

The Reminiscences
of a
Civil Engineering Contractor

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BRISTOL :
JOHN WRIGHT & SONS LTD.

1942

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The Reminiscences of A Civil Engineering Contractor

PART I.

FOR THE PROSPECTIVE CIVIL ENGINEER

CHAPTER I.

INTRODUCTORY. 1861—1877

My ancestors on both sides had for centuries been farmers in the east of Scotland between the Dee and the Forth.

My father, Walter Brodie, carried on the family tradition in Kincardine and Fifeshire until his death in 1883, but on a holiday spent in Scotland some years later I called on his old griever who was lamenting that : “ There’s no’ a Brodie left in the howe o’ the Mearns ” ; and I think the same remark would apply to my mother’s family, the Mollisons of Glenesk.

I had no inclination to follow in my father’s footsteps as to occupation, although I have endeavoured in other respects to keep up his good reputation, but my desire had always been to become a Civil Engineer thus following my uncle Robert Brodie who was one of Brunel’s chief assistants in charge of the construction of the South Wales Railway from Neath to Neyland—now a portion of the Great Western Railway system.

I remember when about ten years old some one came to tell my father that one of the fields was completely flooded and the young neeps would be ruined. He

immediately came to the conclusion that I had been damming the stream and took me down to put matters right, this dam was the forerunner of many that I have since constructed.

After leaving the Madras Academy Cupar, in 1875, I spent two years at the Madras College St. Andrews when my favourite study was mathematics and my favourite recreations were rugby football and athletics. We all played golf but I was never keen on it and I have certainly not kept up the St. Andrews Golf reputation.

I claim to belong to the Brodie Clan although I have not yet adopted the Brodie tartan kilt, but on two occasions while motoring through Morayshire I have left my card at the Brodie Castle Lodge having written on the back "Hail to the Chief."

I once discussed family history with John A. Brodie, Past-President, Inst.C.E., when he told me that he had gone carefully into the matter until he arrived at a border robber who was hanged and he thought it was time to stop, but I told him that he ought to have persevered as my uncle the Rev. James Brodie, of Monimail, a noted Antiquarian, had also traced the border robber but persevered until he arrived at a Pictish King, although he admitted that the latter part was problematical.

I think I must have been rather a precocious youngster as the following instance will show.

We attended my uncle's church and between the forenoon and afternoon services often had a light meal at the Manse. On one occasion when my uncle had made an annual exchange with a neighbouring minister my aunt was ladling out the soup and the maid, who had been with them for many years was handing round the plates. She was rather a character well known throughout the parish as "Manse Jean," and I aged about six dropped a bomb by saying "Mr. Taylor you preached that sermon here before." My aunt was horrified and said "Don't heed him, Mr. Taylor, the laddie's talking nonsense." Then Jean said "Deed mem, he's no talkin' nonsense. The laddie's quite richt." I am afraid Jean and I got into sad disgrace that day.

A CIVIL ENGINEERING CONTRACTOR

CHAPTER 2.

TAY BRIDGE RAILWAYS. 1877—1879.

On leaving St. Andrews at the age of sixteen I became a pupil of George S. Hird, A.M.Inst.C.E., engineer to John Waddell the contractor who was then carrying out the connections to the original Tay Bridge, including two railways each about five miles long to Leuchars and Tayport on the south side, and the Tay Bridge Station and approach works on the North side of the River Tay.

There were no very special features in this contract but it was of such a varied and extensive character that I had a good opportunity to become acquainted with most Railway and Station requirements.

Before I started work my father, who was an extremely moderate drinker, told me that he had been making some inquiries and found that several of the Waddell staff at Dundee were heavy drinkers, and warned me as I was only a boy going among strangers where I would naturally be closely associated with the members of the staff, to avoid drink entirely during my four years pupilage. At the end of that time I should be old enough to know what to do.

I told him I had been a member of a Band of Hope and promised to adopt his advice. This was at a time when drinking was more prevalent than it is now, and I was subjected to a good deal of chaff and scorn.

I remember on one occasion a man offered me a glass of whisky. I told him I did not drink whisky, he said have a pint of beer. I told him I did not drink beer. He expressed surprise and said, will you have a glass of wine. I told him I did not drink wine. He stared at me for a time then asked if I ate grass, I told him no, then he said "You're neither company for man nor beast." I do not know if this was an original remark but it impressed me and I think it had the effect that I started smoking and have carried a pipe ever since, which I prefer to a cigar, while a cigarette is no use to me. So

that in this particular case I am a supporter of Baldwin as against Churchill.

Hird left the Waddell staff before the Tay Bridge work was completed, but I remained on the staff under his successor R. W. Maxwell Muller, A.M.Inst.C.E. and was directly under the two chief assistants Archie Anderson and H. K. Greville from whom I got most of my tuition.

I was standing beside my level one day when Mr. Raff, the resident engineer passed and asked me what I was doing. I told him I was adjusting the level, when he said it was a very foolish thing to do as I would probably ruin the instrument. I replied Archie Anderson had taught me how to do it, but he said Archie knew nothing about adjustments and he had his level adjusted regularly by the local optician, and although it cost him a guinea every time it was well worth the money. I told Archie about this, and he said he always did this work for the optician who only paid him five shillings and he would insist on getting half-a-guinea, which he did, but we did not tell Raff.

Archie was an exceptionally good man. After leaving Waddell he was with McAlpine for some years then went to the Gold Coast where he eventually became chief government engineer.

I met him on his last leave when he told me that the climate had played havoc with his staff, but that he had kept quite well (owing he said, to his avoidance of alcohol and women) and would shortly be retiring on a substantial pension. But unfortunately, the climate got the better of him and he died shortly before he was due to leave.

I was on the first locomotive that crossed the ill-fated Tay Bridge, and I crossed it as a passenger on the night before it fell, this was on Saturday 27th December, 1879, when I was travelling from Montrose to Cupar near where my father lived. Some people in Montrose thought that I had gone home for the week-end and as the train which was lost was the last train north on Sunday night, my name was on the missing list as it was surmised that I was on it.

But my father was a strict Sabbatarian and I was not on this train. When later I arrived at Montrose I had a very hearty reception.

That Sunday night was the most terrific in my experience. Our home was about eight miles from the Tay Bridge as the crow flies, and I was awakened shortly after midnight by a stream of water on the bed caused by the lead covering on the flat roof, weighing over a ton, having been rolled up and carried by the wind to an adjoining field. The mill chimney fell and the stackyard was scattered in indescribable confusion.

This was evidently the centre of the hurricane as the overflow stackyard a quarter of a mile away did not lose a sheaf although it was in a more exposed situation.

CHAPTER 3.

MONTROSE AND ARBROATH RAILWAY 1879—1881.

On the completion of the Tay Bridge Railways I was transferred to Montrose on the construction of the missing link of the East Coast route between Arbroath and Kinaber junction, a length of some fifteen miles, including large rock cuttings and extensive viaducts. Two of them being entirely of ironwork, over the Esk and Lunan rivers, were not included in Waddell's contract but were erected by Hopkins Gilkes & Co. of Middlesbro, who had built the original Tay Bridge.

After this disaster had been thoroughly investigated, the Esk viaduct was condemned, and was subsequently reconstructed by Sir William Arrol. This along with the Tay and Forth Bridges are monuments of his ability, and that of the engineers Sir John Fowler and Sir Benjamin Baker.

The other viaducts and bridges were of masonry and brick-work except when girders were used, which were sublet by Waddell to engineering firms.

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Among my recollections of this contract is an occasion when one of the viaducts about seventy feet high had reached the stage when the abutments and piers had been completed and a staging partly erected for building the girders. My chief wanted to test the levels for setting the bearing blocks, and when he was setting up the level I walked out with the levelling staff along a staging beam about 10 in. by 5 in. on edge across a span of, I think, 66 feet. When he looked round and saw me on the pier he started to blackguard me, pointing out the danger I had run with the result that my nerves were shaken and I dared not walk back but had to return ignominiously astraddle of the beam.

I may mention here that no chainmen were employed. In these days this work was done by pupils or junior assistants and formed part of their training, which the present day pupil would probably consider *infra dig.*

My chief had great theoretical attainments and was a demon for work but was very unmethodical. On leaving the office one evening he asked me if I knew where a certain tracing was and I told him I didn't. But when I returned to the office next morning he was still turning his papers over and over and had been looking for it all night as he was certain it was in that room. I asked him to sit down and I would search for it. After about a quarter of an hour I suggested he might be sitting on it, but he jumped up and showed me the empty chair; then I said it must be in his pocket. He then pulled out a large bundle of papers and there was the tracing!

When the contract was completed and chief office wanted the final certificate, it was found that no finals had been made except the station buildings and some other works that had been done by sub-contractors, and we had to measure up the rest of the work.

As the engineering staff had been reduced to the chief and two assistants, G. W. Porteous and myself, we spent all the daylight hours for some weeks on the outside work cross sectioning cuttings, measuring fencing, sidings etc. It took six weeks of office working from 9 a.m. Monday to 9 p.m. Tuesday, 9 a.m. Wednesday to 9 p.m.

Thursday and 9 a.m. Friday to 9 p.m. Saturday with 3 hourly intervals per day for meals. We took our supper with us, and ate it at about 2 a.m., when the watchman prepared us a pot of tea.

When this had been going on for about four weeks the chief had to take to his bed and Porteous and I finished the work on a Friday evening all but the totalling up.

As Porteous had done the writing out I took the papers over and commenced to fill in the totals while he sat beside me checking. When we had completed several pages I began to be suspicious—6 carry 5 umphm, 2 carry 7 umphm, 9 carry 5 umphm, you're a fool Bill umphm, you're asleep Bill umphm. He was fast asleep but went on saying umphm at the sound of my voice. I woke him up and told him we would finish the work and send it to Edinburgh on Saturday, which we did.

At that time we were using a waiting-room at the new N.B. Station as our office. When the work was nearly finished we heard footsteps on the platform alongside at about five o'clock one morning, then a knock on the door and a man entered saying that he had seen a light and looked in to see if anyone was there. He asked what we two boys were doing and when we explained, he said it was a good instance of attention to duty, and went on to explain that he had had a wire at Dundee the previous evening urging him to report on the condition of the Esk Viaduct to the authorities at Edinburgh, as soon as possible, and as it was too late to catch a passenger train he had boarded a goods train about midnight and had just arrived. I told him that was another good instance of attention to duty. This was the only occasion on which I had the pleasure of meeting the famous Sir William Arrol.

The method of arriving at the final certificate was of course entirely wrong, and since I have attained the position of chief engineer I have endeavoured to secure final amounts of every individual work during slack periods when the staff was not engaged on periodical sub-contractors' accounts or monthly certificates.

In spite of my arduous labours on this contract I found time to make many new friends and to engage in

various pastimes such as bathing, rugby football, cycling on a 54 in. bicycle, theatricals, etc.

It was here that I played my one and only cricket match. My friend, Alick Lyall, eldest brother of Bob and David Lyall, so well-known in engineering circles at home and abroad, called at my office one Saturday morning. He was Captain of the Montrose Cricket Club and wanted me to play in a match that afternoon against a team composed of medical and clerical staff with a few of the harmless patients of the Sunnyside Asylum. I told him I did not play cricket, and he went off to try elsewhere, but returned about one o'clock saying that I must come, and promised to place me in the long field and put me in last man in the batting list, I therefore went.

Sunnyside won the toss and went in first and scored 63. I had managed by some miraculous means to catch one of their big hitters, and while waiting in the tent hoped that I would not be required to bat. But when our ninth wicket fell with only 60 on the board Lyall gave me very strict instructions to block every ball as Doig was 27 not out, and could be depended on to win the game if I could hold up the other end.

I went to the wicket, saw a fast ball coming straight at me and I promptly swiped it into an adjoining hayfield. While they were hunting for the ball, I proceeded to the tent and met Lyall, but instead of congratulating me on winning the game, he rated me soundly for disobeying orders, then told me to return to the wicket as they always played the game out and said now I could do anything I liked. Again I faced the bowling and again swiped at the ball, but missed it and my stumps were sent flying, which Lyall afterwards told me ought to have happened the first time. He never forgave me and was quite annoyed when I used to tell him chaffingly that I had won the match.

My next visit to Sunnyside was when I went with another young fellow as a deputation from the Montrose Amateur Dramatic Society to ask if we could borrow the necessary scenery for a Play we were about to perform.

On arrival at the Lodge we were directed to the Superintendent's office, but he was out and we were referred to another building and again just missed him; we eventually found him and arranged to borrow the scenery on condition that we gave them a representation which as he said would be a good opportunity for a full dress rehearsal.

When we left him we had completely lost our bearings and did not know which way to turn for the lodge, but inquired from a labourer who was evidently one of the harmless patients as to which was the way out. This he considered a huge joke and laughed uproariously, but we only got the repeated remark "No, No ye canna get oot 'o here." We, however, succeeded in reaching the lodge and escaping.

My third visit was when we gave the Play and my gorgeous uniform with a heavy military moustache was evidently too much for one of the susceptible patients who endeavoured to storm the platform. But she was persuaded to sit still and again I managed to escape, but have not ventured to visit an establishment of this kind since.

CHAPTER 4.

WHITBY AND LOFTUS RAILWAY.

1881—1882.

My next move was to the Whitby and Loftus Railway which had been started by an independent company that had gone into liquidation. The line, only partially constructed, had lain derelict for some years until taken over by the North Eastern Railway Company who let the contract for its completion to John Waddell & Sons. John Waddell having meantime taken his eldest son George into partnership.

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arrived. We operated from contractors' offices at Eastrow and Hinderwell, but the central section was not far advanced, and after a few weeks at the Eastrow office, I was sent to Kettleless to take charge of the engineering on the central portion, under Percy N. Meares who then acted as contractors' agent on the whole contract. So I spent the winter of 1881-82 at this small hamlet consisting of about half-a-dozen cottages. I was able to secure a comfortable sitting-room and a bedroom with a dear old widow and used my sitting-room as an office.

On my first day there I had to give some levels in a cutting and went to the nearest squad asking the gaffer to pick out the handiest man he had. He had a look round the squad then called out "Cockney, go with the engineer." I found that Cockney was not only a useful man on outside work but was also a good arithmetician. He was able to check calculations, and continued to act as my only office assistant and chainman on this contract. He remained in my service in varying capacities for about 10 years, when he went into business on his own account, and is now back in Yorkshire in comfortable retirement. He, with my landlady and her two daughters, were my only companions for about six months of a very severe winter, except for an occasional passing visit from Meares, the contractors' agent, and Wilcox the resident engineer. So it will be understood that I had an uneventful time in contrast to the happy associations at Montrose.

The work however, was very interesting. It was my first experience in charge and there were several features which were new to me. There were no tunnels on the Montrose Railway, and although there is what is now called a tunnel between the Tay Bridge and East Station at Dundee, this had been constructed as "cut and cover" work. There were a number of heavy skew arch bridges built entirely of masonry, and the North Eastern Railway Company were very particular that they should be built correctly. This meant that I had to develop each arch and prepare templates for the masons. Fortunately the inspector had been for many years with the North Eastern Railway Company and carried his

“Nicholson” about with him while most of the masons had had experience in this class of work.

The sidings at Kettleness station yard were shewn on a 30 scale plan and I could not see how these could be provided in the limited space available, so I made a careful survey, plotted it on a 10 scale plan and tackled Wilcox about it when we found the original design had to be amended. The station buildings at Kettleness also proved a new experience, as on previous works we had had architectural assistants on the ground, and regular builders' employees while this was carried out by Civil Engineering masons, bricklayers, carpenters and labourers unaccustomed to house building. I used to visit the work early, find out any difficulties, tell the foreman that I would explain matters after breakfast, during which time I consulted my “Building Construction,” and so we were able to get on with the work. These various difficulties were very interesting and afforded good experience to a novice.

I had a thrilling experience one Saturday night which I always hesitate to relate except to those who know me well as I find that when telling it to casual acquaintances they evidently do not believe it, but I vouch for its absolute accuracy. I had been working at the Eastrow office and left there late at night to return home. As I passed the engine shed I noticed a light and went in to see if there was any chance of a lift. I found all hands had gone except the driver of a small locomotive who had just detached the ashpan and was about to draw the fire. He readily agreed to run me up to Kettleness, when we had gone about half-way the headlight suddenly shewed us a man lying on the middle of the road with a leg across one of the rails. The driver shut off steam and I jammed on the brake, but too late, as we felt a bump and heard a crunch. We jumped off the engine and ran back to find the man furiously angry with his leg completely smashed. We managed to carry him along to his hut close to the railway about half a mile further on, and got him put to bed. Fortunately it was his wooden leg that was broken, and as he had a spare one he was able to be back at work on Monday morning. But had

the ashpan not been removed he would certainly have been killed.

During such a very quiet winter it was a great joy to me to get a few days holiday, enabling me to spend Christmas and New Year's Day at home, and two incidents in this journey may be worth recording.

I had to wait about an hour at Newcastle, and strolling out of the station I spotted a heavy skew arch railway bridge. These being very much on my mind at the time I examined very carefully the obtuse angle, and when I crossed the street to examine the acute angle I found quite a crowd of people gazing up at the bridge. When I had finished my inspection the street was blocked with people gazing up at both sides of the bridge, so I left to rejoin my train. I did not get next day's copies of the Newcastle papers, so could only imagine that there might have been some startling headlines as to the stability of the bridge.

Passing through Berwick I put my head out of the window in the hope that I might hear the Scotch accent of which I had been completely deprived for about four months. But there was no one near and I had to wait until I re-booked at Waverley Station, Edinburgh, when the man in front of me said something like THURRDRET-URRNTI BURRINTEELAN, which for the benefit of my Sassenach readers I translate as Third return to Burnt Island.

CHAPTER 5.

SCARBOROUGH AND WHITBY RAILWAY.

1882—1885.

The Scarborough and Whitby was also a derelict Railway, not much work having been done before the original company failed. But another company was formed with Sir Charles Fox and Partners as engineers, and they placed the contract with John Waddell & Sons to complete the work.

