GEORGE STEPHENSON

AND

M. FERDINAND DE LESSEPS.

THE MEN AND THEIR WORK:

THE FIRST PUBLIC RAILWAY

IN THE WORLD:

AND THE

SUEZ AND PANAMA CANALS.

BY

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PREFACE.

THE greater portion of this work was given in lectures in connection with the Salford Free Libraries, at Peel Park Museum; and it is now published to place within the reach of a larger audience, at a moderate cost; a brief account of two of the most remarkable men of the 19th century; and of the inception and carrying out to a successful issue of two of the most important engineering works of modern times.

Additional information as to the Suez and Panama Canals has been added, showing the present condition of these undertakings.

Salford, 1893.

GEORGE STEPHENSON.

The Locomotive & the First Public Railway.

In giving a brief sketch of the life of George Stephenson, who, by his skill and indefatigable perseverance, did so much to advance the social and commercial interests of this country, I also wish to call attention to an event in the history of our iron roads, which was, undoubtedly, the commencement of that system of railway communication which has now spread over the face of the globe, and has proved of such inestimable advantage to civilisation. I allude to the construction and opening of the Stockton and Darlington railway—the first public railway in the world.

The subject naturally divides itself into two heads. First, the man George Stephenson and his connection with the aforesaid railway; and, secondly, the account of the formation and successful completion of this early adventure, which has served as a type for all railways that have since been made. I need not occupy much of your time with a detailed sketch of the life of the great railway pioneer; so many books have been written about him and his connection with that great undertaking, the Manchester and Liverpool Railway, and other important railways in this country, bringing his life and labours prominently before the public, that there are few Englishmen, or at least *reading* Englishmen, but know something of the great engineer that sprang from the banks of the "Coaly Tyne."

George Stephenson was born on the 9th of June, 1781, at the colliery village of Wylam, on the north bank of the Tyne, about eight miles up the river from Newcastle. He was the second of a family of six children. His father, Robert Stephenson, or "Old

Bob," as the villagers called him, was a fireman at the pumping engine at Wylam colliery, and was a careful, hard-working man, with an industrious little wife, "a rale canny woman," as they say in that part of the country. Smiles states that an old Wylam collier described them as "an honest family, but sair hadden doon i' th' world." The earnings of old Robert did not amount to more than twelve shillings a week, and, as there were six children to maintain, the family were necessarily in very straitened circumstances; the father's wages, with the most rigid economy, being barely sufficient to find sustenance for the household. There was, therefore, little to spare for clothing, and nothing for education, so none of the children were sent to school.

We have heard for many years past, and especially in this Lancashire of ours, of men rising from the ranks to professional eminence and social distinction, but there are few cases where strength of character, perseverance, and downright hard work have brought a man out of such unfavourable circumstances into a world-wide celebrity.

At the age of eight George was employed by a widow occupying a neighbouring farm to look after her cows, which were allowed to graze on the sides of the waggon ways, and having plenty of spare time on his hands, it is said that he and a playmate named Thirlwall (afterwards a noted engineer) amused themselves by making models of engines, winding machines, waterwheels, &c., with pieces of wood from the joiner's shop and branches of hemlock, thus giving early indications of the bent of his mind. He was afterwards employed at other farm work, and his wages advanced to 4d. per day, but his great desire was to get employment at the colliery where his father and elder brother were working, and at last he succeeded in getting appointed to drive the gin horse at 8d. per day. His next promotion was to be assistant fireman to his father, and great was his joy at this step, for his ambition was now to become an engineman, a post of more importance than a fireman.

When he was 15, he, with another young man, undertook the firing of an engine at Newburn, twelve hours each shift, turn

and turn about, at a shilling a day. This pit was shortly closed, and another was opened by the Duke of Northumberland near Wylam, and to this pit Old Robert was sent as fireman, and his son George, though but 17, was appointed engineman. The engine was a new one made by Robert Hawthorn, the Duke's engineer, and George now thought he was a "made man for life."

He had now an opportunity for studying the construction and working of a steam engine, and his shrewd, practical mind gained an increase of mechanical knowledge. His engine was like a pet to him, and in his spare moments he would take it to pieces, clean and brighten all the parts, and put them together again, thus making himself thoroughly master of his work, and assisting in developing that mechanical instinct which afterwards led to the great improvements he made in the locomotive, and his other triumphs in mechanical engineering.

It is said that up to this time he had not learnt to read, and it was a great treat to George, and many of his fellow-workmen, who were in the same unfortunate position as regards education, to get some one who could read to them the accounts, from the stray newspapers they got at the village, of the wonderful achievements of Napoleon, then sweeping the Continent with his victorious armies.

It is not necessary to dwell much longer on this part of George Stephenson's career. He subsequently learnt to read at a night school set up in Newburn by an old Scotch Dominie; from him he also learnt to form his pothooks and hangers, and the questions in arithmetic put on his slate at night by the old Scotchman, George worked out in his spare moments during the day whilst attending his engine. It is said this is the only school-teaching he ever had. At this time provisions were very dear and wages very low; this was in the "good old times" we sometimes hear about, but don't wish to see again.

George had a desire to settle down in life, and when a young man has a desire of this kind he generally wants some one to help him to carry it out. He was very steady and careful, but still—like many in the present day—he could not see

his way, so he took to mending and making shoes in his spare time to improve his slender income, and it is said he became a *respectable cobbler*, and actually had the (to him) inestimable privilege of mending the shoes of Fanny Henderson, and by his skill in the gentle craft he gained Fanny's heart, and enough to set up a house with.

This was at Willington Quay, about six miles below Newcastle, where George was acting as brakesman at a fixed engine for drawing the waggons laden with ballast up a steep incline from the vessel's side. To this place he took his young bride, and here, in 1803, was born his only son, Robert Stephenson, who lived to become the first railway engineer of his day; and it was here, under such unpromising circumstances, that he met William Fairbairn, who was then working as a mechanic in the locality, and who often spent hours in George's humble cottage, and sometimes attended to his engine whilst *he* made a little extra money by casting ballast from ships' holds.

It would be interesting to know something more of the many confabs of these two men, who were thus preparing themselves for becoming leaders in the mechanical and engineering world, and who ultimately reached the highest position in these branches of science.

After a stay of about three years at Willington he removed to Killingworth, to the position of brakesman at Killingworth Colliery. Here he gained a reputation as a clever, shrewd workman, and the owners of this colliery were the first to recognise his practical mechanical skill and genius.

In 1806 he sustained a heavy loss in the death of his young wife, who had made his home so cheerful and bright. Probably as a relief to his deep sorrow, he made an engagement to go near Montrose to take charge of an engine there, and walked the whole distance, 150 miles, with his kit upon his back. He remained in Scotland about a year, saved a little money, and having had a disagreement with his employers returned to Killingworth. Here he found his father had, by an accident, been blinded by an escape of steam, and was living with his old wife in great distress and

poverty. Out of his savings he paid their debts, removed them to a cottage near Killingworth, and maintained them until their death. At this time his prospects in life were rather cloudy; England was contending single-handed against Napoleon, the Militia was called out, and George was drawn for one, and must either shoulder the musket or provide a substitute. He chose the latter, and the payment for this substitute swept away all his savings, and he was reduced to such a state of despondency as to entertain serious thoughts of emigrating to America, which he would have done but, fortunately for his country and himself, he could not at that time raise the necessary means, so he determined to struggle on amongst his old friends. An opportunity soon presented itself for the exercise of his skill as a thorough mechanical engineer. A new pit had been sunk at Killingworth, and an atmospheric engine was erected to pump the water from the shaft, but it was found unable to keep the water down. The best engineers in the locality tried their hands at the engine, but to no effect, and for nearly twelve months the engine kept pumping with little or no reduction in the water.

The workmen to and from the pit passed George's engine house, and his constant enquiry was, "Well, lads, have ye gotten to the bottom yet?" He had examined the engine frequently, and knew, or thought he knew, where the defects lay; and one Saturday afternoon he was having another examination, when he met with the master-sinker of the pit, who accosted him with, "Weel, George, what do you mak' o' her?" "Man," said George, in reply, "I could mak' her draw and send you to the bottom in a week."

This conversation was reported to the head viewer who, with his men, was at his wit's end to know what to do. He saw George, who told him he thought "he could put her to rights." "If that's the case," said Dodd, the viewer, "you shall have a fair trial, and if you succeed I will make a man of you for life."

He stipulated that he should be allowed to select his own men, and that they should work to his own orders only. He had the engine thoroughly overhauled, altered certain parts where the

dimensions were wrong, and in four days had her at work again; and after three days' pumping the workmen were, as George had prophesied, sent to the bottom to commence their sinking again. Mr. Dodd was so pleased with the alterations that he made Stephenson a present of ten pounds (and in after years he was proud to tell of this being, up to that time, the largest sum he had ever received at once), and his skill as a pump-curer spread over all the district. He was also appointed engineman at the pit with good wages. During all this time he had carefully kept in view his resolution to give his son Robert a better education than could be got at the village schools, and by dint of great thrift and economy and his extra earnings from mending clocks, watches, &c., he now saw the possibility of carrying out his favourite idea; and about the year 1814 he sent him to Bruce's Academy, Newcastle-on-Tyne, one of the best schools in the North of England.

On the completion of the sinking of the High Pit he was, on the recommendation of Mr. Dodd, appointed colliery engineer to the "Grand Allies," as they were called, a company of noblemen and gentlemen who were lessees of several collieries in the locality, and his salary advanced to £100 per annum. He could now devote his leisure time to the study of the higher branches of mechanics; to drawing, chemistry, and other congenial pursuits, and to preparing himself for further advancement. The practical study which he had given to the steam engine, and the patient manner in which he had groped his way through the details, gave him the power of a master in dealing with it as applied to colliery purposes. He was now entrusted with the designing and making of new winding and pumping engines for the collieries, and improving the wagon ways, and he was so successful in carrying out his improvements that his reputation as a skilful engineer began to spread in the locality. It was about this time that his attention was called to the serious explosions of fire-damp, then becoming very common in the northern coal-field, and frequently attended with fearful loss of life. He was strongly impressed with the thought that something could be done

to avert these dreadful accidents. Dr. Clanny, of Sunderland, had a few years before contrived a lamp, but it was found too large to be practically useful in mines, and Sir Humphrey Davy had been requested by a committee of colliery owners and scientific gentlemen to investigate the cause of these explosions, and read his paper on "The Fire-damp in Coal Mines" before the Royal Society in 1815. It is quite clear that Stephenson had been experimenting, and making and testing safety lamps, before he heard of Sir H. Davy's discovery, and it is now believed that the two inventions of the "Geordie" or Stephenson's lamp, and the "Davy" or Sir H. Davy's lamp (both of which were constructed on the same principle), were made by each inventor working out his own ideas in entire ignorance of what the other was doing. In fact, as stated by Mr. Robert Stephenson many years afterwards, when much angry discussion had taken place on this point, "George Stephenson would have invented his safety-lamp had Sir H. Davy never lived, and Sir H. Davy would have invented his if George Stephenson had never lived."

THE LOCOMOTIVE.

We now come to Stephenson's connection with the locomotive, and it may not be out of place if I, as briefly as possible, give a short sketch of what had been done in regard to propulsion by steam on roads or railways up to that period. I need not dwell on the details of the various engines I shall name, but merely give the date when they were made and the distinctive features of each. The first carriage propelled by steam on common roads was invented by Cugnot, a Frenchman, in 1770. It was a very primitive affair, and was actually tried before the French Monarch at Paris, but was so unmanageable that it was considered dangerous, and in fact, was but an ingenious toy, and never came into practical use; it is now preserved in the *Conservatoire des Arts et Métiers* at Paris.

