partly by the Telegraph Construction Company.

[1] Of Polish extraction, his full name was Count Thaddeus Orzechowski !

[2] Whilst in Spain, connected with the above negotiations, Sir Charles visited Lisbon—partly to see the Portuguese authorities concerning the proposed cable to Cape Verde Isles, and partly with regard to tramways. Thus, in *The Times* of May 23, 1873, we find a news telegram as follows :—

"Lisbon, May 22.—Sir Charles Bright gave a banquet last night in honour of the British Minister, at which many persons of note were present."

CHAPTER XIII

Land Telegraphs

Section I

Transfer to the State

AS we have seen, the Telegraph Act for the settlement of terms with the Companies was passed in 1868. In the following year, the Telegraph Purchase and Regulations Act (for the administration of Government service) became law.

Up to this time our Government was the only one, besides that of the United States, which had not undertaken the erection and control of the country's system of telegraphs. When the transfer took place it was after thirty-three years' working by private enterprise. During this long period those engaged in the undertaking had provided the capital and incurred all the risk, besides developing the telegraph system into a highly lucrative business. Thus, it was but natural that the Companies should show no desire to part with the systems they had created.

The above-mentioned Government Bill was brought forward somewhat suddenly, and without giving the Companies any particulars beforehand. The indecent haste with which this matter was pressed may be gathered from the following extract from a pamphlet entitled *Government and the Telegraphs* (Effingham Wilson, 1868) :—

On Wednesday, the 1st April, 1868, the new Chancellor of the Exchequer, Mr. Ward Hunt, appeared at the table of the House of Commons to move for leave to introduce one of those anomalous measures known in Parliamentary phraseology as "hybrid" bills (i.e. public bills affecting private rights), to enable Her Majesty's Postmaster-General to acquire, work, and maintain Electric Telegraphs. . . . Mr. Ward Hunt rose to ask leave to introduce this Bill at twenty-five minutes before six o'clock. The House of Commons adjourns its Wednesday discussions at a quarter before six o'clock. The Chancellor of the Exchequer had, therefore, only ten minutes to develop "the objects" of the Bill. Having fully exhausted those ten minutes, the Speaker intimated that the hour for terminating the discussion had arrived.

Mr. Milner Gibson and Sir Charles Bright rose to address the House ; but they were too late even to ask a question or obtain an answer—much less to raise any discussion on the principle of the measure.

The Bill, as at first framed, was very arbitrary, and practically looked like confiscation ; but in view of the strong opposition of the Companies, the Post Office authorities [1] came to better terms.

A Parliamentary Committee was eventually appointed to deal with the matter—consisting of the Chancellor of the Exchequer, Mr. Goschen, and others ; and this Committee then proceeded to thoroughly thrash out the con-

[1] The late Lord John Manners was at that time Postmaster-General, Sir Arthur Blackwood being the first Secretary.

ditions of the bill. Sir Charles was at the time in the West Indies, but the Committee secured expert evidence from his brother (on behalf of the "Magnetic" Company), as well as from the following witnesses:—Mr. F. I. Scudamore, one of the Secretaries of the Post Office; Mr. Henry Weaver, Secretary to the Electric and International Telegraph Company; Mr. R. S. Culley, Engineer to the "Electric" Company; and Mr. Latimer Clark. Another important witness was Mr. H. Foster, C.B., of the Treasury Office.

On the Post Office authorities actually taking over the lines in 1870, they at once established a universal rate for telegrams throughout the United Kingdom. One of the benefits of the change was the rapid extension of the system to small towns, and even outlying villages, which until then had no telegraph. This policy was, of course, forced upon the Government. They could not, like the Companies, consider whether a station at any given place would "pay" or not. Partly as a result of this, the State, unlike the Companies, works the telegraphs at a loss in this country—although the amount of this loss is a diminishing quantity each year.

SECTION 2

Railway and Government Arbitration

On returning from their arduous and exhausting work in the West Indian tropics, Sir Charles and his brother were in immediate request by the Railway Companies, who were engaged in important arbitrations with the Post Office authorities as to the value of their interest in the Telegraphs, on account of the purchase and transfer to Government of the Telegraph Companies' system just referred to.

The Railways were concerned in a variety of ways. In some instances the Telegraph Companies paid considerable sums to certain Railways for mere way-leave. For example, the South-Eastern used to receive nearly £2,000 a year under this head from the Magnetic Company alone, besides dividing the message receipts when collected at, or delivered from, the railway stations. In other cases the Railways had their telegraphing and signalling performed by the Telegraph Companies; and, again, in others, the Railway Company had the use of the telegraph as a set-off against the way-leave. The railways, of course, offered a better protected route for the wires than the highways, and were free from the chance of injury by falling trees in storms. The value of this beneficial interest may be gathered from the fact that while the Telegraph Companies obtained £5,847,347 for the whole of their lines, stations, and plant, the Railways received for their interest in the message business and way-leaves £1,817,181.

Mr. R. Price-Williams, C.E., the eminent railway calculator, had very ably worked out the figures for the Railways; and—conjointly with Mr. Latimer Clark, as the former Engineer of the "Electric" Company—Sir Charles and Edward Bright put together the sort of evidence that was needed. For some years the brothers were more or less engaged in attending as witnesses in the many necessarily lengthy arbitration cases. In the above arbitrations the Right Hon. J. Stuart-Wortley, M.P., was umpire, with Mr. F. J. Bramwell, C.E.,[1] and Mr. Henry Weaver as arbitrators. These railway assessment cases were admirably conducted by Mr. Samuel Pope, Q.C., the famous railway advocate, while Mr. R. E. Webster[2] led on the other side.

During the various arbitrations, patent cases, and lawsuits generally, in which Sir Charles was engaged from time to time, he used—even when vitally concerned—to vary the proceedings by taking sketches in court, which afforded some amusement.

1 Afterwards Sir Frederick Bramwell, Bart., D.C.L., F.R.S.
2 Now Lord Alverstone, G.C.M.G., Lord Chief Justice of England.

CHAPTER XIV

Mining

AT several periods of his life Sir Charles had shown a predilection for mining. It attracted him from the scientific, as well as the adventurous point of view—combining as it did chemistry, geology, and mechanics.

Thus, in 1861, he and his brother had taken up the exploitation of a mine in the Valgodemard Dauphine of the south of France. This contained veins of grey copper, i.e. copper ore carrying silver. The mine was worked by the Brights from 1862 to 1865, but eventually the mineral proved too refractory for profitable working. It had been originally brought to the notice of Sir Charles by Mr. E. B. Webb, C.E. This was Bright's first professional connection with Mr. Webb, but for many years—up to the time of the latter's death—a firm friendship existed between them.

The valley in which the Valgodemard mine was situated was exceedingly beautiful. During the working of the mine a claim of 40 francs was made for a very young walnut tree—a mere sapling—which had to be removed in making a watercourse. On it being pointed out that the sapling was not worth even a franc, the owner replied:

"That may be so now, but it would have grown into a fine tree!" This novel form of argument did not, however, prevail with the small local tribunal at Roux, which awarded the greedy old man—much to his chagrin—just the franc deposited by the Valgodemard Company.

Sir Charles' next mining interest was that of the New Mansfield Company. This was formed about 1864 to work some extensive alluvial deposits of low-grade copper ore, near Klausthal, in the Hartz Mountains. Mr. Webb was again a partner in this venture with the Brights. When Sir Charles first visited the New Mansfield mine he was very warmly received by Professor Bruno Kerl (of the great German College near by) and other important persons, who pressed him so much with "chopins" of strong beer that he began to think they had designs upon his head![1] On a couple of the professors paying a return visit, they indulged freely in some port at the works, and became so much affected that when they wanted to go back to Klausthal at night Sir Charles thought it better to have them driven twice round the mining district, and then to bed at New Mansfield. Here, to their great astonishment, they awoke next morning.

Then came the Croscombe lead mines, in Somersetshire. These proved a heavy loss to Sir Charles. He was chairman of the company—an unlimited one—formed about

[1] Bright had been warned by his mining associates that the good folks of Klausthal had a reputation for plying their English visitors with more than enough of their somewhat "heady" beer!

1865. The failure occurred during 1867, whilst he was busily engaged with House of Commons committees. Sir Hussey Vivian, M.P.,[1] was also on the board of directors, but the brunt of the loss fell on Sir Charles.

Soon, however, Bright was destined to have a still closer and more definite connection with mines and mining.

About the year 1868 he foresaw that, as the engineering and electrical science with telegraphy was becoming better understood with each new undertaking, professional services would gradually become less valuable and less sought after. Then, too, the manufacturing firms—since becoming limited liability companies—had acquired a staff which rendered them capable of contracting for the submersion, as well as for the construction, of cables. This being so, Bright determined that he must cast his net wider in the profession of civil engineering. Thus, a little later, he embarked on more general and independent consulting practice, to which larger profits were attached. In this, his brother, Edward, was associated with him.

[1] Sir Hussey Vivian (subsequently first Lord Swansea) was an old friend of Sir Charles' ; and when his big chemical and smelting works at Swansea and Birmingham were being converted into a company in 1883, Bright took up a considerable interest therein.

The Servian Mines

In the middle of 1873 the advantages of the mining domain of Kucaina, in Servia, were brought before Sir Charles and his brother by Mr. J. E. Tenison Woods, who had formerly—on behalf of the *Daily News*—been with Bright on H.M.S. *Agamemnon* during the laying of the first Atlantic cable, and was subsequently one of his assistants in carrying out the first telegraph to India, *via* the Persian Gulf. He had been recently engaged near Kucaina, at Tischivitscha on the Danube—a place that can only be pronounced by a sound resembling that of sneezing.

Kucaina was interesting, not only from the richness of the lead ore—which held a considerable amount both of gold and silver—but in its ancient history. It had been largely worked by the Romans, who had left the remains of a castle partly built with large stones of calamine ore, containing some silver, which was taken out and smelted. The Romans had, seemingly, also had hot-air baths, or *calidaria*, here. These were excavated by the Brights, when some grassy mounds were being dug into for foundations for mining buildings. They were found with the wood ashes and soot in the flues under the stone benches, just as fresh as when this mining settlement was broken up after Trajan's time. In another neighbouring spot were the remains of a mediæval Venetian church with the peculiar apse. Underneath this an ancient smelting floor was found, with a quantity of silver in the interstices. The formation was friable porphyry, in conjunction with indurated limestone, in which the ore was found. There were many thousands of ancient shafts distributed over miles of surface ; but the Romans, Venetians, and, later on, the Austrians, had been beaten by the water at a comparatively small depth below the valley level—although there were many remnants of ancient buckets and other contrivances, with the usual earthenware mining lamps, etc. From the archives at Belgrade it is clear that the Venetians in the 16th century had paid the ancient kings of Servia no less a tribute than 500,000 ducats a year (a ducat being equivalent to 9*s*. 6*d*. of our money *now*, but worth many times more *then*) for the privilege of exploiting this and several other mineral districts. The vast heaps of slag from their smelting furnaces all over the Kucaina and other mining regions show that the ancients went vigorously to work.

After careful examination of the district and tests of the ore by Messrs. Johnson and Matthey, Sir Charles and his brother decided to take up these mines. A little later they sent out pumps, steam-engines and compressed air borers, together with several experienced Cornish miners.

Various arrangements had to be made with the Servian Government relating to the mining rights, royalties, and other privileges, which were conducted with the Finance Minister, M. Chedomille Mijatovich, who showed every consideration and kindness to Sir Charles and Edward Bright. The brothers subsequently made a holiday stay with M. Mijatovich.

In their frequent business at Belgrade they also visited

Prince Milan (subsequently the King) at his Konak, or palace. On the occasion of Sir Charles' first trip to Servia he was accompanied by his eldest son, John Brailsford, shortly after the latter had left Winchester.[1]

Messrs. Bright arranged with Mr. Felix Hoffmann (the former owner) who knew the district thoroughly, to carry on the work for a time under their supervision. He was an able mining engineer, though not much acquainted with modern English or American machinery. The influx of water that had baffled him—in a shaft sunk some forty fathoms by a small Austrian syndicate—was at once dealt with by the new pumps.

The ore thus produced was very rich, yielding—with 50 to 80 per cent. of lead—from one to four ounces of gold, and 20 to 100 ounces of silver to the ton of rough stuff. This was dried in a reverberatory furnace sufficiently to drive off the moisture and a small part of the sulphur, and then shipped across the Danube from Gradishtie to Bazias in Hungary. Then the railway took it to the Royal Saxon Smelting Works at Freiberg, near Dresden, where it "fetched" from £20 to £30 per ton. A consignment was sent to Vivian's at Swansea, but the returns were not as good as those of Freiberg, where they appeared to understand better the treatment of this peculiar ore.

During 1874 and 1875—on the strength of good results—Sir Charles and Edward extended the works, building large stores. They also erected good stone and brick

[1] On his return, this son went to Balliol College, Oxford; and after taking his degree, was called to the Bar (Inner Temple).

houses—in fact, a regular little colony—for the accommodation of the officers and miners, about 200 of whom were allowed by the Austrian Government to come to the colony across the Danube, with their families. Mr. J. E. T. Woods—and subsequently Captain J. E. Hunter, R.N., who had previously co-operated with the brothers in their West Indian cable work—assisted in the management. Others of the staff took part in this mining undertaking and in the analysis of the ore from the various workings—notably Mr. Leslie Hill and Mr. Percy Tarbutt, afterwards a mining engineer of eminence and a director of several African and Australian mining companies.

The two brothers were greatly pleased with the country, and also enjoyed their work; they made yearly a couple of stays of three months each, during which they superintended the mining operations, both above and below ground. When special supervision was not needed at the works there was no difficulty in passing away the time. There were generally some friends out on a visit, including Sir Charles' brother-in-law, Mr. Robert John Taylor, as well as Mr. E. B. Webb and Mr. H. Meissner and others, to form riding parties to explore the forests, and, sometimes, to hunt and shoot.

The domain comprised about eight square miles; while the seignorial and timber-cutting rights extended over sixty square miles—nearly all of virgin forest. This formed the commencement of an enormous tract stretching for nigh upon a thousand miles through Servia and Bulgaria towards the south-west along the range of the Balkan Mountains, as far as the Black Sea. The principal tenants were wolves, deer, and wild boar, besides the hazel huhn, quail, and very big hares.

During his various stays in Servia, Sir Charles wrote a number of letters home, to his wife and others. Although mostly of a domestic nature, the following serves to describe an experience of some interest :—

MIADAN KUCAINA, SERVIA.

July 19*th*, 1875.

. . . I have a chance of writing to-day by a wagon, so I send you this little note. . . .

Yesterday I went to a place outside our land—about two and a half hours' ride—where the Archbishop was consecrating a new church. His chaplain had been here paying a visit with three other priests, and asked us to come.

The Archbishop was in church when we arrived, and the ceremony was half over, as we were a little late in starting. Afterwards he sent his chaplain to invite us to see him, and received me most graciously—as though he had known me for years. He is a very quiet-spoken, gentle, sort of man, and evidently a most amiable person.