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Although the distance between the two towns as the crow flies is only 16 miles, the railway was $21\frac{1}{2}$ miles long and was divided for purposes of construction into two separate sections, Muller being placed in charge of the Southern end from Scarborough to Ravenscar with an office at Scarborough, and Meares at the Northern end from Ravenscar to Whitby with an office at Whitby. My duties were mainly confined to the engineering from Ravenscar to Hawsker about eight miles, with an office at Thorpe, a village about a mile inland from Robin Hoods Bay locally known as "The Bay." So that I was again under Meares, a man of great managerial ability and boundless energy.

The most interesting work on this railway is a viaduct over the river Esk 915 ft. long, with a greatest height from bed of river to rail level of 120 ft., founded on monoliths sunk to the solid through silt with many buried trees. This is very interestingly described in Sir Francis Fox's paper, Vol. lxxxvi, page 303, Inst. C.E. Minutes. The paper also gives particulars as to how we dealt with the Beck Crossings at Fylingdales, and I recommend a perusal by my engineering readers.

My first duties were to locate and cross section the railway, check the bench marks and fix temporary bench marks along the route, and I started this from Ravenscar northwards. The first three miles down a 1 in 40 gradient was along steeply sloping and irregular ground of a treacherous nature, and the final location necessitated a large number of sharp curves to ensure that the formation would be on solid ground. As very few of the original centre line pegs were discovered, this meant a complete realignment. The next mile or so crossed four ravines averaging about 120 ft. in depth, necessitating cuttings each side of about 40 ft., and embankments of about 80 ft. with large culverts averaging about 350 ft. in length. The rest of the railway was fairly normal, and in pasture land most of the original centre line pegs were found, but in arable ground they were lost or unreliable.

I met an old Yorkshire farmer one day on a ploughed field and he asked me if I was looking for "prods" as

he had ploughed up a number but had put them all back again. But had I adopted his "prods" on this field we would have had a very crooked centre line. When I was busily engaged on the re-alignment near Ravenscar, Meares told me he wanted to start a cutting near Hawsker. This was on pasture land and he had found the old pegs on a bit of straight road, so I sent one of my assistants to take levels on these pegs. I told him to start from a B.M. on a milestone and to check on to a B.M. on a building.

He went to do this work and returning to Thorpe office in the evening I found him in trouble as his checking was two feet wrong. I told him to go back early next day and do it carefully, again telling him to be sure that he found the correct bench marks.. About midday a messenger arrived to tell me that his results were the same and as it was urgent work I went down myself. Starting from the milestone I agreed with his levels on the pegs. Then went on to the building on which was an inscription, Wesleyan Chapel built—rebuilt—. I forget the dates, but it was quite evident that the B.M. was unreliable. And when I found that it was upside down, I decided that the builder had more common sense than my assistant.

The treacherous nature of the ground south of Robin Hoods Bay is evidenced by the fact that the clay cliffs nearly 100 ft. high are gradually slipping into the sea. This meant that we had to provide a considerable drainage system of F.C. pipes and rubble filling especially along the sidelong ground near Ravenscar.

Before the railway was completed it was evident that the capital of the Company would not be sufficient to complete the work, and John Waddell & Sons entered into an agreement by which they received an increase of $33\frac{1}{2}$ per cent. on their subsequent work and undertook its completion. This they did by getting authority to issue 5 per cent. Preference Shares, which meant that the railway practically belonged to them, and they eventually appointed one of their clerical staff as secretary of the Company.

My first savings in 1884 amounting to £50 were invested in this 5 per cent. Preference Stock. From this I received £1 7s. 2d. in interest during construction, and had to wait until 1898, by which time the North Eastern Railway Company had swallowed the Scarborough and Whitby, and my share of the transaction was £15. It was a cheap lesson in finance from which I afterwards benefited.

As a large number of these shares were left in the hands of John Waddell & Sons they lost heavily, but they had saved the situation.

When the work was completed in 1885 an agreement was entered into with the North Eastern Railway Company to work the traffic. Some years later there were some considerable slips in the Ravenscar area and the working company contended that the responsibility for the upkeep lay with the owning company.

I was sent for and John and George Waddell and I interviewed their solicitors, Gordon & Falconer, Edinburgh. Gordon shook hands with John and said "Good morning Peace," then with George "Good morning War." The upshot was that I was sent back to the line to investigate and afterwards met George and Falconer (James Falconer, M.P.) in London. I explained to them that there was abundant evidence that the drainage system had not been attended to as some side drains along the tops of the slopes had got into disrepair, and others were covered with brambles and could not be examined. It was decided to call in Cripps (Lord Parmoor) who said we had a good case.

He said we would have Harold Copperthwaite, the North Eastern Railway chief engineer, and probably Sir John Wolfe Barry, their consulting engineer, against us. And although we could doubtless get Sir Douglas Fox to support us and also the government engineer who had passed the railway, he thought it better to get the best independent evidence we could secure to support our contentions. We discussed as to who was the best man and I mentioned that there had been a recent discussion by the Institution on Earthwork slips and we might be able from that to select the best man.

I spent some time that evening in studying the Minutes and found to my delight that the engineer whose views coincided exactly with ours was Copperthwaite. When I shewed this to Cripps next day he smiled and said that we need not trouble to get another witness.

We had to appear before three Railway Commissioners of whom I think Justice Wills was chairman, and Wolfe Barry was first examined. He gave very fair evidence and in cross examination did not dispute that our claim was reasonable but thought that the maintenance which they had undertaken to do should be confined to the permanent way.

When Copperthwaite was afterwards examined he was most emphatic and held that we had no case at all. Cripps asked him a few questions to establish the opinions expressed in his paper then turned to me sitting behind him. During the short pause Copperthwaite who had been looking fixedly at the Commissioners turned round and when he saw me handing Cripps the Minutes he turned as red as a beetroot and was completely upset when Cripps examined him on it.

Cripps then addressed the Court and said that he had abundant evidence that the drainage system had been neglected but he did not wish to take up the time of the Court and would merely put Sir Douglas Fox and the Government Inspector into the box to prove that the drainage had been carefully carried out and was in perfect order when the line was handed over. This only took a few minutes and the chairman summed up, and within about half an hour of Copperthwaite leaving the witness box we had secured an award in our favour.

In his summing up the chairman quoted, "Oh that mine adversary would write a book"; so that if I have any adversaries they will now have a chance to go for me.

Owing to the large number of men who were employed on the cuttings, culverts, quarry, etc., at Fylingdales it was necessary to erect huts, stables, workshops, etc., and an open space known as "The Opening" near Fyling Hall was selected for this purpose. Here Waddells also provided a Mission Room which was used as a

recreation room during the week for games of various kinds, and there was generally a sing-song on Saturday nights which helped to keep the men away from the public houses at Bay and Thorpe.

Mrs. Meares took a lively interest in this work, assisted by members of the staff and local volunteers, who supplemented the talent found among the workmen themselves, and it was altogether a very happy combination. R. H. Bicknell and I were expected to provide the comic element and I tell a story about Bicknell in Appendix B, page 102, which I must not here repeat. On one occasion Mrs. Meares called to enquire for a gaffer's wife who had become the proud mother of twins. She asked what names they were going to give them and the mother said they had thought of Clementina and Angelina. Mrs. Meares said she thought these were rather too high flown and she herself preferred the everyday names with which all were familiar. So on her next visit the mother told her they had decided to follow her advice and had therefore had them christened Aberdeen and Dundee. I sometimes wonder how these girls enjoyed their names as they grew older.

There was a very friendly atmosphere on this contract, not only with the kindly natives but also throughout the officials and employees on both sides, which is such a help in carrying out work of this kind. The Inspector of the Central Section was William Glen, referred to in *Sixty-three Years of Engineering*, by Sir Francis Fox. He was most conscientious but sadly at sea with what he called "them skeway kind of bridges," and was always most useful and willing in mission and first-aid work.

The country was lovely and when time permitted one could always get a day's shooting, hare or fox hunting, and fishing either in the streams or on the sea. The climate was most bracing as shewn by the number of summer visitors who came regularly to the Bay.

One afternoon Frank (afterwards Sir Francis) Fox called at my lodgings in Thorpe and explained that he had been working very hard, was thoroughly run down and had come to "The Bay" for a fortnight's complete

rest, but his sitting room window looked on to a blank wall and the chairs were not too comfortable. I said why not use my room while you are here? There is a very comfortable easy chair with a glorious view and there is a cherry tree on the wall from which I am permitted to take all the cherries I can reach from the window. He tried the chair, admired the view, enjoyed the cherries, then spotted the morning paper and asked how I had managed to get this as he could only get his late in the afternoon when the carriers' wagon arrived from Whitby. I told him that I had arranged with the postman to get mine with the letters in the morning and he said that was all very delightful; so I told my landlady she could expect him every day. For two days he came and expressed his great appreciation of the rest he was enjoying, but he failed to continue the cure and we discovered he was out on the cliff top with his family chasing butterflies.

Two days were quite enough to restore him, and I had the same experience some years later when I visited the Bay on holiday (after a very trying time on the Mersey Tunnel) which I planned to spend on my back by the seaside. A friend called on the Saturday evening of my arrival and told me that the Juggra was in fine condition and he had arranged to go there fishing on the following Tuesday. Would I go with him? The Juggra was some six or seven miles away across the Moors and I told him what my plans were and that such a day was out of the question. But on the Monday evening I called and arranged to meet him at seven o'clock next morning and we had a most enjoyable day.

It was at Robin Hood Bay that I found the treasure with whom I promptly fell in love. In those Victorian days it was expected that on an occasion of this kind one should burst forth into song preferably original, but those who have accompanied me so far have probably arrived at the conclusion that I am not much of an author nor can I claim to be much of a poet; still less a composer. So I borrowed two popular songs and with apologies to the poets for slightly altering the words to suit the altered conditions, I first got—

“ She is as beautiful as a butterfly
 So bright and so gay,
 Is Mary Alice Gibson
 Of Robin Hoods Bay.

This was afterwards altered by deleting the surname and re-inserting the adjective “ Pretty ” of the original song. This was followed by—

“ Twas thy voice my Gentle Mary,
 And thine artless winning way
 That has made this world an Eden,
 Bonnie Mary o’ the Bay.”

We were married shortly after I went to Birkenhead and she has been the centre of a united and happy family circle still unbroken at the dawn of 1942, when this sentence was written (but the Centre is now gone *see* page 69), including three daughters, Nellie, Elsie and Molly, two sons-in-law, Joe Lorraine and Thomas Johnston (familiarily known as Johnnie), two granddaughters, Sheila Lorraine and Patsy Johnston and three grandsons, Dick, Bob and Jeph Lorraine, all in the Army. Unfortunately the eldest, Major R. C. Lorraine, R.E., was captured at Crete and is now a prisoner of war in Germany.

“ Oh God of Bethel! by whose hand
 Thy people still are fed,
 Who through this weary pilgrimage
 Hast all our fathers led :

Our vows, our prayers, we now present
 Before Thy Throne of grace
 God of our fathers! be the God
 Of their succeeding race.”

CHAPTER 6.

MERSEY RAILWAY. 1885—1887.

When the Scarborough and Whitby Railway was practically completed I was suddenly called away to take the place of Waddell's chief assistant engineer on

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the Mersey Railway, who was seriously ill, and until his return some six months later I was engaged in carrying on his duties.

For some five years Waddells had been engaged on the construction of the Mersey Railway extending from the Lyceum Shaft at Central Station, Liverpool, to Rock Ferry Station to connect with the L.N.W. and G.W. Joint Railways. This work had been entrusted by them to James Prentice, agent, and D. A. Davidson, engineer, who had just previously completed for them the Llanelly and Myndd Mawr Railway which, like the Scarborough and Whitby Railway, had also got into financial difficulties and was now in Waddells' hands.

After the Mersey Railway from James Street, Liverpool to Rock Ferry was opened by King Edward, then Prince of Wales, on 20th January, 1886; the completion of the Central Low Level Station, Liverpool, and Extension to the Cheshire Lines railway, with Meares as agent, and the branch from Hamilton Square to Park Station, Birkenhead, connecting with the Wirral Railway with Prentice as agent, were put in hand. D. A. Davidson was engineer on both sections, while I was appointed independent engineer to measure up sub-contractors, and to measure up and check the costs of every daywork foreman on the job.

This arrangement was made because the Mersey Railway Company had run short of funds, and Waddells had undertaken to finance the Company, if given a free hand to control administration, design and construction. For this purpose they appointed James Falconer, M.P., as chairman of the Company.

This work gave me extremely useful experience in carrying out large works of very varying character efficiently and economically. The extension at the Liverpool end was almost entirely in fairly solid sandstone rock, but was complicated by the fact that the low level Central Station and Extension had to be constructed under the existing Cheshire Lines, without interfering with the traffic and with heavy restrictions as to blasting.

The Birkenhead Park branch commenced in solid sandstone rock under Hamilton Square, but in travelling

along Beckwith Street we encountered running sand and afterwards stiff clay.

Number 2 shaft worked with a winding engine and cage, was situated between Hamilton Square and the east end of Beckwith Street, along which shafts 3, 4, 5, 6 and 7 were sunk and worked with five three-ton Chaplin cranes.

It will interest my engineering and contracting readers if I give the average costs per cubic yard of excavation (mining, pumping, winding and carting away, including establishment charges). Number 2 was entirely in solid sandstone rock which could be utilised on the work and elsewhere—41,350 cu. yds. cost 6/4d. Number 3 was in mixed ground and was mostly tipped to spoil—12,750 cu. yds. cost 9/2d. Number 4 was in such bad ground owing to running sand that tunnelling was abandoned. 12in. by 6 in. P.P. piles were driven both sides and excavation was taken out from ground level. The cost of this length was very heavy and included the rebuilding and repairing of property damaged by subsidence. Number 5 was in mixed ground mostly stiff clay, which was carted to Park Station yard, and made into bricks largely used in the building of Port Sunlight—12,320 cu. yds. cost 8/7d. Number 6 was entirely in stiff clay—17,960 cu. yds. cost 6/10d. Number 7 was entirely in stiff clay—16,780 cu. yds. cost 6/3. It should be borne in mind that the work was done in 1886, when what is now called the X rate was then four pence.

This is a very good illustration of the difficulty an engineer or a contractor has in estimating the probable cost of a work of this description when the nature of the ground is uncertain, especially in a built-up area.

George Waddell frequently visited the work and on the basis of my reports fixed piecework prices as this method was adopted wherever it could be arranged. When his father came it was understood that three members of the staff should meet him as he liked a game of whist. On one of these occasions three of us met him at the Adelphi Hotel when he asked if there was a wire for him.

This was found, and he told us that he had been offered a certain sum for a block of Mersey Railway shares, but before leaving Edinburgh he had refused the offer. On

reaching Carlisle, however, he wired acceptance and this wire indicated that the offer was now £500 less and he told us to wire acceptance. We then had dinner and he afterwards lost half-a-crown at whist which worried him more than the £500 on his shares.

In addition to the main line tunnel work, we had to provide access headings, sewer diversions, etc., and it will be readily understood that as a great deal of my time was spent underground with naphtha lamp fumes and sometimes sewer gas, it was neither a pleasant nor a healthy occupation and I was not sorry when it was completed.

There was little time for recreation although I did manage to visit and enjoy the Grand National and the Waterloo Cup. My Saturday afternoons were generally spent with my wife at Birkenhead Park where we both enjoyed watching the cricket and rugby football.

As I was a keen rugger player in my youth, I have since taken a great interest in the game and have been particularly fortunate in having been settled at places where I could watch Birkenhead Park, Blackheath, Swansea, and Bristol Clubs, who have supplied many international players during the past fifty years.

At Birkenhead we saw good club, county and international matches. Perhaps the best individual three-quarter-back play I ever saw was that of A. J. Gould at Birkenhead in the Welsh-Irish International of 1887. The Park then had a very good all-round team. The names that linger in my memory are Holden, Black, Spence, Kendall, Hulme and the brothers Jackson. We thought that the Park half-backs should have represented England, but the English selectors did not then attach the same importance to combination as the Welsh selectors, and they had too many clubs to choose from and too many influences to consider.

My playing memories take me back to 1875-81. After that I lived for several years in a district where there was no rugby, and since then I have been merely a spectator.

We then played nine forwards, two quarter backs (right and left), three half-backs and one full-back. I do not

know why the naming of the backs was changed from quarter to half, and from half to threequarter, and I think the original naming was the better. This might raise an interesting discussion.

A ludicrous incident occurred one afternoon. A man called A. S. Smith, a well known regular spectator, was sitting in the front row near the centre of the stand. During the interval, in a club game, a wag sitting behind him wrote in large letters the initials A.S.S. on the back of his programme and pinned it to Smith's collar. This caused a smile among about 20 spectators nearby, but afterwards, when a try was being scored in the right-hand corner near the stand, Smith, who was rather short stood up thus exposing the placard to the left-hand spectators who began to laugh. Smith turned round to see what was up thus exposing the placard to the right-hand spectators and the whole stand joined in a roar of laughter. Smith, who was a cheery soul, caught the infection and joined in the laugh which of course caused a fresh burst of laughter. This led to a temporary stoppage of the game, the wag then took off the placard, showed it to Smith who collapsed and the game was resumed.

CHAPTER 7.

BURNTISLAND AND INVERKEITHING RAILWAY. 1887—1890.

When the Mersey Tunnel was completed, George Waddell told me that they were about to start the Burntisland and Inverkeithing Railway connection to the Forth Bridge, and said they wanted me to take full charge of the engineering, and to share in the management with his brother Bob. I suggested that this meant a rise in salary, but he told me that he thought I ought to consider myself lucky to go on at my existing figure as it was a toss-up among five men—two from the Mersey

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Tunnel, two from other contracts just completed, and myself; I therefore applied to T. A. Walker, who was then about to start the Manchester Ship Canal.

I had never met Mr. Walker, although he was, like myself, descended from Fifeshire farmers and was in fact related by marriage. He gave me an interview and agreed to my appointment as chief engineer on one of the sections, on the understanding that I would be promoted to the position of agent if he were satisfied with my qualifications after he knew me better. He gave what was an interesting opinion from a man so fully qualified to judge, that a good engineer was frequently not a good manager, and this opinion I approve after experience with my own staff.