Several other inventors of road engines in subsequent years were occupied in reducing their ideas to practice, and published their views and made working models, but without practical results.

Richard Trevethick, of Cornwall, in 1802 patented an engine for "driving carriages and other purposes;" this engine possesses great claims to originality, in fact, Trevethick was truly an inventor, and the first mechanical genius of his time. In the working of the engine by the pressure of steam on both sides of the piston, and the connection of the piston rod to the axle of the wheels, his engine possessed the broad essential features of the locomotive of the present day. His engine was exhibited in London, where it drew behind it wheel carriages full of passengers, but the second day, although crowds had gathered to witness its performance, the eccentric genius shut up the place and had the engine secretly taken away. He afterwards made another engine, which was used for drawing waggons laden with iron, at Merthyr Tydvil, but at this time he was tempted to South America to go into some mining speculations, and giving up his scheme for improving the locomotive he went abroad, taking with him several pumping engines he had constructed for clearing the mines of water. But the next thing heard of poor Trevethick is that he is at Darien, making his way back to this country, with neither shirt in his portmanteau nor sixpence in his purse. He was begging his way back to England to organise a grand gold mining company, which was to make the fortunes of thousands. With all his splendid genius, he died poor and in the same obscurity in which he had been born. It was his to go through the labour, but the destiny of less gifted men to reap the reward.

In 1812 Mr. Blenkinsop, of Leeds, took out a patent for a locomotive, the most important feature of which was that it had two cylinders (Trevethick's engine had but one), and was provided with toothed wheels to work into a rack which was laid alongside the rail, it being thought that there would not be sufficient adhesion between the engine wheels and the rail to enable the locomotive to draw carriages. Several of these engines were working for years in the Yorkshire district.

To overcome this supposed difficulty Mr. Chapman, of Newcastle, in 1812 patented a system of traction, by means of a chain stretched from end to end of the railway, and passed round a

barrel under the engine, and as the barrel turned it dragged the engine along the railway. This system, being expensive and difficult to keep in repair, was soon abandoned.

A Mr. Brunton, of Butterley, in Derbyshire, patented in 1813 a still more curious expedient for propelling the engine, for he actually proposed to have two legs behind the engine, like the hind legs of a horse, by working which alternately the engine was to be forced along. This engine never got beyond the experimental stage.

These various engines were chiefly tried in colliery districts; for the conveyance of coal from collieries to shipping places and large towns was a serious item, many of the collieries having to keep 300 or 400 horses for this purpose. Mr. Blackett, of the Wylam Colliery, near Newcastle-on-Tyne, had a tramway to Leamington, where the coal was shipped. Being a man of advanced ideas, and wishful to reduce the expense of hauling the coal to the Tyne, he determined to have a locomotive constructed. He knew what had been done by Trevethick, Blenkinsop, and others, and, in conjunction with his viewer, Mr. Hedley, a very ingenious, energetic, and able man, he set to work to make an improved engine. For this purpose Hedley's first business was to prove, by actual experiment, that the friction of the wheels of an engine upon the rails was sufficient to enable it to draw a train of loaded wagons. To determine this he constructed a carriage with four wheels, loaded it with iron, and attached handles to the axles; four men stood on stages suspended at each side of the wagon and worked the handles; he hooked on coal wagons to this experimental wagon, and thus practically demonstrated the truth of his theory, and showed by this simple experiment that erroneous ideas in the minds of engineers on this point had led them into the adoption in the locomotive of unnecessary and expensive appliances.

He then set to work to make a locomotive, which was finished in the early part of 1813, but, through imperfect workmanship and the difficulty of getting workmen and tools adapted for this class of work, and from insufficient boiler

power, the engine was not a success; the boiler was of cast-iron, and the furnace flue went direct through the boiler to the chimney. To remedy these defects, and with the true spirit of a north Briton determined not to be beaten, he had another engine constructed, the flue of which was made to return inside the boiler back to the firing end, where the chimney was placed. It also had two cylinders. This engine was patented in March, 1813, and was put to work in May of the same year, and, as stated by Mr. M. Dunn, late Government Inspector of Mines, in his work on the northern coal trade, published in 1844, "This engine succeeded so well that it drew eight loaded wagons at the rate of four and five miles per hour, and completely superseded the use of horses, which at that time was a ruinous expense to the colliery, and notwithstanding that the railway was upon the tramroad system. In justice, therefore, to Mr. Hedley, he is entitled to the honour of being the inventor of locomotion on the present principle."

This engine continued working for many years, and in 1862 it was removed to the South Kensington Museum, London, where it may now be seen; and we must admit the fact, that the five miles of rough wagon way from Wylam to Leamington bore the first of those wonderful iron horses that now, in nearly every part of the world, are the willing servants of commerce and civilisation.

Stephenson, like Hedley, saw the advantages of the steam horse, as it was called. He had seen Blenkinsop's and Hedley's engines at work. He thought he could improve upon them, and commenced to make one for the Killingworth Collieries, and after ten months' anxious work, with many alterations in the working parts, it was, in March, 1814, got to work, and drew about 30 tons weight at the rate of four miles an hour, but the expense of working the traffic by this engine was, at the end of a year, found to be nearly as great as when worked by horses. There was great difficulty in keeping up steam. Hedley's engine, with the return flue in the boiler, generated more steam and was more economical, and but for the perseverance and ingenuity of Stephenson his locomotive might have been condemned as useless. But the idea

occurred to him that by turning the exhaust steam into the chimney he could increase the draught, get greater heat in the furnace, and generate more steam. The result of this improvement was, that the power of the engine was at once doubled. He then commenced making another engine, combining further improvements, and from this time for some years one improvement followed upon another until, with others, he commenced the celebrated Stephenson's Engine Works at Newcastle-upon-Tyne, where the locomotive was brought to even greater perfection than he had dreamt of.

After much investigation and careful study of the history of the locomotive, I think it may fairly be stated that to Trevethick must be given the honour of inventing the principal movements in the locomotive, to Hedley hardly less honour for being the first to bring these ideas into practical operation, and to Stephenson the credit of applying his mechanical genius and wonderful perseverance to the improvement of the working details, and the addition of such improvements as have made the locomotive in its most important features what we see it to-day.

But something more than improvement in the locomotive was needed to ensure the progress of the new system of conveying goods. The railways, chiefly composed of cast-iron tram plates, were uneven, rough, and constantly out of repair. Stephenson adopted a new kind of rail and chairs, and made other improvements in the wagon ways, as they were called, so as to fit them for his improved locomotive. This led the way to other firms in the colliery districts adopting the same means for conveying their coal to the shipping places—amongst others, the Hetton Coal Company, who engaged Stephenson to reconstruct their tramway, about eight miles in length, from their collieries to the river Wear. This work he carried out in a most satisfactory manner, and now his name and fame began to spread beyond the boundaries of his own immediate locality, and an opportunity soon presented itself for giving fitting employment to his talents in developing the railway system—that most important factor in promoting civilisation and overcoming the natural barriers that separate man from man.

Glimmerings of the possibilities that might be obtained from the employment of steam power in connection with railways were beginning to beam on the minds of earnest and energetic men in different parts of the country; far-seeing men were already advocating, through magazines and the press, what some considered wild and visionary views on this subject; others approached the question in a more practical and determined manner, and amongst the latter may be classed the promoters of the Stockton and Darlington Railway, and foremost amongst them Mr. Edward Pease, of Darlington, who has justly been called the "Father of the Railway System."

Stephenson has erroneously been designated the inventor of the locomotive, and the originator of railways. From the brief sketch which I have given of the history of the locomotive, it will be seen that others have laboured and done good and successful work in developing the idea of steam locomotion, and the same may be said with greater force in regard to railways. In fact, railways have gone through a process of *evolution*. The first man that levelled the ground and placed a line of stones in the road to prevent the wheels of a carriage of any kind from sinking in the earth was the originator of railways, for in time timber rails superseded the stones, then the timber was covered with iron plates; afterwards cast-iron flat rails or tram rails were used, and these ultimately developed into the rails and chairs we now see in all our well-constructed railways.

Edward Pease was a woollen manufacturer at Darlington, and also largely interested in collieries in South Durham. He belonged to an old Quaker family long settled in the place, and was noted for his diligence in business, and, beyond the custom of most men, he had learnt that "in all labour there is profit," and that "the end of man is an action, not a thought." At the time we are now speaking of he was over 50 years of age and took a leading part in all public matters relating to the town and locality. A very prominent topic for many years had been the construction of a canal from the South Durham coalfield to Stockton-on-Tees, a port on a navigable river where coal could

be shipped to London and other places. In 1768 the ground had been surveyed for a canal, but nothing further was done in the matter, and again in 1812 Rennie, the engineer, was engaged to survey and report as to the advisability of adopting a canal or a railway; but, from one cause or another, the project was allowed to sleep for some years. In 1818 the question was again raised, and a public meeting was called by the Mayor of Stockton chiefly in support of the canal scheme. From this it will be seen that in those days, as now, the question of canal *versus* railway was rather a difficult problem to solve; but the railway advocates carried the day, chiefly through the energetic efforts of Mr. Pease, of whom it was said he could see a hundred years ahead, and who succeeded in enlisting the sympathies and co-operation of the Backhouses and Richardsons, wealthy members of the Society of Friends, and of other gentlemen in the district; and in November, 1818, a public meeting was held in Darlington to consider Mr. Rennie's report as to a canal, and the report of a Mr. Overton, who had been engaged many years in putting down tramways in South Wales, and who had recently surveyed the ground between Stockton and Darlington to ascertain the practicability of making a railway through the district. At this meeting Mr. Pease and Mr. Backhouse made telling speeches in favour of the railway, and before the meeting separated the first railway prospectus ever issued was concocted, and it was decided to apply to Parliament for an Act to empower the projectors to carry out the scheme.