He received us (Hunter and me) in a sort of bower, made up for the occasion of wooden poles set in the ground, with branches of leafy trees twisted all round so as to make an arbour of about twelve feet square. Sweetmeats were brought in, according to custom, and we conversed, through our interpreter, for about twenty minutes, about all kinds of things. . . .

He then asked us to take breakfast with him ; so, afterwards —breakfast being here about noon—we went to a long table (also in the church grounds) covered with a similar kind of arbour or foliage, erected just for the time. There at the upper end of the table sat the Archbishop ; I was on his right, and Hunter sat next to me. The Natchalih, or principal civil officer of the district, was on his left, and about a dozen priests, or "popas," on each side. Then below were all the chief villagers—that is to say, the oldest men, or communal heads. The table (made of planks on trestles) was about 100 feet long, so you may imagine there were a great number present. We had some curious soup, and other food, in the course of which the Archbishop drank his first glass to me, and I to him, according to the Serbish custom. What do you think the glass contained ?—*beer !* Afterwards various toasts were drunk. One to the Prince was proposed very quietly by the Archbishop. The latter then retired, and a few minutes later sent a fine melon to me as a present.

On taking leave he was most cordial, and begged that I should never be in Belgrade without coming to see him. He, on his part, promised to visit me at Kucaina.

At the ceremony the robes were very gorgeous. The Archbishop wore a crown of some pearl and silver-like stuff—probably pearls strung on silver wire—with silver lace embroidery, and a splendid—— I don't know what to call it ; I know it can't be right to call it a cloak, though it was something of that sort.

After the ceremony all the people walked by and kissed a cross which he held in his left hand. Then they kissed his right hand, in which he had a little bunch of flowers, with which he gave them a little pat on the forehead, by way of blessing. . . .

But the profits, as well as the pleasures, of Kucaina were not to last. Towards the end of 1876, of all unconscionable things that could happen, the little State of Servia—with a certain incomprehensible self-confidence—declared war against the Turks ! It suffices to say that the result was disastrous to the mines ; for Austria, objecting to the war, had called back all the Hungarian miners, who were mostly in their Frontier Guard, or "Landwehr." At the same time, both Austria and Turkey—whose territories entirely surrounded Servia—prohibited the export of dynamite or gunpowder. As the former was an essential for dealing with the hard limestone, and could not be made in the country, work was practically stopped for lack of men and explosives.

Sir Charles and his brother kept operations going for some years after; but it was such a costly and troublesome process that the mines had eventually to be given up.

CHAPTER XV

The Fire Alarm

Electron sits, a sentinel alway—
To watch the fire fiend in his stealthy start,
And then to stir the town with clamours at its heart!

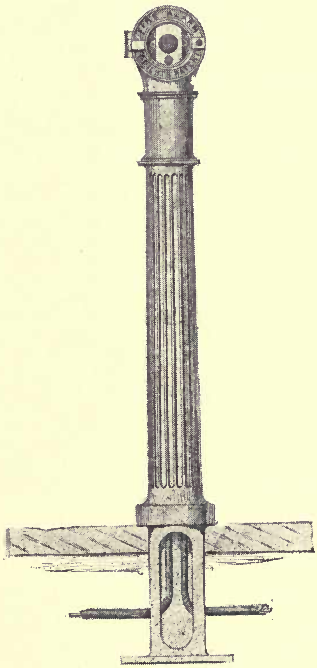
IN the course of the year 1878, the brothers brought out a system of fire alarms[1] based upon their method of ascertaining the locality of faults in telegraph conductors, which they had patented as far back as 1852, and which has already been referred to.

The advantage of a prompt warning as soon as a fire begins scarcely needs urging. A Committee of the House of Commons had recently reported on the Metropolitan Fire Brigade. This report stated that the first duty of a police constable on the breaking out of a fire was to give the alarm to those about; and, if the fire was in a house, to arouse the inmates. Some time would thus be lost—more in running to the nearest station—and, as has been justly said, the very period in which the fire could be nipped in the bud is lost in these preliminary arrangements. Indeed, the first five minutes at a fire is worth (in the opinion of the chiefs

[1] See Patent Specification No. 3,801, of 1878.

of the Fire Brigade) the next five hours. It remains only to remark that the "prompt warning" advocated above is best secured electrically.

In the United States, and many countries of Europe, fire alarm call-posts were already an accomplished fact, but over here scarcely anything had been done in this direction. A few call-posts on the American system, with clockwork as the leading characteristic, had only been introduced tentatively. Such apparatus not only costs a good deal, but was, from its very nature, subject to get out of order — from rust, wear and tear, and other causes.



FIRE ALARM POST

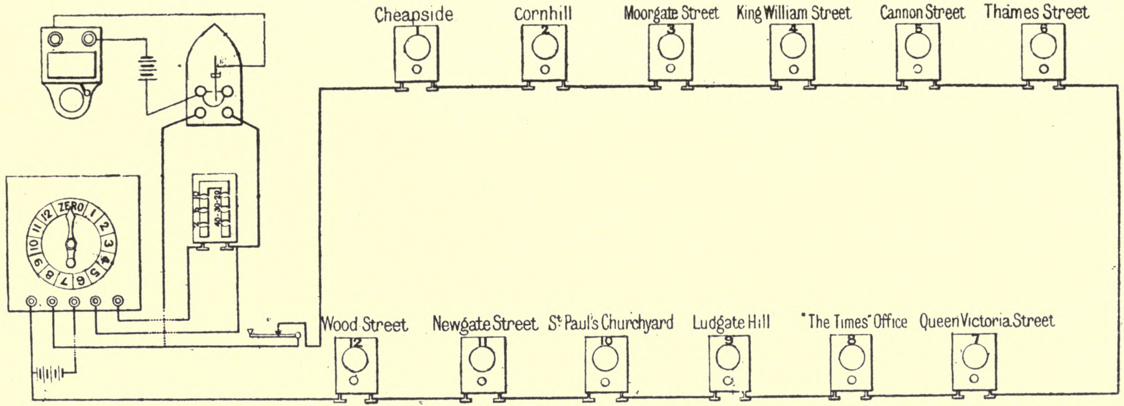
By the Bright system, thorough simplicity and reliability were obtained, combined with low initial cost. The locality of the fire—or, rather, of the call-post from which the summons to the engine is given — is indicated by a few yards of wire in the post, or call-box. Each coil of wire has a definite electrical resistance, peculiar to itself, which is introduced into the line circuit by merely pulling out the "short circuiting" handle. This disturbs a balance of resistance at the central (fire) station and rings a bell. The fireman on watch then turns a handle, which inserts resistances in the circuits corresponding to those in the posts. Thus, when the bell stops ringing, the handle points to the place whence the alarm proceeded, the particular coil (i.e. call-post) being thus indicated at the Fire Brigade station—and this without clockwork or anything that can suffer from exposure to air or moisture in the posts.

After showing working models to Captain Shaw,[1] the Chief of the Brigade, and also to the Metropolitan Board of Works, this simple but effective system was largely adopted in and around London.

As it was deemed desirable that an acknowledgment should be given from the brigade station to the person effecting the call, the resistance wire was coiled upon an iron core, and thus converted into an electro-magnet in close proximity to an armature. To the end of the latter was fitted a light red disc, which showed itself at a hole in the call box, when the current passed. The acknowledgment is then made from the engine station by breaking and making the circuit with an ordinary key, thus occasioning the disc at the alarm post to wave to and fro.

As a proof of the great advantage of such street calls, no less than fifty calls were given to fires in ten months on the first fifteen call points put up in the City and in Southwark. After this, the system was rapidly extended to twenty circuits in London, comprising nearly ninety miles of line and one hundred and forty call points.

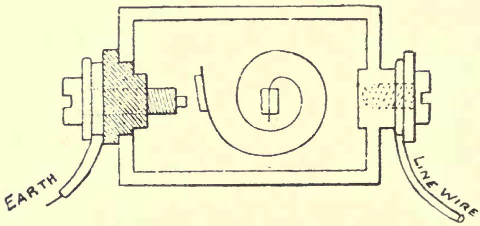
[1] Afterwards Sir Eyre Massey Shaw, K.C.B.



BRIGHT'S STREET FIRE ALARM

A further extension of the principle by another patent[1] was then introduced by the brothers. This applied it to giving automatic notice of fire starting in buildings by contact being made to connect up the apparatus and ring a bell, or bells, upon undue heat arising in any room.[2] It was introduced throughout the South Kensington Museum and in several other important buildings.

There are various contrivances by which an undue or



AUTOMATIC FIRE ALARM

abnormal increase of temperature in a room may be made to give an alarm by electricity—such as the rising of mercury in a tube, or the melting of easily fusible metals ; but the brothers determined that the cheapest and most convenient was a small bi-metallic spring. By making it of brass on one side, and steel, or platinum, on the other, it was shown that the difference of expansion of the metals causes the spring to move until it comes into contact with a screw terminal, which can be adjusted to the desired temperature.

[1] Specification No. 596, of 1878.

[2] This apparatus was especially intended for out-of-the-way (unvisited) warehouses—particularly corn mills. It can be adjusted so as to give the alarm at any predetermined temperature.

As the heat detectors may be set to give warning at any temperature exceeding that of the normal state of the air in a building, they can be employed to indicate the commencement of any heating in heaps of corn, jute, etc.—either when on board ship or stored in warehouses—thus calling attention before actual harm is done, or spontaneous combustion sets in.

In the same way the heating of coal on board ship can be at once detected, either in holds or bunkers. As we all know, this is a prolific cause of fire at sea ; and it was, then, in this direction, partly, that the above automatic fire alarm was intended to come to the rescue.

Where the system was to be used as a self-acting alarm in buildings or ships, a " localiser " was placed in combination with mere " detectors." The object of the " localiser " is to make known the particular part of the building (or ship) affected. The " heat detector " is set to a given temperature—say 110° Fah.—and immediately that temperature is exceeded in any portion, contact is made automatically, and the alarm given by a loud (electric) bell, or gong, placed in the most effective position.

From the foregoing, it will be seen that the invention had a number of other practical applications where a specified temperature requires to be maintained.

When exhibited later, at the International Electrical Exhibition at Paris, in 1881, the Bright Fire Alarms gained the only gold medal awarded to such apparatus; and the distinction of a gold medal was also awarded to the system at the English (Crystal Palace) Exhibition in 1882.

The invention was extensively brought forward by papers and lectures in London, Liverpool, Manchester, Leeds, Bradford, and Hull; but, for some time, the public generally showed much apathy about these life and property saving appliances, forgetful of Shakespeare's proverb:—

> A little fire is quickly trodden out;
> Which being suffered, rivers cannot quench.

As for the Insurance Companies, although they received premiums in the United Kingdom of more than twelve millions per annum—of which, on the average, they repay for losses by fire about 50 per cent., or six millions[1]—their United Tariff Committee persistently declined to make any concession in rates in connection with these self-acting fire alarms. This though they afford the means of bringing hydrants and extincteurs to bear on a fire at the outset—when they may be used with some effect! [2]

As a reason for turning a deaf ear to the alarm, a certain manager (of one of the largest Insurance Societies) frankly said that the general use of such appliances might militate against their business, inasmuch as they found that a large fire now and then actually benefited them—bringing a shoal of new insurers!

An interesting episode occurred when the first patent was taken out in 1878. Those days being before the appointment of a special "Controller," the application was referred to the law officers of the Crown, and this came before the

[1] *Insurance Cyclopædia.*

[2] Yet the companies make considerable reductions where hydrants, extincteurs, and water buckets are kept on the premises insured.

then Attorney-General, the genial Sir Hardinge Giffard, Q.C. —now Lord Halsbury. His patent expert did not see how the system of resistances could be worked or made the subject of a patent, nor could Sir Hardinge, after a personal explanation at his Chambers in the Temple. He was, however, considerate enough to come to the *habitat* at Golden Square,[1] where Sir Charles and his brother showed him working models, which he tested himself. The result was that he became perfectly satisfied, and at once gave his fiat for the patent.

A little later, Mr. Edward Bright read a paper at the Society of Telegraph Engineers and Electricians with reference to the fire alarm in all its aspects.[2] During the course of the discussion which followed, one of the speakers alluded to an American invention which reminded Sir Charles of another, which he humorously referred to as follows :—

I have in recollection a burglar alarm which I believe hailed from the same quarter. It was a system which, in ingenuity and ambition, could hardly be surpassed. By an electrical arrangement embodied in this invention, when the burglar stood in position to open the safe, a trap door under his feet opened and precipitated him into a cell below, where he would be safe till morning, when an indicator would show that the trap door had been in action ! The only defect in the arrangement seemed to

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[1] This large corner house (No. 31), occupied as offices and experimental rooms by the brothers, was said to be that referred to by Dickens as Ralph Nickleby's.

[2] "Electric Fire Alarms." By E. B. Bright, M.Inst.C.E., Member of Council (*Journ. Soc. Tel. Eng.*, vol. xiii).

be the absence of an automatic handcuffing arrangement when the burglar was trapped.

The Bright Fire Alarm in all its varieties—as now fitted up throughout London and other towns—was described in the newspapers and technical journals at the time; and the *Graphic*, of September 6th, 1880, contained a fully illustrated article thereon.

CHAPTER XVI

Telephony

WITH the advent of the telephone there commenced a new epoch in the progress of electrical communication, and ever since Professor Graham Bell exhibited, in 1876, his original "speaking telegraph" at the Philadelphia Exhibition, Bright took up the subject warmly.

A year later, Professor D. E. Hughes invented the microphone—perhaps the best transmitter in conjunction with the Bell receiver. Sir Charles had first observed (as early as 1852) that pressure altered the resistance of a mercury contact—a fact which has some historical interest in connection with the theory of the microphone. The carbon transmitter invented by Edison, about the same time, also helped to render the telephone a practical success. A number of other transmitters and receivers followed, some of which Sir Charles experimented with and reported on.

Various companies were soon promoted in the United Kingdom for establishing Telephony throughout towns. In 1880 the United Kingdom Telephone Company[1] was incorporated in England for purposes of telephone exploita-

[1] Now, by amalgamation, the National Telephone Company, which eventually absorbed all the other telephone working concerns in this country.

tion, since which most of our large cities have been connected by trunk telephone lines. Central exchanges for intercommunication by word of mouth have been established in all the larger towns, and the telephone is now in constant use in almost every office, as well as in a large proportion of the private houses throughout towns.

Another important company established about the same time was the Edison Telephone Company, and soon after its formation the Crown took legal action against them for infringement of their telegraph monopoly of this country. It was to be a "test case"; and Bright was applied to by Government to give his views as a witness on their behalf. This he did. In his evidence, Sir Charles proved at length that telephones worked merely by varying currents of electricity through a wire—no sound actually passing. He, in fact, showed conclusively that a telephone was a form of electric telegraph, and therefore came within the meaning of the Telegraph Acts of 1868 and 1869. It may be added that his view was supported by most of the eminent practical experts of the day.

As an outcome of the above proceedings, the National Telephone Company now works under licence from the Government for the use of telephones amongst themselves by people in the same city or town. It is only a question of a few years when the telephone system comes altogether under the direct management of the Post Office. The sooner this takes place, the better for the public—it being indisputable that the telegraph and telephone are intended to work together.