As I was leaving the room he said "By-the-by, why are you leaving Waddell? He is a personal friend of mine and I would not put him to any inconvenience." I explained the position and he said it would be all right if I got a line from Waddell to that effect. That night I wrote a letter to Waddell which was received in Edinburgh by John Waddell who wrote to George, then in London, to return via Liverpool and fix me up for Burntisland. I then wrote explaining this to Walker, little dreaming that afterwards I would be so closely associated with his eldest daughter, Mrs. L. P. Nott and her family.

It was a great pleasure to me to return to the County where I had been brought up, and to the construction of a railway through delightful scenery, which I have always looked upon as the ideal job for a contractor's engineer, when the associations with the chief engineer and his subordinates were pleasant as they were in this case.

I was able to rent a suitable house at the charming village of Aberdour near the centre of the job, and I established my office there in one of the houses taken over by the N.B. Railway Company.

It was an interesting work with a viaduct across the streets at Burntisland, several bridges and culverts, pitched slopes to the embankments, where exposed to the river Forth, and a number of heavy cuttings mainly through Whinstone rock. Each cutting was priced at

varying rates according to the anticipated nature of the ground and to enable the contractors to arrive at a price. A few trial pits had been sunk, one of these was at the centre of a long cutting at Aberdour where rock was found a few feet below the surface. It had been estimated that this cutting, some 30 ft. deep, would be mainly in rock and was priced accordingly. But had that trial pit been sunk 20 ft. west, soft ground would have been found right down to formation level, so that about half the cutting was mainly in rock with $\frac{1}{4}$ to 1 slopes, and the other half in soft ground with $1\frac{1}{2}$ to 1 slopes; an unusual instance of a nice plum for the contractor.

My experience with skew bridges in Yorkshire helped me here, as all my masons and the inspector had been accustomed to build square and skew arches with joints parallel to the abutments, and I found it difficult to explain the requirements to them.

Motor cars and buses were then unknown, and although we had a dog cart it was not of much use to the engineering staff and walking was the rule. But an enterprising haulier at Burntisland used regularly to run a two-horse brake from there to the Forth Bridge, for the benefit of those who wished to visit the bridge during construction, and I frequently found this convenient for a lift.

On one occasion I was going from Burntisland to Aberdour and boarded this brake on which a young fellow with two lady friends were passengers. The ladies were very interested in the bridge and kept plying their companion with questions about it. But he could only explain that it was on the cantilever principle, as to which he was as much in the dark as they were. So to relieve him I said, "If you ladies will have patience for a few minutes you will be able to see the bridge as soon as we reach the top of the hill." They stood up excitedly, and reaching the top one of them exclaimed, "Oh, now I understand, it is on the switchback principle: how nice."

On another occasion I boarded the brake with some of my staff when there were no other passengers. I was sitting beside the driver when we saw the village policeman with a handcuffed prisoner. The driver asked me

if I objected to his giving them a lift. I said "certainly not." Shortly afterwards we saw a country woman waiting with a lot of parcels and stopped to take her on. The policeman opened the door at the back and got out to assist the woman. The prisoner one of our employees said, "Please excuse me madam, I would have been most happy to assist you but unfortunately my hands are tied." He was one of those happy-go-lucky chaps frequently met on public works who had lost a good position through drink and had come down to casual labour.

As to recreation, we had curling and shooting in the winter with bowling in summer. Also we had constructed a good tennis court and formed a harmonious tennis club from the staff, local enthusiasts, and summer visitors.

It was while I was on this contract that I had the honour of launching Augustine Birrell on his parliamentary career, for I took the chair at his first political meeting held in Aberdour as candidate for the representation of West Fife. Many years later he addressed a meeting at Bristol, and told the audience that he had suffered many things at the hands of many chairmen. But I do not think he had me in mind, as I recollect that my introductory remarks were very brief. He was then comparatively unknown except in literary circles, but I had read "Obiter Dicta," and after his very excellent speech I ventured to predict that within ten years he would be a Cabinet Minister.

CHAPTER 8.

LOCH KATRINE AQUEDUCT. 1891—1895.

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contract near London where about 60,000 cu. yds. of gravel would be required for ballasting and concrete work. and I visited a large gravel pit to get the cost of this. I explained to the proprietor that we would be prepared to strip the soil, lay it aside and after excavating the gravel we would level the ground and return the soil. He said he would give us a price which would include 2d. per cu. yd., as my commission. I told him I wanted a net price. He said he always allowed a commission to the agent, and his price to Waddells would include this two pence, and I could do as I pleased; evidently not believing that I would refuse to accept it.

Bob and I prepared the tender and sent it to George for his approval. He wired me to go to Edinburgh as he wished to discuss several of the prices. He pointed out that I had made a mistake in my gravel prices as I had taken one shilling instead of one and twopence. When I explained, he expressed astonishment and said this probably confirmed some suspicions he had entertained in connection with another contract he had carried out in the South. We did not secure this Railway contract. But shortly afterwards Waddells entered into a contract with the Glasgow Corporation for the Loch Chon section of the Loch Katrine aqueduct and I went there in charge with Jack Waddell, the youngest brother.

The Loch Chon section of the Loch Katrine aqueduct consists of eight straight lines commencing near the farmhouse of Frenich, some three miles south of Loch Katrine, and continuing from angle 1 to angle 7 a distance of about 3,500 yds. along the west side of Loch Chon. Then passing under Dow of Chon on the west side of Loch Dhu, about 1,050 yards to angle 8, then for about 1,450 yds under Blaruskin to angle 9 where the Duchray section starts. This, with the sections further south, were approaching completion when we commenced the Loch Chon section.

The centre line had first to be very carefully set out on the surface, and as the ground was very irregular, there being a difference of level of about 500 ft., it was necessary to have intermediate pillars erected.

At the highest point between angles 7 and 8 one tall pillar was required, and two between angles 8 and 9. These were built in masonry surrounded by walls with a wooden building on top, where a semaphore was erected. Owing to the inaccessibility of this observatory tower, donkeys were provided to carry the material to the sites.

At angles 2 and 8 stop plank chambers were provided to allow for the deviation of the water to the original aqueduct, and this gave us good base lines for transferring the centre line to the bottom, but elsewhere this was done by shafts from 30 to 80 ft. deep with base lines of about 6 ft.

When about 100 ft. of the tunnel had been completed, at the first two faces the resident engineer and I spent a Sunday fixing the permanent centre line in the tunnel. But our focus was so different that the eyepiece of the theodolite had to be constantly shifted, and as this was against accuracy, I afterwards assumed the full responsibility for fixing the lines and the result was that all the final meetings were less than an inch wrong.

Towards the end of the contract we had a visit from the Corporation Water Committee and one of them told me that the centering had been very accurate, but what he thought was more astonishing was the levelling had also been accurate. My engineering readers will of course know that the levelling was a very simple job.

On the occasion of another annual visit, an elderly member of the committee asked a gaffer if he ever found any fossils, and he replied that we did have a visit from a few once a year.

So long as the tunnel-driving was in progress I spent about half my Sundays checking and extending the centre lines and fixing the levels, as this work could not be done during the week owing to the traffic and to the tonite smoke and naphtha fumes obscuring the atmosphere.

Because of the steep cross section of the ground we were able in several cases to drive headings with a slightly rising gradient instead of shafts, and this cut out the cost of winding and pumping. At one shaft we utilised this steep slope by fixing a tank on an inclined

bogie, so adjusted that when the tank was full of water it raised the full wagon up the shaft and the empty wagon then pulled the empty tank back again.

At the Frenich end we were in conglomerate rock which was difficult to bore as the drills were inclined to jam. But there was not a great deal of this as the bulk of the work was in silurian rock, with here and there bands of whinstone, which we crushed for the concrete lining and invert of the tunnel. The excavation averaged about 12 ft. by 9 ft., and for comparison with the Mersey double-line tunnel our costs per cu. yd. were for silurian rock about 10/6, whinstone rock 11/9, conglomerate rock 13/4 with the same X rate of 4d.

The progress of the various faces was from 6 to 12 lineal yards per week working day and night.

Getting sand for the concrete work was a problem as there were no sand deposits in the neighbourhood, but this was finally solved by selecting the likeliest places on the hillside to which water pipes were laid. These delivered the water into a box covered by a sloping grating to reject stones over 1½ ins. into which the excavation was tipped. From this the water carried the remainder of the excavation down a steep 5 in. water pipe not less than 100 ft. long, to a trough covered by a sloping grating to reject stone over ½ in.; so that the sand was deposited in the trough, the gravel alongside, and the dirt was washed away with the escaping water.

As there was no accommodation in the neighbourhood except the farm buildings at Frenich, and the water inspector's house and offices at Loch Dhu, we had to erect huts and other buildings on the site, mainly at Loch Dhu, where we also built a Mission Room; but my home and office were at Aberfoyle, seven to nine miles away, where we had to put up stables for the conveyance of coal, cement, etc., to the job.

The catering for the huts at Loch Dhu and Frenich was mainly done with vans by Aberfoyle tradesmen. On one occasion when the grocer's van arrived at Frenich the women and children gathered round and a little nipper from behind his mother's apron called to another nipper of about the same age, "I'll gie you a

black e'e Jock." Jock treated this remark with silent contempt. Then "I'll gie you a bluidy nose Jock." Jock then replied "aye, and whare will I be when a' this is gaun on?" I expect this was one of the Jocks who fought so gallantly in 1914-1918 and hope he is again at the front.

There was plenty of fishing and shooting to be had here, including fox shooting as the country was too wild for foxhunting. So occasionally fox drives were arranged when the shepherds with their dogs arrived to drive the foxes, and the gamekeepers guarded the passes. On one occasion I was given the favoured pass in a very exposed situation, but as it was snowing heavily and the ground was deeply covered with snow, I got so frozen that I could not manipulate the gun and crossed over to Mack, one of the gamekeepers who had a position under the shelter of a big rock. He told me that I had the best post, but offered to exchange and went to my post where he lay down and was presently invisible under the snow, but got several shots while no fox came within my range.

When it was dark we returned to Aberfoyle where most of the gang adjourned to the Bailie Nicol Jarvie Hotel, but I went home and had a hot bath. As I was showing some friends out at my gate about the time the Bailie Nicol closed, I saw Mack and a few others going home in the condition described by Burns as "Tam was glorious o'er a' the ills o' life victorious," but when I raised my bedroom blind at seven o'clock next morning, Mack was going past with his gun on his shoulder carrying a pair of rabbits that he had shot in a nearby plantation where they had been nibbling the bark of the young trees.

We had golfing in the summer and curling in the winter which my wife told me was the only game for which I ever neglected my work, but I explained that as the tunnelling was then finished and only concrete lining was in progress, the frost prevented us from doing any work.

We had a very good Curling Club at Aberfoyle. One very severe winter we played thirteen home and away

matches against neighbouring clubs, winning twenty-five. The last was played against Loch Katrine Club. We had sent a cartload of Curling Stones on the Friday but the thaw started on Saturday morning and the ice was dull. Their side was composed chiefly of powerful gamekeepers, gillies, and shepherds who were able to select the lightest and keenest stones in their club room, and as some of our men could not get over the hog score we were badly beaten.

Aberfoyle is situated on the North bank of the Forth, but as our pond was on the south side of the river, we were reckoned as South of Scotland and I played at the annual bonspiel for the South.

After this work was completed I went to Edinburgh to prepare a tender with George Waddell for a large dock extension at Leith. When this was nearly finished he had to attend an executors' meeting and returned to tell me that the papers might be destroyed as the bank had refused to allow them to tender for any heavy contracts until the overdraft was put right. This had been raised on the security of large blocks of Myndd Mawr, Scarborough and Whitby, and Mersey Railway Shares, so I had to bid good-bye to the Waddell family with whom I had had such a happy association for over eighteen years.

The father was then dead and the three sons, who had all married remarkably charming and handsome wives, had to set to work to do the best they could with the paper capital he had left. This led to their working the Myndd Mawr Railway and Colliery whose name they anglicised to Great Mountain, now part of the "Amalgamated Anthracite" of which George's eldest son John is a director. The three sons all died some years ago. Mrs. George who is also dead used to have a joke on me. She was sitting in her drawing-room one afternoon when a recently acquired housemaid entered in an agitated manner and told her that the master had rung up from the office to say that he was bringing a Mr. Brodie home with him for dinner and to stay the night and there was not a drop of whisky in the house!

CHAPTER 9.

FRASERBURGH HARBOUR IMPROVEMENTS
1895—1896.

When it was apparent that Waddells would not be able to continue contracting for a time at least, and as a matter of fact it was a final retirement, I wrote to three friends: Sir Francis Fox and Messrs. Galbraith and Meares. Sir Francis replied that they had no vacancy but would keep me in mind. Mr. Galbraith said he would shortly be requiring a resident engineer for the London Underground and offered me the job. Mr. Meares wrote that Mr. C. J. Wills, on whose staff he then was, required a new agent for the Fraserburgh Harbour (then under construction) and I could have the appointment, offering the same salary as offered by Mr. Galbraith. I therefore wrote to Mr. Galbraith and told him that I had this offer but would prefer to get on the engineering side. He replied that Mr. Yerkes was having so much difficulty in arranging the finance that it might be a considerable time before they were able to start, and he therefore advised me to accept Mr. Wills' offer which I did. Some time later the finance was arranged for the Underground, and this position was secured and was very ably filled by the late Sir Harley Hugh Dalrymple Hay.

I therefore started work on 1st September, 1895, five days after my engagement with Waddells terminated. This gave me an overlap of five days, and as my next break was from 30th June to 1st July, 1896, I have been continuously employed since June, 1887, until now, which is very unusual for a contractors' engineer who is liable to be idle between contracts through no fault of his own.

The Fraserburgh contract had been let by Mr. George Abernethy the consulting engineer to Messrs. Price Wills & Reeves in 1894, but there was provision that the work had to be suspended during the herring-fishing season, June to September. This meant the removal

of the cofferdam about 100 ft. long, at the entrance to Balaclava tidal harbour which had been ably designed by Mr. Daniel Connery the contractors' chief engineer.

The cofferdam had been and was afterwards a very satisfactory job, but the surrounding walls of the harbour leaked badly and we required four 12 in. centrifugal pumps driven by four 25 H.P. portable steam engines to keep the harbour dry at high water. One of these walls was so unsatisfactory that we had to back it up with a high bank of sandbags, and considerable reconstruction of this wall was required.

The main work here was to deepen Balaclava harbour so as to give 7 ft. of water at spring tides for the trawlers, which had now taken the place of the sailing fishing fleet. But we also had to do a lot of underpinning, build new jetties, and also construct a new breakwater on the south side of the harbour.

The excavations were almost entirely in whinstone rock, and the work was carried on night and day so as to get it completed before the next fishing season, which we managed to accomplish.

The deepening of the harbour entailed the deepening of the entrance, under and outside the cofferdam. This was done by divers, with the assistance of a staging which was moved about by a 3 ton Scotch derrick crane on the wall, from which the shotholes were drilled at all stages of the tide, and the firing, quarrying, and filling into skips was done by the divers.

The south breakwater was built in concrete and founded at about low water level, so that we had to take advantage of all exceptional spring tides between 6 and 8 a.m. and p.m. to get this foundation in. I gave an experience on page 82 of Appendix A with reference to this foundation which I need not repeat.

When this work was nearly completed it was found that the old Balaclava breakwater foundations were giving way in places, and it was decided to erect an apron to strengthen the outer toe of the wall which was subjected to furious N.E. gales, with no protection as Captain Mackay the harbour master said, nearer than Spitzbergen. Mr. Abernethy prepared a plan for this apron,

but the resident engineer and I could not agree as to the method of construction and I decided to give in my resignation.

As I was only here from September to June there was not much time for outdoor recreation, but I carried away with me an intense appreciation of the friendliness and hospitality of the Fraserburgh people. Aberdeen has a reputation for thrift but my extensive experience is that Aberdeenshire people are the kindest I know, bringing to my mind a little book I read as a child, entitled "Warm hearts in cold regions."

CHAPTER 10.

PETERHEAD HARBOUR IMPROVEMENTS.

1896—1897.

The engineer for this work was Mr. James Barron of Aberdeen who let the contract to Mr. L. P. Nott, and on the recommendation of Mr. C. J. Wills I was appointed agent. Mr. Barron's eldest son James acted as resident engineer, and the chief inspector was Mr. Milne who had been the trustees' engineer before. With all of these gentlemen I had the most harmonious association and the work was carried out very satisfactorily.

There was remarkable similarity between this contract and that at Fraserburgh except that this excavation was in red granite. The Port Henry tidal harbour had to be deepened, the walls underpinned and new jetties erected, and there was also a new South Breakwater founded at about low water level under similar conditions to Fraserburgh. I give an experience on page 84 of Appendix A with reference to this foundation which I need not repeat.

The deepening at the entrance was more extensive than at Fraserburgh, and we also had to deepen the entrance to the existing North Harbour alongside. This

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could not be reached by a derrick crane so the divers did the boring under water with compressed air drills. Great care had to be taken to prevent the incoming fishing boats fouling the air pipes, and special instructions were issued. But on one occasion a boat fouled and cut an air pipe. Fortunately it was one of those that supplied air to the drills, and it was an astonishing sight to see this damaged pipe waving about in the air and scaring the fishermen who thought it was a sea serpent.

There was practically no leakage through the cofferdam or through the Port Henry outer wall, which had been recently well constructed, but there would have been heavy leakage through Birnies pier which separated Port Henry harbour from the North harbour.

I had however sunk a narrow trench to the rock along the centre of the pier, filling it with concrete up to low water level, and building on that foundation a thin concrete wall which gave us a watertight pier.

A 12 in. and a 9 in. pump had been provided, but the 9 in. easily dealt with the water, except when there was an easterly gale with a heavy sea. Then at high water the waves dashed over the cofferdam and occasionally over the parapet of the outer wall when both pumps had to be utilized.

I am afraid I offended the parish minister when he called at my office soon after the work started and handed me a list of local labourers whom he wanted me to engage. I told him that these men must apply to the various gaffers on the job, and explained that the gaffers engaged the labourers, that I collaborated with the walking ganger as to the engagement of the gaffers, but never interfered with the engagement of the labourers. He started to argue the point but I refused to discuss the matter.