The public advantages to be derived from this railway were of an important character; the cost of conveying coal and other goods by the means then used was excessive. Coal, when sent by carts, cost from 8d. to 9d. per ton per mile, so that the price of coal carried, say 10 miles from the pit, was increased 7s. 6d. per ton for carriage; but much of the coal was carried about the country in bags, slung across the backs of donkeys, ponies, and horses. These were taken in droves from town to town and the coal retailed out to purchasers along the route. This means of conveyance was more expensive still, amounting to about 2s. 6d. per ton per mile, for the roads were in

a very different state then from what they are now. These coal drovers were not a very exemplary lot, in fact, they were a cross between a gipsey and a Spanish muleteer. It is said the cost of provender was not a serious item in their expenses, as the farmers' haystacks, pastures, and turnip fields were found convenient; and one great argument used by the Committee for the Railway, in appealing to landowners for their support, was that the nocturnal visits of these free and easy conveyancers would be done away with. In Parliament the Act met with great opposition, chiefly from the Duke of Cleveland, who wrote to the Committee that "he considered the measure to be harsh, oppressive, and injurious to the interests of the country through which it is intended the railway shall pass." The fact was some of His Grace's fox-covers might have suffered, and in those days private fox-covers were of far greater importance in the eyes of the nobility than public railways, and when the Bill came before Parliament it was rejected by a majority of 13. Nothing daunted by this defeat, the promoters, in the following year, had the line re-surveyed, made improvements in the route, published a manifesto showing the advantages of the railway to the manufacturing and mining interests, and announced their intention to apply for another Act in 1820. Its passage was, however, delayed by the death of George III., 1820. They determined to make a great fight for the Bill. Influence was brought to bear upon Members of Parliament, the nobility were propitiated as far as possible, by giving their fox-covers a wide berth, and public opinion was appealed to at meetings and through the press, but after all, like many other great projects, it was nearly wrecked on financial rocks. Parliament demanded that two-thirds of the capital should be deposited. The committee were £10,000 short of the required amount. The solicitor, Mr. Mewburn, got introduced in London to members of the Stock Exchange and wealthy merchants to raise the needful, but could not succeed. He wrote from London to Mr. Pease that, unless this amount was raised in three or four days, he must come home again. The subscribers in Darlington did not dare, or did not care, to risk more in the

undertaking, when Mr. Pease came forward and subscribed the other £10,000 in addition to what he had already invested. On the second application to Parliament the Bill was successful, and in April, 1821, it received the Royal Assent. This Act provided for making a railway from the river Tees at Stockton to Witton Park Colliery, near Darlington, with several branches therefrom, all in the county of Durham. In the preamble it stated that the line would "be of great public utility by facilitating the conveyance of coal, iron, lime, corn, and other commodities from the interior of the county of Durham to the town of Darlington, and the town and port of Stockton." No powers were taken in this Act to use locomotives or stationary engines, but it was named with convenient vagueness that the company "shall appoint their roads and ways convenient for the hauling and dragging of waggons and other carriages passing along the said railways, with men or horses or otherwise." In a subsequent Act, passed in 1823, the company acquired power to use locomotives or movable engines for the conveyance of goods, merchandise, and passengers upon and along their railways. These were the first Acts of Parliament for railways in England, and have no doubt served as a basis for all subsequent Acts relating to similar projects.

Having obtained their Act the company at once proceeded to carry it out, and here again Mr. Pease was the head and front of the movement. He had heard of George Stephenson and his improvements in railways, in fact, at that time Stephenson was busy reconstructing the Hetton tramway, and an appointment was made for a meeting between those two remarkable men. History records many meetings of celebrated characters and the results, social and political, which followed from such meetings, but very few have had such important influence on the manufacturing and commercial industry of this country as this meeting between George Stephenson and Edward Pease to arrange for engineering the first public railway. The meeting took place at Darlington, but not exactly in the rather sensational style named in Smiles's life of Stephenson, although it is a fact that Stephenson, with his friend Mr. Nicholas Wood, did walk part of the way from

Killingworth to Darlington and back, to meet Mr. Pease, who was struck with the honest, sensible look of his visitor, and admired his plain, unvarnished, practical talk about railways, the locomotive, and the great results already attained by its use. He surprised the cautious Quaker when he told him one locomotive was worth fifty horses for hauling purposes, for up to this time Mr. Pease and his friends contemplated using horse power only. At this interview it was arranged that Stephenson should be recommended to the directors as the engineer for the new railway, and the following very characteristic letter from Mr. Pease to Stephenson shows the clear-headed, business-like character of the man.

Darlington, 7th mo. 28th, 1821.

Esteemed friend, George Stephenson,—Annexed are some resolutions passed at our last general meeting. We beg thee to take them into consideration, and so soon as thou canst name thy charge for effecting all they contain which attaches to thee as engineer, drop me a line. The resolutions are so definite and comprehensive, it does not seem needful to add more, than to request that as soon as the crops are off the ground, no time may be lost, provided nothing can be done in the meantime. In making thy survey, it must be borne in mind that this is for a great public way, and to remain as long as any coal in the district remains. Its construction must be solid, and as little machinery introduced as possible—in fact, we wish thee to proceed in all thy levels, estimates, and calculations, with that care and economy which would influence thee if the work was thy own; and it would be well to let comparative estimates be formed, as to the expense of a double and single railway, and whether it be needful to have it only double in some parts, and what parts; also comparative estimates as to the expense of malleable or cast iron rails. We shall be glad to hear from thee soon, and I am, on behalf of the Committee, thy assured friend,

(Signed) Edward Pease.

To this letter Stephenson replied as follows:—

Edward Pease, Esq.,

Sir,—After carefully examining your favour I find it impossible to form an accurate idea of what such a survey would cost, as not only the old line must be gone over, but all the other deviating parts, which will be equal to a double survey, and, indeed, it must be done in a very different manner from your former one, so as to enable me to make a correct measurement of all the cuts and batteries on the whole line. It would, I think, occupy me at least five weeks. My charge shall include all necessary assistance for the accomplishment of the survey, estimates of the expense of cuts and batteries on the different projected lines, together with all

remarks, reports, &c., of the same; also the comparative cost of malleable iron and cast-iron rails, winning and preparing the blocks of stone, and all materials wanted to complete the line. I could not do this for less than £140, allowing me to be moderately paid. I assure you, in completing the undertaking, I will act with that economy which would influence me if the whole of the work was my own.

George Stephenson.

Killingworth Colliery, August 2nd, 1821.

I suppose an engagement between a railway company and its engineer in the present day would cost about as much in agreement stamps, solicitors' charges, and parchment, as Stephenson got for himself, his assistants, and the whole of the survey and estimates for this railway.

In the autumn of 1821 he commenced the survey, and had for one of his assistants his son Robert, who here first tried his "'prentice" hand at railway making. With the imperfect engineering knowledge of the time, and the difficult nature of the ground, this part of the work was no easy task, and was not completed until early in 1822, and the first rail was laid on the 23rd of May in the same year.

Stephenson recommended malleable iron rails, 28lb. per yard, of the fish-bellied pattern, and the committee decided that two-thirds should be laid with these rails and one-third with cast-iron rails. The weight of the two rails and chairs as first laid in this line was 68lb. per yard, and this was a great advance on previous railway work. To show the remarkable advance in point of strength and durability since that time, I may state that on some of our principal railway lines the weight of a yard of railway with chairs is more than fourfold the weight of the rails and chairs first used in the Stockton and Darlington Railway. Stephenson kept persistently in view the ultimate employment of locomotives on the line, and in season and out of season pressed his opinion on the directors, who had many discussions on the relative merits of locomotives and horse power; but a visit made by Mr. Pease and his committee to Killingworth, to see the locomotive at work there, settled the question, and in September, 1824, two locomotives were ordered at Messrs. Robert

Stephenson and Co.'s engine factory at Newcastle-on-Tyne, for the sum of £500 each. The first of these engines, "The Locomotion," or "No. 1," after working for many years on this railway, was at last elevated to a prominent position on a pedestal in front of the railway station at Darlington, where it may still be seen. These engines weighed about five tons each, and the contrast between them and modern locomotives, many of which weigh 40 tons, is even greater than in the case of the permanent way.

Notwithstanding the many oppositions the committee had met with, and the serious difficulties they had to contend with from the exhausted condition of their finances, and from other causes, these brave men worked on with unabated confidence in the future success of their enterprise, and at length they were enabled to report to the shareholders that the principal portion of the line, about 27 miles. was completed; and they proposed that the railway should be opened, with befitting ceremony, on the 27th of September, 1825.

This event was looked forward to with great interest by the populations of the principal towns in the district. Many had said that the Peases and their colleagues were more fit for Bedlam than for anything else; even the great Lord Eldon said, "As to railways, &c., which speculation running wild is introducing, I think Englishmen, who were wont to be sober, are grown mad." Another enlightened genius said "he would undertake to eat all the coals Stephenson's iron horse could draw after it."

It is amusing now to read some of the objections raised against this and similar projects, and it ought to make people careful how they prophesy. Even the learned *Quarterly Review*, in March, 1825, whilst supporting the Manchester and Liverpool scheme, said, "We are not the advocates for visionary projects that interfere with useful establishments; we scout the idea of a general railway as altogether impracticable. The gross exaggerations of the power of the locomotive may delude for a time, but must end in the mortification of those concerned." They also held that it was palpably absurd and ridiculous to talk of locomotives travelling twice as fast as stage coaches; and finished up with

trusting that Parliament would, in all railways it sanctioned, limit the speed to eight or nine miles an hour.

Under such circumstances, and in face of such comments, the directors issued the following modest programme for the opening ceremony:—

THE STOCKTON AND DARLINGTON RAILWAY COMPANY

HEREBY GIVE NOTICE,

THAT the formal opening of their railway will take place on the 27th instant, as announced in the public papers.—The proprietors will assemble at the Permanent Steam Engine, situated below Brusselton Tower, about nine miles west of Darlington, at eight o'clock, and, after examining their extensive inclined planes there, will start from the foot of the Brusselton descending plane, at nine o'clock, in the following order:—

1st. The Company's Locomotive Engine.
2nd. The Engine's Tender, with water and coals.
3rd. Six Wagons laden with coals, merchandise, &c.
4th. The Committee, and other Proprietors, in the coach belonging to the Company.
5th. Six Wagons, with seats reserved for strangers.
6th. Fourteen Wagons, for the conveyance of workmen and others.

☞ The whole of the above to proceed to Stockton. The Company take this opportunity of enjoining on all their workpeople that attention to sobriety and decorum which they have hitherto had the pleasure of observing.

As a precaution against possible accident, and, perhaps, also to give a more imposing effect to the procession, the company engaged men to ride on horseback in front of the engine. These heralds held flags in their hands, and gave notice to all whom it concerned that the locomotive was approaching.

Everything went off successfully and without the slightest accident at the opening. The train started off at the appointed time, and with a weight of about eighty tons in goods and passengers (the latter numbering about 600) the engine worked steadily along at the rate of ten to twelve miles an hour. Great excitement prevailed amongst the spectators as the engine came in sight, and many of the older ones were much disappointed, as, having heard so much of the "Iron Horse," they fully expected to see some sort of a machine stalking along on four legs, with at least some resemblance to their old acquaintance. On the arrival of

the train at Stockton, the whole population turned out to meet the strange visitors, and, as a matter of course, the event was celebrated in true English style by a banquet in the Town Hall at Stockton. It is not unworthy of remembrance that the chairman of the Liverpool and Manchester Railway Company (then newly projected), and the first chairman of another of the earliest railways—the Liverpool and Birmingham line — were among those present. The chairman of the meeting, in concluding his record of the day's proceedings, remarked that "the prospects of the company are now most flattering. Whilst they have the satisfaction of seeing the price of coal reduced one-third to the public, they have the strongest grounds to expect a much larger tonnage to pass on their road than was originally anticipated. An export trade is now certain; for an order has been already given for 100,000 tons of coal annually for five years, by one house in London, the produce of which alone to the company will more than pay 4 per cent on their whole expenditure. The shares are now valued at £40 premium each. Plenty of purchasers, but no sellers."

Thus happily began the greatest innovation of the nineteenth century. It has often been asserted by those uninformed in these matters that the Manchester and Liverpool was the first public railway opened. This is a mistake; the Act of Parliament for this line was not passed until 1826, and, while the Bill was still under consideration, the Secretary, Mr. Henry Booth, wrote as follows to Mr. Pease:—

Royal Hotel, St. James Street, London,
March 10th, 1825.

EDWARD PEASE, Esq.