CHAPTER XVII

Electric Lighting

OUR friends across the Channel were enthusiastic about electric lighting long before it was seriously dealt with in England. Important installations in Paris illuminated the Rue de l'Opera and other main thoroughfares several years antecedent to any public lighting being carried out in London.

The earliest experiment here was made with a few Jabloch-koff lights on the Embankment; and the first commercial undertaking in this direction was the British Electric Light Company, established in 1878. Mr. Joseph Hubback, a former mayor of Liverpool, was the chairman, and among the directors were Mr. Edward Easton, C.E.; General Sir Henry Green, K.C.B.; Mr. Frederick Walters, of the firm of Frederick Huth & Co.; Mr. Adam Blandy, and Mr. Edward Bright, whilst Sir Charles acted as their consulting engineer.

The basis of operations was the purchase of the English patents for M. Gramme's dynamo machines, and the subsequent acquisition of Mr. St. George Lane Fox's incandescent lamps, as well as the arc lamps of Mr. Brockie — the first really steady light of the kind. Public exhibitions were given, and lighting contracts were carried out with a number of clubs, factories, mills, and shops, besides various large steamers, including some of the Navy. Amongst the latter was H.M.S. *Bacchante,* commanded by Captain (now Vice-Admiral) Lord Charles Scott, just before taking the young princes Albert Victor and George on their voyage round the world. Among other installations was the South-Eastern Railway Station at Cannon Street with its approaching bridge. Stafford House was also lighted by the Company for the Duke of Sutherland.

For some years after its start, the Company made good progress. Their competitors were Messrs. Siemens Brothers and Messrs. R. E. Crompton & Co.—both of whom had very good machines of their own—as well as the "Brush" Company, who adopted an American variety of dynamo. The "British" Company established a large central station and factory in Heddon Street, at the back of Regent Street, and started lighting some clubs in Albemarle Street and Dover Street, by means of overhead wires, in 1880. These wires were slung from a tall mast on the roof of the premises, for at that time there was no Electric Lighting Act giving powers to undermine the streets for underground wires.

The Company prospered, and were making profits by 1881. They exhibited their improved Gramme apparatus and lamps on a large scale at the Paris Exhibition of that year, and received a high award. They were also the first to bring forward M. Faure's great improvements on M. Planté's storage cells. In the following year (1882) the "British" Company gave a beautiful demonstration of the lighting effects of the Lane-Fox coloured incandescent lamps, for dinner table ornamentation and house decoration; this was at the Crystal Palace during the International Electric Exhibition held there. The Company also lighted a large section of the building with their Brockie arc lights.

But the good time did not last long. The Company's overhead wires were cut by neighbouring landlords, on the ground that, although the lines were stretched far above their buildings, their (landlord) rights went farther and extended from the bowels of the earth *usque ad cœlum*—or even beyond. Maybe these soil holders were also gas holders! Then again, when the limited number of contracts were just enough to give a profit to the few engaged in the business, their principal opponents, the "Brush Company" suddenly brought out and floated a spawn of minor companies, to each of which was assigned a county or small division of the United Kingdom, so that the competition was tenfold, to the detriment of all save the parent company. Sir Charles predicted that a "winding-up machine" would soon be required; and this proved to be so, for in a few years most of these subsidiary companies went to the wall.

In 1882 a Bill was brought in by Government giving electric lighting powers. It, however, acted as an obstacle to development, and was apparently framed to protect the threatened interests of the Gas Companies; for while it gave municipalities the right, under certain conditions, to lay underground wires and supply lights, it also gave them the power to take over the works of any company in twenty-one years at a valuation of their apparatus, pipes, wires, etc.—for what they would fetch, rather than as a "going concern." Their profits and "goodwill" were, in

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fact, not to be taken into account. It is needless to say that neither a capitalist nor the investing public would "go in" on such terms, and electric lighting was practically hung up for five years till the new Act was passed in 1887. That extended the purchase period to forty-two years.

During this early stage in electric lighting, Sir Charles had devised various ingenious improvements in dynamos, storage cells, methods of transformation and distribution, besides modified arc and incandescent lamps for special purposes.

He was also largely engaged as an expert before Parliamentary committees on the subject; and in this connection he and his brother furnished a number of particulars relating to the cost of producing light by electricity.

The Corporations of many important towns, being anxious to consider the question of supplying themselves with the electric light, applied—during several years following 1882—for estimates and specifications, a large proportion of which were carefully worked out by Sir Charles, in conjunction with Mr. John Muirhead, M.Inst.C.E., and his brother, Dr. Alexander Muirhead; but the majority of the municipalities were at that time afraid to make the venture.

The slow rate of progress was, no doubt, largely due to the state of affairs referred to in the following letter of Sir Charles' to *The Times*:—

Electric Lighting

To the Editor of "The Times"

Sir,—

Your leading article of to-day on the present outlook of the working of the Electric Lighting Act points to the considerable dangers to be apprehended by ratepayers. They also point to trouble of other kinds hereafter, arising from the legislation of last year, which was, to my mind, too much hurried.

My object in addressing you now is to show that much dissatisfaction will be the outcome of the operation of the Act, if the Provisional Orders being issued by the Board of Trade should be confirmed by Parliament without a thoughtful forecast being made of the future position of the consumers and the persons to whom the concessions may have been granted.

It happens that I had to give much attention to the matter, for I have been consulted (in association with Mr. John Muirhead) by many corporations and local authorities upon the technicalities involved in the Provisional Orders in which the ratepayers' interests are greatly concerned.

I am glad that Sir Hussey Vivian has succeeded in removing the difficulties in the way of obtaining a full hearing of objections to the Bills; but unless the local authorities take advantage of this by acting promptly, they will, I think, have cause for regret hereafter.

It was clearly intended, both by the Act itself and by the regulations of the Board of Trade, that local authorities should apply for the orders to supply electricity. It is expressly stated in Rule 2 that the Board "will give a preference to the application of the local authority of the district." As it is, very few have so applied; consequently the consumers will have to look to the various newly-formed companies, who have made applications, for their supply.

I do not wish to criticise the position of these companies, but, as a fair example, I find that one company has paid nearly a quarter of a million pounds in cash and shares merely for one of the many forms of incandescent lamps. What hope, therefore, have the ratepayers in a district to be served by such a company of obtaining the electric light at a reasonable price?

Several millions have been spent by the companies applying for Provisional Orders in unproductive purchases of this kind;

and if action is not now taken, the ratepayers will have to provide dividends on the enormous sums thus improvidently expended on promoters and patentees.

Furthermore, such companies are tied to the so-called "systems" for which they have paid so heavily; and, if they are allowed to obtain what will be virtual monopolies, they are not likely to sell their obsolete plant at the value of old iron in order to introduce superior and more economical apparatus—when they have the consumers at their mercy. For it may be assumed that—although not contemplated by the Act—a virtual monopoly will be acquired owing to the natural objection of the authorities to grant permission to several companies to break up the same streets.

It is a notable fact that the original "Gramme" patent for the best known and most largely used electric lighting machine expires and becomes public property in less than a year. When this occurs, the capital sunk in most of the other patents—even assuming that they have any present value—will, *pro tanto,* be rendered unproductive.

Surely, then, the local authorities, as representing the ratepayers, should ask Parliament to refrain from confirming to the companies these Provisional Orders until the whole question is more thoroughly considered in all its bearings. The Metropolitan Board of Works have already taken a step in this direction by lodging a petition to Parliament.

My opinion is, that if the present Provisional Orders as granted by the Board of Trade to the various light companies are confirmed by Parliament, the effect will be to double the necessary price of electricity to the consumers in the districts affected.

Yours faithfully,

CHARLES T. BRIGHT.

31, GOLDEN SQUARE, LONDON,
July 6th, 1883.

In December, 1884—as a result of the unsatisfactory condition here alluded to—the Board of Trade called together a select committee to thoroughly consider some proposed amendments to the Electric Lighting Bill of 1882.

This committee was formed at the instance of Lord Thurlow. Besides Sir Charles, it included Sir Frederick Abel, K.C.B., F.R.S.; Sir Frederick Bramwell, F.R.S.; Sir Daniel Cooper, K.C.M.G.; Sir Rawson Rawson, K.C.M.G., C.B.; Sir David Salomons; Sir William Thomson, F.R.SS. (L. & E.); Professor W. E. Ayrton, F.R.S.; Mr. Latimer Clark, M.Inst.C.E.; Mr. R. E. Crompton, M.Inst.C.E.; Professor W. Crookes, F.R.S.; Professor George Forbes, F.R.S.E.; Mr. James Staats Forbes; Captain Douglas Galton, C.B., F.R.S.; Mr. Robert Hammond; Professor Andrew Jamieson, F.R.S.E.; Professor Fleeming Jenkin, F.R.SS. (L. & E.); Major S. Flood-Page; Mr. J. W. Swan; Professor Silvanus Thompson, and Mr. Frank Wynne.

Sir Charles sometimes presided at the meetings of this committee; Mr. Emile Garcke acted as secretary throughout, whilst the entire management thereof came under the control of the late Sir Henry Calcraft, K.C.B. (an old friend of Sir Charles'), as Permanent Secretary to the Board of Trade.

This select committee of inquiry had a number of meetings, and eventually some favourable changes in the Act were submitted and approved.

Amongst others, the authorities of Bristol once applied to Bright to investigate the question of utilising the great tidal flow of the river Avon as a source of power to drive dynamo machines for the distribution of electric light and power. He was first approached by Mr. William Smith, of Clifton Down, while at his post in Paris as a British Commissioner to the Exhibition. The following is a copy of Sir Charles' letter to Mr. Smith on the subject :—

PARIS, *27th October,* 1881.

DEAR SIR,—

Since you left Paris I have considered your enquiry as to employing the tidal waters at Bristol for electric lighting and other purposes, and the particulars of the local conditions of the question which you named to me.

The practical (or controlling) feature of the proposition lies in the availability of the force intermittently accumulated by the tide. From your description of the tidal action, and the sketch plan which you drew at our first discussion upon the subject, there appears to be an hydraulic force—which, expressed in horse-power, would be very great indeed—now thrown away, but which is capable of utilisation.

I know many places in England and other parts of the world where tidal power is economically used ; and at a lecture given in the early part of the year at the Society of Arts upon "Electrical Railroads and Tramways," I drew attention to the special applicability of electricity to the transmission of force from our great watersheds, and the tidal power where the physical circumstances of the place can be profitably dealt with. You may assume, at all events, that there are millions of horse-power at present running to waste in many places, but which by the perfection of dynamo electrical machines during the last few years, and the facility of carrying force by electricity to a distance, may be brought into service in a commercial and lucrative shape. This may be taken as an established scientific fact.

Of course, further progress will be made, of which advantage can be taken by those who are first in the field to secure the use of available water-power ; but as far as we have progressed at present you may take it for granted that given so much in horse-power you may get so much in light—or motive power—for distributing to workshops, without any cost beyond the wear and tear, lubrication, and expense of supervision (which can be distributed over many machines) in places where water-power is economically available.

I shall be glad to run down to Bristol on my return to England and examine the locality of your water storage, and consider its applicability on the spot.

Yours very truly,
CHARLES T. BRIGHT.

When the letter was placed before the Town Council, it was accompanied by some interesting data from the Dock Engineer, Mr. Thomas Howard, as to the amount and speed of the water passing, supplemented by a series of calculations worked out by Professor Silvanus Thompson, F.R.S., of Bristol University College, showing that the available tidal power amounted, per tide—taken only on the outflow—as follows :—

At Totterdown, 279,389 horse-power.
,, Rownham Ferry, 859,658 horse-power.
,, Mouth of River, 2,149,146 horse-power.
Giving a total of no less than 3,288,193 horse-power per tide.

The economical utilisation of this enormous power—representing about 75 billions of foot-pounds per annum—was a curious problem to solve.

In working out the details, the calculations made by Sir Charles went to show that the cost of the cumbrous appliances necessary to turn the tide to account—whether by a great series of slow-moving mill wheels, or by great floats—coupled with the necessity for storage of electricity during the intervals of motion, would entail a far heavier prime cost than steam power close to its work on shore. The conditions were, in fact, unfavourable in this instance to the economical utilisation of water power.

Whilst at Bristol in connection with this matter, Sir Charles stayed a little distance off with his son-in-law and daughter, Mr. and Mrs. Mervyn King—a visit he naturally much enjoyed.

At the special invitation of the Governors of the Bristol Trade and Mining Schools he distributed the prizes for that year. In doing so he gave an exhaustive address to a great audience of scholars. Sir Charles chose for his subject "Electric Science," and during his discourse he explained the various developments of its application up to date.

Sir Charles Bright continued to take an active part in the development of electric lighting up to the last.

Early in 1888 he undertook to act as engineer to the St. James' and Pall Mall Electric Lighting Company—one of the companies formed under the New Act.[1] A long report was drafted by Bright for the Company a day or two before his death, but he did not live to sign it. His brother subsequently sent it in to the Board; and Sir Charles was later succeeded in the capacity of consulting engineer by an old friend—Professor George Forbes, F.R.SS. (L. & E.).

[1] The enormous work done by the "St. James' and Pall Mall" Company—over a comparatively small area—up to the year 1895, was well shown in the *Electrical Times* of March 5th, 1896. This Company is certainly one of the greatest successes of the new illumination.

CHAPTER XVIII

Various Evidence and Reports

The " Direct United States " Cable Arbitration

AN interesting Cable case was arbitrated upon in 1878, in which Sir Charles Bright gave important and rather amusing evidence :—

The " Direct United States " Cable was made and laid by Messrs. Siemens Bros., in 1875, for the Company so named, between this country and the States. But owing to their opponents—the original Anglo-American Telegraph Company—cutting the message tariff down to a shilling per word, and partly to mysterious breaks of the cable, the " Direct Company " did not yield a sufficient return, and the majority of shareholders resolved to wind it up. The liquidators appointed arranged to form a new company to work with the " Anglo-American Company " under an arrangement ; but owing to differences on the subject the matter had to be brought before an arbitrator.

Naturally much of the value of the " Direct " Company depended upon the existing condition of their cable, and it was sought to show, on behalf of those negotiating the proposed alliance with the " Anglo," that the serving of yarn protecting the outer wires was in a state of rapid decay, and that the wires themselves were partly rusted away. In corroboration of this, a length was produced which had been picked up when a fault had been grappled for. Sure enough, the yarn covering was scarred with the pit-holes, as though it had had the small-pox ; moreover, at the ends of the specimen the iron wires were attenuated to fine points.

The holes above alluded to were attributed by the other side to the ravages of the teredo. Sir Charles, however, created somewhat of a sensation on the tenth day of the arbitration by pronouncing that they were more likely to be due to cockroaches ! In the first place, he expressed his disbelief in the existence of teredoes in great depths in the North Atlantic ; and after minute examination of the specimen, he said, regarding the nibbles :—

I have formed an opinion that they have not been caused by any insect at the bottom of the sea, but I believe them to be produced by *cockroaches at the bottom of the ship.* I have had a book of my own in my cabin in the West Indies, which is eaten, in circles like that, by cockroaches. This is almost exactly similar to the leaves of the book eaten through. I should like to know the history of that specimen from the time it was picked up.