Our walking ganger, Bill Tidswell, was a very good man. He came on the job shortly after the start of the work, under the influence of drink and I told him to go home, take a week's holiday and report to me at the end of the week. He wanted to discuss the matter but as I refused to do this he demanded his money. I then told

him that I was entitled to a week's notice, and again asked him to meet me at the end of his week's holiday. When he did report he was in a very different frame of mind and continued in my employment with very satisfactory results, for over 20 years.

He had an interesting experience when in 1908 I gave him a Bonus of £50 on a contract where he had done excellent work. He consulted a friend who was in a stockbroker's office in Liverpool as to the investment of this money. His friend gave him a list of some half a dozen companies including the Cement Combine whose £10 shares had dwindled down to about 10/-. Bill examined the list and the word "cement" decided him in its favour. About ten years later when he had started business on his own, he wanted some capital and wrote to this friend to sell at the best price he could get. Not having studied the financial news, or received any dividends, he naturally expected that he would not get much for the shares, and was astonished when he promptly received a cheque for about £750.

Most of the excavation from the harbour was conveyed by steam locomotives to back up the south breakwater. This had to be taken along the street that separated the North and South harbours from the town, and as there was a lot of cross-carting traffic, Tidswell had appointed a local sailor to control this traffic, which he did very well, and I do not remember any collision having occurred. This man had been captain of a sailing ship belonging to a local syndicate. They had been a little doubtful about him, but he was the son of the largest shareholder and they decided to risk it, sending a mate with a master's certificate with him. He was chartered to the far East and had instructions to cable on arrival. The ship was later in arriving than they had expected, but at last they saw in the *Shipping Gazette* that she had reached Yokohama. They met to consult as to what should be done, and spent a considerable time in drafting a cable, in as few words as possible, then anxiously waited for the reply which was presently received: "I am doing the grand in a foreign

land ten thousand miles away—Charlie.” They then cabled to the mate to take charge of the ship.

We had a nasty accident while deepening the harbour. I was standing on the dock wall and actually looking at one of the men working with a pick among the debris. The pick struck a frozen gelignite cartridge which exploded injuring several men, two of whom lost their eyesight.

It occasionally happens when a number of shots are being fired at the same time that one may misfire, or the firing of one may dislodge the charge of another, in which case the unexploded cartridges are exposed to the weather and may become frozen. It is the duty of the man in charge to count the number of shots fired, and if he is not satisfied that all have gone off there should be a careful examination made to find and withdraw unexploded cartridges.

In Scotland when any such accident occurs it is the duty of the Procurator-Fiscal to make an investigation and he went into it very thoroughly. As it was not known whether this shot had been charged that morning or during the night before, both gaffers were interrogated and I was relieved when he decided that it was accidental.

I was able to get a few games of golf here and also some curling, and as the Peterhead Club had entered for the Annual Bonspiel I again played there, but on this occasion I played for the North of Scotland.

When Port Henry harbour was completed there was a formal masonic opening with all the *elite* of the town present. The school children had a holiday and were lined up in the bottom of the harbour. The band played, speeches were made, and photographs taken, then we had to get everyone out before opening the sluice in the cofferdam.

After the completion we had to leave the divers working at the two entrances as a number of dangerous reefs still required levelling down, and when this was about completed I was on a cycling holiday from Swansea with my wife and visited Peterhead to arrange this matter with the harbour trustees. When I visit a job I always prefer to stay at an hotel so as to be

quite free for business meetings, and when we arrived at Peterhead we went to the Royal Hotel, engaged a room and had tea before meeting anyone, as we were quite certain that the friends we had made there during our sojourn of thirteen months would all want us to stay with them. After tea we called on one of these friends. The custom at Peterhead was to have breakfast, dinner, tea, and supper, and during this three-day visit we had two meals at the hotel and ten at ten different friends' houses. This is a good illustration of the hospitality of all the Aberdeenshire people.

PART II.

FOR THE QUALIFIED C.E. AND THE GENERAL PUBLIC.

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SWANSEA AND LLANELLY. 1897—1900.

In 1921 the Bristol Educational Authorities decided very wisely, I think, to arrange a course of addresses to the senior pupils of the secondary schools, with the object of their selecting a suitable career, and for this purpose experts from the various professions and occupations were invited to address them. My address on Civil Engineering is given in Appendix B.

This led to several interesting conversations with prospective pupils and their parents, and I felt that this address might be supplemented by a short sketch of my career and be given publicity, so that this really formed the genesis of these reminiscences.

I have now given my experiences for twenty years, and in doing so I have given particulars of the various contracts in some detail which ought to be both instructive and interesting to those really desiring to

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I have now given my experiences for twenty years, and in doing so I have given particulars of the various contracts in some detail which ought to be both instructive and interesting to those really desiring to

become Civil Engineers. If they have not been interested I advise them to turn to some other occupation.

Now I think it advisable to leave out in future those minor details which cannot be of much interest to experienced engineers and still less to the general public.

The main contracts I had to supervise at Swansea were the Prince of Wales Dry Dock, the two new entrances to the North Dock, and the new entrance lock to the South Dock with jetties in all cases; and at Llanely, the Llanely Dock and the Lleidi Reservoir.

My most vivid recollections of the work at Swansea are the cofferdams of which there were eight, averaging about 100 feet each. None of these gave serious trouble except one at the North Dock entrance which burst during my temporary absence, when the engineer I had left in charge foolishly dumped a considerable amount of concrete to fill up the opening that had been scoured out. It was not long before the water found its way round the block of concrete now set hard, which increased very greatly the work of getting the dam right again.

I was walking along the dock side at Swansea one day when I saw two friends gazing at the parapet wall on top of a high ferro-concrete building. This parapet was built with white glazed bricks with the name "Weavers Flour Mills" picked out in blue bricks. They accosted me and said they were having an argument as to the height of the letters, which one estimated at three feet and the other at ten feet, and they had thought that with my engineering eye I ought to be able to decide which of them was nearer right. I had been quietly counting the bricks and then told them that I had great difficulty in deciding, because their average was 6 ft. 6 in., whereas my estimate was 6ft. 5½ in. They laughed at my pretending to reckon to a half an inch, so I advised them to call on the manager, well known to us all, and have the letters measured: which they did, and found that my measurement was correct.

As this happened about 44 years ago I will not guarantee the wording, the colour of the bricks or the exact height, but it is a good illustration showing how one may get a good reputation. Before we parted one of them

said they had also had an argument as to whether I smoked or not, which would be an easy question to answer. I said it was easy but I could also tell them that it was Seymour who thought I smoked. This rather puzzled them and their opinion of my sagacity was still further increased. But I did not tell them that I frequently travelled down in the tram with Seymour immediately after breakfast and met the other man on the way home on the tram just before dinner, and I never smoke on an empty stomach, which advice I now pass on to my youthful readers.

I have to my horror just made a calculation that during the past 65 years I have smoked 10,000 ounces of tobacco, fortunately at an average price very much less than the $2/5\frac{1}{2}$ I paid this morning. I have only once attempted to restrict my smoking, when I decided to allow myself one ounce a week, which my youngest daughter and I used to buy on Saturday afternoons. But this was evidently too drastic, as shortly after I had a birthday and found on the breakfast table a box containing half a pound of tobacco, and on the box my two elder daughters had had the cheek to write "To dear dad who is simply unbearable on Friday evenings."

One of the disadvantages of a roving life like mine is that you lose sight of the friends of your youth. I envy the members of my club who are constantly referring to the stories of the past, as I can only remember one occasion while on holiday when I met any of my school companions, and it was therefore a great delight to me to visit Llanelly where a cousin of mine Walter Brodie lived with his elderly aunt and his two sisters. He was the Pooh Bah of Llanelly. I was invited to a dinner given to celebrate his twenty-five years as Magistrates' Clerk, and shortly afterwards to another celebration of I forget how many Assizes as Under Sheriff, at which I said I hoped ere long to help him celebrate his 1000th inquest. There stands at Llanelly a handsome Brodie Y.M.C.A. hall as a memorial to his work and that of his sisters for the benefit of the town.

This Brodie family joined with five other families one winter in holding weekly Shakespearean readings in

each other's homes. There were to have been twelve such meetings but for some reason the course was interrupted and it was early summer before the last meeting could be held. It was their turn and they decided to have a Croquet party following up with the last reading. This Croquet party was in full swing when Walter with his next door neighbour Mr. Innes, turned up. They had been engaged on some business and wished to refer to a book in his library. While doing this one of his sisters came in and after scolding them for being late, said, just come into the other room and see the various dresses of the men. One had come in evening dress which had been used at the other meetings; one had on a morning coat, one a blue serge suit and the other was in tennis costume. Shortly afterwards Innes turned up in a flaming blazer and Walter in a velvet jacket.

We appointed W. H. Haydon agent on the Llanelly work. He had previously been with me at Burntisland, and after the Llanelly work was completed he continued to act as agent on several large Dock and Railway contracts. He was an example of a good engineer with good managerial qualifications.

I visited him frequently at Llanelly in my supervising capacity, and on one of these visits I had taken my seat in the train at Swansea when the station master brought a Frenchman along, showed him into my compartment and told him to change at Landore the next station. He was evidently a nervous chap and before the train started he had asked two porters "Am I right for Lanely?" to which both replied "Yes—change at Landore." When he arrived at Landore we both changed, and after I had taken my seat again the Frenchman was brought along and placed in my compartment and assured that he was all right. But again he asked a passing porter "Am I right for Lanely" and was told "yes, all right." But as the guard was starting the train he put his head out and this time changed the query to "Is Lanely ze next stop?" The guard replied—Cocket Gowerton Loughor Llanelly. He turned to me in a dazed condition and said "did he

say it was ze first stop or it was not ze first stop?" He was greatly pleased when I told him I was going to Llanelly and would guide him to his destination.

This story should only be told by a Welshman who knows the pronunciation and intonation of the names.

After another similar visit I had to change on my return home to go and dine with friends, and found that I had lost my wallet in which I knew there was over £20. I immediately communicated with the police, the Railway Co., and my cousin Walter, and was glad to hear from him early next morning that the wallet with £22 in it had been found in an easy chair at the Stepney hotel, where I had lunched. Thus proving that the familiar poem beginning with "Taffy was a Welshman" is a libel on the Welsh nation.

Early one Saturday morning at Swansea, my foreman mason Alick Shand, told me that the local masons had decided to go on strike, the grievance being that I was employing a number of Scotch masons. It was really absurd as so much of my work was in granite and none of the local men were granite masons. I was rather upset by this but remembered that Dick Jones one of the local men was to be married that day, so I told Alick to slip along to the ship's chandlers and get a good supply of bunting and string it up as soon as possible. Jones was a very popular man, being Owen's partner at half-back for the Swansea rugger team, and I heard no more about the strike.

My home in Swansea was in Bryn Road, directly opposite the grand stand at St. Helen's where we used to watch Bancroft batting and Creber bowling, but were more interested in the rugger games as the Swansea team was one of the best in the country at that time. It was a great pleasure to watch them play, especially Bancroft at full back; Trew, Davies, Rees and Gordon at three-quarter; and the brothers James at half-back, who were succeeded by Owen and Jones after they joined the Rugby League. I consider that the brothers E. and D. James were the best half-back combination I have ever seen, and I have visited many International matches.

I travelled from Swansea to Cardiff with a friend to see the Welsh-Irish International in 1899. Beside us in the compartment were an English commercial traveller and about a dozen Welsh enthusiasts. At that time Wales was in the ascendant, and these Welshmen were intensely proud of their countrymen. They held that Wales, through Arthur Gould and others, had taught the other countries how to play the passing game, but the English commercial traveller told them that the best passing game he had ever seen was in 1877, before Gould's time.

His business took him all over the country, and as he was very keen on rugger he contrived, if possible, to spend his week-end in some town where he might expect to see a good game.

One Saturday found him in Dundee where the Institution F.P.'s were one of the best teams in the country, and on questioning the hotel porter he was told that they had had a good match arranged. But this, for some reason, had been scratched; and they had, therefore, arranged to take over a match which the Institution school team had fixed with a school team from St. Andrews. He realised that the school team would have no chance against the Institution F.P.'s, which included several Scotch internationals, but having nothing else to do went down to see the boys get a lesson and the men some practice for an approaching important match. On reaching the field he found a fair crowd present, who began chaffing the boys good naturedly. But as the game proceeded their sympathies veered round, and when it ended in a draw they gave the boys a very hearty cheer. The result, he said, was due to the combination of the boys who threw the ball about in a way that quite bewildered their opponents.

I told him his account had interested me very much as I was captain of this school team, and was proud to find that he had considered us pioneers.

CHAPTER 12.

THE MERSEY. 1900—1908.

Mr. Nott appointed me resident agent in 1900 on Canada Branch Dock No. 2 at Liverpool, and at the same time gave me supervisory charge of all his contracts, including the preparation of tenders, etc. When the Canada Dock was nearing completion he secured the contract for the Tranmere Docks, so that the same arrangement was continued until the completion of the Tranmere Docks in 1908.

These were his two largest contracts during this period, but additional work had been secured at Swansea and Llanelly, and there were a railway for the Great Central in Bucks, a breakwater at Wicklow, and other works which I had to visit from time to time.

The Canada Dock was under the charge of Mr. A. G. Lyster, with his chief assistant, Mr. Le Mesurier, and afterwards Mr. William Brodie, and his chief new works engineer Mr. Sutcliffe. Mr. Lyster kindly gave me several interesting and appreciative letters of introduction when I visited Canada in 1907, with a view to starting work there. One of the Dock Board staff who had seen these letters asked me "how did you manage to get round the chief, he always refuses to give testimonials but allows the applicants to give his name as a reference." Mr. Le Mesurier paid me the compliment of asking me if I would take W. D. Lancaster, the son of a friend of his, as a pupil, because he said he would learn more with me than at the Dock Board or any other office he knew. Mr. William Brodie and Mr. Sutcliffe were very friendly, and altogether I spent a very happy time on this contract.

Mr. Sutcliffe with whom I came more in contact was a very good practical man with a great amount of dry humour. He told me once that his age was 14, and when I ventured a doubting remark, explained that his birthday was on the 29th of February. Early in the contract I showed him my plan of campaign and took him round

the job to show him the various curves, gradients, temporary gantries, etc. He said very little, and as he was leaving I asked if he were satisfied? He laid his hand affectionately on my shoulder and said "Don't ask me a question of that kind: if I am not satisfied at any time I'll very soon let you know." On another occasion I was showing him a sample of Norwegian granite coping which he said had a very rough surface. I suggested mildly that it should not be too smooth as we did not want anyone to slip into the dock, and he replied "No, but we don't want them to trip in either."

The upper 20 feet or so of this excavation was in made ground, which we excavated with a French Navy running along on the surface, and depositing into Manchester Ship Canal pattern side-tip wagons which tipped their contents into a fleet of five steam hoppers, whence it was conveyed to the Dock Board dumping-ground outside the Bar. The remainder was good stiff clay difficult to get rid of, as it stuck in the hopper barges, so most of it was loaded by two ten-ton Wilson steam excavators into railway trucks, and hauled by us to Alexandra Dock station and despatched from there to Edge Lane five miles away, at the rate of 96 trucks, that is 4 trainloads per 24 hours by the L.N.W. Railway Company.

I had great difficulty in fixing this traffic rate with them. Lime Street quoted their minimum rate of 2/- and I offered them 6d. in owners' wagons. I had several interviews with them but got no satisfaction, and in disgust said I would take it up with Euston. I caught the first train and was not long in fixing an 8d. rate. At the conclusion of the work I had a call from a Euston representative enquiring why the traffic had been suspended, and after I had explained that the work was completed he admitted that it was the best paying job on their books.

The Bucks railway contract was not a success as we had atrocious weather with extensive flooding, and there was trouble with some of the engineering staff, but the Wicklow breakwater was again under Mr. James Barron with Mr. J. S. Young as resident, and all went well.

I should like to expatiate on the Tranmere contract, which so far as the river wall, entrances and launchway wall are concerned were again under the guidance of the Mersey Board staff; while the inner basin, graving docks, launchway yard and buildings were under Messrs. Wood & Fowler, with Mr. Somers Ellis the resident engineer. He was succeeded by Mr. A. R. Ellison for the Tranmere Bay Development Co., afterwards Cammell Laird. I would refer my readers to Minutes of Proceedings Inst.C.E., volume clxxi, page 127, where there is a very interesting paper by Mr. Somers Ellis, supplemented by myself, giving further details of the cofferdam.

My most exciting experience there was when Tidswell rang me up about one o'clock one morning asking me to come down to the job, as there was a very strong North Westerly gale blowing and the tide was rising alarmingly. I went down at once and spent two very uncomfortable hours watching the result, which is fully described in the paper mentioned above.

Some months after this I was in London, and met my old friend Meares who enquired as to the progress at Tranmere. He told me that C. J. Wills had been speaking to him about this work, and said that the newspapers had been full of praise for the work done by British contractors on the Nile Dam, but he had tendered for both jobs, and considered the Tranmere work was the boldest and most successful civil engineering contract then being carried out.

When the Tranmere work was drawing to a close and no big works were in prospect, I told Nott that I had for some time been desirous of taking a long holiday to visit my two elder brothers, Walter in Virginia and Jim in British Columbia, and he said that as work was scarce in this country why should I not combine business with pleasure and see if I could pick up a contract in Canada. This suited me very well, and in 1907 I sailed by the Allan Line to Canada calling at Quebec, Montreal, Ottawa, and Toronto, where I got in touch with Government Officials and leading Dock and Railway engineers, and found Mr. Lyster's letters of great assistance.

My brother Jim who was a doctor had recently died, a martyr to duty. He had been seriously ill with what was called Mountain fever but was convalescing in a hospital when he overheard a conversation about one of his patients who wanted him and he insisted on going to visit her, against the very urgent desires of his nurses. This meant a journey of several miles on a very cold night. He found the patient so ill that he insisted on a nurse being provided, and travelled on to get one but she was nursing some miles away. He followed on until he found her and arranged that she should go immediately to take charge of his patient. Then he set off for home but was found next day unconscious under some trees. This brought on a serious relapse with complications from which he eventually died. His widow returned to Scotland where she now has a nursing home. Their only son, Cunningham Brodie, a private in the London Scottish, was killed in September, 1916, while trying to save a wounded comrade.