Dear Sir,—I take the liberty to address you on behalf of the Liverpool and Manchester Railway. Our bill is now before Parliament, and we are of course anxious to strengthen our case on every side as much as possible. We understand our opponents mean to represent the Darlington Railroad as a complete failure. This differs very much from our idea of the fact. May we trouble you to transmit to us some correct information on the subject; that is, whether the rail is found strong enough to carry the weight which is now moved or intended to be moved upon it, whether the breakages are frequent, and whether the rail bends when it does not break. The strength of the rail, I believe, is 28lbs. per yard. In short, does it answer, and is it likely to continue to answer the purpose for which it has been constructed? I was at Darlington last spring with Mr. Ellis and Mr. Saunders, and we certainly carried back with us a very favourable impression of the principle on which the rail is constructed. Mr. Stephenson also (who is here) has just shown me a letter from Mr. Mewburn, speaking of your road in very favourable terms.

May I beg the favour of an *early* reply?—I am, dear sir, yours most obediently,

HENRY BOOTH.

The passengers between Stockton and Darlington were not numerous, and the directors did not for some years work the passenger trains by locomotives, but in October, 1825, one month after the opening, they commenced to run a coach with horses, and the company issued the following simple handbill, which may be taken as the first railway time-table ever issued:—

THE COMPANY'S COACH,
CALLED THE
EXPERIMENT,

which commenced travelling on Monday, the 10th of October, 1825, will continue to run from Darlington to Stockton, and from Stockton to Darlington, every day [Sundays excepted], setting off from the depot at each place at the times specified as under.

Afterwards several coach proprietors ran coaches on the line on their own account, under arrangement with the company, but locomotive passenger trains were not regularly established until 1834. The colliery proprietors of South Durham provided their own trucks and horses. The principal traffic for some years was the conveyance of coal to Stockton-on-Tees, for shipment, and the colliery district being at a much greater height above the sea level than Stockton, there were several inclines between the two places. On the level track a horse would draw four or five trucks. Each train had, after the last wagon, a low truck, the bottom of which was about 12 inches above the ground. When the train reached an incline the horse was unhooked, the wagons proceeded down the incline at an increased rate of speed, the horse trotted after the wagons, and, by a display of agility acquired by practice, and worthy of a circus horse, jumped into the low wagon provided for this odd railway passenger, who thus secured a ride, a rest, and a feed to refresh him for further labours. The writer, when a boy, has, with his companions, enjoyed many a ride in the "dandy wagon," as it was called, with its equine occupant.

When we think of our Flying Dutchman going at the rate of sixty miles an hour, and of a continuous journey from New York to San Francisco, or a trip from the Atlantic to the Pacific by the Canadian Pacific Railway in five or six days in a railway train, with all the luxuries of a Pullman sleeping car, &c., and consider that men now living have seen these grand results from the small beginning here recorded, we may safely say that in no period in the world's history have such important changes, having such a direct influence on the welfare of the nations, taken place in so short a period of time.

The Stockton and Darlington Railway has had a most successful career, the wonderful development of the Cleveland iron trade rendering it one of the best paying lines in the country. For many years its average dividends were nine per cent., and when at length it was absorbed in the powerful North-Eastern System it formed one of the brightest feathers in the cap of that great company.

George Stephenson's career after this time was one of unvaried success in his profession. He acted as engineer to some of the most important railways in this country, and at last retired to his estate at Tapton, in Derbyshire, where for some years he enjoyed a fitting reward for his labours in peace and quietude in his beautiful retreat, and died there in August, 1848, in the 67th year of his age, honoured and respected by all who knew him, and honoured in this and other countries, as the one man who had done more than any other to improve and forward that system which has tended to multiply and spread abroad the conveniences of life, opened up new fields of industry, brought nations nearer to each other, and promoted the great ends of civilisation. And now we may say with the poet—

"Lay down your rails, ye nations, near and far,
Yoke your full trains to steam's triumphal car;
Link town to town, unite in iron bands
The long estranged and oft embattled lands,
And break the barriers that, since earth began,
Have made mankind the enemy of man."

M. FERDINAND DE LESSEPS.

BEFORE giving a description of the great undertakings with which the name of de Lesseps will for ever be connected, a brief sketch of his career may be found interesting. By his countrymen, he was at one time undoubtedly looked upon as one of the heroes of the 19th century, not by any means as a military hero, for, as a witty writer observed, he is one of the few Frenchmen who have started on an enterprise without promising to come back "dead or victorious"; and, although all his great expectations have not been realised, and engineering and financial difficulties have, in the case of the Panama Canal, thrown a cloud over his latter days, it must be admitted that, to his courage, resource, and determination, in face of enormous difficulties, we are indebted for the successful carrying out of one of the most important engineering works ever designed for promoting intercourse between the different nations of the world.

M. de Lesseps was born at Versailles, in 1805, so that he is now 87 years old; he received a good education, and was trained for the diplomatic service, in which service his father had gained some distinction, having represented France in Egypt after the Peace of Amiens. At the age of 23, young Lesseps was appointed attaché to the French consulate at Lisbon, and afterwards appointed Consul at Barcelona, and during the siege of that place he, by his energy and discretion, rendered valuable service to the French residents. In 1849 he was sent on an important political mission to Italy, and afterwards, through a change in the Government at Paris, he was asked to follow another line of conduct from that he had been sent to carry out; he could not conscientiously lend himself to what he considered dishonourable behaviour towards the Italian Government, and he was therefore recalled; he then, after 21 years of diplomatic service, gave up political

life, retired to a farm at Berry, and began his life over again. For five years he studied the various aspects of trade between the West and the East; he had been in Egypt, and like many before him thought that the narrow strip of the Isthmus of Suez should not for ever remain an insurmountable barrier between the Mediterranean and the Red Seas; and here it may be named that the idea of a canal between the two seas had long been entertained. When Napoleon the First attempted the conquest of Egypt, he meant it to be a stepping-stone to India, and a canal was to follow the conquest. Some French savant in 1799 took levels across the Isthmus, and came to the conclusion that the Mediterranean was 30 feet lower than the Red Sea, and that if a small canal was cut between the two, the flow of water from one sea to the other would by degrees enlarge it sufficiently for vessels to pass through; this crude idea was never carried out, for many scientific men did not believe that such a difference in the level of the two seas existed.

At length, in 1847, this problem was set at rest; a joint commission of engineers and scientists was appointed by France, England, and Austria, and the result of their labours was the complete upsetting of the theory of the French savant, and the establishment of the fact that the two seas have exactly the same level. Mr. R. Stephenson, the English Commissioner, came to the conclusion that it was not practicable to make a ship canal across the Isthmus; or that, if made, it could not be kept open without enormous expense; and, with a kind of left-handed compliment to M. de Lesseps, said the public might rely on his perseverance, as he would never abandon the work until every shilling of the shareholders' money was expended. Facts have in this, as in many other things, shown how theory may, to serve a purpose, be paraded and used to the detriment of practical work.

Mr. Stephenson therefore recommended a railway viâ Alexandria, Cairo, and Suez. This was opened in 1858, but a more direct line was opened in 1868. The French engineers did not, however, give up the idea of a canal; and M. Talabot, the French

Commissioner, on his return to Europe, published, in the *Revue des Deux Mondes*, the details of a scheme for a ship canal; but nothing was done in the matter. In the meantime, M. de Lesseps had been studying the question, and on the accession of Said Pacha as Viceroy of Egypt in 1854, he determined to proceed to Alexandria; and, relying on a personal friendship with the Pacha, endeavour to get his consent to the carrying out of his scheme for an International Company for making the Canal. The concession was granted in November, 1854. The Viceroy appointed three French engineers in his service to assist De Lesseps in the survey of the route across the desert for a canal without locks direct from sea to sea. This was a long and dangerous business, for four persons 60 camels were required, 25 of them loaded with water and victuals, sheep, fowls, &c.; for the engineers and fellahs had to be provided for a two months' exploration of the sandy barren desert. After this preliminary survey, which completely convinced De Lesseps and his colleagues of the feasibility of the project, long and tedious negotiations with the ambassadors of continental nations followed. Explanatory letters to the *Times*, to Mr. Cobden and other eminent Englishmen, to meet the attacks of the opponents of the scheme, had to be written. At length an International Commission was formed to examine and report on the practicability of carrying out the project. The Commissioners were—For Italy, M. Paléocapa, engineer, Minister of Public Works, Turin; for Germany, the Privy Councillor Lentzé, chief engineer of hydraulic constructions in Prussia; for Holland, the Chevalier Conrad, chief engineer of the Water-Staat; for Spain, M. de Montesino, Director-General of Public Works; for England, Mr Rendel, engineer, Mr. MacLean, engineer, and Commander Harry Hewet, captain of one of the East India Company's ships; for France, M. Renaud, *Inspecteur-Général des Ponts et Chaussees*, and M. Lieussou, naval hydrographic engineer. On January 2nd the Commission reported to the Viceroy of Egypt—

"Our exploration, favoured as it has been by unexceptionally fine weather, and facilitated by the ample means placed at our disposal, is now completed.

"We have found numberless obstacles, or rather impossibilities, to cutting the Canal via Alexandria, and unexpected facilities for forming a harbour in the Bay of Pelusium.

"A direct Canal from Suez to the Bay of Pelusium is, then, the only solution of the problem of the junction of the Red Sea and the Mediterranean; its construction is easy, its success certain.

"It is our unanimous conviction that the results to the commerce of the world will be immense.

"We will explain our reasons in a detailed report, supported by hydrographic plans of the bays of Suez and Pelusium, sections giving the relief of the ground, and borings indicating the nature of the ground to be traversed by the Canal."

And now the financial part of the scheme had to be faced, and, to add to his difficulties, the rival scheme of M. Talabot had been supported by many engineers and scientific men in France. The political horizon also began to darken around him. Lord Palmerston, no doubt from patriotic but erroneous motives, looked with disfavour on the project, and used his influence in England, and with the Sultan of Turkey, against it. All the diplomatic skill, perseverance, and determination of M. de Lesseps was now called upon; he visited England, had meetings in all the large towns, then back to Paris, Constantinople, and Cairo, and, as he has stated, about this time he travelled 10,000 leagues every year in furtherance of his scheme. In France he met the supporters of the rival scheme by engineering and scientific evidence; in England he met the opposition by commercial statistics, and, as he afterwards said, he found sympathy in the commercial and lettered classes, and heads of wood among the politicians.

A recent writer says: "As a practised diplomatist he either won over princes and statesmen to his side or neutralised their opposition. His tact and knowledge of the world won his great venture troops of friends, and his absolute fearlessness, perseverance, readiness of speech, and something of a democratic fibre in the man which the masses felt, enabled him to get the money for his great enterprise, not from this or that knot of capitalists, but from the whole of the French people. During all this long period

of preparation his greatest enemies were the leading politicians of England." In Parliament in 1857, Lord Palmerston said, "I can only express my surprise that M. F. de Lesseps should have reckoned so much on the credulity of English capitalists as to think that by his progress through the different commercial towns in this country he should succeed in obtaining English money for the promotion of a scheme which is in every way so adverse and hostile to British interests," and in another speech he is reported to have said, "I therefore think I am not much out of the way in stating this to be one of the bubble schemes which are often set on foot to induce English capitalists to embark their money upon enterprises which in the end will only leave them poorer, whoever else they may make richer." This opposition on the part of a prominent section of the English people, and the demands of some of the English financiers for their services in placing the scheme before the public, contributed in no small degree to its popularity with the French nation.