There are some small shells in and about the outside of the cable—in fact, such as you would always get up with any cable which has been resting at the bottom. But they are not insects of the character I have been accustomed to see in specimens brought up where the hemp has been eaten into by them, and in which—in every case I have seen specimens—a great number of the insects have remained, almost filling up the holes themselves. There are many of these specimens in existence, and some have been photographed.

The Umpire: "Cockroaches bore, do they?"

Sir Charles: "They eat round the holes with their mandibles."

The Umpire: "How deep?"

Sir Charles: "I have had forty or fifty pages of a book bored through."[1]

As regards the attenuation of the iron wires at the end of the specimen, as alleged, from general rusting away, Sir Charles put the wires in a gauge and showed that they were the same size as when the cable was made, except just at the end of the specimen, where the cable had broken, and where they were drawn down to points—as he explained—by excessive strain.

The above facts and opinions naturally went some way in upsetting the important contentions of the other side.

Other Atlantic Cables

Since the 1865 and 1866 Atlantic Cables, several others had been laid. In addition to the Direct United States Cable just referred to, there had been the French Atlantic Cable of 1869, to which Sir Charles had acted as consulting engineer. These and the Anglo-American Company's lines were eventually "pooled" together so far as commercial earnings went.

Owing to the continuance of the Atlantic Cable monopoly by the amalgamation or "pooling" arrangements come to from time to time by the companies concerned, Mr. James Gordon Bennett, the well-known proprietor of the

[1] Arbitration between Johann Carl Ludwig Loeffler and the liquidators of the Direct United States Cable, August 9th, 1878. Questions 4,249–4,253.

New York Herald, combined with Mr. Mackay (the Silver King), in 1882, to lay a couple of entirely independent lines. Mr. Bennett—with his agent in England, Capt. A. H. Clark—consulted Sir Charles on the subject, and the latter drew out a full specification embodying all that was best for the construction of an Atlantic cable.[1]

The lines were subsequently made and laid by Messrs. Siemens; and have been worked most satisfactorily since, as the Commercial Cable Company's property.

Duplex Telegraphy

During 1883, Mr. John Muirhead, who—in conjunction with his brother and Mr. Herbert Taylor had long before invented the system of electrically duplexing cables so universally adopted—found that the French Government had been employing a similar method of duplexing recently patented by Mr. Ailhaud, in connection with certain cables belonging to the Administration. He was obliged to take proceedings in the matter, and consulted Sir Charles, who studied the case very closely and wrote a digest on the subject. The report was long and necessarily technical; but, determined on the fact of infringement, his conclusions were as follows:—

> In the arrangement for the Marseilles-Algiers cable they (the French Government) use at least two of the methods invented by Muirhead, and consequently they infringe his patent.
>
> I am informed that Ailhaud's Counsel allege that as he did

[1] Sir Charles' Report on the subject was reproduced in Appendix 23 of Vol. II of the original biography.

not employ in his combination the special form of artificial cable patented by Muirhead, he could not have infringed the latter's patent. To this I reply that the devices indicated by Muirhead constituting separate and distinct inventions, may be applied equally to all forms of duplex, and may be worked with any system of artificial line. I am of opinion that Mr. Muirhead's invention has been laid under contribution by Ailhaud *in all its essential features.*

CHARLES T. BRIGHT.

July 17th, 1883.

It remains only to be said that the matter was ultimately settled in Mr. Muirhead's favour.

The Phonopore

In the year 1884, Mr. C. Langdon Davies invented his phonopore telegraph. It was almost immediately brought to Sir Charles' notice. He became much interested —in fact enthusiastic about it—and drew up a long report thereon. Sir Charles was afterwards the first president of the Phonopore Syndicate, remaining so up to the time of his death.

This apparatus forms a most valuable adjunct to land-line systems for purposes of duplex telegraphy—the line being duplexed also, if required—and it is perhaps surprising that it has not been yet turned to still further account. On aerial lines, it has proved to be capable of working through 500 miles and over. It is now doing good work on the Great Western, Midland, Great Eastern and Brighton Railways. If applied in connection with ordinary duplex telegraphy the combined systems effect no less than 180 (twenty to thirty worded) messages an hour!

CHAPTER XIX

The Paris Exhibition

SO far ahead had France progressed in public electric lighting, and so important had the question of the introduction of telephones become—in conjunction with the many improvements in telegraphy and other electrical appliances—that in 1880 the Government of the Republic decided to inaugurate an International Electrical Exhibition in Paris during the following year. In October, 1880, they communicated officially with the other Governments. The result, as regards England, is very clearly stated in the following extract from *The Times* of July 4th, 1881 :—

The English Foreign Office—after the natural period of incubation for such documents—received an invitation to appoint Commissioners to assist in the work.

By the time this had been received and duly considered, the Belgian Government, to quote one instance out of several, had collected together double the number of exhibitors that England had the slightest chance of bringing forward. Meanwhile the Foreign Office found itself unable to deal with the undertaking proposed, so it was passed on successively to the Post Office, the Board of Trade, South Kensington, and every department which could possibly be expected to deal with a suggestion that an Exhibition could be held on other than the approved models, and without an expenditure of £50,000 or £60,000 of public money. Mr. Gladstone, on the perfectly intelligible general ground that it is not the province of Government to foster special and sectional exhibitions, refused to sanction any grant of money, and the entire matter sank into stillness till a question was asked in the House of Commons of Sir C. Dilke, as Under-Secretary for Foreign Affairs, whether the Government had really no intention of taking any part in what was going on. Sir Charles Dilke replied that the Government had no intention of appointing any Commissioners.

Upon Sir Charles Dilke's reply becoming known in Paris, M. Berger, the Commissaire-General of the Exhibition, wrote to the principal technical society in England devoted to electricity and invited its co-operation in default of that of the Government.

The Society of Telegraph Engineers and Electricians at once set to work, by forming and sending to Paris, to put things into shape, a special committee, of which Sir Charles Bright was chairman, and Mr. W. H. Preece and Mr. Edward Graves, chief officers of the Postal Telegraphs, and Professor D. E. Hughes, together with several other well-known scientific men, were members.

The time originally cut to waste having been in great measure recovered, and every arrangement having been made without official aid or interference, the Government was at last moved to appoint a Commission, of which the Earl of Crawford and Balcarres, K.T., was the Chief Commissioner, supported by Sir Charles Bright, Professor Hughes, and Colonel Webber, R.E.[1]

After the appointment of the Commission matters were pushed on in this country, and a large number of exhibitors came forward.

The exhibition was opened during the summer of 1881 in the great Palais de l'Industrie, and proved a thorough

[1] Subsequently Major-General C. E. Webber, C.B.

success. As the chief president of the British section, Sir Charles attended especially to the allocation and arrangement of the spaces for British exhibitors. Among the latter was his brother, who showed on a large scale the fire alarm system already widely adopted in London and elsewhere, together with other of their joint inventions, for which a gold medal was awarded by the International Jury. The British Electric Light Company—with which Sir Charles and his brother were, as already shown, closely associated—also had an extensive exhibit of Gramme machines, Brockie arc lights, and Lane-Fox incandescent lamps, which illuminated part of the Exhibition. The latter work was ably carried out by their engineer, Mr. Radcliffe Ward, who has more recently taken an active part in the introduction of electro-motor omnibuses and vehicles in London.

Subsequently, a paper concerning the Exhibition was read by Sir Charles and Professor Hughes before the Society of Telegraph Engineers.[1]

His many friends in French official circles, coupled with his unvarying urbanity, served to render Sir Charles very popular in Paris as a British Commissioner.

An International Congress—consisting of about 200 of the most distinguished electrical *savants* of Europe, each nominated by their respective Governments—also held a series of meetings and discussions in a special congress room at the Exhibition. Bright was naturally amongst

[1] "The Paris International Exhibition of Electricity," 1881, by Sir Charles Bright, M.Inst.C.E. and Professor D. E. Hughes, F.R.S. See *Journal Inst. E.E.*, vol. x, p. 402.

the delegates for the United Kingdom. Many important questions were discussed and dealt with, including various points of international electrical measures and nomenclature.

During the period of the Exhibition the Prince of Wales —now His Majesty the King—paid it a visit, and on this occasion Sir Charles conducted His Royal Highness over. This honour Bright had previously enjoyed during the manufacture of the First Atlantic Cable—a fact which the Prince had, as is his wont, kept fresh in his memory.

The French Government recognised the services of Sir Charles and his three colleagues by making them officers of the Legion of Honour.

About this time the Société Internationale des Electriciens came into existence, and Sir Charles had the honour of becoming the first President, representing Great Britain.

CHAPTER XX

The Institution of Electrical Engineers

AT the end of 1886 Sir Charles was elected President of the Society of Electrical Engineers and Electricians [1] for the Jubilee Year (1887) of Her Majesty's reign.

As President, Sir Charles gave the usual inaugural address at the commencement of the session. Being also the Jubilee of the Electric Telegraph, he chose as his subject the initiation and progress of Electric Telegraphs (land and submarine) up to date, bringing forward some noteworthy episodes. [2]

Speaking of this address and of his presidency, the *Electrical Review* remarked :—

The election of Sir Charles Bright on the occasion of the Jubilee year of the Telegraph, as well as in the Jubilee year of the Queen, may be taken as a special compliment to one who has worked so hard to promote the interests of telegraphy. So identified has been his career with the step-by-step progress of the telegraph that it would have been impossible to avoid mentioning the part

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[1] Since incorporated as the Institution of Electrical Engineers.

[2] Sir Charles' Presidential Address was reproduced in full in Appendix 25 of Vol. II of the original biography ; and also, of course, in the *Journal* of the Institution in 1887.

he personally played in the advancement of the science, without creating a number of serious blanks in the story. Sir Charles' address will long be remembered for its early recollections and history of telegraphy. It is, in fact, imbued with all the force and character of an autobiography.

Leading articles concerning Sir Charles' address also appeared in *The Times, Standard* and other journals the following morning.

In the capacity of President, again, Sir Charles and Lady Bright received the Institution at a *soirée* on December 15th, at Prince's Hall, Piccadilly, at which a large and distinguished assembly were present.

During his presidential year, many papers of great interest were read, but the one which Sir Charles naturally took special interest in was that of his former pupil, Mr. Edward Stallibrass, A.M.Inst.C.E., on "Deep Sea Sounding in Connection with Submarine Telegraphy."

Sir Charles had scarcely completed the period of presidency when his untimely and sudden death occurred.

On the occasion of his funeral, the Council of the Society attended in full force.

The President, who followed, was an old friend of Sir Charles' from the earliest telegraph days—the late Mr. Edward Graves, Chief Engineer of H.M. Post Office. At the first meeting of the Society after Sir Charles' death, Mr. Graves commenced the proceedings by moving the following resolution:—

"That an expression of our deep regret for his loss and our sincere sympathy with Lady Bright and the members of Sir Charles Bright's family in their bereavement be agreed to; and that the Secretary be instructed to convey an expression of the same to Lady Bright."

This followed on some remarks of the President, in which he said, *inter alia* :—

"Sir Charles Bright, our immediate Past-President, was known to every one by the reputation he early acquired in connection with the spanning of the Atlantic Ocean by a submarine cable, and by proving that there was no limit of distance, or depth, to the success of submarine telegraphy. I will not attempt to deal with all his other great works. In him we lose not only a member of great eminence, whose name will be for ever associated with some of the greatest achievements of Electrical Engineering, but those who were personally acquainted with him, as I was for more than thirty years, lose also a genial and kind-hearted friend."

In the following year Sir William Thomson (afterwards Lord Kelvin) became President ; and in opening the proceedings, he took occasion to make a special allusion to his former shipmate. Again, at the first annual dinner of the Institution in the same year, Sir William Thomson (President), in responding to the toast of the evening—"The Institution"—proposed by Lord Salisbury, began by paying a warm tribute to Sir Charles' work.

Yet again, as a further tribute, on taking the presidential chair in 1897, Sir Henry Mance, C.I.E., M.Inst.C.E., remarked in his address :—"If we, as engineers, desire to do honour to any one individual who pre-eminently distinguished himself in the development of oceanic telegraphy, we have simply to refer to the list of our Past Presidents, and select the name of Charles Tilston Bright."

CHAPTER XXI

Colleagues and Pupils

NO man could carry out such arduous and great works as were undertaken by Sir Charles Bright without able assistance, and in selecting his associates and assistants, Sir Charles evinced throughout his knowledge, not only of antecedents, but of character. Further, amongst all those who worked with him—on the Atlantic, in the East or West Indies, in this country or elsewhere—he always established and maintained a thorough *esprit de corps* and good feeling, that led to the happiest results.

Generally speaking, his coadjutors were men of mark; and the pupils which he occasionally received, have, as a rule, made names for themselves in the engineering and scientific world. Most of these have been referred to, as occasion arose, in the course of this memoir.

In only one instance did Sir Charles despair of a pupil, and the case was peculiar. The young fellow was well trained, and the grandson of a great legal luminary. He had mostly lived in the country, and was an amateur about bees. He used to bring bars of honey to the office, and the dear little insect filled his head so entirely that no electricity could be got into it ; in fact he really had " a bee in his bonnet," and the arrangement with him had to be cancelled. Subsequently making his way to the Antipodes, he got together heaps of hives, and has done well ever since—in the bee line, at any rate.

CHAPTER XXII

Volunteering

FROM the outset both Charles Bright and his brother interested themselves greatly in the Volunteer movement; and very shortly after Government authorised the formation of corps—during the French scare of 1859—Sir Charles raised a company from the officers and employés of the Magnetic Company in London. His brother Edward did the same at Liverpool, and both received commissions as captains.

It was necessary that isolated companies should form part of a battalion, so Bright joined the 7th Surrey Regiment, which had started a little before under the command of Colonel Beresford, M.P.

Though for many years afterwards Sir Charles attended Volunteer gatherings of one description or another, he became too much occupied to take an active part in the drilling, parading, shooting, etc., and eventually had to resign when going out to lay the cables in the Persian Gulf.

His brother raised a second company in Liverpool, and was promoted to Captain-Commandant.

CHAPTER XXIII

Freemasonry

FROM an early period in his life Sir Charles interested himself in Freemasonry. Both he and Edward Bright joined the craft in 1854, entering the Cambermere Lodge of Cheshire on the same day.

In later times he filled the position of Master in the Bard of Avon and other Lodges. He also passed through the Chair of several Arch Chapters, as well as in Mark Masonry.

Then, again, Sir Charles was for a considerable time the Deputy Grand Master for Middlesex, of which the late Colonel Sir Francis Burdett, Bart., was Grand Master.

Moreover, he was a member of the "Prince of Wales" Lodge, of which H.R.H. is permanent Master.

Finally, he was a founder of the "Quadratic" Lodge at Hampton Court, of which he became Master; the "Saye and Sele" Lodge at Belvidere; and the "Electric" Lodge. Of the latter his brother was the first Master, followed by Bro. W. H. Preece,[1] and by the late Mr. Edward Graves, at that time engineer to the Postal Telegraphs. The latter Lodge was, in fact—as may be imagined—constituted for members of the electrical profession.

[1] Now Sir W. H. Preece, K.C.B.