I did not therefore get my hoped for visit to British Columbia, but went to Virginia, and spent a very happy holiday with my brother Walter and his wife and family. He went to Virginia about 1873, where he married Nannie, daughter of Admiral Mayo of the U.S. Navy, and had only once re-visited the old country, when he stayed a day or two with me in Yorkshire in 1883.

The business result of my visit to Canada was that Mr. and Mrs. Nott travelled to Montreal, and he took a contract for which he sent Haydon with a foreman and clerk to establish an office at Montreal and start the work.

Shortly after this, Nott and I met at Greystones, Co. Wicklow, to prepare a tender for a reservoir. While there we received a cable from Haydon explaining that the engineers for the Canadian contract had raised certain new conditions, and unless we could come to terms on these the contract would be withdrawn.

This cable was received on a Tuesday, after we had visited the site of the reservoir and we discussed the matter very fully. Nott decided that if we launched into work in Canada I would have to reside and have my

chief office at Montreal. He was prepared to place £50,000 at my disposal with full powers to run the business there. The alternative was that he would transfer his chief office from Bristol to Westminster and I would take charge there.

I told him that before leaving Liverpool on Monday morning, I had made enquiries at the Allan Line Office and found that they had a ship sailing for Canada on Friday but it was already booked up. I happened, however, to see the chief purser with whom I had travelled out before, and he said I could have his cabin if I let him know by 12 o'clock on Wednesday. I was therefore prepared to go, but we decided to sleep on it.

When we met on Wednesday morning I asked him if he had made up his mind. He said he had decided to leave the decision with me. I asked him if he wanted me to go? After some pressing he said, no. Then I said that decided the matter.

Mrs. Nott was with him and he turned to her and said that my motto was business before pleasure, but he was afraid I preferred London to Montreal. I told him he was wrong because although he was right as to my preference, I considered it my duty to do as he desired.

So ended our first attempt to secure foreign work. We did not like their methods, and at once cabled to Haydon to close down and come home to a Graving Dock contract at South Shields. I cleared up at Liverpool and went to Westminster.

CHAPTER 13.

INSTITUTION OF CIVIL ENGINEERS.

In order to relieve the monotony, I propose to turn from the historical to more general and perhaps more controversial matters, and naturally start with the "Institution of Civil Engineers" which claims to be the mother of kindred associations.

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The Institution was established 2nd January, 1818 for the "General Advancement of Mechanical Science" and has undoubtedly done an enormous amount of good work, and is at present giving great assistance to the Government in the prosecution of the war.

I became a student 31st May, 1881, an associate member 7th December, 1886, a member 4th March, 1902, and for the year 1928-29 I was chairman of the South Western and South Wales district. My address on this occasion is given in Appendix A, and to the list of names given in the last paragraph of that address I now wish to add Messrs. J. Barron, E. Box, W. Brodie, W. C. Easton, and L. S. McKenzie, who have since passed away, and perhaps the Institution will not object to my adding J. A. McPherson, who is happily still alive and well, but has definitely resigned from his engineering work as he is older than I am.

Under the heading of Arbitration in that address, I said that "the Institution of Civil Engineers has failed to agree upon a model form of conditions." This was nearly fourteen years ago, and we are still waiting, but hope that after the war is over some agreement will be arrived at satisfactory to all parties.

I have been looking through the latest list of members and reckon that there are 47 Members and 32 Associate Members older than I am, and 5 Members and 3 Associate Members the same age. These have all been transferred from Studentship, but several others were doubtless over 26 when they were elected, and you may take it that there are well over 100 above 80 years of age in the Institution, a proof of the healthiness of the profession.

During the past 55 years I have had under my charge about 200 contracts aggregating about £5,000,000, and have therefore come in close contact with about 120 chief and resident engineers. I have gone carefully through this list and have divided them up into four categories: Very Good 26, say 22%; Good 68, say 57%; Bad 16, say 13%; Very Bad 10, say 8%. This is only a small number of members, but I think it may be taken as fairly typical.

It is a great mistake for employers to imagine that if they appoint what is commonly called a strict engineer, they will get the most economical results. In tendering for work Waddell, Nott and I always took the character of the engineer into consideration and priced accordingly. If he was a "Good" man we would give him a good tender, but if he was "Very Good" we deducted about 5%, whereas if he was "Bad" we added 5%, and definitely refused to tender at all if he was "Very Bad." Of course we had to take the risk when tendering to a man whose character we did not know and could not ascertain, and we frequently did not know what resident would be appointed.

I do not propose to go into details as to the faults which relegated these 10 men into the "Very Bad" category, remembering the story which I heard while working on the Tay Bridge railway about Willie Thomson, the Tayport grave-digger. Willie was fond of a dram and was found by the local Doctor one evening lying at the roadside. The Doctor who was a strict teetotaler, roused him up and said "Oh Willie how often have I to speak to you about this fault of yours?" Willie looked up and said "Ach Doctor haud y'r tongue, mony a faut o' yours I've happit up and said naething about it."

I attended one of the Annual dinners of the Institution when I had the pleasure of sitting beside the able and genial Secretary Dr. Jeffcott. We were both rather fed up with some of the speeches, and I indicated two men present, one a Dean the other an M.P., who I thought would have been much more interesting but he said they could not invite a Dean to speak when there was a Bishop present, or an ordinary M.P. to speak in the presence of a Cabinet Minister. I also criticised the entertainment which was very high-brow and told him that we managed our Dinner better at Bristol. He admitted that the Bristol was the best of all Institution Dinners. But when I suggested that I might be able to get our entertainer Charlie Thomas to come to the next London Dinner, he appeared to be rather horrified at the idea of securing a provincial.

When the Tranmere paper was being discussed, an engineer said he had carried out several harbour works using sea-water for his concrete, and wished to know why we had required to purchase the water supply. I ventured to remind him that "The quality of Mersey is not strained," but this caught the eagle eye of the then secretary Dr. Tudsbury, and was suppressed.

I expect the Institution as a body will consider me rather frivolous, but I would remind them of the old adage "A little nonsense now and then is relished by the wisest men."

CHAPTER 14.

FEDERATION OF CIVIL ENGINEERING CONTRACTORS.

It had been felt for some time that Civil Engineering Contractors ought to combine, as it was difficult for individual contractors to deal with employers, contemporaries, and employees who were represented by combinations. The employers had the Institution of Civil Engineers, the contemporaries had Builders' and other Associations, and the employees had their various Unions.

I remember attending a meeting at the old Westminster Palace Hotel when the matter was very fully discussed. But the Meeting was not sufficiently representative, and it was felt that it would be difficult to arrange unless it was supported by the leading firms. It took some time to do this, but eventually under the able leadership of Viscount Cowdray, the Federation was formed in 1919.

It has been singularly fortunate in its choice of Officers. The Past-Presidents: Viscount Cowdray, Mr. Gerald G. Lynde, Sir Evan D. Jones, and Sir Harry F. Brand, being all men of outstanding ability. So also have been the Past-Secretaries: Messrs. E. J. Rimmer,

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K. Thomas, and J. Bryan ; and the assistance they have been able to give not only to members but to the country has been very substantial.

The present leaders, consisting of Mr. H. T. Holloway, President, and Mr. R. Kean, Secretary, are very ably continuing the excellent work of their predecessors.

As originally formed there were Members and Associates. The latter class being provided for Builders who also did Civil Engineering work. In 1937 there was a re-organisation by which all became full members, and the number is now over 500, there being very few firms of any note who are not members.

I was elected on the Council in 1929, and Chairman in 1934-35, and have ever since been one of the Vice-Presidents. In 1939 I resigned from the Council owing to increasing deafness, and my son-in-law, J. W. Lorraine, was elected to fill my place on the Council.

One of the difficulties with which the Federation has to contend is the conditions of Contract referred to in the previous chapter. This is a matter they have persistently kept to the front in negotiating with Government and other authorities. These authorities are scattered all over the country, and I am afraid that when members received their reports some may have jotted down the names of obstinate authorities along with the very bad Engineers, for consideration when preparing future tenders. In 1930 we were able to settle a " Form of Agreement and General Conditions of Contract " with the " Association of Consulting Engineers," which has been very largely accepted, and we are still hoping to get an agreement with the " Institution of Civil Engineers " that will be accepted by all.

Agreements have also had to be discussed with the various employees regarding hours of labour, rates of pay, overtime, etc., and in 1920 a Conciliation Board was formed, largely under the leadership of Sir Ernest Moir for the Federation, and Col. John Ward, Secretary of the Public Works Union, for his Union, and for about half a dozen other similar Unions. This Conciliation Board has been kept well up-to-date and is now accepted by the Government and other authorities as a Standard.

In 1920 I prepared a "Geometrical Solution of the Labour Problem" (Appendix C), which was printed in "The Dock and Harbour Authority," copies being sent to leading Members of Parliament and other financial authorities, including Mr. J. M. Keynes, whom I have pleasure in congratulating on his recent well earned Birthday Honour. The matter raised therein was largely dealt with by the subsequent Conciliation Board, but I would here point out that we have not yet dealt with the labour problem affecting Foreign Countries, who may be paying lower rates, to the detriment of our trade at large. Perhaps this can be tackled by the United Nations after the declaration of peace.

Other matters dealt with by the Federation included Demarcation between Civil Engineering contractors and builders, prevention of accidents, research work, stabilization of materials, and direct labour. This question of direct labour has been a subject of discussion for many years, and I am sure that some 20 to 25% would be saved to the long suffering ratepayers and the unfortunate shareholders, if this could be universally adopted, as contractors have better control over their employees, and they and their staffs have had public works and commercial training, and have or can secure the necessary plant. While their reputation and livelihood depend on their doing the work properly and economically. I admit, however, that there are bad contractors, but this can be rectified by employers taking care to select only those contractors on whom they can depend.

When I started work 65 years ago the navy's rate was from $\frac{2}{4}$ to $\frac{2}{8}$ per 10-hour day, and if a man was late he lost a quarter. The Builders' Operatives' Union and the Builders' Association have agreed that every individual class of employee must be paid the same rate, so that the incompetent or idle man is paid the same as the competent or industrious man, which is against common sense and also against the rule of life. The Public Works Union and the Federation contend that this should be remedied, either by subletting or by

payment of a bonus on results, which I am glad to see has now been adopted in the recent Government war-time agreements, in the settlement of which, and in many other matters the Federation has given great assistance to the various Government departments.

Had there been a similar Federation during the last war and subsequent boom, the Country would have saved enormous amounts, although they certainly recovered a good deal by Excess Profits Taxation, to which I am proud to say Mr. Nott did not require to contribute, as although he did a lot of war-work all over the Country, he insisted on its being done for actual out-of-pocket cost.

We have an Annual Meeting to which all members are invited, followed by an Annual Dinner at the Dorchester, to which we invite our engineering and other friends, and exchange compliments as well as entertain our friends. But I am afraid that this entertainment is rather low-brow. This year, however, we had a lunch for members only, followed by the Annual Meeting in the afternoon, and as this lunch had to be short the toast list was limited to "The King." After this had been enthusiastically carried, the President, Mr. H. T. Holloway, very kindly suggested that they should also drink my health as the oldest member present, which gave me great satisfaction.

I should like here to tell you a story as I am sure it would interest the Federation Members. When I was a youth in my teens I was on a cycling holiday in my native county Kincardineshire, and called on an old aunt who lived there. She persuaded me to stay the night and also to accompany her on a visit to a neighbour to meet his daughter-in-law and her little two-year-old son. When we arrived there we found that this little boy was greatly interested in a litter of newly-born pigs. A great novelty to a town bred child; and he insisted on my going to inspect them. So with one hand in his grandfather's and one hand in mine, we walked about 200 yards, and having duly admired the piglets, turned back to the house, but by this time he was tired so I

carried him home. I think I could still carry a two-year-old boy that distance, but would not like to carry that little boy who is now our illustrious and weighty Past-President, Sir Harry F. Brand.

CHAPTER 15.

WESTMINSTER. 1908—1914.

Mr. Nott having decided to remove our chief office to Westminster, we took rooms at Caxton House, and I purchased a house at Bickley where I hoped to settle down for good after thirty-one years of roving life.

My heaviest work now was the supervision of current contracts which included Wicklow Breakwater, Wick Harbour Improvements, Invergordon Oil Depot, Cromarty and Dingwall Railway, South Shields Graving Dock, Killingholme Jetty and Oil Depot, Bucks Railway, G.C.R. Blackfriars Power Station Inlet, Cardiff Reservoir, Abergele and Llandulas Widening L.N.W.R., Widnes Dock Lock, and other contracts in the Birkenhead and Bromborough area.

Mr. Nott's health was not good, but he arranged to supervise the Cardiff Reservoir contract, which he could reach with his car, and pay occasional visits to the other works. He came to Westminster frequently at first, then only rarely with Mrs. Nott when I met him at Paddington. She remained at the Station Hotel until I brought him back. He was a man of boundless energy. One day we had arranged an important interview at 2.30, but when we arrived at the appointed hour the man was out and had left a message asking us to wait as he would soon be back. I told Nott that we had had a very heavy morning, and did my best to persuade him to take a quiet rest, but his natural energy prevented relaxation, and as we had a long wait he grew more and more worried. A clear case of cause and effect. A gradual increase of the heart trouble led to his doctor

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refusing to allow him to travel at all, and we had to decide to transfer the chief office to Bristol again, in 1914, just before the war.

My supervision entailed a great amount of travelling all over the country, the worst case being Wick, which is 725 miles from London. This had to be extended occasionally to consult with Mr. Barron at Aberdeen, as he was engineer for both the Wicklow and Wick Harbour authorities.

The Wick Harbour merits a few words as it was an exceptional piece of work. I find from my diary that I visited it forty-one times during this period of six years, a total travel of about 6,000 miles.

It was constructed many years ago by James Bremner who was engineer for most of the North of Scotland Harbours in his day, and he provided a massive breakwater, as there was no shelter from the most terrific seas on the British coast which entered this converging bay.

Bremner's Breakwater which we had extended, was seriously damaged by a very heavy storm shortly before our work was completed. Fortunately our men and plant were still on the ground to temporarily fill the breach and afterwards complete the rebuilding, which of course added very considerably to the cost of the work and extended the time of completion.

About 1870 the Government decided to construct a Harbour of Refuge outside the Wick Harbour which would not only give Wick the necessary shelter but would also provide a refuge for ships passing round the North of Scotland. When this outer breakwater was partly constructed it was destroyed by a very heavy storm, and nothing further has been done, nor I am afraid will anything be done until the local M.P., Sir Archibald Sinclair, can turn his attention from the Air Ministry to some work for the benefit of his constituency. It is interesting to note that Robert Louis Stevenson gained most of his Civil Engineering experience on this Harbour of Refuge, before studying law and afterwards confining his attention to literary work.

When tendering for this work in May 1908, I visited the site. Provost Geddes the chairman and Dan Georgeson the Secretary met about a dozen contractors and entertained us to lunch at the Station Hotel.

Georgeson was a noted character, "A pawky Scot," who in his welcome address sympathized with us on the stormy condition of the weather. In my reply I thanked them for their kind reception and said how fortunate we were in getting such a beautifully fine day.

Our tender having been accepted, I again arrived at Wick in June to arrange for starting the work. Georgeson with the usual highland hospitality invited me to his house and introduced me to his mother. The lady said "I hope you know him Mr. Brodie," I said "Oh yes, Miss Georgeson, I know him all right, but in any case I should have seen at a glance that you were his daughter." She then turned to her husband "That's one for you, Dan." It was Georgeson who told me he had seventeen engineers on his Board—some of them civil.

Most of my evenings at Wick were happily spent in their home, and he and I became very good friends. One evening he told me we would be able to see more of each other as Leicester Harmsworth (Lord Rothermere) the then M.P. for the district, wanted him to go to London, and he was therefore leaving Wick. I reminded him that Caesar had said that he would rather be the first man in a village than the second man in Rome, and advised him to stay where he was which he did. I don't think he ever had any intention of leaving.

I was taken down a peg once when I stayed a night, as I frequently did, at the Royal Hotel, Inverness. I arrived late in the evening, and after a wash, remembered that on the last occasion I had omitted to note the number of my room, so looked at the door and found it was 25. This I thought I would not forget as it was my 52nd birthday. I went to the coffee-room where there was a waitress who would be described by Sir Harry Lauder as "A Bonnie Heelan Lassie." She greeted me with a smile and asked me if I remembered my number this time? I said yes, and was not likely to

forget it as the numbers on my door were the same as my age, this being my Birthday, so she could probably guess what it was. She looked at me solemnly and said she thought I must be making a mistake. I asked what she meant and she replied "We have nothing over a hundred in the house!" Who says the Scot has no sense of humour?

Another of my duties was the preparation of tenders for advertised and invitation contracts all over the country, and assisting in the promotion of various schemes, such as the Wembury Dock near Plymouth with Mr. J. M. Dobson as engineer. This was intended to be the main Transatlantic Dock most suitable for transfer of traffic to the South Western and Midland industrial areas, London and the Continent, in opposition to Fishguard and Southampton. But the Great Western and South Western Railway companies got this thrown out in the Lords. There was also a Hydraulic Power Scheme at Loch Sloy with Mr. John Ferguson as engineer (he with J. E. Harrision were the engineers of the Cromarty and Dingwall Railway). We also had a scheme for a Light Railway from Londonderry to Moville, and another for a Slob land Reclamation at Rosslare, but the war put a stop to all these ventures.