In 1858 the company called *The Compagnie Universelle du Canal Maritime de Suez* was formed for carrying out the scheme. The capital was chiefly subscribed in France, and in a great measure from the causes already named, the subscriptions came in rapidly.

In a lecture given by M. de Lesseps, after the completion of the canal, he gave some amusing instances of French patriotism. "Two persons came to the office to subscribe. One was an old, bald-headed soldier, who said to me, 'Oh, those English, I am glad to be able to be revenged on them by taking shares in the Suez Canal,' and the other applicant said he wished to subscribe, for *le chemin de fer de l'île de Suède* (the railway of the island of Sweden). 'But,' it was remarked to him, 'it is not a railway, it is a canal; it is not an island, it is an isthmus; it is not in Sweden, it is at Suez.' 'That's all the same to me,' he replied, 'provided it be against the English I subscribe.'" Mechanics clubbed together and took shares, the thrifty French peasantry and even the poor priests invested their hard-earned savings in the scheme.

In 1860 a commencement was made with the work, and, thanks to the skill of the French engineers and the energetic efforts of M. de Lesseps to raise the sinews of war, he was able to announce to the world that the canal would be opened on the 17th November, 1869.

The Sovereigns of Europe and the leading political and commercial men of every civilised community were invited to the opening. The Empress of France was present in a French steamer, and a fleet of about 150 vessels of all nations passed safely through the canal on that day, and thus, chiefly by the energy, perseverance, and indomitable courage of one man, one of the most important works ever projected for promoting the intercourse of nations was brought to a successful issue.

A few days after the opening of the Canal he married, for his second wife, a young creole, of English extraction. I suppose he had for some time been too busy to attend to domestic matters of this nature. In 1870, The *Societé Geographique* of Paris granted him their prize of 10,000 francs, which he generously handed over to the Society's funds for the expedition to equatorial Africa. Honours showered from all sides on the man who ten years before had to almost beg to be listened to. The Grand Cross of the Legion of Honour was bestowed upon him, also the Freedom of the City of London, and—think of it, oh! shade of Palmerston!—he was made a Knight Commander of the Star of India.

M. de Lesseps was now fully occupied in perfecting the entrances at Port Said and Suez and in improving the Canal. But another grand scheme began to attract his attention, and the growing success of the Suez Canal was a stimulus to his active mind, to engage in a still more hazardous and difficult undertaking. The cutting of a canal through the narrow neck of land connecting North and South America to form a communication between the Atlantic and Pacific Oceans, had long been the dream of the scientific and engineering world. In his speech before a scientific assembly at Paris, after the opening of the Suez Canal, he said pointedly to the Americans then present, that it was useless to go

on making red and blue lines across the map of the Isthmus of Panama to shew imaginary routes for the canal, and that no good would result from their labours until they had made an actual survey of the country, taking the levels, and making borings, and established a scientific basis to work upon. In 1879 he visited America, and in 1880 *The Universal Inter-Oceanic Canal Co.* was formed for making the Panama Canal, under the Presidency and Directorship of M. Ferdinand de Lesseps. This work, and the necessity for enlarging the Suez Canal, again fully called into action all his diplomatic skill and varied experience. Amongst other places in England, he visited Manchester—advocating his views regarding the widening of the Suez Canal, and met with a reception worthy of the greatest heroes of industry.

As a very racy description of M. de Lesseps, and his mode of life at this time, and of the esteem in which he was held by his countrymen, the Paris correspondent of the *Illustrated London News* gave the following graphic sketch:—"He flames in every part of the field—to-day in Paris, yesterday in Ismailia, and to-morrow in London. At one moment it is a meeting for Suez, at another a meeting for Panama. He is a sort of engineer of the public confidence; and holds himself ready to fly anywhere to avert a bursting of the banks. Panama is just as much on his mind as Suez, though we forget it is not so much on ours. As a matter of fact, he had only just pacified the United States by giving the bulk of his Panama contracts to Americans before the British broke out. Yet he has nothing more soothing for either side than the promise of a new canal by 1888! Opposition has nothing new to say to him; a long and bitter experience of it has enabled him to formulate all its terrors. As it was at Suez, he will tell you, so it is at Panama, and so it will be at Suez again. It is a fever that runs its course by stages. There is the political flush and then the technical flush; and then the two combine to make the crisis—and that over, the worst is past."

"In the first stage Panama was a danger to the interests of America, just as Suez was a danger to England; in the second it was an impossibility—again, in the same way. The firm rock was

the obstacle in the one, just as the shifting sand was the obstacle in the other. M. de Lesseps partly reasoned, partly lived, all this down; his wonderful confidence was of more use to his enterprises than his skill in engineering. He is not pre-eminently an engineer in the professional sense of the term. There are half a dozen noiseless men on his staff at either Isthmus who would leave him nowhere in a technical examination, but as the negotiator, the diplomatist, the general of his scheme, he stands alone. The feeling with which his countrymen regard him is something infinitely more intense than admiration; it is rapidly warming to the glow of idolatry. When, therefore, M. de Lesseps holds a meeting of shareholders, they follow him as certain congregations follow a favourite preacher. His report is accepted like a deliverance from the pulpit; it is all unanimity, or the only interruptions are from gushing, grey-haired shareholders rising to propose a vote of thanks and medals for him. He is as impatient of discussion as any other prophet, his calls for yeas and nays seem a mere matter of form, his meetings are models of despatch.

"Apart from his power, the French love in him his human nature; he hurried back from London in the very crisis of negotiations to watch a sick baby, and you may see him any day in the Bois de Boulogne riding at the head of a whole detachment of healthy ones. It is really one of the sights of the Paris Row. The cortége goes in a quaint diminuendo, from the rather stout father on a big horse, down to the tiniest daughter on a pony not much larger than a mastiff. If you go to see him unless on business, and sometimes even then, he will talk about his family all the time, and on the slightest excuse he will lead you out of his study into the bedroom where they lie, as in the dormitory of a boarding, school with their beds all in a row. They troop in to meals, they troop in to kiss him in the morning, they troop to lessons and to play, they take a corner at the Tuilleries gardens all to themselves. M. de Lesseps sometimes comes to look at them, forgetful entirely of Suez and Panama."

At this time M. de Lesseps was at the zenith of his popularity, and certainly such a combination of good qualities is rarely met

with in one man. His sanguine nature and imperfect information led him to overlook difficulties in connection with the Panama scheme, and the financial scandals in connection with that project have brought disgrace on some of the leading politicians of France, and thrown a cloud over the latter days of M. de Lesseps, when, after such a career, rest and repose would have been a fitting reward. In speaking of the Panama Canal, further particulars will be given of the Nemesis that has followed the unwisdom of some of his actions, and verifies the saying of Carlyle, that, "All idols have to tumble, and the hugest of them with the heaviest fall."

THE SUEZ CANAL.

So much has been written and spoken about the Suez Canal during the last few years that a lengthy description of it is scarcely necessary at the present time. A brief epitome of some of the most important facts may, however, be useful to those who have not time or opportunity for consulting more detailed accounts of this important work.

The Isthmus of Suez is a narrow neck of land, about 72 miles across, connecting Africa with Asia, and separating the Mediterranean and Red Seas; it is chiefly low, sandy, desert land, without the least appearance of vegetation. There were several dried-up lakes, the bottoms of some of which were 30 feet below the level of the sea, and as the water from the Red Sea was let into them by making the Canal, they now form immense lakes, through which the Canal passes. The ruins of many ancient cities are found on the Isthmus, and Port Said, at the entrance to the canal was founded nearly on the site of ancient Pelusium, which formed a bulwark against invaders at a time when Egypt was the admiration and envy of surrounding nations. Formerly there was a canal in the Isthmus, and some traces of it are still to be found. It was commenced by one of the Pharaohs and finished by Darius; it did not, however, connect the two Seas, but only the Red Sea with the Nile; it is recorded that this canal was blocked up by sand in the year 767, and has remained in that condition ever since, and had not De Lesseps been endowed with indomitable courage, as well as self-reliance, the sight of this ancient water-way, and the knowledge of its fate, would have caused him to hesitate in his hazardous undertaking; but it remained for the intrepid Frenchman 1,100 years after the closing of this ancient canal, to cut a navigable passage across the Sandy Desert, and through the black and dismal swamps of the Isthmus, to connect the two seas. As already stated, the project met with considerable

opposition, and in some points this opposition reminds one of what was said when the Manchester Ship Canal was projected. One self-satisfied critic, after describing the dangerous character of the Bay of Pelusium, where M. de Lesseps proposed erecting his breakwaters for the entrance into the Canal, wrote as follows :—

"The coast of Egypt produces nothing; labour, materials, provisions, must all be imported, and the stones for the breakwaters are not to be had nearer than the Greek Island of Rhodes, or Valencia in Spain: to make these breakwaters, form a channel or entrance three hundred feet wide and thirty feet deep, dredged in liquid mud on a soft, sandy bottom perpetually agitated by a rolling surf, would, with imported labour and material, cost fifteen to sixteen millions; and then it would be impossible to resist nature and keep it open; and in thick or stormy weather no shipmaster dare make for it."

The prospects on shore are not more encouraging in the eyes of this critic, and after describing the shallow marshes, the shifting sands, and the dangerous lakes, he comes to the conclusion that forty millions would not construct the port and canal; and that, if constructed, no possible expenditure could prevent it becoming a stagnant, shallow ditch, useless for any great commercial purpose.

A commission of English engineers was formed to investigate and report upon the scheme. Amongst them were Mr. R. Stephenson, the late Mr. Rendel, Mr. MacLean, and Mr. Manby. Mr. Stephenson declined to act, as he stated after three visits to Egypt that the most lavish expenditure of capital would only produce a stagnant ditch between two tideless seas, unapproachable by large ships under any circumstances, and only capable of being used by small vessels in favourable winds. The report of the other engineers was equally unfavourable. The fact was, Stephenson was then urging forward his scheme for improved railway communication across the Isthmus, which was soon after this time carried out.

The critic then goes on to say that M. de Lesseps' scheme may be consigned to the limbo of impossible projects. English

capitalists have, from the first, steadily refused any support to it; the principal members of the Institution of Civil Engineers have condemned it; and it is only to be ranked with such chimerical ideas as a tunnel from Dover to Calais, or a railway from the Black Sea to the Persian Gulf.