As an instance of the esteem in which the subject of this memoir was held by his brother Masons, we may mention that his name was adopted as the title of the Sir Charles Bright Lodge at Teddington. Of this he was the first Master.

CHAPTER XXIV

Home Life and Recreations

IN his domestic relations the subject of this biography had his share of happiness, as well as the reverse. Let us confine ourselves to the former.

As we have seen, at the early age of twenty he married Miss Hannah Barrick Taylor, fourth daughter of the late John Taylor, of an old Yorkshire family (originally hailing from Treeton) who had been previously connected by marriage with the Brights. Lady Bright survives Sir Charles.

In 1877, Sir Charles' eldest daughter, Agnes, married Mr. Mervyn Kersteman King, son of Mr. William Poole King, of Avonside, Clifton Down, formerly High Sheriff of Bristol, and head of one of the leading Bristol ship-owning firms.[1]

The second daughter (Mary) married Mr. David Jardine

[1] To the deep grief of all her relations—and indeed of all who knew her intimately—this daughter died of scarlet fever, in 1894, leaving a son and daughter. The son, named after Sir Charles, is probably the only instance of a boy who (when leaving Eton for Cambridge) was 6 ft. 4 in. at the age of seventeen. In this he more than took after his grandfather, for Sir Charles stood a little over 6 feet. He later joined the Coldstream Guards, and quite recently married Lady Clare Noel, daughter of the Earl of Gainsborough.

Jardine, now of Jardine and other Dumfries-shire estates, son of the late James Jardine, and nephew of Sir Robert Jardine, Bart, M.P.

The latter marriage was solemnised at St. Paul's, Knightsbridge, on January 14th, 1886, Bright giving away his daughter.

A few months later—owing to heavy pecuniary losses—the family removed from Bolton Gardens, South Kensington, to a smaller house in Philbeach Gardens, a little further west.

The following year, on the occasion of the Queen's Jubilee, Sir Charles and his wife were amongst those present at the service in Westminster Abbey. This was the last occasion on which they appeared in public together.

Let us now, finally, say a few words regarding Bright's social enjoyments. The subject of our biography was not, at any time in his life, what would be called a "Society" man. His profession always kept him fully occupied; and as regards entertaining, his tastes ran rather in the direction of small and quiet parties of real friends, than of entertaining a roomful of mere acquaintances.

Shooting and Fishing

Although Sir Charles adhered, as a rule, to the adage he had adopted and often quoted through life, of "*nulla dies sine linea*," yet he liked "a day off" occasionally; and thoroughly enjoyed relaxation from work in shooting and fishing—particularly the former. He had been brought up to both from boyhood, and in the sixties he joined with his friends, Mr. Edwin Clark, C.E., in a lovely shooting manor, Boughton Court, near Maidstone, where game was plentiful, coupled with good pike and perch in a mere on the estate. It was one of his hobbies to be up early and get a bit of fishing before the shoot—in fact before breakfast began [1]; and on such occasions his maxim of "*nulla dies sine linea*" was applied to the fishing-line.

It was rather an awkward country to shoot over in September (though hilly and beautiful), owing to various hop gardens and the many hop-pickers on the manor; and an instance occurred when the sport was somewhat marred by one of his guests peppering both a schoolmaster and a hop-picker in the course of the same day. The friend was a fair, but greedy, shot, and wouldn't wait for the birds to rise properly.

Later on, he had some very pleasant days of sport near Horsham with his friend Sir Richard Glass (who made half of the first Atlantic Cable) and others. Still later, with his son-in-law, Mr. Mervyn King, at Kingsnympton Park, near South Molton and Chulmleigh, North Devon.

Sir Charles was also wont to shoot with an old school-

[1] Bright was always an early riser. When not employed as above it was a custom with him at daybreak to sketch out ideas on a slate kept at hand.

Thus, he got through a good deal from 6 o'clock till breakfast time. He similarly occupied his spare moments when on holiday as well as at his office; and thus his slate saw the gradual evolution of many an invention.

fellow, Capt. Cosby Lovett, at Combe Park, near Leighton Buzzard, in Bedfordshire.

Some of his most enjoyable shooting days were, however, spent with another school-fellow, John Stallibrass, the squire of Eastwoodbury and Thorpe Hall, near Rochford. A part of Mr. Stallibrass' domains extended to Foulness Island off the Essex coast. Once there, the game was also there; for the furry portion, at all events, couldn't go to sea, and the partridges didn't like to. The high sea embankments, grown over with scrub, formed capital shooting ground after the birds had been driven to them. For lunch, the squire's lessees of the famous oyster beds in the inlets used to provide a hamper of fresh oysters at one of the farm-houses.

Some of the best sport Bright ever experienced was when he took over the Harleyford shooting from Sir William Clayton, Bart., in 1874. The shoot extended from close to Great Marlow up to Medmenham, and a long way inland from the Thames, covering over 2,000 acres, with a large amount of woods, coming down to the chalk cliffs above the river. A number of pheasants had to be bred each year to keep up the supply; but of hares, partridges and "bunnies" there were plenty. Sir Charles' rule was to shoot at intervals with small parties—his brother and two or three other guns. Those who came oftenest and stayed longest were, perhaps, the late Count Gleichen,[1] Mr. E. B. Webb, Mr.

[1] Afterwards Admiral H.S.H. Prince Victor of Hohenlohe-Langenburg, G.C.B.—cousin to our late Queen.

Edwin Clark, Mr. Latimer Clark and Mr. Robert Fowler.[1] The object was never a big *battue,* but a varied and reasonable day's sport.

Sir Charles revisited Marlow and that part of the river more than once. He was always very popular there,[2] and was at one time asked to stand for the borough. This, however, he did not see his way to do.

Yachting

Though, perhaps, the most important moments of his active life were spent at sea, in a way that had many of the advantages of yachting, Bright was seldom able to revel in any lengthy cruises solely on pleasure bent.

He, however, frequently allowed himself a few days' trip at sea after a manner that was so near his heart.

Captain Cosby Lovett was his usual host on these occasions. Captain Lovett's wholesome sea-going yacht *Constance* (200 tons) was quartered at Southampton; and from here these two old friends would go out for a sail along the South Coast—and even further afield—at short notice, when Sir Charles' professional engagements permitted of it. Some sea-fishing also formed a part of the programme as a rule, but both were greatly interested in all the intricacies of yacht-sailing for its own sake alone. They were, in fact, yachtsmen in the strictest sense.

[1] Mr. Fowler was a partner in the firm of Hargrove, Fowler & Blunt, Sir Charles' solicitors. He was also a brother of Sir John Fowler, Bart., K.C.M.G., LL.D.

[2] Even now, his portrait may be seen hanging on the walls of the *Complete Angler Hotel.*

Another friend with whom Sir Charles used to go yachting occasionally was Mr. J. B. Saunders, of Taunton, with yachting headquarters at Teignmouth. Mr. Saunders' yacht was the *Pixie,* and in her they had pleasant cruises to the Channel Isles, Falmouth, the Isle of Wight, etc. Mr. Saunders—a most genial host—was originally an old telegraph acquaintance in the Electric Telegraph Company. In later days he contracted for the telegraph work of some of the railways in South Wales.

River Sailing.—From early boyhood Bright had been devoted to the river, as we have already seen. Thus when at Marlow some of the time was spent in sailing as well as rowing.

The "Beatrice" Parties.—Sir Charles' steam launch *Beatrice* [1]—which has already been referred to in the chapter on the West India cables—was for a time kept on the lower reaches of the river. She was occasionally used for excursions up river, and has witnessed more than one Oxford and Cambridge Boat Race, with a festive party on board.

Tours and Picnics

When in the country or at the sea-side, Bright used sometimes to make up driving and riding parties; and when once staying at Eastbourne, Mr. Karl Siemens and his charming daughters joined Sir Charles and his family in some of these.

[1] Named after his youngest daughter.

The most extended tour in which he took part was, however, a month's picnic of an entirely novel character, during August, 1876. This charming novelty of absolute freedom from work, coupled with pleasurable excitement, came about from what might be termed an inspiration on the part of an old friend that fairly eclipsed any "happy thought" that ever shone in the luminous pages of Mr. *Punch.* It is especially interesting now, in view of the hold motoring has since taken upon us.

The idea occurred to the fertile brain of Mr. James Caird, of Dundee, to invite some friends of both sexes to a peripatetic picnic in a special Pullman car train. The ingredients of the party were like plum pudding—varied but pleasant. Besides the host, his wife and sister, there were Mr. Frederick Leyland, of steamship renown, with Mrs. Leyland, their son, and two daughters; Captain Herbert Marryat—related to the famous nautical author—represented the military contingent; then Art had her exponent in the late Mr. Phil Morris, R.A.[1]; Music in Mr. Horace Jee; while Science claimed Sir Charles, whose eldest daughter Agnes accompanied him. Mr. Shenstone Roberts, the genial representative of Messrs. Pullman in this country, with his wife, was also there. Finally the party was completed by Mr. Edward Bright, who took upon himself to preserve some sort of account [2] of any interesting incidents during this "voyage on wheels" in and about the most delightful

[1] For a short time also the late Sir John Millais—a connection of Mr. Caird's—was one of the party.

[2] This was afterwards reproduced in the *Daily News*, which also gave a "leader" on the subject.

scenery of England and Scotland, intermingled with a little shooting and fishing.

The programme was to start from London in a special train, with servants, supplies, sleeping quarters, and entertaining rooms, so as to be as independent of hotels as the dwellers in a caravan. This holiday trip was to include calls upon friends here and there, and visits to a number of the most interesting and beautiful places in our island—staying a day or so here and there, wherever there proved to be the greatest attraction.

It was understood from the first that nobody was to enquire too curiously of their entertainer as to where the expedition was next going; and Mr. Caird so arranged everything, that each day's excursion proved a pleasant surprise to his friends during the month's trip.

The freedom of promenading throughout the cars—a distance of 120 feet—and the comfort of all the appliances for resting and amusement, prevented any tedium being experienced. Between the cars were roomy railed platforms, upon which members of the party often sat cosily upon camp stools for pleasant chats, while enjoying both the fresh air and charming views passed through—particularly in Derbyshire and the Highlands.

The saloon was so full of windows from one end to the other that unimpeded views could be had of the scenery throughout, and through many districts—especially on the Highland Railway and its branches—the train went at a purposely low speed in order that the beauties of the country around might be enjoyed leisurely.

A very able American "conductor" took charge of the Pullman cars he was so well accustomed to, and greatly contributed to the comfort of the company. Being a good fisherman he now and again caught a creel of trout before breakfast. Then there was Sir Charles' old valet, Field, with another, and a ladies' maid.

The Railway Companies proved most considerate, and gave special time bills throughout.

The start was made from St. Pancras on July 30th, the train proceeding first to Bristol and Clifton to interview some friends. Thence to Bath and Cheltenham, where the "waters" were "sampled."

Next on to Worcester, where, after admiring the Cathedral the party pottered about the Potteries, and left for Derbyshire, where Chatsworth, Haddon Hall, Matlock and Buxton were visited.

Onward by the new Settle and Carlisle route, through the beautiful Eden Valley, they were passed forward to the North British system. Making a halt at Melrose, they visited Abbotsford, Dryburgh Abbey, and the tweed factories at Galashiels.

At Edinburgh, they went to Rosslyn Castle and Abbey, etc., and thence their wanderings extended to the Highlands, *via* Perth, after having the cars safely ferried over the Firth of Forth to Burntisland.

The party then wended their way to the west, making some stay amid the wild mountainous scenery of Loch Carron, at Strome Ferry and Plocktown. A flying visit to the Isle of Skye was thought of, but accommodation could not be arranged for so large a number. Mr. Caird had provided carriages at the railway siding, so delightful drives were made to Loch Maree and Gairloch.

They next passed onward to Thurso, where all is slate and paving-stone. One old dame here passed her opinion very audibly on the platform: "Hech, eets jeest a gatherin' o' strollin' players, ye ken!"

The train was then sent back round the Wick, while the party drove to John o' Groats and had a great hunt on the shore for the famous "buckle" shells. The next move was on to Barrogill Castle at the invitation of the Earl of Caithness, who entertained the party with much hospitality. Besides knowing Mr. Caird, he had met Sir Charles in Cuba, where the Countess—formerly Countess di Pomar—had large estates. She believed in spiritualism, and that she belonged to the "Inner Circle"—whatever that might portend. She once told Sir Charles of an interview she had one night with the wraith of Mary, Queen of Scots, in the ruined chapel, when staying at Holyrood Castle.

Returning from this northernmost part of the "Land o' Cakes," a pause was made at Wick to see the herring fleet of about 800 vessels crowding out of harbour on a sunny afternoon with their variously-coloured sails—a scene of which Mr. Morris made some interesting sketches. The next morning their return was witnessed—laden to the gunwale with the silvery prey, afterwards to be shovelled out by stalwart fishermen standing amongst the fish up to their thighs.

Once when the train was passing over one of the less frequented lines, some of the ladies were initiated into the mysteries of stoking and driving on the engine, at which they proved themselves adepts—especially in whistling. With regard to the latter one of them afterwards remarked: "We pulled away at all the handles we could get hold of, and were not a bit nervous!"

The curiosity of the people in many places was very great, and sometimes the crowd at the railway stations made it difficult to get in and out. Dinner-time in the cars proved an especial attraction to the outsiders—as at the Zoo; and at Wick a vast number of herring-scales were left adhering to the windows as a reminiscence of the faces and fingers of the admiring multitude.

On the way south the expedition pulled up at Dunrobin, having been invited by the Duke of Sutherland to visit the Castle.

Next succeeded a visit to Sir Alexander Matheson, Bart., at his beautiful seat, Ardross Castle. Here, again, the party were most hospitably entertained. Near by, there were moors all round belonging for many miles to our host, who, however, being somewhat elderly, did not care to shoot—while Lady Matheson's principles were opposed generally to anything being killed. These principles she lived up to, for she did not eat fish, flesh, or fowl. However, when out in the grounds after lunch, Sir Alexander said there were a couple of guns and a brace of dogs if any cared for a pretty stroll and a bit of shooting. Sir Charles and Captain Marryat elected to go; and on taking leave, Lady Matheson characteristically wished them a "very pleasant walk—but *'long life' to the grouse!*"

A different route was chosen for the return of the Pullman expedition; and Lochs Lomond, Long, and Fyne were successively visited by using the steamers from Balloch and Helensburgh.

The party finally made their way to London, *via* Glasgow and Dumfries.

On the lines in the North of Scotland it was found that the cars were too lofty to pass under the bridges, but some navvies who were sent forward—accompanied by Sir Charles and the assistant engineer of the railway—obviated the difficulty by scraping away the ballast from under the sleepers, and so lowering the permanent way a few inches where necessary. One of the bridges proved, however, such a close shave that it cut off the tops of some of the ventilators.

At several points the party were taken for Americans, the tune of "Yankee Doodle" being expressly played for their benefit by a band at one station, while at Buxton a flower girl, on getting but a shake of the head when proffering her bunches, remarked: "It's no use talking to them; they'ar Americans, and don't speak English!" At Edinburgh a gudewife's verdict upon one of the cars was, "Weel, it's just a gingerbread-looking thing!"