These tenders and schemes added greatly to the travelling in connection with my supervision of contracts. One night in the depth of winter, with heavy snow falling, I was waiting at the Elephant and Castle for a train to Euston, walking about well wrapt up with a rug on my arm, when I entered into conversation with an inspector who asked me if I was travelling far? I told him I was going on the longest railway journey I could take from London. He sympathised with me, and said I would probably find facilities very bad in the Highland districts. I told him I travelled a great deal and mentioned that during the previous fortnight I had been to Dover, Plymouth, Liverpool, Glasgow, and South Shields, and was now going to Wick. I therefore had experience of all the Companies so perhaps he would like me to give him my impression as to which was the worst. He said it would be very interesting, so I said I would

give the South Eastern and Chatham the lowest place, for on the previous day I had taken the 8.20 a.m. from Bickley to Victoria, and my carriage which had been standing in the open in Bickley siding overnight, had the seats and cushions covered with frost like a Christmas card. I had not dared to sit down but walked backward and forward in the compartment all the way to Victoria. Now I would have a comfortable sleeper to Inverness with a delicious breakfast handed to me at Kingussie, while at Inverness although there were no standard heating arrangements, I would get two foot-warmers which would be renewed at Bonar Bridge, where we stopped long enough to get a better plate of Scotch broth than we could procure south of the Border.

I was a good traveller, read a good deal, made temporary friends on the way, and thoroughly enjoyed good scenery, having special recollections of the Autumn Tints in the pass of Killiecrankie and on the Braes of Invershin. I had a pleasant incident one day at York when sitting in the train, and two men evidently sailors appeared to be interested in me. Presently they came across and the elder man asked me if I was Mr. Brodie? I said yes. Then he told me his son George thought he recognized me and wanted to let me know that he had kept the pledge which he had signed some twenty years ago in my Band of Hope.

We entered into negotiation for several works abroad. In Canada, British Honduras and Portugal, which I did not have time to visit, but sent my assistant engineer Percy Thomas to make surveys and report. None of these came to anything, nor did a Mexican Concession on which we engaged another cousin Walter, who had spent most of his life in Mexico, as a mining engineer on silver mines. That concession was upset by a revolution so we have never carried out any foreign contracts.

A company had been formed to salve the gold ingots and coins lost in the "Lutine" at the mouth of the Zuider Zee, but very poor progress had been made, and at a stormy meeting of shareholders it was decided to consult an expert in Cofferdam work, to see if any better results might be secured. The Chairman, Mr.

W. A. Smith, and consulting engineer Mr. Andrew Hamilton called on me and explained the position. They had secured a suitable vessel with Captain Gardiner who had previously done salvage work, and had an experienced crew of sailors and divers, the vessel had been fitted with large centrifugal pumps and appliances.

The wreck was lying in the open sea near Terschelling, in about twenty feet of water, and covered with some twelve feet of sand, but the exact position had not been definitely ascertained. After full discussion I told them they should abandon the idea of a cofferdam, but as they said some of their shareholders were sure that this was the best method, they pressed me to view the site and give my advice. I consulted Mr. Nott and visited Terschelling, meeting Hamilton and Gardiner, who were evidently capable men but over optimistic. I was soon able to convince them that a cofferdam was out of the question, and advised them to carry on their pumping more systematically by studying the tide and current, so as to create a channel that would scour and lay bare the wreck and enable the divers to get to work.

I understand that afterwards they did this and exposed the wreck, but were unable to work during rough weather in the winter months, and in the following spring it was silted up again, and lack of sufficient funds caused the work to be abandoned.

I was brought up in the Presbyterian order of worship, having been admitted to membership in my uncle's Church when I was about 18, and in travelling about have been generally fortunate in being within easy reach of a Presbyterian Church, and had been a member of eleven before going to Bickley. When no Presbyterian Church was available I had worshipped either with the Church of England or the Wesleyan Methodists of which my wife had been a member.

There has been a good deal said lately about a Union of the Churches, but I prefer the word Unity as Union means conforming to rules which might not be acceptable to all. The Brodie Coat of Arms shows a hand grasping a bunch of arrows and underneath it is the one word

Unitas, and here again I prefer to translate the word as Unity. It might illustrate Christian work, the arrows representing the various churches working in unison.

I joined the Trinity Presbyterian Church at Bromley where I was afterwards ordained an Elder by the Rev. F. W. Armstrong and through which I made quite a number of good friends. We were also very friendly with Mrs. White, our next door neighbour, and her daughter and two sons lifelong friends of the Lorraine family, and shortly after we went there another cousin Walter who had lived in London for about fifty years removed from Wimbledon to Bromley to be near us. Following the example of my father who had gone from Kincardine to Fife to be near his brother James, and of my Uncle John who went from Kincardine to South Wales to be near his brother Robert, thus adhering to the family motto.

The mention of this Walter reminds me of a story. When on a visit to my old home about 1880, my eldest sister asked me to go for a walk as she wished to visit an old bed-ridden widow whose husband had worked for our Uncle James. During the conversation she asked if we had heard lately from this Walter; we answered that we had and that he was well. She said "they tell me he's getting mairied." My sister replied "Yes," "to an English leddie." "Yes," "I dinna like them." "You mustn't say that, the English are very nice people." She raised herself up in bed and said solemnly "They tell me, Miss Brodie, that they have roast beef for dinner ivry day." This, to her mind, was great extravagance. They had raised two sons and two daughters on about 12/- a week. The sons were then head-masters of good schools, and the daughters in very responsible situations.

My father had been one of six brothers. Five had families, in each case the eldest son was called Walter after his grandfather, which is customary in many Scotch families.

I have already introduced you to four of these—from Virginia, Llanelly, Mexico, and London. My other cousins and the members of the following generations

are scattered all over the world, so characteristic of the Scottish inclination to roam.

Another friend we had here was Dr. Brookhouse, the family Doctor. I met him coming out of my house on my arrival home one Saturday afternoon and after a short chat he said "I have been coming to this house for over five years but have not yet had you through my hands." I said "I am always delighted to meet you Doctor; when you have a spare evening look in and have a smoke and a rubber, but I don't want to meet you professionally". He replied "Aha I'll get you yet." About a fortnight later I called at his home and was shewn into the consulting room. When he came in he said "Well, who is it this time?" I told him I had come on my own account. He said "I told you so." He drew in his chair, laid his hands on my knees and asked me "what is it?" I explained that I had a letter from the Bank of England containing a document that had to be witnessed by a J.P. His astonished remark was "You rascal, I've a jolly good mind to turn you out of the house."

CHAPTER 16.

BRISTOL. 1914—1942.

Shortly after our arrival in Bristol war was declared and that seriously interfered with some of our existing contracts. The Government commandeered the rails, sleepers, etc., and certain plant on the Cromarty and Dingwall Railway which of course put a stop to any further work being done during the war, and although an attempt was made to resume the project after peace was declared, the attempt was unsuccessful.

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was carried to the house of Lords, who gave a verdict in our favour by a majority of four to one.

This fight went on for about three years, 1915-18, and cost some £25,000, about four-fifths of which was borne by the Cardiff Corporation.

The average reader is not interested in the details, but I strongly advise those who are interested to peruse the legal documents which are available to the public and will be found to be most instructive.

During the first of the great wars, as I have previously indicated, Mr. Nott did a considerable amount of war-work in those districts where he had men and plant available, such as Cromarty, South Shields, Killingholme, Bristol, and Liverpool, and during the second great war we adopted a similar attitude, mostly at London, Bristol, Milford Haven, and Liverpool.

Between the wars 1918-39, we continued our usual programme, but our contracts were confined to England and Wales. Few promotion schemes were investigated, and no foreign schemes were considered, as these were generally submitted to Westminster contractors, and we had found that in most cases the stumbling block was graft. So my travelling was much restricted, especially as my three principal agents, Brebner, Lorraine and Bonner, were now directors of the firm with whom I collaborated, but they required no supervision and were able to assist me in this work.

Our contracts included Railways, Docks, Roads, Reservoirs, Pipetracks, Catchment Board Improvements, etc., all over England and Wales. Perhaps the most interesting was "The Portway," a five mile road connecting Bristol with Avonmouth Dock on which L. S. McKenzie was engineer and J. W. Lorraine was our agent. This cost the Corporation of Bristol about £800,000, part of which was done by direct labour, but our share of the work amounted to nearly half a million.

The largest cutting, at the "Horse Shoe Bend," was 2,400 feet long with a depth of 90 feet at the deepest point, for a road width including footpaths of 65 feet, containing about 360,000 cu. yds., largely in rock.

Alongside an old Roman harbour there was a viaduct over the Trym, for a similar width of roadway, consisting of six 46ft. 6in. arches with a rise of 12 feet. The abutments were founded on the rock at about 14 feet below the level of the field. Three piers were founded at about 17ft., 21 ft., and 40 ft., below field level which is 36 ft. below the coping level of the viaduct. Two other piers were founded on groups of oval monoliths composed of precast concrete blocks built up on steel shoes and sunk through silt to depths of 52 ft. and 57 ft. below field level showing a greatest depth of 93 ft. below the coping level. This was a difficult job as it was tidal. The rock was found to be very irregular and the base of each monolith had to be level throughout its complete area.

This viaduct was built of concrete faced with limestone from the Bristol end of the road, except the inner portion of the six-ring brick arch. The parapet, springers and keystones were of red Corsehill stone from Dumfriesshire.

A heavy skew girder bridge was built over the railway, the foundations being taken out inside steel sheet piling to a depth of 55 ft. below the field surface. This was of concrete faced with Winterbourne pennant stone.

At the Bristol end the road ran close to the river Avon and concrete retaining walls had to be provided for nearly 3,000 ft., but beyond that for about 450 ft. the road was carried on a ferro-concrete viaduct with 30 ft. spans. The excavation for the piers being carried out inside timber sheeting under tidal conditions to depths varying from about 10 to 25 ft.

Further on the road was carried on an embankment and owing to the treacherous nature of the ground a length of about 400 ft. of steel sheet piling, supported every 10 ft. by 12 in. by 12 in. pitch pine piles 50 ft. long, was driven to prevent the weight of the embankment forcing this treacherous ground into the river.

The Portway was originally planned with a double tram-road extending the Bristol Tramway system from Hotwells to Avonmouth Dock, but this would have entailed a considerable increase in cost, which would

have had to be borne by the Bristol Tramway Company or the Corporation, who were then negotiating with a view to taking over the Company, for which they had powers. But while these negotiations were proceeding, a proposal was brought forward to substitute rail-less buses, and a short portion of the road near the Avonmouth end was actually carried out with this idea in view. The proposal was, however, thrown out at a town's meeting and the road was afterwards completed with a tarmac surface, which the additional traffic of all kinds of vehicles during the present war, has proved to have been the best solution.

Mr. Nott succumbed to his heart trouble on 4th July, 1916, aggravated no doubt by his worry over the Cardiff arbitration and anxiety about his three sons, all officers in the 6th Gloucesters. Tom—Lt.-Col. Cameron—Captain and Adjutant, and Pat—Captain. The first to fall was Pat, on 27th April, 1916, then Tom and Cameron on 18th April, 1917. So that within a year Mrs. Nott lost her husband and three sons. She died 27th May, 1930, leaving six daughters who are all actively engaged in good works, more especially connected with welfare of youth. Jean, the eldest, succeeded her mother as Director of Nott, Brodie & Co. Ltd., representing the family.

To Mr. and Mrs. Nott and all the family I owe an immense debt of gratitude for their unfailing friendship and kindness during a period of over 46 years.

After Mr. Nott died, the business was carried on under the the title of "Exors of L. P. Nott" and after my co-executor Tom Nott was killed in 1917, I carried on as "Exor of L. P. Nott" but I did not like Mrs. Nott to have the individual responsibility, and as further capital was required I provided what was necessary and founded Nott, Brodie & Co., Limited, which was incorporated on 19th January, 1922.

I think the best testimonial I ever received was contained in a letter from the firm's bank manager, who wrote me on receipt of our annual balance sheet for 1932.

“ Considering the exceptionally difficult conditions of the past year I think you are to be warmly congratulated on the result. It has been a matter of extreme pleasure to me to see the steady progress of your undertaking and I think you are personally entitled to the greatest possible credit.”

The 14th of March, 1942, was a very sorrowful day for us all as my dear wife passed away peacefully in her sleep after nearly 56 years of very happy married life. She had suffered from heart trouble for about six years before her death, aggravated for the last 2½ years by anxiety about our three grandsons, and by a shock from a heavy bomb which exploded about 50 ft. from the house, breaking every window and doing other damage while we were sheltering in the basement.

In the Autumn of 1940 she had to give up her favourite pastime of motoring in this delightful neighbourhood, owing to the excessive daylight raids which we then had and she gradually became frailer.

For about a year before she died she was only able to take short walks on the Downs in front of our house. She read a good deal, and being unable to go to church, specially appreciated Rev. Dr. James Reid's sermons in the *British Weekly*.

This was the first break in our happy family circle, and I am unable to convey to you how much we owed to her loving care.

We had been again fortunate in having access to a Presbyterian Church, and joined “ Trinity ” of which since June, 1916, I have been treasurer, with the capable assistance as co-treasurer for the past ten years of Harry Pelley. With the help of many generous friends we have succeeded in raising the church from insolvency to a satisfactory financial position, and very good work has been carried on in all the other departments.

Another source of friendship was the Caledonian Society of which I was President in 1928. I was succeeded some years later by Sir Robert Sinclair, to whom I send hearty congratulations on his appointment to-day

as deputy in Washington to Mr. Oliver Lyttleton on the Combined Production and Resource Board.

We follow the example of Pont Street, London, in having a Caledonian Service on the nearest Sunday afternoon to St. Andrew's Day. In my year as president this was taken by Rev. Dr. Ivor Robertson, who said in his address that the family likenesses of the children of Scotland were "independence, love of freedom, a passion for knowledge, pride and glory in hard work, and a reverent fear of the Lord.

I suggested to him afterwards that he might have added "a strong sense of duty," and he agreed, but we were also agreed that those characteristics could not be claimed as universal.

In 1937, when I had completed 60 years of service, I thought it was time to retire although I rather dreaded cutting myself off from work I had so much enjoyed.

As most of the capital of the Company was held by the Nott Trustees and myself, it was rather difficult to arrange for my withdrawal, but in 1939 I was negotiating with a friend with that end in view when war was declared and I felt that I ought to carry on for the duration. These negotiations were therefore suspended and as this friend is now dead they will have to be opened up afresh with someone else upon the declaration of peace.

I now leave my house at 9, and generally get home in time to hear the 6 o'clock news during the week, and the 1 o'clock on Saturdays. But instead of the former hasty lunch, I spend some two hours at "The Bristol Club" luncheon and billiard rooms, where I have made a number of congenial friends owing to a large extent no doubt to the extreme geniality of the President and other officers of the Club.

We think we have some superlative billiard and snooker players until we get an occasional visit from Joe Davis, when I think this adjective is perhaps too superlative. These visits of Joe Davis raised about £40 each for the Red Cross fund, but Percy Warriner, our champion cueist, was not satisfied with this, so got other Bristol clubs to combine and invited Joe Davis, Gordon

Richards, Jimmy Wilde and others who with the assistance of our popular Charlie Thomas, Jerry Hunt, etc., held an entertainment at the Victoria Rooms which raised £950 for the Red Cross fund.

Some of my cheeky friends call me a slow coach but if they would alter the adjective to deliberate, I would agree with them. Like the G.O.M., I like to chew my food properly, and I also like to consider my thoughts carefully before arriving at a decision. I therefore make a poor witness or debater, and would be useless as a member of a Brains Trust, who I notice sometimes have to amend their opinions.

I suppose if it were put to the vote the late Lord Birkenhead would be near the top as a debater. I remember an occasion about 40 years ago when the Mersey Dock Board were defendants in a case that hinged on a rather intricate engineering question. Sutcliffe and I were chosen to fight the case. F. E. Smith (Lord Birkenhead) was engaged for the defence. We had a hurried consultation when we endeavoured to explain the problem to him but felt that he had not grasped our arguments, as mathematics was not his strong point. After he had given his closing speech Sutcliffe whispered "did you ever hear such rot?" I said "never." Then the Dock Board solicitor came along and whispered "wasn't F. E. magnificent?" We looked at each other, smiled, and then agreed that it was a magnificent speech. The twelve good men and true were evidently impressed as they promptly gave a verdict in our favour.

I have been blessed with very good health, having had no serious illness or accident, which I attribute largely to abstinence from alcohol, and what I call my A.B.C. theory, Ammoniated Quinine tablets, Bunters Nervine, and Chloride of Potash Pellets. These I keep in my suit-case in my dressing-room so that they are always available either at home or on my travels, for immediate application on the first symptoms of cold, toothache or sore throat.

One frequently hears a man say "I am as fit as ever," but if this is carefully considered, doubts arise. I

certainly do not hear, see or write as well as I used to, and I could not now win a mile race in 4.24 as I did at St. Andrews in 1877, when I think the amateur record was 4.20. Nor could I walk over 50 miles in a day as I did with one of my staff in 1884, on a gull nesting expedition to Flamborough Head. But I can say that I am still hale and hearty and am sometimes referred to at my club as young Brodie. As I like to keep fully occupied, this rigmarole was started more than a year ago, and has been compiled during a spare hour or two of an afternoon at my office, with frequent telephone and other interruptions so that I am afraid it is rather disjointed.

From information received from my friend Archie Powell, the popular Bristol news provider, I find that a representative Bristol Rugby Football Club was formed in 1888, and before the end of the century, Bristol had advanced to be one of the foremost clubs in England. They provided Wally Jarman as forward, and other notable international players before the 1914–1918 War, Harry Shewring, three-quarter back, Vincent Butcher, half-back, W. R. Johnston, full back, and five others.

Other notable players were Lord Caldecote, a stalwart forward in the nineties, Jimmy Oates, full back, 1896–1906, who afterwards continued to give valuable assistance to the club, and Walter Pearce, half-back, 1890–1897, who was also one of the earliest members of the Club. He subsequently held the highest office the game can confer—President of the English Rugby Football Union for three successive years, a unique honour.

When War was declared in 1914, the Bristol Club went in a body to the Recruiting Officer to offer their services, and only nine pre-war members were available for the re-opening game in 1919. They played on a temporary field, but as the Bristol area had lost about 300 rugby players, it was decided to purchase a field known as Buffalo Bill's Field, and negotiations were put in hand to equip this as a "Memorial Ground" for headquarters. This was accomplished with the great help of Sir Frank Cowlin, President, Mr. Conrad Cowlin, Treasurer, and Mr. James Tucker, Member of

Committee, who became guarantors to the bank. It was opened on 24th September, 1921, and is now one of the best playing fields in the country.