The capital for this important work was chiefly raised in France and Egypt, and the surveys and work carried out mainly by French engineers, under the direction of M. de Lesseps. The total length of the Canal, from the lighthouse at Port Said to the Red Sea at Suez, is 101 miles; about one quarter of the length is through Lake Timsah, and the Great and Small Bitter Lakes; the width of the Canal at the surface through the greater part of its length was 325 feet, with a depth of 26 feet in the centre, and large enough for vessels 500 to 600 feet long and 50 feet beam; the width and depth have been increased during the last few years. At the entrance to the Canal at Port Said, two breakwaters are carried out about a mile and a half seawards, enclosing some hundreds of acres as a harbour. The expense and difficulty of procuring stone to build the breakwaters was overcome by making blocks of concrete 20 to 30 tons each from sand and hydraulic lime. The labourers for carrying out the excavating of the Canal were chiefly found by the Egyptian Government; they were generally paid piece work, and were treated fairly and with justice, for, as one of the Imaums said to de Lesseps, "If you want the birds to come throw bread to them, and if you want our men to come you must sow justice and they will work for you," and this advice was quite in accordance with the straightforward and generous character of de Lesseps. The difficulties in feeding and in providing what is as necessary as food, good water, in such a hot, dry climate, for an army of 25,000 workers were very great, but the energy and skill of de Lesseps and his assistants were able to surmount them. The Canal is chiefly cut through sand, but rock was met with in one or two places, and great consternation was caused a few days before the opening of the Canal, when the fleets from all nations were gathering at Port Said ready for the opening ceremony, by the discovery of some unexpected rock in a part of

the Canal they were just finishing. I will give De Lesseps' graphic account of the unfortunate position they were placed in by this discovery :—

"I never have seen so clearly how near is failure to triumph, but at the same time that triumph belongs to him who, marching onward, places his confidence in God and man. Fifteen days before the inauguration of the Canal the engineers came to tell me that between two soundings or borings, taken at distances of 150 metres, a hard rock had been discovered, which broke the buckets of our dredgers. At this sad news I hastened to the place pointed out. There we found a boulder rising five metres above the bottom of the Canal, and leaving only about three metres of water above it. What was to be done? Everyone began by declaring that there was nothing to be done. In the first place," I cried, "go and and get powder at Cairo, powder in masses, and then, if we cannot blow up the rock, we will blow up ourselves." The sovereigns were on the road to the rendezvous ; all the fleets of the world had been bidden and were about to arrive ; it was necessary at any price to be in a position to receive them. The intelligence and energy of our workmen saved us ; not a minute was lost ; the rock was removed ; and all the splendid cortege was enabled to pass through on the day announced for the opening."

In all about 76,000,000 cubic metres were excavated. The highest ridge of sand to be cut through was about 60ft. high. Twenty thousand men were employed in cutting through this ridge. The fresh water for their use had to be brought a distance of 20 miles, and 2,000 camels were employed for this purpose. At about five or six miles apart there are passing places for vessels, the Canal not being wide enough for two ships to pass each other. Nor are they allowed to proceed through during the night unless carrying the electric light. Most of the physical difficulties which it was prognosticated would operate against the Canal, if not altogether bar it as a navigable channel, were easily overcome, and the ominous prophecies proved to be entirely fallacious. There is very little current, and what there is is chiefly caused by

the difference in the tides. From Suez to the Great Bitter Lakes there is a regular flow of seven hours, the ebb running out in five hours, whilst from Lake Timsah there is a very slow current towards the Mediterranean at the rate of half a mile to one mile per hour. The saving in distance between England and India by this route in comparison with the route by the Cape of Good Hope is shown by the following table :—

	Viâ the Cape. Miles.	By Canal. Miles.	Saving. Miles.
From the Land's End to Bombay ...	11,500	6,300	5,200
" " Kurrachee.	11,200	6,100	5,100
" " Calcutta ...	13,000	8,000	5,000
" " Singapore..	13,000	8,200	4,800

And so great has been the saving in point of time, that it has been found possible to send a cargo of cotton from Bombay, land it at Liverpool, send it to Manchester to be manufactured into calico, and in 12 days ship the calico at Liverpool back for Bombay, and deliver it there within 60 days from the time it left India as raw cotton. The Indian mails have also been accelerated in a wonderful degree, for letters, papers, &c. from India are now, by canal and overland mail *via* Brindisi, delivered in England 15 or 16 days after despatch from Bombay. The total cost was about £25,000,000, and as a commercial speculation its success has been in keeping with the magnitude of the undertaking ; although in the first few years it grew but slowly in public favour. In the first year after it was opened 486 vessels passed through, and the receipts were 4,345,758 francs.

The following table shows the wonderful progressive increase in the number of vessels and gross receipts for each year since the opening :—

Year.	Number of Vessels.	Net Tonnage.	Gross Receipts. Francs.
1870 ...	486 ...	436,609,370 ...	4,345,758
1871 ...	765 ...	761,467,050 ...	7,595,385
1872 ...	1,082 ...	1,160,743,542 ...	14,377,092
1873 ...	1,173 ...	1,367,767,820 ...	20,850,726

Year.	Number of Vessels.	Net Tonnage.	Gross Receipts. Francs.
1874	1,264	1,631,650,140	22,667,791
1875	1,494	2,009,984,091	26,430,790
1876	1,457	2,096,771,613	27,631,458
1877	1,663	2,355,447,695	30,180,928
1878	1,593	2,269,678,315	28,345,672
1879	1,477	2,263,332,194	27,131,116
1880	2,026	3,057,421,881	36,492,620
1881	2,727	4,136,779,769	47,193,882
1882	3,198	5,074,808,885	55,421,039
1883	3,307	5,775,861,795	60,558,488
1884	3,284	5,871,500,925	58,628,759
1885	3,624	6,335,752,984	60,057,259
1886	3,100	5,767,655,847	54,771,076
1887	3,137	5,903,024,094	55,995,298
1888	3,440	6,640,834,446	63,037,618
1889	3,425	6,783,187,122	64,412,511
1890	3,389	6,890,094,414	65,427,230
1891	4,207	8,698,777,360	81,540,836
1892	3,559	7,712,028,610	74,452,436

This return clearly indicates the tendency towards larger vessels. The average gross tonnage ten years ago was 2,000 tons, now it is 3,000 tons. While five years ago the draught of the deepest vessel was 24ft. 7in., it now reaches 25ft. 7in. Between the two measurements there passed through the canal in 1891, 135 vessels. The transit receipts have therefore gone up at a greater ratio than the number of vessels, although not quite so fast as gross tonnage, for the increase in eleven years is but a little over 110 per cent. The vessels passing through the canal in 1891 numbered 4,207, measured over twelve million gross tons, and the payments made came to nearly 83½ million francs, or 3½ million pounds sterling. The increase has been distributed throughout the whole year, but, as in previous years, the larger number of vessels pass through in the summer months. May has a total of 454 vessels, although the 424 vessels which passed through in July made up as large a tonnage. The long day has little to do with this, for an increasingly large number of vessels go through

the Canal at night. In 1890 the proportion was 83·6 per cent, and in 1891 it rose to 88·2 per cent, or 3,711 of the total; and yet the average time taken is less, being but 23 hours 31 minutes. It was longest in April and May, and shortest in December. For vessels navigating by night as well as by day the average duration was only 21 hours 58 minutes, and for vessels navigating by day only 34 hours 54 minutes. The electric light now carried by each vessel passing through the Canal during the night has been an important feature in bringing about such satisfactory results.

It is satisfactory to note that Britain has improved her ratio of vessels, for the increase in her case is 27·5 per cent, while the gross increase was but 24 per cent, the total number of British vessels having been 3,217. The number of German vessels continues to increase, whilst the number under the French, Dutch, and Italian flags remains nearly stationary. Other nations only contribute 5·6 per cent of the total. Britain is credited with 76·63 per cent of the total; Germany, 7·12 per cent; France, 5·05 per cent; Holland, 3 per cent; and Italy, 2·26 per cent. Of merchant vessels in cargo there were 3,060 of over six million net tons, and of those Britain contributed 89 per cent, and Germany 6·25 per cent. Britain clearly holds her position in shipping. By the concession it was expressly stipulated that the Canal should be open always as a neutral passage to every commercial vessel crossing from one sea to the other, and Article 2 of the Company's regulations states—

2. The transit through the Suez Canal is open to ships of all nationalities, provided that their draft of water does not exceed seven metres and eighty centimetres (25ft. 7in. English), and that they conform to the following conditions:

Sailing vessels above fifty tons are bound to be towed through.

3. The maximum speed of all ships passing through the Canal is fixed at ten (10) kilometres, equal to 5⅓ nautical miles per hour.

The Tolls are as follows:—

The net tonnage resulting from the system of measurement laid down by the International Commission of Constantinople, and inscribed on the special certificates issued by the competent authorities, or on the ship's official papers, is the basis for levying the special navigation due, which is at present nine francs (9 fr.) per ton.

The charge of ten (10) francs per passenger above twelve years of age, or of five (5) francs per passenger from 3 to 12 years old, as well as the transit dues, must be prepaid on entering the Canal at Port-Said or Port-Thewfik.

The management of the company's affairs is under the control of a Council of Administration, the English members of which are :—Lord Brassey, R. S. Donkin, M.P., J. Laing, Sir W. Mackinnon, Bart., C. J. Monk, Sir T. Sutherland, K.C.M.G., M.P., H. Austin Lee, Major-General Sir J. Stokes, K.C.B., and Sir C. R. Wilson, K.C.M.G., C.B., the last three representing Her Majesty's Government on the Council.

The concession of the Company is for 99 years from Nov. 17th, 1869. The accounts are made up annually to Dec. 31st, and submitted in Paris in June. The revenue is to be devoted, firstly, to the payment of the interest and amortisation of the Bonds; then to the payment of 5 per cent on the shares, next to provision for the redemption of the shares within the period of the concession. Five per cent of the sum then remaining has to be placed to reserve (this provision is not now compulsory, the reserve having reached the minimum fixed of 5,000,000 francs), and the balance is to be divided as follows :—71 per cent as supplementary dividend to the shareholders, 15 per cent to the Egyptian Government, 10 per cent to the founders, 2 per cent to the directors, and 2 per cent to a fund for the benefit of the servants of the Company. The excess dividend from surplus profits has for the last eleven years averaged 60 francs per share per annum. The capital stands as follows :—

400,000 fully paid ordinary shares of 500 francs each, with coupons representing interest at the rate of 5 per cent per annum, payable January 1st and July 1st, with participation in excess revenue, as stated above. The shares are repayable at par by annual drawings on December 15th. Of these shares 176,602 were subscribed by the Viceroy. These are the shares which were in 1875 bought by the British Government. They do not rank for dividends upon the revenue of the Company till after July 1st, 1894, and the Viceroy engaged to pay 5 per cent interest on them until they rank equally with the other shares. In 1885 and 1886

the interest on these shares under the new arrangements regarding the Egyptian debt was reduced to 4½ per cent. So far 6,670 shares have been redeemed, and rank for surplus dividends, and the certificates representing this interest are known as shares *de jouissance*. Voting power, one vote for 25 shares; maximum, 10 votes; present price, about £105 per share.

333,333 obligations or preference debentures of 500 francs each, bearing 5 per cent interest, and redeemable at par by 1918. These obligations were issued in 1867 and 1868 at 300 francs, and the number outstanding is 260,793.

120,000 30-year bonds of 125 francs each, issued in 1871 at 100 francs bearing 8 francs interest, and repayable by 1901; the number outstanding is 61,520.

400,000 bonds of 85 francs each, bearing 5 per cent interest. These bonds were issued in August, 1874, for 7 half-yearly coupons on the ordinary shares, and are repayable at par by 1921; the number of bonds outstanding is 396,698.

120,000 delegations of 500 francs each, bearing 5 per cent. interest and repayable by 1894.

73,026 bonds of 500 francs each, issued in 1880, and since ranking for 3 per cent interest, and repayable at par in 50 years from 1885; bonds outstanding 70,937.

19,500 bonds of 500 francs each, issued between 1887 and 1891, ranking for 3 per cent interest, and repayable at par by 1962; outstanding is 19,302.

100,000 founders' shares with right to participate in surplus profits in the proportion described above. Many of these bonds have been issued to meet expenditure incurred in widening and deepening the canal, and other improvements.