The weather was fine throughout, and no hitch whatever occurred to mar the trip.

A delicious sensation of comfort and freedom was experienced on reaching each fresh halting-place from the fact that no baggage had to be removed from the cars. Moreover, all were utterly independent of the thousand and one troubles connected with hotel accommodation—carrying their rooms, servants and provisions with them. There was also the feeling of thorough privacy which could never have been obtained for so many at the inns on the way. Practically such a party could not have travelled throughout the country from the West of England to John o' Groats by any other means ; as at many of the most interesting localities where a stay was made, beds and sometimes provisions for such a number—eighteen all told—would not have been procurable. The idea of "home" in connection with the cars grew stronger every day of the journey ; and on returning after drives, walks, rowing or fishing expeditions to the railway siding—where their travelling houses were temporarily bestowed—every one felt as if going to a most pleasant *rendezvous*.

The company started out for a fortnight's trip ; but it was at once so novel and so delightful that it was extended to a month, and terminated to the regret of all concerned. It constituted a kind of yachting voyage on land, without the accompaniment of baffling winds or topsy-turvy seas.

Club Reminiscences

Sir Charles was an eminently "clubable" man—full of varied information, an accomplished *raconteur*, and always most genial. He was a member of the Reform Club, where he frequently enjoyed a game of billiards with his namesake, the late Right Hon. John Bright, and other friends. He also belonged to the Garrick, Whitehall, and Royal Thames Yacht Clubs. This last was his favourite resort for lunch and in the evening. Here he sat down to many a pleasant supper with professional friends, after meetings of the various Societies and Institutions to which he belonged.

His taste for yachting had something to do with this preference for the club in Albemarle Street. For a number of years he was on the Council and Committee, whilst his brother acted as auditor.

Sir Charles seldom missed the annual Thames Yacht Races. On these occasions he used to make up a party for the Club steamer.

When once Bright took to any one he stuck to him; and his most frequent guests at the Races were, perhaps, the late Count Gleichen (Prince Victor of Hohenlohe-Langenburg), Baron Gudin, Messrs. E. B. Webb, Rudolph Glover of the War Office, Charles Dibdin of the Admiralty, W. H. Preece, and George Forbes—beside various wives, sisters, and daughters of these and others.

The Thames Yacht Club was always an eminently sociable resort—a large proportion of the members knowing one another in yachting circles.

In 1875, Count Gleichen executed a marble bust of his friend. This proved a capital likeness, beside being a most artistic piece of work, as may be seen from the reproduction here given. It was duly exhibited in the Royal Academy of that year and was much admired as a faithful and life-like portrait. Plaster duplicates were made; one of these was presented to the Institution of Civil Engineers, whilst another is in the library of the Institution of Electrical Engineers.

BUST OF SIR CHARLES BRIGHT

Executed by Prince Victor of Hohenlohe-Langenburg

CHAPTER XXV

Death and Funeral

Slowly, slowly up the wall
Steals the sunshine, steals the shade;
Evening damps begin to fall,
Evening shadows are displayed.
Darker, darker and more wan
In my breast the shadows fall;
Upward steals the life of man,
As the sunshine from the wall,
From the wall into the sky,
From the roof along the spire;
Ah, the souls of those that die
Are but sunbeams lifted higher!

LONGFELLOW.

SIR CHARLES never really got over the severe attack of malarious fever, to which he nearly succumbed when laying the West India Cables; and which were recurrent every now and then long after his return to England.

He had been in failing health for some time. This was largely owing to various worries and the need of an entire rest from work.[1]

His comparatively sudden death occurred at early

[1] Edison is said to have told a friend: "Don't worry, but work hard, and you can look forward to a reasonably lengthy existence." Sir Charles, unfortunately, *had* to worry as well as work.

morn on Thursday, May 3rd, 1888, from failure of the heart, while on a visit to his brother, near Abbey Wood, in Kent.

The obituary notices and leading articles in the various newspapers which appeared on this occasion with regard to Sir Charles, were given in the last Appendix of the original biography, as well as the references to his funeral from *The Times*, *Morning Post*, *Pall Mall Gazette*, *St. James' Gazette*, *Globe*, etc.[1] The technical press, however, naturally provided the most detailed particulars; and the concluding words of the *Electrical Review* obituary notice of May 11th, 1888, may be suitably quoted here :—

> We have endeavoured to give a summary of the life of the late Sir Charles Bright—a life spent from its early beginning with the creation of the electric telegraph—pointing out some of the important works he was engaged in, some of the improvements he had introduced and originated, and showing at the same time the type and character of the man, who could so readily and easily devise, undertake, and carry out such works.
>
> He leaves behind him many of his old friends and fellow-workers to grieve and mourn his loss, but he also leaves behind a monument of lasting fame. The works he has accomplished bear evidence for all time of his skilful handiwork, his intuitive knowledge and unerring judgment; and as the great fabric of the modern telegraph system rises and spreads throughout the world, its foundations and superstructure bear evidence of the vital part played by Sir Charles Bright in their construction and formation. We may, indeed, safely assume that so long as the broad Atlantic, separated by its broad expanse of water

[1] The week after his death, the *Illustrated London News*, *Graphic*, *The Engineer*, and other journals also contained good portraits of Sir Charles.

from this country, carries at its utmost depths the electric connecting chain of communication, so long will the name of the Atlantic and its first cable be connected with that of Charles Tilston Bright.

The funeral took place on the following Monday (May 7th). To quote further from the *Electrical Review* with reference to this :—

The service was conducted at St. Cuthbert's, Philbeach Gardens (opposite Sir Charles' residence), South Kensington, and the burial in Chiswick churchyard, where the family vault was situated,[1] and near which the family used to live.

Besides the relatives of the deceased, a large and distinguished gathering of friends attended to pay their last tribute of esteem and affection—though no one was actually bidden.[2] Among those present were: His Serene Highness Prince Victor of Hohenlohe-Langenburg, G.C.B.; Sir Francis Burdett, Bart.; Sir David Salomons, Bart., nephew of the late Sir D. Salomons, who sat with Sir Charles as member for Greenwich for several years; Sir Robert Jardine, Bart, M.P.; Sir F. Goldsmid, K.C.S.I., C.B.; Mr. William Lindsay and Lady Harriet Lindsay; Lady Smart; Mr. Phil Morris, R.A.; Mr. Linley Sambourne, of *Punch*; Sir William Thomson, LL.D., F.R.S.,[3] Sir Samuel Canning, M.Inst.C.E., and Mr. Henry Clifford—the last three his fellow-shipmates and pioneers on H.M.S. *Agamemnon* in the first Atlantic cable expedition.

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[1] Here his wife's mother had been buried in 1871, and again, his wife's brother was interred here in 1884. For both of these, who had predeceased him, Sir Charles had always a strong affection, and the latter—Robert John Taylor—had probably been his best friend through life.

[2] The only intimation of the funeral was given through the newspapers.

[3] Afterwards Lord Kelvin, O.M., G.C.V.O.

Amongst his professional friends were also Mr. Latimer Clark, F.R.S., M.Inst.C.E., for several years his partner; from the Post Office, Mr. E. Graves, and Mr. W. H. Preece, F.R.S., M.Inst. C.E.,[1] associated with him from the days of early telegraphy, Prof. D. E. Hughes, F.R.S. (a fellow Government Commissioner with Sir Charles at the Paris Exhibition); Mr. F. C. Webb, M.Inst.C.E. (for some time on his staff); Mr. H. C. Forde, M.Inst.C.E. (a previous partner); Mr. John Muirhead, M. Inst.C.E.; Mr. F. H. Webb, Mr. R. Collett, and Mr. E. Stallibrass. Amongst those who were out on Sir Charles' last and most trying cable expeditions in the West Indies of 1869–72 were Mr. R. Kaye Gray, M.Inst.C.E., Mr. E. March Webb, Mr. H. Benest, and Mr. James Stoddart—all of the Silvertown Company.

The Council of the Society of Telegraph Engineers (of which Sir Charles was last year President for the Telegraph Jubilee) were present, and the Royal Astronomical, Geological, and Geographical Societies had sent officials to represent them.

The Institution of Civil Engineers was represented by its Secretary, Mr. James Forrest, who was also a personal friend of Sir Charles. To all of these bodies Sir Charles belonged very early in life.

Most of his pupils, past and present, were also there, and amongst the many wreaths one was placed on the coffin by them. Some of Sir Charles' old mechanics and servants in his different undertakings also attended.

Though choral, neither service was of an elaborate character. At St. Cuthbert's, the hymn selected for singing was "Rock of Ages" (a favourite hymn), whilst at the grave it was "Now the labourer's task is o'er."

On the churchyard being reached, the funeral service was read by the Vicar of Chiswick, the Rev. Lawford Dale, M.A.

[1] Now Sir William Preece, K.C.B.

—an old schoolfellow of Sir Charles', who had rowed in the same "eight" with him.

The inscription on the coffin was merely :—

Charles Tilston Bright

Born, June 8th, 1832

Died, May 3rd, 1888

CHAPTER XXVI

Summary

IN attempting to summarise Sir Charles Bright's career in the course of a few concluding words, the question at once presents itself whether to characterise him as a great inventor, as an eminent engineer, or as a man of affairs. He was prominent in each of these respects—a rare combination in any single individual.

His numerous and largely used inventions have been briefly dealt with here.[1] Throughout life a note-book was in his pocket, in which—almost daily—he sketched ideas forming the embryos of many inventions.[2] In telegraphic and submarine cable work—of which he has been rightly characterised as the pioneer—these are still indispensable; for without them long cables could scarcely be laid or worked—even at the present time. In electric lighting, again, he helped—as we have seen—to point the way, besides devising several important improvements. Telephony also owes something to him. Electric traction was not sufficiently within the realm of practical progress at that time for Sir Charles to turn his attention to it; but this was the only branch of electrical engineering and applied science to which he had not devoted his energies at one time or another.

[1] They are all dealt with further in the Appendix.

[2] Quite a collection of these small note-books have been preserved.

In everything he undertook there were the same characteristics evinced of profound practical thought in the initiation of each enterprise, coupled with untiring energy and dauntless pluck in carrying them to a successful issue. Besides these qualities, he was always courteous and genial in his bearing towards his staff and those with whom he had to deal.

As we have seen, Bright's life was a life fraught throughout with danger and anxiety. In his various undertakings he was calm under adversity, brave in emergencies that would have caused many to quail. Greater force of character is perhaps required by a submarine telegraph engineer than by any other engineer whose work is practically done when the designs are made, whereas the greater part of a telegraph engineer's difficulties occur in the laying and repairing of the line, and in unforeseen mishaps which are always liable to take place. Heavy weather, or a moment's error of judgment, have repeatedly ruined the whole work of an expedition.

We will not prolong this summary by dwelling on his political and other services, but will conclude by quoting from the closing observations in a biographical sketch of Sir Charles, which appeared in the *Electrical Engineer*. The sentence runs thus :—

It will be seen that the work of Sir Charles Bright has been of a wide and varied character—both in land and submarine telegraphy—dating from the earliest days of the electric wire. Indeed, he may be said to have been a leader in the rise and progress of electrical industry.

The same article went on to say :—

There are some men whose talents impress us more than any other of their merits, and stand out gaunt and bare like some projecting cliff with nothing gentle to relieve the eye or mask the height. There are others in whom a keen intellect is sometimes veiled by geniality of manner, just as a rocky hillside may be overhung with verdure. It is to this category that Sir Charles Bright belongs ; and though his past services may well command our admiration, the better part of our praise is that those who have had the pleasure of his acquaintance, love rather to remember the kind and sociable qualities of the man than the successes of the engineer. His attractive ways and well-known figure will be missed by many for some time to come.

Though, for a professional man, Sir Charles did well pecuniarily at times, he died poor.

May it not be said that whether a man ends well provided with this world's goods or otherwise is largely a matter of luck—quite irrespective of genius, which is, of course, on the other hand, inborn. Apart from luck, however, there was a *trait* in Bright's character which would naturally conflict with his amassing a fortune—and adhering to it. That *trait* was the taste for converting money into things which gave himself and his friends immediate pleasure : it may be summed up by the words hospitality and generosity.

Furthermore, he seemed throughout to bear in mind that

Life is mostly froth and bubble,
Two things stand alone :
Kindness in another's trouble,
Courage in our own.

Appendix [1]

SIR CHARLES BRIGHT'S INVENTIONS

SHORTLY after their introduction to Electric Telegraphs in 1847, Charles Bright and his brother Edward—when young fellows of seventeen and eighteen—began to discuss weak points in the existing apparatus, and to work out improvements. But in those days a patent was an expensive luxury, for what with Mr. "Deputy Chaff Wax"—who put the great seal on, eighteen inches round, and over an inch thick—and the heavy fees, stamps, etc., coupled with the high charges of the patent agents for legal verbiage and technical drawings, the cost mounted up to about £200 down. There was then no distribution of fees over many years, as at present. But—and this is an important "but"—a large number of separate inventions and improvements relating to the same general subject, might at that period, be comprised and protected in a single patent.

So the brothers continued piling up their ideas by sketches and descriptions in a locked "Inventions Book" till 1852, when they saw their way to taking out their first patent. This patent (E. B. and C. T. Bright, No. 14,331, of October 21st, 1852) embraced no less than twenty-four distinct inventions, illustrated by twenty-eight drawings, as described in fifteen specification pages. It became an historical one; and it may fairly be said that few patents have contained so much variety, and so many novelties. The greater part came into active use, and a considerable proportion are still employed as the most satisfactory apparatus for the purposes for which they were designed.

More than thirty years afterwards (July 2nd, 1883), the *Electrical*

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[1] Inasmuch as the inventions of the subject of this memoir have only been referred to in part—and then but briefly—in the body of the book, it has been thought well to deal with them here in further detail, whilst giving illustrations and descriptions of those which have not formed part of the main narrative.

Engineer thus described some of the principal inventions embodied in this patent of 1852 :—

1. The system of testing insulated conductors to localise faults from a distant point, by means of standard resistance coils in series of different values, brought into circuit successively by turning a connecting handle. A drawing in the patent specification represents the best forms of resistance coil arrangement at present used in testing land and submarine telegraphs.

2. In dividing coils into compartments, and in winding the wire so as to fill each compartment successively, and thus gain a greater determination of polarity. This system of winding coils was afterwards suggested in 1854 by Herr Poggendorf, subsequently by Herr Stohrer, of Leipsig, as well as by M. Foucault, and again by M. Ruhmkorff, *vide* Du Moncel's *Applications de l'Electricitè*, vol. ii. pp. 241–243.

3. The employment of a moveable coil pivoted on an axis, actuated by a fixed coil outside it. The one reacting upon the other, the same electrical current traverses both, for obtaining unvarying standards of power. This invention is similar to that now being brought forward by others as a novelty for electric lighting purposes. A differential method of testing with a standard galvanometer also foreshadowed the differential galvanometer.

4. The double roof shackle generally used at the present time for leading in wires over house telegraphs, telephones, electric light wires, and whenever great strains are involved by long spans. This was further improved in a patent of Sir C. Bright, No. 2601 of A.D. 1858. See also *The Electric Telegraph*, by Lardner and Bright.