From 1919–1938 my two elder daughters and I seldom missed a Saturday afternoon watching the Club playing, either at home or at the nearest club grounds, although we did not go to South Wales, Leicester, London, or the Varsities. During this period Bristol provided for England:—

2 *Captains*—Len Corbett, Sam Tucker.

7 *Internationals*—Bunny Chantrill, Tom Brown, Reg. Pickles, Don Burland, Jimmy Barrington, G. G. Gregory, A. T. Payne.

13 *Trial Internationals*—A. S. Prowse, K. C. Kinnerley, Reg. Quick, A. W. Lillicrap, Cecil Carter, P. J. Williams, Mervyn Shaw, W. Bryant, J. N. Hazell, C. R. Murphy, R. G. Hurrell, P. Z. Henderson, J. P. Haskins.

I have not included two Internationals who gained their Caps before joining Bristol, Harold Locke (English) Birkenhead Park, and Ronnie Morris (Welsh) from Swansea.

I started to select other outstanding players, but there was such a large number it was difficult to know whom to leave out, and I thought it more discreet to omit all except Archie Hore, a thrusting forward who scored occasional tries, but was such a wonderful place kicker that in one season he scored 131 points for the club.

International rugby matches are very interesting and enjoyable, but what I enjoy most is a good club game when combination is so conspicuous. The most enjoyable game I ever saw was between Oxford University and Bristol, in 1923, when Phil Macpherson brought his team with the famous Oxford and Scottish three-quarter line to Bristol. Our three-quarter line was Quick, Corbett, Pickles and Spoor. It was a magnificent and very equal game until about ten minutes from the end when Budd, our stand off half, was injured and had to leave the field, thus breaking up the combination, after which Oxford scored the winning points.

Some years later I was on holiday at Newtonmore

which is my favourite holiday resort, and met Phil Macpherson. This is his native heath, where I suppose his forefathers "swore a feud against the Clan Mc-Tavish." I told him the last time I had seen him was at Bristol. He said "Did you see that game, it was the most enjoyable game I ever played up to the time that Budd was injured."

I have said a good deal about outside sports but not much about my indoor amusements; these consisted mostly of Billiards, Music, Dancing, Parlour Games, Bridge, Solo (with 5 or 6 present), and Patience. Here I would like to tell a story for the exclusive benefit of old folks.

About 40 years ago my wife and I had a few days holiday at West Kirby Hydro. Sitting in the lounge one evening we saw an old lady playing Patience and an elderly gentleman watching her play. She asked him if he ever played, and when he told her he had not, she said "You are laying up for yourself a weary old age." I don't think either of us had played it before but afterwards we played a good deal, and my wife frequently had a few hands before going to bed. About three months before she died, when she was very frail and her eyesight failing, she laid aside her knitting and book, and started a hand at Patience, but as she looked tired I asked her to sit aside and watch me playing Demon. After several hands she said it was rather monotonous and suggested my playing some other kind of Patience. I therefore selected Demon, Chinaman, (but with two rows of four cards instead of one row of seven,) Touching and Aces, and played these one after the other in that order: which was quite an interesting variety.

We used to play three rounds of each and I kept a record for 38 evenings, that is 114 rounds or 456 hands. We got out 18 times at Demon, 14 times at Chinaman, 23 times at Touching and once at Aces; care of course should be taken that the cards are well shuffled and cut for each hand.

I do not wish to add to the vast amount of rhetoric about the present war, beyond saying that I am sure we shall win in spite of some of the carping critics who

persist in worrying the Prime Minister in his stupendous task, to the great delight of Goebbels, the mystification of our Allies, and the deep disgust of the overwhelming majority of our people who cannot understand why, if a member has a grievance to lodge or a suggestion to make, he should not approach privately the head of the department concerned.

Some illiterate people are fond of using big words, and I give a few amusing illustrations which I have jotted down from time to time :—

Quantum sufficient.

I have had a very monotonous journey.

Wealth is not a panacea for all troubles.

Rich suffer from worry and insomnia.

The Mountains were very precipitous.

I lost my equilibrium.

Sacred and Circular Music.

Underground and subterranean passages.

Annihilated from his father.

Erect statues to perpetrate their memories.

Very picturesque scenery.

Before closing I desire to thank my present staff for their loyal and able support.

J. Brebner, 39, Engineer, Agent, Director.

J. W. Lorraine, 34, Engineer, Agent, Director.

R. Bonner, 29, Engineer, Agent, Director.

J. C. Mann, 42, Company Secretary and Accountant.

H. S. Bingham, 23, Cashier and Assistant Accountant.

The figures indicate not the age, but the length of service. Nor would I forget the foremen and subordinates who have also rendered loyal and able service. Until recently the oldest hand was Billy Harrison, who started in 1882 in Yorkshire, a nimble wagon tipper, and finished in Birkenhead a reliable gaffer. Now I think my oldest hand is Pincher, one of the old school of navvies who has been with me off and on for 45 years.

[Since these Reminiscences were placed in the hands of the Publishers, I have suffered a very sad loss in the sudden death, in an air raid, of Mr. J. C. Mann, on 28th August, 1942.

On hearing of his death our auditor rang me up to sympathise with me, and referred to Mr. Mann's extraordinary efficiency. I desire to adopt and endorse this description, adding that he was also extremely helpful and loyal not only to his employers, but also to the Nott family, to his home, and to the Redland Park Congregational Church, of which he had been an important office bearer for many years.]

APPENDIX A.

PAPER ON "SPECIFICATIONS."

*delivered as Chairman's Address at Bristol, on 9th, and
at Cardiff on 22nd November, 1928.*

I accepted the position of chairman with some feeling of hesitation because it is somewhat unusual for the Institution to confer this honour on one who throughout his whole career has been on the contractorial side of the profession, and on that account I feel that I must thank you with special cordiality for the honour you have conferred upon me.

It is usual on these occasions for the incoming chairman to take as his subject the particular branch of the profession on which he has been engaged, but my time has been fairly equally distributed on Railway, Dock, Reservoir and Road Construction and therefore I have selected the very general subject "Specifications," on which I may be able to give you some interesting personal narratives and throw some light derived from an experience extending over a period of more than fifty years.

A technical paper descriptive of any particular work is specially interesting to those engaged on similar work, but not so interesting to those who are engaged on another branch of the profession. But "Specifications" are the delight of every engineer and the bugbear of every contractor, and therefore the subject should be interesting to all, and ought to produce a thoroughly interesting and instructive discussion, and I am going to ask you to speak your minds freely and not to treat this as the usual 'presidential address' which is supposed to be faultless and therefore, above criticism.

A Specification is a document which is intended to show the ideal method of carrying out the work, and in order to arrive at the ideal method it is necessary to insert stipulations which it is not absolutely necessary to enforce. For instance, it is invariably, and quite rightly, specified that water and sand must be 'clean,' some however go to the absurd length of saying 'quite clean' or 'absolutely clean.' I have known concreting to be stopped because the water taken from a neighbouring brook had been slightly discoloured after a day's rain, and I had a resident engineer who used to come on the ground with a tumbler of pure water, place a little sand in the tumbler and expect the water to be absolutely clear after stirring it with a spoon. Again, timber is generally specified to be 'free from sap,' in some cases 'perfectly' or 'absolutely' free from sap. I am glad to say that we have some practical engineers who recognize the position. One specifies 'reasonably free from sap,' another says 'not more sap than approved by the engineer.' If all engineers would adopt this reasonable attitude there would be less trouble with contractors, but when an engineer specifies an ideal condition, especially if he emphasizes this with a dogmatic adjective, the contractor has a bad time if he gets an inexperienced resident engineer or a disgruntled inspector on the job.

A contractor should not be bound to the strict letter of the specification but to a broad and reasonable interpretation of it.

It is customary in Scotland, when inviting tenders for a contract, to fix a day when the resident engineer will take intending contractors over the ground. Coaches and luncheon are generally provided and as a rule they have a very pleasant outing, although I prefer to pay a quiet visit either before or after the official inspection. On one such occasion, during the luncheon, a very well known contractor asked the Resident to explain how some particular work was to be carried out. The Resident expressed surprise and pointed out that this was fully explained in the specification. The contractor's reply was "Good Lord! You surely don't

think I have read the specification. Any man who reads a specification before tendering will never get a contract."

So much for the general view ; and now I turn to the individual items.

Earthwork. The British Railway Engineer, as the result of great experience, specifies a uniform slope of $1\frac{1}{2}$ to 1 unless in rock or in exceptional ground where the natural angle of repose is flatter, and this $1\frac{1}{2}$ to 1 slope, in cuttings and embankments, is covered with 4 in. of soil. Before this soil is put on rubble drains are provided wherever there is moisture, and these are connected with a drain along the foot of the slope. Additional drains and ditches are provided where required, and the result is so satisfactory that there is practically no maintenance required. The Road Engineer, as a general rule, does not seem to specify any slope, takes his excavation out as steep as it will temporarily stand, does not cover it with soil, cuts his ditches with plumb sides which frequently fall in, and leaves a job which is untidy and will cause no end of future trouble and expense. The initial cost of the railway is greater, due to the increased amount of excavation and to the additional land required, but I am convinced that the Railway Engineer's policy is the better in the long run.

The question of *punning* is sometimes a cause of friction between the engineer and the contractor. In certain embankments and fillings it is customary to specify to be 'well punned' or 'well rammed.' Personally I think punning is of very little value, especially in dry weather when one boy with a hosepipe will do more good than a dozen men with rammers. The main factors in consolidation are rain, traffic and time, and as time is required I think a permanent roadway should not be constructed until the embankments have had time to consolidate. I have recently seen both concrete and tarmac roads badly distorted on new embankments, whereas if a temporary macadam road had been accepted for two or three years it could easily have been kept in repair until the bank was fit to receive a permanent covering.

Concrete. There are probably more differences of opinion about concrete than about all the other branches put together ; masonry, brickwork, steelwork, etc., have all become more or less standardised, but concrete is the engineer's cockpit and many a battle has been fought here, and many more will doubtless be fought in the future. Taking first the question of ingredients :

Stone. The maximum size specified varies from $1\frac{1}{2}$ in. to 2 in. for mass concrete, and is usually $\frac{3}{4}$ in. for ferro-concrete. Any good hard stone is usually permitted, but some engineers will not accept limestone, and on one job I was not allowed to use sandstone while for a similar job sandstone was specified although it was in a whinstone country. The question of size does not usually arise, but I had an interesting experience on an aqueduct contract. When the job was starting we had to build a small culvert to give access to the works. This entailed the provision of about 20 cu. yds. of concrete foundation, and I put a man on to break sufficient stone by hand for this. The resident engineer then drew my attention to the clause in the specification requiring that all broken stone for concrete must pass through a revolving screen with $1\frac{1}{2}$ in. holes. I pointed out that we would be engaged in tunnelling for nearly a year before we required to start the concrete lining and that I did not intend to get a crusher until then, but he insisted on the specification being rigidly adhered to and I had to purchase one at least six months before it was required. When this contract was completed I had about 100 tons of broken stone left over, which I offered to sell to the local road surveyor but he refused to purchase at any price as he would only use hand-broken stone.

The question of gravel instead of broken stone is another matter of dispute. Most engineers allow gravel, and some prefer it. I once visited the site of a reservoir to make up a tender. One of the inspectors went over the ground with me and when we reached the head of the valley, about a mile above where the dam was to be constructed, we inspected the site of a small road bridge, and as the bed of the stream was full of beautiful whinstone gravel I remarked that the concrete material for

the foundations would be easily found. He explained that the engineer would not accept gravel and would certainly insist on broken stone as specified, which meant either breaking on the site or conveying over the moor from the quarry alongside the dam. Against this you have the opinion of a well known engineer, expressed a few days ago, as follows:—"It is obviously desirable that the stone should be rounded, not angular. The strength of the concrete is improved by the use of rounded material."

Sand. In the same address this engineer says:—"It is not only unnecessary for the sand to be sharp but it is actually detrimental although such sharpness is usually specified." I agree with him that sharp sand is usually specified, and I can only remember one instance where I was allowed to use wind blown sand. The engineer in this case was one of the leading Westminster engineers and he stated his opinion to me that sand was merely an adulterant. I have had some curious experiences with the use of sand. On the aqueduct contract previously referred to the concrete was made with broken whinstone $\frac{3}{8}$ in. $1\frac{1}{2}$ in., and clean coarse pit sand was specified. As this was difficult to get I tried to get the engineer to allow me to use the screenings under $\frac{3}{8}$ in., but he absolutely refused. I made numerous experiments, and in every case I got better results from the screenings, but the contract was completed before I could convince him. I did, however, have the satisfaction of convincing him in the end, and when the next section was advertised I found that it specified the screenings and barred pit sand. Unfortunately I did not secure the next section, and on visiting the ground afterwards it was rather galling to find that the successful contractor was getting his sand from my spoil bank.

Some years ago I was preparing a tender for some Filter Beds in the North of England and found that Leighton Buzzard sand was specified. I examined the plans and documents at Westminster and said to the assistant engineer that I supposed this referred to the filtering material but he said it applied to *all* the sand to be used on the works, which included concrete

foundations, pipe coverings, fence wall, etc. I then visited the site and was told by the clerk of works that only Leighton Buzzard sand would be allowed; in fact he was then building an office with this sand although there was an excellent sand pit within half-a-mile of the job. I found that the cost of this sand delivered on the ground was nearly as much as the cost of cement.

Plums. These are generally allowed in heavy concrete work, and the distance apart varies from 3 in. to 12 in. I think that 3 in. apart and 6 in. from the face would be a satisfactory stipulation. I was once engaged on two contracts about 12 miles apart and I said to one of the engineers that I wished I could get a quarry about half-way between as I could then use all the stone as it fell. His specification was "not *larger* than a man can handle"; the other engineer specified "not *less* than 1 cwt." He asked me what on earth was the reason for this and I replied that I could not say—in fact the one specification was as great a mystery to me as the other. I had a trying experience once in the placing of plums. I was superintending the founding of a wall at low water of an exceptional spring tide, when every moment was golden. We had fixed the shuttering, got a layer of concrete on the bottom and covered this with plums stuck in on end and only required a few skip-fulls of concrete to level the wall, leaving the tops of the plums projecting to form a bond, when the resident engineer appeared and told us all stones must lie on their natural bed and we must therefore lift all the plums and relay them properly. We did so at breakneck speed and were about to cover them when the assistant resident appeared and ordered us to lift all the plums and stick them up on end. I ordered the men to proceed with the concrete and explained as politely as possible to the assistant that although his instructions exactly coincided with my original arrangements we had to obey superior orders.

Water. I have already referred to the purity of water, but a much more contentious subject is the quantity. This is a subject that does not affect the contractor very much and I prefer to leave the consulting engineers to

fight it out, merely remarking that the weight of opinion now favours as dry a mixing as possible.

Passing now to the question of *depositing concrete*. I am old enough to remember when it was specified that concrete should be deposited from barrows at a height of 20 ft. and staging had to be erected with inclined barrow roads to secure the necessary height. I think that is a thing of the past and concrete has now to be lowered into position, but there is a modern practice of using a tower with inclined chutes at varying gradients leading to the place of deposit. This is prohibited by some engineers on the ground that the mixture has to be too wet in order that it may flow, and I am inclined to agree with this.

I do not think I need say much about the question of *brickwork*, but I might mention that when an engineer specifies "in no case are joints to exceed $\frac{1}{4}$ in. in thickness" he is drawing a hard and fast line which may cause trouble.

In *masonry* the question sometimes arises as to quality of stone, uniformity of colour and character of dressing, but time will not permit me to go fully into these matters.

I do not think it is fair to make a contractor responsible for the alteration or making good of drains and other unknown works which may be discovered as the work proceeds, or to invite him to put in a price to cover this responsibility, as he has no knowledge of the conditions, whereas the engineer ought to have this knowledge and should put in a provisional sum to cover it; nor do I consider it right that the contractor should be held responsible for the design of the work. This is a matter for which the engineer should accept full responsibility.

I also think that payments should be made regularly, at stipulated periods, with provision for interest in default, but this is rarely done; in fact I had a specification before me last week which reads—"the contractors shall not be entitled to interest upon any balance which may at any time, or upon the final settlement of their account, be found to be due to them." Some employers are notoriously bad payers, generally due I think to

delay in certification. I have frequently had to wait for payments, and I can only remember one case where I have received interest; that was a case where the employers were unable to pay, and it was only after payment had been due for more than a year that an agreement was arrived at providing *in the future* for interest being paid until they were in a position to find the capital.

I ought, perhaps, to say a word about the inspectors who are appointed to see that the specification is carried out. These ought to be honourable men of mature age who have had considerable experience in the type of work which is to be carried out, and should be what is generally known as "decent fellows." The incompetent inspector is at the best an incubus; the juvenile inspector is the proverbial "pig in a poke"; the unscrupulous inspector is a serious hazard; and the cantankerous inspector is a positive danger. I was once on a railway contract on which there were a number of bridges and culverts being built by sub-contractors, where the inspector was so incompetent that for our own protection we appointed a foreman mason to give general supervision.

On a dock contract I once had two inspectors, both quite competent men, but while one was a 'decent fellow' the other was a 'grouser.' The 'decent man' came to me one day and asked if it was absolutely necessary that we should put in a certain foundation that evening as he wished to go to a son's wedding. I explained that we were bound to take advantage of the favourable spring tide, and assured him that he might safely leave us to do the work, promising to be on the ground myself to see that everything was right. I stopped on the job from 6 till 10, and when leaving, after the tide had risen, the foreman remarked that I had put in a bit of overtime and asked if I was afraid that he would take advantage of *that* inspector's absence, assuring me that I need not have been afraid as he would certainly not have done so even if I had told him to. But if it had been the other 'devil' there is no saying what he might have done. I have known inspectors

who evidently expected to be bribed. One man gave me some very broad hints when I was visiting a job. The following day I received a letter from the agent telling me that this inspector had discovered a joint fully $\frac{1}{4}$ in. thick and had ordered about 40 cu. yds. of brickwork to be pulled down and rebuilt. I appealed to the engineer, but he was a lamentably weak man and told me he could not go past the specification, which stipulated $\frac{1}{4}$ in. joints. Another inspector had a subtler method. He started raffling a pig and badgered the contractor, the staff, the sub-contractors and the merchants to take tickets. After drawing a good deal more than the value of the pig he announced that his son had drawn the winning ticket and was going to raffle it again. This time he did not get such a big contribution, and his daughter was said to have secured the pig; but further efforts on his part were unsuccessful.