The growing importance of this improved communication to our eastern possessions soon led the trading classes in England to see that Lord Palmerston had made an egregious blunder in declining on the part of the British Government to take any interest in the project, especially when the large and growing preponderance of British vessels using the canal was seen, and with all his undoubted desire to protect British interests, it was left to

men with wider views and more acute commercial insight to secure for our Government, a pecuniary interest and a share in the management of the Canal more in keeping with the great interests we had at stake.

A statement as to how this came about has lately been given by Mr. W. T. Stead, in the "*Review of Reviews*," claiming the chief credit of that purchase for Mr. Frederick Greenwood, at that time editor of the "*Pall Mall Gazette*." He says:—

Mr. Greenwood had thoroughly established his reputation as a shrewd, strong-headed, powerful journalist, who had on his staff, more or less, the whole of the aristocracy of journalism. The paper was then, as it continued to be to the last, the paper which was read by the political and literary classes. This gave him a great vantage, which he used with singular success on one occasion. It was Mr. Greenwood who saved the Suez Canal for England. He heard of it by the purest chance. He was dining at a club when Mr. Oppenheim told him that the Khedive was about to sell his shares in the Canal to the French, or to representatives of the French interests. Mr. Greenwood made enquiries, which satisfied him that Mr. Oppenheim was well informed. He at once went to Lord Derby, and informed him that unless he took prompt action the Canal would practically become a piece of French territory. Lord Derby was astonished. Our representative at Cairo had left the Home Government entirely in the dark on the subject. Lord Derby, however, promised to telegraph and inquire. A few hours later, when Mr. Greenwood called again upon the Foreign Secretary, the news was confirmed. What was to be done? Mr. Greenwood did not hesitate a moment; the shares must be secured for England. Mr. Disraeli concurred. Lord Rothschild supplied the four millions, and the public were startled before the week was out by the announcement that the Khedive had parted with his shares to England, and that the English Government was now possessed of proprietary rights in the Suez Canal. It was a bold stroke, which met with almost universal approval.

Mr. Stead then states how he supported the purchase of the shares in the columns of the "*Northern Echo*" (of which paper he was then editor), in opposition to many of his political friends, and proceeds to say:—

Events have signally justified Mr. Greenwood. The shares, which, but for the action of the "*Pall Mall*," would have passed irrevocably into the hands of French proprietors, were valued at the time of the purchase *at four million sterling; they are now worth twenty millions sterling*, a clear gain of sixteen million sterling, to say nothing of the enormous strength which their purchase gave to our imperial position in Egypt and to our commercial ascendency on the Canal.

By this canal another link is added to the chain which binds mankind together, and the glowing prophecies and hopeful anticipations of M. de Lesseps have been more than realised, by the practical working and financial success of a project which, aided by every contrivance which engineering skill and science has furnished and by the unbounded confidence of his countrymen he has been able to carry out, and thus overcome the barrier which nature interposed between great empires; realising results for the benefit of mankind, which all the conquests in the world could never have achieved. And if in his old age he failed to carry out the great undertaking which he began with such impetuous ardour, backed up by the admiration and support of his countrymen, and was unable to surmount the invincible resistance of rivers, mountains, and financial difficulties, we must all admit that the sentence passed upon him is, under the circumstances, unworthy of the people that flattered and glorified him as long as they believed the capital entrusted to him would bring them good interest and glory, for in his best days, as the "*Times*" correspondent says:—

When the man went abroad, the world acclaimed in him his country and its genius. He carried far and wide the glorious evidence of the genius of his race, and in him were greeted the French daring and greatness that had made the Suez Canal and joined two seas. He alone did more to restore to France the glory diminished by her disasters than all the miserable politicians taken together who pursue him with their hate.

THE PANAMA CANAL.

THE Isthmus of Panama forms a portion of the long, narrow, neck of land connecting North and South America. It is about 460 miles long, and in its widest part 105 miles, and in its narrowest part 27 miles across. Formerly, the Isthmus and other portions of South America were Spanish Colonies, and remained in the possession of Spain for over 200 years, but after a long series of Revolutionary Wars it now forms a portion of the Republic of the United States of Colombia. The surface of the Isthmus is extremely irregular, being traversed by a great chain of mountains rising in some places to a height of nearly 12,000 feet above the sea level; some portions of it are rich in vegetable productions, with fine tracts of prairie land; other portions are covered with tropical primeval forests abounding with wild animals. Since the time when Vasco de Minez crossed the Isthmus and discovered the Pacific in 1513, the desire for a means of transit from the Atlantic to the Pacific across this narrow strip of land, has been growing in intensity. The natural difficulties of the country, and the intestine wars for many years prevented the most sanguine and adventurous from making any attempt in such an unpromising speculation. At length the rapid progress of America, with her valuable possessions in the Pacific, the growing trade of England with Australia and California, and the immense increase in the number and power of sea-going steamers, gave such an impetus to the question, that it seemed a disgrace to the engineering genius, and a stigma on the commercial spirit of the age that a narrow strip of land, not forty miles across, should be allowed any longer to obstruct the traffic between the increasing millions of the East and West. The railway in this as in many other cases was the first to supersede the primitive mode of travelling by mules, which had for some years been carried on,

but not before several attempts had been made, chiefly by our neighbours across the water, to form companies for making a canal, and as early as 1836 a concession was granted for a canal to Mr. Klein and Mr. Salomons, but nothing was done and the concession lapsed. It was afterwards renewed, and the concessionaires prevailed on L. Philippe and M. Guizot to have a survey made in 1843, but the scheme was not carried out. In 1848 our American cousins came into the field and a concession was granted to Messrs. Aspinwall, Stephens, and Chauncey, three eminent American railway speculators for constructing a railway across the Isthmus. The work was commenced in 1850 and opened in 1855; it commences at Aspinwall, or Colon, on the Atlantic side of the Isthmus and terminates at Panama on the Pacific. The entire length of the railway is forty-seven miles. I will not dwell on the bold and picturesque scenery of this line. Huge basaltic cliffs and conical peaks rise on all sides. Marine shells and corals are found on the very summits of the hills, and the whole region shows unmistakably that violent volcanic forces have been at work at a comparatively recent period.

A great traffic in goods and passengers is carried on over this railway. Some of our most important lines of steamers and large numbers from the United States and other countries trade to Colon, where goods and passengers are trans-shipped for the Pacific. The rates are, however, very high, the costs of trans-shipment heavy, and no wonder that the question was continually being asked, "Shall a narrow strip of land, not over forty miles across, be allowed any longer to remain a barrier on the highway of nations? Shall the engineering genius of the 19th century, with all the aids which science has brought to its assistance, confess itself baffled in the project of cutting a canal of such immense importance to the commercial world?"

As before named, concessions had been granted for making a Canal, and in 1852 another was granted to Messrs. Fox, Henderson, Brassey, and M. Cullen for cutting a canal through the Isthmus of Darien, a short distance from where the Panama

Canal is being made. Dr. Cullen was a great advocate for the Darien route, and read a very interesting paper on the subject before the meeting of civil engineers in 1868. This project also fell through, and it was not until the successful hero of Suez appeared in the field that a really practicable scheme was placed before the public. In 1879 a concession was granted to M. de Lesseps and others by the United States of Colombia for making the Panama Canal, and in 1881 the Inter-Oceanic Canal Company was formed, and M. de Lesseps announced that the International Technical Commissioners appointed to examine and report upon the scheme, confirmed the feasibility of the Maritime Canal. The total estimated cost of the work was £24,000,000. The prospectus for the new company stated that cutting the Isthmus would shorten by 3,000 leagues on an average the distance for ships going from one ocean to the other, and the saving in time, insurance, and greater safety would be equal to 80 francs per ton. The tariff dues were proposed to be 15 francs per ton.

The saving in distances by the Canal instead of passing round Cape Horn is given as follows:—

	Miles.
London to San Francisco	10,500
New York to San Francisco	14,100
London to Sydney	6,600
London to Sandwich Isles	8,400
New York to Valparaiso	8,100

Many different estimates have been made of the tonnage of shipping that would be likely annually to make use of the Canal. Here are a few of the most important:—

	Tons.
M. de. Lesseps himself	6,000,000
Dr. Long, American Consul at Panama	3,000,000
San Francisco Board of Trade	5,000,000
Admiral Ammon	3,762,000
M. Levasseur	7,500,000
M. Moneal	5,500,000

There are many other estimates, including that of 10,000,000 tons by the capitalists of Paris, and that of 9,304,000 by the *Revue-Gazette Maritime et Commerciale* of France.

The money for this great undertaking was subscribed chiefly in France and America. It was decided to commence the Canal in the harbour of Colon, in the Bay of Limon, on the Atlantic coast, and to terminate at Panama on the Pacific side. Great difficulties were met with in making the survey. The unhealthy climate spread disease and death to an alarming extent amongst the pioneers in this work. A new port had also to be formed, with wharfs, &c., for the reception of the machinery and materials for making the Canal; and a new town, with workshops and dwellings for the workmen, was built on the low marshy beach of the bay, acres of which had to be covered with nearly 500,000 cubic yards of material brought from a distance to form a foundation for the new city.

The river Chagres empties itself into the bay at this point, and a portion of the river has been utilized for the Canal proper, which for some miles is made in the valley of the river. At Matachin the Canal leaves the Chagres river, and following the valley of one of its tributaries, passes over, or as was proposed by M. de Lesseps, through the Culebra Hill, which is one of a range forming the backbone of this portion of the Isthmus. It then enters on the Pacific slope by the valley of the Rio Grande, and enters the Pacific at the Port of Panama. It is in all about 44 miles long, 28 feet deep, and 165 feet wide at the water level, and was intended to be an open cutting from sea to sea without locks, but it was found that on account of the variations in the tides, which at Colon only average about 23 inches rise, whilst at Panama they vary from 15 feet to 25 feet, a dangerous current would be caused. M. Dingler, the engineer, therefore proposed to construct locks at the Panama end to overcome this serious drawback, thus adding considerably to the first estimated cost of the Canal. The proposed cutting through the Culebra was perhaps the largest undertaking of the kind upon record; at the highest part of the hill the depth to be excavated is 460 feet by 984 feet wide at the top, and 200 feet at the bottom. This cutting will be 6 to 8 miles long, but not all of this depth, and it is estimated that about 80,000,000 cubic yards will have to be removed at this point. Imagine an excavation deeper than the height of the Manchester Town

Hall spire, and as wide as Albert Square, made from Manchester to Bury. This will give some idea of what the Yankees may well call "the biggest cut in creation;" and it is here the questions of time and money become of vital importance, for the Canal cannot be completed without locks, as first proposed, until this great trench is finished. The total amount to be excavated in making the canal is variously estimated at from 120 to 150 million cubic metres. The work in its early stages was somewhat retarded by difficulties and disputes with the contractors, some of whom seemed to attach little importance to clauses in the contracts. Early in 1886 the difficulties in dealing with the waters of the Chagres river, and the excavation of the granite rocks of the Culebra hills, began to make themselves more apparent. The old assurances of success were confidently repeated by de Lesseps, but with great reservation as to details. He scouted the idea of asking the French Government for financial aid. All he wished for was power to institute a lottery. "With this he was willing to rely on the patriotic, wise, and noble French people."

Reports on all sides from travellers, experienced engineers, and specialists began to arise as to the slow progress of the work, and the utter impossibility of completing it by the time named by de Lesseps, and for the estimated outlay; in most cases these reports were treated as the outcome of prejudice and national jealousy, chiefly on the part of England and America. It was said that there was nothing new, from an engineering point of view, in this great project, nor any difficulties to be met with in carrying it out, that could not be surmounted; the chief consideration was the enormous aggregation of problems each requiring a separate solution, rather than any insuperable obstacle, and by all disinterested careful observers it began to be seen that, to overcome the difficulties already foreseen, increased capital and the highest skill and perseverance would be required.