5. The now universal system of telegraph posts with varying lengths of arms, to avoid the chance of one wire dropping on another.

6. The partial-vacuum lightning protector for guarding telegraphic lines and apparatus. This has since been re-patented in various forms.

7. A translator, or repeater, for relaying and re-transmitting electric currents of either kind in both directions on a single wire. This contrivance was used with great success by the Magnetic Telegraph Company, up to their purchase by Government in 1870, and was the first device of the kind in any country.

8. The employment of a metallic riband for the protection of the insulated conductors of submarine, or subterranean, cables. This also has been recently re-invented and re-patented, and is found to be the best protection for the insulator, either on the sea bottom or underground.

9. Another improvement was the production, in an automatic key, of a varying contact proportionate to the pressure exerted upon it, for adjusting the time length of change in testing or signal-

ling. This was by means of mercury—on the same principle as a sand-glass.

Besides these, a new type printing instrument, a novel mode of laying underground wires in troughs, and other telegraphic improvements, were included in this early patent of the Brights.

In addition to the appliances referred to above, the first form of curb key—for working long cables—is given in this patent. Spring catches are made to slip over a cog of their respective catches and wheels by the movement of a key, lever, or handle. Alternate currents may thus be sent. When the apparatus is at rest, the sending coils are put on short circuit, and the line wire connected to earth.

Again, another form of lightning protector here described, consists of two "condensers" in juxtaposition and garnished with points, and a third of fine wire brushes.

Let us now consider "No. 1" in the above digest of the *Electrical Engineer*—the system of localising faults. This apparatus is still in constant use—fifty-six years afterwards. The *Electrical Review*—in its obituary notice of Sir Charles—characterises it as "a special system for testing insulated conductors, with the object of localising the distance of an earth, or contact from a station, by the use of a series of resistance coils mounted in a box. This is the first mention of resistance coils specially constructed of different values to be met with, and the credit of being the first to use this system of testing rests entirely with the late Sir Charles Bright."[1] The obituary notice of the Institution of Civil Engineers also speaks of the invention in a similar strain.

The preceding was, it will be seen, a purely telegraphic patent. The brothers, however, also devised, between 1849 and 1851 :—

1. Feathering floats for paddle wheels; also a feathering screw.
2. Agricultural ploughs for mechanically shifting the lower half of the soil penetrated at the top.
3. An improved lightning conductor for buildings.

These were described and illustrated in the *Mechanics' Magazine* at the time.

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[1] *Electrical Review*, vol. xxii. pp. 508–512.

[1] The next patent was dated September 17th, 1855, No. 2103, C. T. and E. B. Bright. It embraces seventeen further inventions, illustrated by eighteen figures described in thirteen pages of text. This joint patent of the Brights in 1855 is thus referred to in the *Electrical Engineer* of July 2nd, 1883 :—

"Up till the year 1854 the system of telegraphing by the movements right and left of a magnetic needle or needles was generally employed, and as the receiving operator had to watch the movements with his eyes, he had to dictate to an amanuensis seated by him. Apart from the cost of the second clerk, many errors arose from words—of like sound, but unlike spelling and meaning—being misunderstood by the writer, besides the strain on the eyes of the operator, which became fatigued, and thus added to the number of errors. To meet these objections, Sir Charles devised an acoustic telegraph (still very extensively used), giving a short and separate sound to the right or left of the receiving operator, corresponding to the movements of the needle.

"This system was rapidly extended over the 'Magnetic' lines, and resulted in a large saving of staff—as the writing clerks were dispensed with—and also in far greater accuracy, besides being the speediest apparatus of the non-recording class. It was later on successfully adopted by Sir Charles for working each cable between the various West Indian Islands.

"Professor Morse, in his report on the French International Exhibition of 1867, notes the fact that 'this Bright's Bell System is the fastest manual telegraph.' The above apparatus has ever since been universally known as 'Bright's Bells.' It consists of three distinct parts, which were described in the *Electrical Review* of May 11th, 1888, as follows :—

1. The apparatus for, and method of, transmitting signals.
2. The receiving relay, which has the means of increasing its sensitiveness, and of protection from the effects of return currents.
3. The 'Phonetic,' a sounding apparatus. This may be either used as a complete instrument, or applied in part to other telegraph instruments now in use. The magnet, when acted upon by electro-magnetic coils, causes the axle to vibrate or deflect in one direction, thus sounding a bell by means of a hammer head on one arm, the subsequent reversal of the electric current causing a muffler on the other arm to stop the sound."

[1] *Minutes of Proceedings of the Institution of Civil Engineers*, vol. xciii.

This patent also included a very simple and effective method of duplex working—almost the very first—which was used successfully on some of the Magnetic Company's wires, enabling signals in opposite directions to be made simultaneously.[1] It also covered the means for producing working currents from induction coils, and a machine for producing continuous currents from secondary induction coils by the action of a quantity battery in the primary coils.

As expressed in the obituary notice of the Institution of Civil Engineers :—

" It will be seen from an examination of these two early patents what a large practical and scientific field Charles Bright covered as the result of his experience and intuitive knowledge—in addition to his experimental investigation and foresight in the requirements of telegraphic science. We might enter more fully into the details of these various inventions, but sufficient evidence has already been given of his wonderful insight into the mysteries of the profession in which he played so large a part." [2]

It is to be regretted that the specifications of these two patents are now out of print, for they are, perhaps, especially of interest, on account of the youth of the inventors at the time—as well as owing to the extensive use of the inventions they refer to.

Charles Bright next patented a series of improvements in apparatus for laying submarine cables (under date April 8th, 1857, No. 990), after becoming chief engineer to the Atlantic Telegraph Company at the age of twenty-four. It covered six separate inventions. In this patent, young Bright described the first cable dynamometer. He says :—

I cause the strain which the length of cable hanging . . . between the stern of the vessel and the bottom of the sea . . . to be measured and indicated. . . .

One method . . . consists in placing the *axle of the stern wheel in bearings held back by springs*—which may be made to assume

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[1] See *Submarine Telegraphs*, by Charles Bright, F.R.S.E. (Crosby, Lockwood & Son, 1898).

[2] *Inst. C.E. Proc.*, vol. xciii.

an angle in a line with the direction of the cable. Or I measure the tension of the cable by lateral pressure, or water or atmospheric pressure, and other suitable means may be adapted to the same object.

The strain is indicated on a dial. *The whole can be so constructed, that should the strain amount to more than it is considered safe to permit, a* SELF-ACTING *management slackens or* RELEASES *the brakes or other restraining agents of the machinery.*

Afterwards the full specification says:—

The first part of my invention consists in measuring and indicating the strain. . . . The machinery . . . becomes a *compensating regulator . . . and consists in causing the strain* when it has reached its "safety point" *to act upon and release a brake,* strap, or other retarding agent. *When being so released, the cable will be free to run faster over the paying-out apparatus,* and thereby prevent fracture.

It is a pity that time (owing to the way Bright was hurried in order that the expedition should start in 1857) did not permit this ingenious apparatus to be then applied. The following year, however, a vertical dynamometer was adopted for the laying of the 1858 cable; and in this the principle of the above invention was largely worked on.

Here, also, was described and illustrated an automatic machine for the regular coiling and uncoiling of the cable in the holding vessel. This, though never brought into use, might very suitably under certain circumstances be adopted—to the great saving of cable hands, and of trouble. In these days of strikes it might be well if such an apparatus were always at hand—*and in full view* of the British workman!

The paying-out apparatus in this patent consisted of sheaves, "the grooves of which are so adapted to the figure and dimensions of the rope, as to grasp it firmly, at the same time that they preserve its conformation."

Had this plan been more generally adopted, it would have saved many an open-sheathed cable of early days from being put out of shape by the pressure on the flat surface of the ordinary drum.

Another useful appliance was first set forth in the same specification as follows:—

To ascertain at all times the rate at which the vessel is going, I register its speed on deck by the rotations of a vane submerged in the sea (in the manner usual with what is known as the patent log) being electrically communicated through a wire, or wires, contained in the cord by which the vane is sustained to an indicating instrument on deck; and I show the rate of the cable upon a dial by toothed wheels acting upon the axle of one of the sheaves on the stern wheel. The total distance passed over by the vessel, and the total lengths of cable delivered into the sea, are also indicated by these registers.

This ingenious arrangement was particularly referred to in the descriptive pamphlet issued by the Atlantic directors in 1857 [1]; and was used on the ships of that year's expedition, as well as on the successful one of 1858.

A month later, he followed this up by taking out a further patent for some improvements in the paying-out machine, with Mr. Charles de Bergue, an engineer and "machinist" of London and Manchester. This patent was dated May 7th, 1857, No. 1294. The variation from the previous patent was mainly directed to the arrangement of the paying-out sheaves and their gearing on to a friction brake, regulated by hand from the indications of strain, as shown by levers connected to a Salter's balance. The paying-out machine used on the Atlantic expedition of 1857 was constructed upon this specification.

In the following year, when the cable was successfully laid, a brake with a self-acting release arrangement at a given point of pressure was employed. Here, only a maximum agreed strain could be applied—this being regulated from time to time by weights, according to depth of water, and consequent weight of cable being payed out. The above device was based on Appold's apparatus for measuring the labour performed by prisoners at the crank. Its application to the exigencies of cable-laying was worked out by Charles Bright in conjunction with Mr. C. E. Amos, M.Inst.C.E.

Three months after laying the First Atlantic Cable, Sir Charles took out a patent containing a series of important improvements connected with the insulation of overground wires, including the construction of his insulator with double insulating sheds—one superimposed on the other. The outer, while adding vastly to the insulation, was composed of hard wood, papier maché, gutta-percha, etc., so as to act as a shield to protect the inner glass, or glazed earthenware, cup which it covered.

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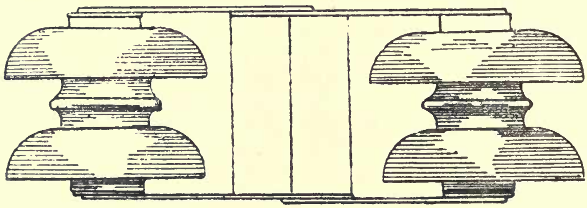
[1] See also *The Engineer*, vol. iv. p. 38.

He also, in this patent (18th November, 1858), described an improvement in his self-adjusting terminal insulators, which are still in general use under the name of "Bright's shackles."

Fifteen months afterwards a number of additional novelties in telegraphic apparatus were comprised in a patent (dated 20th February, 1860), which contained seventeen drawings relating to nine distinct inventions, covering apparatus for "duplex" signalling, improved "curb keys," testing appliances, printing telegraphs, etc.

About two years later, Bright took out a patent for increasing the rate of signalling through long submarine, or subterranean, wires, by a perfected compensating (curb) key, which effected the neutralisation of the excess (or residual) electricity, so permitting a rapid succession of signals.



BRIGHT'S DOUBLE-ROOFED SHACKLE

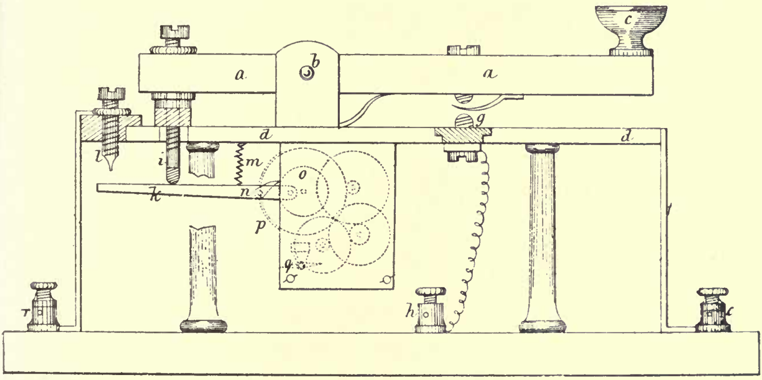
Sir Charles thus describes it in the Specification—No. 538 of 1862 :—

The third part of my invention has reference to the sending apparatus, whereby currents are communicated to the conducting wire.

In passing currents into long lines of submarine, or subterranean, telegraph wire, the speed of signalling in the usual manner is retarded, and the distinctness of the several signals one from the other is impaired by the effects of induction ; so that, for instance, a dot is liable to be merged into a dash at the distant end—unless the sending key is operated so slowly as to allow a sufficient pause between the signals for the line to become clear of the residual effects of the preceding signals before the following current is sent.

My present improvement consists of a key which is operated in the same manner as the lever keys generally used, but which regulates the force or duration, or the force of the currents sent into the line.

The figure here represents the key as adapted for regulating the ordinary single current alphabet of dots and dashes. *a a* is a lever key working upon an axle *b*, and operated by the pressure of the finger upon the ivory button *c*. The key and base, *d d*, upon which it is fixed, are connected with the terminal *e* by the metallic strap *f*, and the terminal *e* is connected to the line wire when the instrument is in use. The stud *g*, which stops the motion of the key, is connected to the terminal *h*, which is connected to one pole of the battery. The other pole of the battery is connected to earth so that a current flows into the line when the key is depressed. At the short end of the key is a screw *i*, the lower end of which presses against a small arm or lever *k*, and thus prevents it from coming in contact with the screw *l*, against which it would otherwise be pressed by the spring *m*. A click *n* attached to the arm *k* takes hold of the rough surface of a wheel *o* upon the axle of



BRIGHT'S CURB TRANSMITTING KEY

which is fixed a spur wheel *p*, which gears into a train of wheels terminating in the fan *q*. When the key is depressed, the click takes hold of the wheel *o*, and the speed at which the arm *k* rises is regulated by the adjustment of the fan *q*. The screw *l* is connected to the terminal *r*, which is connected to the other pole of the battery—or to some intermediate point in the battery; so that if the key is depressed for a longer time (say for sending a stroke) than the time at which the arm *k* arrives against *r*, the battery is placed upon short circuit, and no current flows along the line (or a part of the battery may be cut off) if the connection with *r* is made at an intermediate point. By this means a longer interval takes place after a long signal than after a short one, although the operator is manipulating the key with the usual pauses irrespective of the currents actually sent into the line; and when once the rate of motion of the arm has been properly adjusted to the requirements of the line operated upon, the signals will come out at the other end with equal spaces between them.

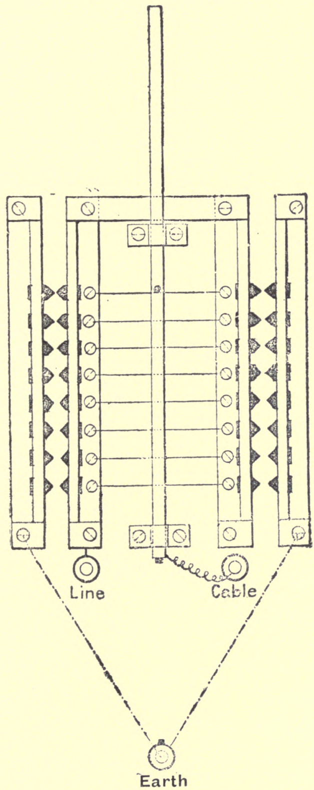
A second arm, controlled by a fan, to regulate the time of commencement of the currents after spaces of greater length than the spaces between the separate signals, may be used on circuits of very great length.

I have described a fan as the regulator for time, because the periods under control are so brief that such regulation is sufficiently precise, and it is easily understood by operators of common intelligence; but I do not confine myself to its use, as other regulators may obviously be applied to govern the speed of the arm *k*. This system of adapting the duration or force of the current to the requirements of the line may be readily applied to the keys now employed to send currents after the ordinary single current, dot and stroke, system; or to the method in use to some extent of sending two currents of opposite names for each signal recorded. But the positive and negative currents may be separately utilized after the manner invented by E. B. Bright and described in the specification of Letters Patent granted to him dated January 13th, 1858 (No. 54), and improved upon in the specification of my patent of February 20th, 1860 (No. 465), by placing upon the axle of the key a wheel formed of two plates of metal insulated from each other, and connected to the two poles of the battery. The direction of the current is here changed at each upward motion of the key by means of a ratchet wheel fixed to the commutator, and worked by a click upon the key.

I claim under this third head of my invention the method of adapting the duration or force of the electric currents to the requirements of the line.

In the above patent is also described an ingenious fluid relay, in which mercury (or other conducting fluid) is allowed to flow vertically in a fine stream between the orifices of two reservoirs. The magnetic needle, or arm of the relay, on passing into the conducting stream, completed the local, or secondary, circuit; and on leaving broke it. Thus, the conducting surface was continually changed; while no force was needed from the needle or relay arm to make contact by pressure, as in previous devices of a similar character. This, with other inventions already described, was shown at work in the International Exhibition of 1862.

In addition to the foregoing, there was included in this patent, his system of protecting cables against both rust and marine insects. It constituted a new method of applying a preservative coating by means of an elevator, to layers of yarn or tape, as an external protection to submarine cables, instead of passing the cable through the heated mixture. The object here was to avoid the danger of injury to the gutta-percha core. The mixture employed was pitch and tar, with finely ground flint, which was found to resist the teredo and other boring sea-worms. Further details of the invention are severally given in Chapters II. and III. of Vol. II. of the original biography. It at once came



BRIGHT'S LIGHTNING GUARD FOR SUBMARINE CABLES

into general use, and yielded a large return to Sir Charles and his partner, Mr. Latimer Clark.[1]

Shortly after taking out the above patent, Bright devised his

[1] The above was worked in connection with a previous patent belonging to the firm, on which it was a great improvement.

"ladder" lightning guard, for insertion between an aerial line and its signalling instrument or submarine cable with which it is working. The guard was mainly intended for out-of-the-way cable huts used for connecting land wires with cables, and only visited periodically for testing purposes. It is unnecessarily costly and elaborate for land-line work pure and simple. In this device (see illustration on page 459) a series of fine platinum wires are strung horizontally—one above the other—at small distances between two conducting plates, between which is a metal rod with a pin resting on the uppermost wire. This rod is connected to the cable or telegraph instrument, and the wires to the land-line apparatus. Should lightning enter the line, the thin wire is instantly fused by the charge before any current reaches the cable or telegraph instrument, thus only allowing it to pass to earth across the discharging points. The vertical rod then drops by gravity to the next cross wire (or "rung") of the miniature ladder ready for the next similar emergency; thus the communication between the line wire and the cable or telegraph apparatus is not interrupted, but always maintained through the wire and rods. This apparatus has been used extensively in the cable service since its introduction. It has always been found to protect the cable efficiently.[1] With previous lightning guards based upon the fusing of a thin wire, the communication was entirely interrupted until a fresh wire or another protector had been inserted—sometimes entailing a lengthy and difficult journey.[2]

In 1878, Bright embodied an important system of lighting by induction in a provisional specification,[3] stating that "at each point where the light is used, the light, or a group of lights, is actuated by the secondary coil, or coil, of an induction apparatus fixed there. The primary coil, of such induction apparatus is in circuit with a metallic main conductor, common to all, and connected with an electric battery or a magneto-electric machine, which generates the current at any convenient locality.

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[1] There may, of course, be any number of these wires. When the last is fused the rod drops on to the earth terminal. The aerial line is then insulated, whilst the cable is direct to earth: and this being observed, fresh wires are then inserted as soon as possible.

[2] For further particulars see *Journal of the Institution of Electrical Engineers*, vol. xix. p. 392.

[3] No. 2602 of 1878.

"The size and length of the primary and secondary coils of the induction apparatus are adapted to the number of lights employed at each point where the secondary currents actuate the electric light."[1]

In connection with this system of transforming the current, he also specified various forms of incandescent lamps.

In pursuing his experiments, Sir Charles was, however, led to the conclusion that it was not an economical mode of distributing electricity, owing to the unavoidable loss in conversion as compared with the direct, or continuous, current; and he did not, therefore, proceed to the final specification.

Some time afterwards the system was re-patented by Messrs. Gaulard and Gibbs, and an important installation established, having its initial centre of distribution at the Grosvenor Gallery. A little later an action was brought by those interested to restrain others from employing "transformers." The case, however, fell to the ground on the score of want of novelty, when Sir Charles' specification was cited.

The method is now very largely used, chiefly owing to the difficulty of finding suitable sites in the heart of London and other cities for manufacturing electricity on a large scale, except at a considerable distance from the lighting area.

By employing currents of great intensity, very small main conductors can be available, compared with those needed for direct currents of low voltage. To take an instance, the mains from a great distributing centre at Deptford are insulated to withstand the enormous tension of 10,000 volts! Entering the primary wires of induction coils in the City, it induces currents of greatly moderated intensity in the much larger wires of the secondary coils. These secondary currents are still further reduced, by a similar process of transformation, to the low and innocuous 50 or 100 volts, or whatever may be required for the lamps.

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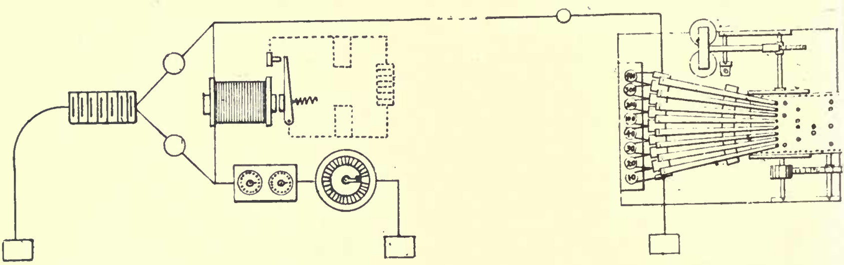
[1] In reference to this invention, the *Electrician*, of October 14th, 1892, remarks: "1878. Specification No. 4212. Sir Charles Bright here patented the lighting of vacuum tubes (lamps) by the secondary coils of an induction apparatus situated at each point where the light was required, the primary coils being coupled up to a main conductor common to them all. May not this, indeed, be freely interpreted as allowing a transformer to each house?"

In the same year (1878) Sir Charles brought out a novel printing telegraph,[1] in which the various letters are determined by a series of consecutively differing resistance coils—the resistances being inserted by means of a keyboard at the sending station. Here the type-wheel ceases to move at the receiving station—where a different relay is inserted—on the equivalent resistance being reached.

By an arrangement of the apparatus, the type-wheel is caused to move the letter to be printed to either direction, instead of rotating in one direction only, as in previous printing instruments. Thus is avoided the delay arising from passing over letters rarely wanted.

During that year, again, the two Bright fire alarm patents for street and house (automatic) duties saw the light of day. As



BRIGHT'S PRINTING TELEGRAPH

a chapter has been devoted to this matter no further allusion seems necessary.[2]

In 1879 Bright patented (Specification No. 792 of that year) a series of improvements directed to increasing the delicacy of the relays and other telegraphic receiving instruments.

This apparatus proved far more sensitive and decided in action than the lightest Morse relays of the time.

His principle was to control the moving part of the receiving apparatus, by which the signal is given or the contact is made (whether magnet, armature, or coil), by a second moving part worked by the same current. Here, the restraint is withdrawn

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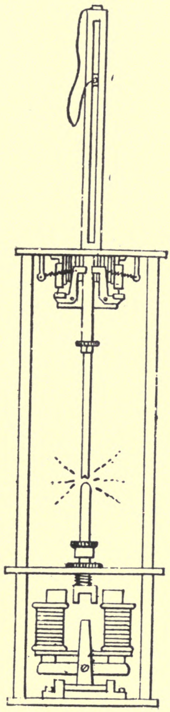
[1] See Patent Specification No. 4873 of 1878.

[2] See also the Society of Telegraph Engineers' paper on "Electric Fire Alarms," by E. B. Bright, M.Inst.C.E., Member of Council (*Jour. Soc. Tel. Eng.*, vol. xiii.).

from the first or signalling part while the current is passing, but renewed and brought back to zero when there is no current on the line.

Some further improvements to increase the sensitiveness and lightness of telegraph receiving apparatus were included in a patent, No. 2387 of 1880. Here, he turned to account levers made of aluminium for lightness.



BRIGHT'S ARC LAMP

He made a special application of this arrangement to acoustic instruments, or "sounders," by making use of the principle in the construction of ordinary needle instruments; and in the present day "Bright's single needle sounder"—in one form or another—may be seen in almost every country post office and railway station. On the same pivot with the needle is a pin, which, with each movement, beats against either one of two cylinders of different metal and pitch. Thus, the clerk can read by sound instead of by sight, with all its attendant advantages, and this course is nearly always adopted in receiving actual telegrams.

During the following two years, several patents followed for improvements in electric "arc" lamps, chiefly relating to the "feed" of the carbons so as to ensure a steady light—a great desideratum, but not attained to at that period.

In the latter year he also devised a novel storage battery or accumulator, with the view (as stated in the patent of June, 1882) "of lessening the weight and space required for a given surface of the elements employed, besides augmenting the effective action for receiving, storing, and utilising the charges of electricity, while also simplifying and economising the construction and preparation of the secondary batteries.

"In carrying out the first part of my improvements each division, or cell, of my secondary battery is separated by a porous diaphragm into two parts, which are filled—or nearly so—with a great number of small spherical granules, made of any suitable conductor.

"Electrical connection is made with the two masses of spherical granules in each side of the cell by means of electrodes communicating with them.

"I find the ordinary small lead shot, although containing a very little arsenic, to be very suitable as spherical granules; and in using them I employ electrodes made also of lead. Sulphuric acid diluted with water as the conducting fluid in the cells."

The remainder of the patent gives his method of chemically converting the surface of the granules—as well as other forms of secondary batteries—into protoxide of lead, by the employment of dioxide of lead, etc.

During 1883 Sir Charles was largely occupied in the production of a peculiar dynamo-electric machine, the principle of which is thus shortly described in his patent of May 4th of that year:[1]—

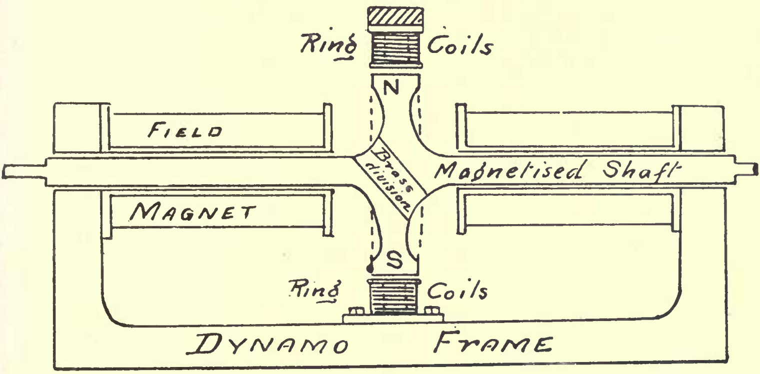
[1] Specification, No. 2280 of 1883.

" In the machines hitherto constructed the coils either of the armature or field magnets, or both, are made to rotate at a very high rate of speed.

" In my invention the coils both of the armature and field magnets are fixed."

It seems a puzzle, but he attained this object by the employment of moveable induced poles of a special and peculiar shape.

The field magnets (see illustration below) were wound upon fixed hollow cores, through which passed an iron or steel shaft, which was divided by a non-magnetic metal between the coils. The divided ends of the shaft—also made of iron or steel—were extended into the form of segments of a circle or radial arms but on opposite sides to one another, and so shaped that the



BRIGHT'S CONTINUOUS CURRENT DYNAMO MACHINE

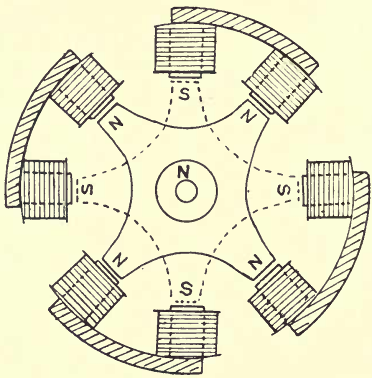
outer ends of the segments or radial arms revolved in the same plane.

In immediate proximity to the outer parts of the segments or radial arms, a circular series of insulated conducting coils were fixed, forming an armature—either of the ring type, or of a number of electro magnets.

The divided shaft with its two central segments would be polarised by the field magnets (or by permanent magnets for machines of small type, if preferred), N. on one side and S. on the other. Its rotation communicated successive waves of polarity (and hence dynamic currents) to the coils of the surrounding fixed armature as the segments passed round.

This patent of May, 1883, also included an improved commutator in which a circular metallic brush was employed to make the requisite electric contact between the rings or cylinders.

The above machine was, however, only applicable to the production of a continuous current; but in November of the same year he took out a further patent,[1] shown in the drawing below, extending the principle to alternating current dynamos. In this, as previously, the armature coils are fixed as well as the field magnets, the central shaft which rotates being divided in the centre, as before, by a piece of brass or other non-magnetic metal. The magnetic parts of the shaft expanded at each of their central ends into discs, from the outer edge of which spaces were cut, so as to constitute radial arms, which thus formed poles,



BRIGHT'S ALTERNATE-CURRENT DYNAMO

North on the one side of the now magnetic division, and South on the other. The N. and S. radial arms *alternated* with one another in position, as shown, and thus, when rotated before the armature coils (which were linked in pairs), produced alternating currents.

By this invention it will be seen that the arrangement of the apparatus is such that the employment of collectors or commutators is altogether dispensed with. Again, the repairs which arise from the damage of coils of wire moving at a high speed are avoided—as well as the inequalities of the current arising from imperfect contact—besides the wear between the collectors and commutators with the frequent adjustment entailed.

[1] Specification No. 5422 of 1883.

The *principle* involved in both these improvements may be thus tersely described : Instead of the currents being set up in the coils of the armature ring by revolving rapidly within or adjacent to the poles of the field magnets, the divided shaft itself forms the field magnet's poles, and induces the requisite currents in the armature coils, by its rotation before (or in juxtaposition to) them.

To sum up this digest, Sir Charles Bright took out some twenty patents, comprising about one hundred and thirty distinct inventions, which were either entire novelties or else practical improvements upon his own or other previous apparatus. A large proportion of these came into use.

From the first essay in 1852—for more than thirty years—his average came to something over one invention every three months.

The foregoing analysis tends to show over what a wide field Bright's reasonings and researches extended, and how versatile was his inventive genius.

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