In July, 1886, a resumé of the work done and to be done was given before the Engineers' Club, Philadelphia, in which it was stated that at the rate of progress then going on, it would take eight years longer to complete the Canal were there no other

problems than excavation to be considered, and that the unknown quantities in the problems were too many for ordinary methods of solution.

In July, 1887, it was proposed to abandon the suggested lock gates at Panama where the tide rises 15 to 25 feet. English engineers pronounced that the Canal without the gates would be an impossibility. In America the opinion of engineers was also unfavourable, and it was generally believed by all competent judges, and openly stated, that the collapse was simply a question of time.

The impracticability of a level canal across the Isthmus with the financial means at his command at length became so apparent to de Lesseps and his colleagues that it was decided to abandon his idea, and M. Eiffel designed a series of locks, particulars of which translated from *La Nature* are given in *Engineering*, in 1888, as follows: "By the alteration the amount of excavation still remaining is reduced from 105 millions of cubic metres to 40 millions. Starting from the Atlantic the first 22 kilometres will be at the sea level; the first lock will then occur, and will have a lift of 8 metres. The second lock will be constructed at the thirty-seventh kilometre, and will also have a lift of 8 metres. The third and fourth locks, each of 11 metres lift, will occur at the forty-second and forty-sixth kilometres. The summit reach will thus be raised 38 metres (124 feet 3 inches), and it is possible that a further lock of 11 metres may be used to raise it 49 metres (160 feet 8 inches). On the Pacific slope it is intended that the Canal shall descend by three locks of 11 metres, situated, two at the fifty-seventh kilometre and one at the sixty-first, and by a lock of 8 metres fall at the fifty-ninth kilometre. The total fall will thus be 3 metres greater than the ascent, to allow of the increased fluctuation of the tides on the western side of the Isthmus. The locks will have a length of 180 metres, and the width of the gates will be 18 metres. The quantity of water expended in carrying a vessel over the summit will be 80,000 cubic metres, part of which will be derived from the rivers Chagres, Obispo, and Rio Grande, and part by pumping.

The contracts undertaken by Messrs. Eiffel and Co. were:—

1. The excavation of all earthwork necessary for the locks and foundations.
2. The provision and fixing of all the lock framing, gates, and controlling.
3. The masonry and beton sides, inverts, and filling of the iron caissons.

As matters then stood the Canal had cost about £46,000,000. This sum had been gathered chiefly from French subscribers. But most unwisely a large portion of this capital had gone to pay interest on shares and debentures, and it may safely be said that had this money been applied to the works, the position would have been very different. Early in 1888 the French Government refused to submit to the Chambers the bill by which it was proposed to empower the Panama Canal Company to issue a lottery loan. In consequence of this refusal M. de Lesseps urged the shareholders of the company to carry on an agitation, and bring all possible pressure to bear both on the Government and on the deputies of their districts to get the decision reversed, and subsequently, through these and other influences of which we have heard so much lately, the Government authorised a lottery loan of 800,000,000 francs, but without being guaranteed by the State. The proposals to raise new capital were favourably received, and those whose money had been sunk did not hesitate to make further sacrifices to attain a result which they were assured would bring ample return for the capital invested, and glory to the French nation. Public meetings were held, and early in 1889, at a meeting at the Paris Hippodrome, attended by 7,000 people (representing 298,000 shares), resolutions were passed to prosecute the work with renewed vigour, and De Lesseps was as much applauded as if he had declared a dividend of 10 per cent.

Up to the date of the meeting various efforts had been made to form new financial combinations, and one of them appeared full of promise that new funds would be raised in sufficient amount to continue and finish the Canal. This combination proposed the visit of a commission to the works, and the preparation of a special

report. In reference to this point M. de Lesseps said, "As to the works, I will go myself and examine them. I will accompany this commission, not only to give its members all the information they may desire, but also, in your name, to shake hands with those noble workers—those heroes—who, over there, without allowing themselves to be discouraged, have defended, have saved your work, the work of France." The meeting appeared perfectly satisfied at the prospect of their Grand Old Man going to Panama to shake hands with the staff; and one individual, who was unreasonable enough to have doubts on the subject, was promptly bonneted. So the resolution of absolute confidence was passed, and every one went away sure of final success.

But it soon became evident to any one who sought to take an impartial view of the matter that there was no bottom to the undertaking; that its funds were being raised upon the most ruinous terms; and that the company was the prey of every kind of commercial harpy. The inevitable liquidation long foreseen by experienced engineers and financiers soon followed, and with it the retirement of M. de Lesseps from the chairmanship of the company.

In 1891 the report of M. Bonaparte Wyse was published. He had just returned to Paris from Central America, where he had, on behalf of M. Monchicourt, the liquidator of the Canal Company, successfully completed negotiations with the Colombian Government for an extension of time, in order to allow of a reconstituted company carrying on the work of cutting through the Isthmus. As a result of his visit to Central America he revived the proposal which he originally made of completing the undertaking by means of a central artificial lake. A principal point is made in the report of the economies which, in the opinion of the engineers, MM. E. Jacquemin and P. J. Sosa, might be made. These consist chiefly in the utilisation of the water-power available for the transport of the material extracted. By this means the work might be completed in five or six years, and much saving would consequently result in the estimated expenditure, which is calculated for a duration of eight years.

If this scheme were carried out it would take sixteen hours to traverse the Isthmus, one half of which would be occupied in passing through the locks. Vessels would, however, be able to go at full speed across the lake, when not only would the ship's bottom be benefited by the action of fresh water, but opportunity would be afforded of cleaning the tubes of the boilers, and taking in supplies of water.

M. Bonaparte Wyse found it was no easy matter to prevail on the Colombian Government to allow of an extension of its concession to the old company another three years. If a new concern is constituted a still further extension will be necessary, but this is what the Colombian Government, for financial reasons, is not willing to give. If something is not done in a short time the works of the Panama Canal will be utterly effaced, and it will be impossible to take up the scheme at the point where it was arrested without great additional outlay. At present the works along the Canal are idle, millions of pounds worth of machinery are going to decay, and miles of deserted villages along its banks are gradually disappearing beneath the rapid growth of tropical vegetation. The money that might have allowed of a reconstitution of the company is gone, and in face of these hard facts, and the refusal of the Government to take any responsibility, it would be idle for the various committees of French shareholders to seek to avoid the inevitable. But apart from all this the late exposures in the Law Courts of France will render it difficult for any syndicate, company, or body of promoters to raise the funds to complete this ill-fated enterprise. Probably the climax of its troubles was reached in the first month of 1893, when, as the "*Manchester Guardian*" says—

"The Court of Appeal dealt with the most important of the Panama promoters. M. de Lesseps, of the Suez Canal, and his son Charles were each sentenced to five years' imprisonment. M. Eiffel, the hero of the tower, was sent to prison for two years and was fined £800. M. Fontane, historian, and M. Cottu received sentence of two years' imprisonment and £120 fine apiece. In giving judgment the Court recalled a few of the chief facts

proved at the trial. At the time of its liquidation the Company had spent 1,300,000,000 francs, and could only show work done for it to the value of 700,000,000 francs. Six hundred millions of francs had been sunk at the bottom of that deep sea, the pockets of company-promoters, swindling contractors, venal journalists, and corrupt second-rate politicians."

These exposures and prosecutions having, to some extent, cleared the commercial atmosphere, and at last opened the eyes of the too confiding shareholders to their true position in regard to this unfortunate project, the question arises who is to solve the difficult problem of the completion of the Canal. Undoubtedly it will be completed. The advantages offered by this inportant waterway to the commerce of the world are so far-reaching that, having arrived at its present stage the undertaking, ambitious, and recklessly entered upon although it was, cannot now be abandoned.

No doubt the air will soon be full of projects from engineers and financiers for the completion of the Canal; and the "*Manchester Guardian*," in a leading article, gives a concise resumé of a French editor's views on this point, as follows :—

"Can the Panama Canal be completed? Given enough money, can the engineers promise to overcome the physical difficulties? And, given this promise, can enough money be raised? In the new number of the *Journal des Economistes* M. de Molinari, the editor, offers an answer to each of these questions. As for the physical difficulties, he accepts the view of an expert engineer formerly engaged on the construction of the Suez Canal, that the Panama enterprise is now relatively as far advanced as the Suez Canal was in 1865, four years before it was opened for traffic. Half the necessary work, this engineer thinks, is already done. Of course he does not mean half of the actual digging of the Canal bed, for M. Rousseau officially certified the other day to the French Government that only one-eighth of the whole cubic contents of the actual trench had been excavated at the beginning of last year. He means one-half of the whole work that had to be done from the first steps in the

preparation of the engineer's plant down to the completion of the Canal itself. In the remaining half M. de Molinari finds no practical impossibilities, always granting, of course, that the Panama is to be a lock canal and not a dead level one, as was wildly proposed at first. With this opinion M. Rousseau agrees. In the minds of both it is only a question of time and of money and of belief in the possibility of an ultimate dividend. As to time, M. Rousseau believes that nine years' work at the old pace would suffice. As to money, it has been calculated by the Commission of French and foreign engineers sent to Panama in 1889 by the liquidator of the company that £36,000,000 would be required to cover every expense. M. de Molinari next asks what are the chances of raising this capital. There is not the least prospect of drawing it from the class of small investors of whom some 800,000 were severely bitten by the failure of the original Company, and who are now heartily sick of the Canal and everything connected with it. The money must come either from the great holders of capital or from nobody. As a rule the great financiers of Paris treated the Lesseps enterprise coldly. Will they now see better prospects for a new company founded on its ruins? M. de Molinari thinks that this might happen if the new company could acquire the property of the old one at the price, say, of a quarter of the eventual profit on the working of the finished Canal. If the great financiers can be satisfied that the Canal would bring in returns sufficient to give a satisfactory dividend on their own subscribed capital of £36,000,000, and also pay a dividend at the same rate on a further sum of £12,000,000—the capitalised value of the old company's share in the ultimate profits under the proposed arrangements—and if they can indeed purchase the assets of the old enterprise on these terms, then it is conceivable that they might, as he suggests, put a fresh capital of £36,000,000 into the Canal. But that is all that can be said. The article is a mere sketch of a complicated and obscure financial problem. It would be pleasant to accept it as the truth of the matter, but it will need—to mention only one point out of many—a far fuller examination of the prospects of ultimate profit before

French investors of any class are likely to think of a new Panama Company as anything but a fresh facility for throwing good money after bad."

It must be borne in mind that the question is now solely a financial one. Engineers can complete the work, but will it pay fair interest in the future on the capital now required to complete the work? I think it will. The immense advantages to trade and commerce which this new *route* between the Atlantic and Pacific presents will, as in the case of the Suez Canal soon attract and stimulate the growing maritime connection between the two oceans, and justify the outlay of capital required. The 19th century has surpassed all preceding centuries in the great strides it has made, through the progress in science and engineering skill, in the means of rapid communication between nations and communities, and I hope and trust that before its expiration we shall see the fleets of the world traversing this great waterway, not only to promote commercial gains, but also to spread civilisation, and peace and goodwill amongst the nations of the earth.

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