On the other side, I was once asked by a foreman what allowance I made on cement bags. I asked for an explanation and he told me that his previous employer had given him 1/- a bag on all cement saved on the specification; so that it is evident that there are black sheep in both folds, but I am glad to be able to assert that I have no personal knowledge of corruption on the part of any engineer or contractor in this country. Some engineers, I think, carry this a little too far. I had it on the authority of a mutual friend, that one resident engineer who spent an afternoon in the country with me had suffered great agony simply because he would not ask me for a match.

I should like to say something in favour of Contract Work as against Direct Labour, but I am afraid this scarcely arises under the heading of 'Specifications, except that I have noticed that engineers do not always carry out their direct labour jobs to their own specifications.

The only other item I wish to refer to is *Arbitration*. The Royal Institute of British Architects, the Institution of Electrical Engineers, the Institution of Mechanical Engineers, and the Institution of Gas Engineers have

agreed with their Contractors' arbitration conditions which in all respects comply with the principles for which the Federation of Civil Engineering Contractors stands. Although our work is more hazardous than the others the Institution of Civil Engineers have failed to agree a model form of conditions, and the result is that every Civil Engineer is free to decide what form of contract he will adopt, so that you have specifications where the engineer is sole arbitrator, and others where the arbitrator is appointed, but so many things are left to the engineer that the clause is of little value. Independent arbitration is the ruling principle of commercial life and is the recognised practice in other industries, and I should have thought any engineer would have been glad to accept an arbitrator in his own interests, as there is no more invidious position for a man than to be the decisive judge of his own character ; and no matter how fair-minded a man may be, he is put in a position in which it is extremely difficult to exercise complete impartiality.

This is arguing the case from an ideal point of view, but unfortunately we do not always have ideal conditions. I grant you there are bad contractors, but there are also bad engineers, and, what is much more important, we have weak engineers who are over-ruled by domineering residents or cranky inspectors, or who are subservient to their employers ; and a man must be strong as well as fair-minded to be a good arbitrator. There is a story of the late Sir John Hawkshaw that on one occasion he presented to a Board of Directors a certificate which was considerably in excess of the original estimate. The chairman said, " I am not going to pay that amount," but Sir John turned to him quietly and said, " Excuse me, but what John Hawkshaw signs you pay."

I should like you to contrast this with an experience I once had when discussing a final certificate with an engineer who was also in the position of being sole arbitrator. We had discussed the matter for a considerable time, and I think, being at a loss for an answer to my contentions, he blurted out, " It is no use discussing this matter any further, my chairman will not give a penny more than the sum I am offering you."

If I go on much longer I am afraid you will think that I am always looking for trouble, but I can assure you such is not the case. I have had charge of about 100 contracts, representing a total outlay of about four million pounds, and I have only had arbitration on one contract. This was fought to the bitter end, and as the other party had to bear the costs you will be able to judge who was responsible.

We cannot do without specifications altogether, but they should only be used for reference and produced in cases of emergency. I recently completed a £60,000 contract for a firm of engineers. One of the partners had occasion to look through his letter book, and he remarked to the other, "Do you know that we have only written two letters to Nott, Brodie & Co. Ltd." This is what I call an ideal state of affairs and is fairly typical of the majority of the contracts I have carried out.

Of the four million pounds, three-quarters of a million had no inspector, and a further quarter of a million had neither a resident engineer nor inspector on the ground, and I am convinced that the work did not suffer in consequence of this. I can only think of two engineers that I should refuse to tender for again, but there are several others for whom I should not cut too fine. It is a mistake to suppose that the keenest engineer does the cheapest work. I remember on the completion of a railway contract that I had to get certificates of satisfaction from the local proprietors for certain private roads. One of these, who considered himself an astute man, met me on the site with a couple of men armed with picks and shovels and proceeded to test the thickness of the metalling. I managed to satisfy him, though, like the Scotsman who counted his change, he found it was 'only just right.' He remarked that if he was an engineer he was sure contractors would not make so much money. But I assured him he was mistaken because his reputation would be known and contractors would put on 5 per cent. to cover additional charges, and a further 5 per cent. as a solace for aggravation—which the employers would have to pay.

I cannot close without paying a tribute to the very estimable qualities of the great majority of the engineers under whom I have been employed. It would not be etiquette for me to mention the names of those for whom I have worked in the past and for whom I hope to work in the future, but I am justified in mentioning those who have passed away, and names which occur to me are :— Mr. W. R. Galbraith, Sir Alexander Rendle, Mr. A. G. Lister, Mr. A. O. Schenk, and our mutual friend Mr. Lashmore, for all of whom I felt a profound admiration and very sincere affection.

APPENDIX B.

ADDRESS GIVEN TO PUPILS OF SECONDARY SCHOOLS.

10TH MARCH, 1931.

The authorised definition of Civil Engineering is :—
 “The art of directing the great sources of power in nature for the use and convenience of man.” This is a concise and perhaps, rather an ornate definition, and I would amplify this by explaining that it means the surveying, levelling, designing, estimating, specifying, setting out and superintending the construction of Railways, Roads, Docks, Waterworks, Sewerage, etc. In the case of Railways and Roads it includes the construction of earth works, bridges, culverts, retaining walls, tunnels and drainage. Docks include, dock and river walls, quays, piers, breakwaters, graving docks, dock gates, sluices, cofferdams, piledriving, and dredging. Waterworks include, storage, and service reservoirs, earthen and masonry dams, filters and pipe lines. Sewerage includes sewers, outfalls, purification and

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disposal works. These entail a knowledge of masonry, brickwork, timber work, concrete and Ferro-concrete which in recent years has, to a great extent, taken the place of the other methods of construction. I do not contend that it is necessary to be a qualified mason, painter, or mechanical engineer. The foreman carpenter probably knows more about timber and the foreman fitter more about engines than you do, but you require to have sufficient knowledge of these matters to judge if the men working under you are fully qualified to carry out your instructions.

Allow me to give you one instance of Civil Engineering which must appeal to you all. Bristol with a population of about 400,000 must have a constant supply of pure water, not to mention the large quantity of water required to keep all its factories and works in operation. To provide this the Civil Engineer has to find the water, pump it into the reservoirs which he has constructed, pass it through filter beds, and convey it to every house in the city. Most of you have seen the Blagdon Reservoir and the other reservoirs, and also the filter beds at Barrow Gurney, all the work of the Civil Engineers employed by the Bristol Waterworks Company. They have recently had to go as far as Cheddar to obtain an additional supply. You have probably seen two cranes working near the Suspension Bridge, one on each side of the River Avon. These cranes have been engaged in sinking two shafts nearly 100 ft. deep and driving a tunnel underneath the river to take the pipes which bring the Cheddar water into Bristol. This tunnel was driven from both ends and in order that they should meet correctly in the centre the Civil Engineer had to give very careful directions, and the result was that when these centre lines and levels met the difference was only $\frac{1}{4}$ in., which I think you will agree was a very satisfactory result.

From all this you will see that a vast amount of knowledge has to be acquired if you are to become a fully qualified Civil Engineer. It is one of the most attractive callings for anyone with an imaginative and constructive turn of mind, and with its wide and varied

field of opportunities holds out a career full of interest and promise, but in order to succeed you must be both scientific and practical, and endowed with what is generally called common sense.

You must also have the instinct which will enable you to adapt existing means to the ends in view with a due regard to the obstacles which may be encountered. You must have a sense of proportion so that you may not lose sight of the commercial value of your work. These are the qualities that have raised Civil Engineering to the ranks of a profession and distinguished it as a calling from mere mechanical skill. The prospects of success are quite good. If you enter an Engineer's office in Westminster you cannot all become a Sir Benjamin Baker, or a Sir John Wolfe Barry, but there is no reason why you should not attain a good position as a consulting engineer. If you enter a municipal or county engineer's office there is no reason why you should not become city engineer, or county engineer and surveyor. If you enter a railway or dock engineer's office there is no reason why you should not become chief engineer in either of these branches, and there is also the chance that should you show administrative ability you may become manager as well as chief engineer.

Mr. J. C. Inglis, the Chief Engineer, became General Manager of the Great Western Railway Company and President of the Institution of Civil Engineers. Mr. Donald Matheson, the Chief Engineer became General Manager of the Caledonian Railway Co. and in our own City as you all know, Mr. Thomas Peace, Chief Engineer became General Manager to our Bristol Port Authority.

I cannot imagine any more delightful occupation than making a survey or setting out a new railway through a lovely pastoral country on a beautiful summer day, but go back to that railway six months later when the work is partly constructed, to put in a few centre pegs, you are ankle-deep in mud, you are wet to the skin and your hands are so cold that you can scarcely adjust the screws of your theodolite. But the pegs must be put in and levels taken so that the navvies can resume work when the rain stops.

There are other discomforts in the outside work of an engineer. Tunnel work, for instance, is invariably wet, and you have to put on oil skins and long rubber boots, while the air is impure owing to the perspiration from the workmen, and the fumes from explosives and lights. However, the latter is not so bad now where electric light can be used, but in the olden days, and even now where electric light is not available, the fumes from naphtha lamps and tallow candles are very objectionable. This of course is greatly increased when sewers are encountered.

Tunnels have to be visited at all times, but the bulk of the engineer's work must be carried out on Sunday when the air is comparatively clear and there is no traffic to interfere with the work of fixing centre lines and levels.

I have referred to the advantages and disadvantages of outside work, but you have somewhat similar conditions in the office. The designing of an important work is extremely interesting, but there is a good deal of drudgery in working out the details, and it frequently happens that designs, estimates, etc., are required in a hurry, which means working at high pressure and for long hours. I have often worked all night and frequently landed home with the milk in the morning.

I had an interesting experience once on a railway contract in Yorkshire (you will excuse me if I tell a few yarns, I know that young people appreciate them). My office was about a mile from my lodgings, and walking home about 4 o'clock one morning I took a short cut through one of the tunnels. As I went along singing, I noticed that the sound was very reverberant, and it struck me that it was a good opportunity to rehearse a tragic recitation which I had promised to give at a village concert on the following evening. I therefore set down my lamp and recited "Clarence's Dream" from Shakespeare's "Richard the Third," which as you probably know is very weird and eerie. It begins, "Oh, I have passed a miserable night so full of ugly sights, of ghastly dreams," and so on, and when I reached the line "Seize on him furies, take him into torment," I heard a howl in front of me. I discovered that a workman had fallen

asleep in the tunnel on the way home, and upon opening his eyes, seeing the light and hearing the voice he imagined that he had gone below, and it took me a long time to pacify him, and escort him home, vowing that he would never touch drink again as long as he lived.

On another occasion three of us were working late on an estimate that had to be submitted on the following day, two were working on the estimate while the junior was merely there to check calculations when required. During his spare time he commenced making some old newspapers into a parcel which he enclosed in a sheet of brown paper, and addressed to a parson who lived on the opposite side of the street. This parcel he deposited in the middle of the road, and kept watch on it from his seat near the window. Presently about 5 o'clock in the morning he saw a cart coming along, and we all watched to see what would happen. The driver saw the parcel, jumped out of his cart and picked it up, then carefully looked around to see if there was anyone about, and finally made up his mind to deliver the parcel at the parson's house. He rang the bell, and waited a long time until a maid appeared. They had a long conversation, but the maid evidently objected to calling her master at that early hour, and the driver proceeded on his way. Just as we were about to leave at 9 o'clock, we noticed the cart returning and the driver again stopped and rang the bell, evidently expecting a reward. The maid again appeared and after a further talk, the parson came to the door with his arms full of newspapers, which had all been opened out, and after a further talk the driver went off looking very unhappy and we all went home to breakfast.

On another occasion two of us were working late when the office door was opened and a man appeared, who introduced himself and explained that he had travelled down on a Goods train, and seeing a light in the station buildings, had looked in to see why there was a light at that time. This was the only occasion on which I met the famous engineer Sir William Arrol, who did not secure his exalted position by taking things easy as this journey of his testified.

Another serious disadvantage is the fact that the employment of young engineers is often of a temporary character. It is the practice for Engineers and Contractors to employ assistants for each particular job, and when that is completed, they are thrown out of work no matter how competent they may be.

It is therefore essential that their training and experience should be broad, in order that they may qualify by knowledge of those elements which are common to all constructional work, to take such appointments as may offer from time to time. He should also be prepared to leave home, and take up duties either at home or abroad, and here again the question of climate, etc., may be a serious disadvantage.

I have given you these few instances of the advantages and disadvantages of a Civil Engineer's life because I do not want you to adopt the profession unless it is what you would naturally like to do and what you are best qualified for.

I was constructing a railway some years ago and a friend of mine who was home on leave from somewhat similar work abroad, asked if I would show him round, and if he might bring his host with him. We spent an afternoon going over the job and my friend was deeply interested in all that he saw. The day was fine and the conditions ideal, except that the ground was soft, and therefore, if you stepped off the sleepers, you went into several inches of mud. When they were leaving me my friend thanked me profusely, and thinking his host had not shown due appreciation, he said to him, "Don't you think we have seen some very interesting work?" His reply was, "I have seen nothing but these confounded sleepers all the time." Which goes to show that if you are to be successful you must have a real interest in the work. My friend had the engineering sense and became a highly successful engineer; had his host adopted the profession he would undoubtedly have been a failure, whereas, he turned his attention to trade and is now a very wealthy man.

It is not an easy matter to decide. A good many people are under the impression that they are born

engineers. I do not know if there are any such in the Bristol City Council, but I remember doing some Harbour work in the north of Scotland where the Harbour affairs were managed by 17 trustees, all local men, fishcurers, shopkeepers, etc. At one of their meetings a member brought forward a proposal which the other members thought quite good, and passed unanimously, and accordingly the secretary wrote instructing me to carry out this work.

I knew it was a foolish thing to do, and I called on the secretary, and asked him if the matter had been referred to their engineer. He said the engineer was ill and had not been able to attend the meetings. I told him that I thought it would be better to refer it to him before I put it in hand. "My dear Sir," he said, "We have 17 Engineers on the board—some of them Civil," however, the matter was referred to the Engineer and he promptly turned it down.

Having fully considered the necessary qualifications and also the advantages and disadvantages of the profession you must now consider the course of study that has to be faced. Unlike other professions where a definite course of study must be followed there are many routes which one may follow in order to qualify as a Civil Engineer, and it is impossible to define a single course to be followed by all.

I should like to emphasize first of all the fundamental importance of passing the equivalent of a matriculation examination which for an intending engineer should include higher mathematics. Then undoubtedly the best method is to take an Engineering Course at a University, finishing up with a B.Sc. degree. While this course is being followed it is of great importance that the student should get some experience on Public Works during the vacation, so that he may be able to appreciate the theoretical training he is receiving. When he has successfully completed his University course he may, if financial conditions will admit become a pupil of one of the leading engineers, where he will get the necessary practical training. He may be required to pay a premium for a pupilage of at least three years, but there are many

engineers and contractors who would be willing to engage a B.Sc. at a commencing salary of about £100 a year.

The advantage of being a pupil is that he should be trained in the various branches of the profession, whereas if he is a salaried assistant he is liable to be kept at one particular job and thus get into a groove from which it might be difficult to escape. It may be that his theoretical training has specially fitted him for the designing of steel girders and roofing, or for Ferro-concrete construction, and having shown an aptitude in one particular line he may be kept on it all his life, and thus fail to realise his early ambition to become a qualified all-round engineer.

It is advisable that the student should be trained under a corporate member of the Institution of Civil Engineers, otherwise he is not eligible to become a student of the Institution, and the ultimate associate membership of that is the recognised Diploma for the leading appointments at home and abroad. I have sketched the method of procedure for those whose parents can afford to send them to the University; and it might here be pointed out that there are scholarships open to enable boys from the Secondary Schools to take the University course without bringing a heavy charge on their parents, but we have also to consider the case of those who cannot take this course, and must relieve their parents as soon as possible from financial assistance other than their upkeep. A likely boy might be able to get into an engineer's office where he would have facilities for practical training, but if he has only had the ordinary schooling it would be at least two years before he could expect any salary, and then he might be worth £100 a year, which is the valuation I put upon the boy who has gone through the University.

The methods of qualifying for the Engineering profession are so diversified and elastic that given the necessary aptitude, intellectual capacity and earnestness, it is possible for such a boy to qualify for corporate membership of the Institution, but it is a very difficult and uphill job.

I have studied the syllabus of the Merchant Venturers' College for Evening Classes, but although there are several classes that would be very beneficial for the Civil Engineering Student, they would not qualify him to pass the Students' examination for the Institution, and he would have to fall back on tutors or correspondence classes, the latter being the better way if the student is moving from place to place in connection with his practical training.

When the parent is unable to pay for the upkeep of the boy for the period of two years, and it is essential that he should commence earning when he leaves school, I would not recommend him to adopt this profession, although he might get work where he could qualify for certain grades of the profession. He may, for instance, get a job as tracer in an engineer's office and later become a draughtsman, or he might get a job as chainman in a surveyor's office and in time become a surveyor, or as an office boy in an engineer's office and in time become a general assistant.

Perhaps I ought to say something to boys who have not yet left school as to the studies to which they might devote special attention if they feel they would like to become Civil Engineers. It is of course essential that the education should be broad and general, indeed a literary education up to a certain point is perhaps of greater value to the engineer than to anyone else. Mathematics are of high importance in engineering, more so than in any other calling, and it may be taken as a general rule that the best mathematicians are likely to make good engineers, and those who are not well up in this subject had better try some other occupation. English subjects such as History, Geography, and Literature are also important, and if possible some knowledge of Elementary Chemistry and Physics should be obtained. He should also devote some time to drawing so that he may be able to set down on paper, objects in proper proportion and perspective. A knowledge of modern languages is also advisable, particularly French and Spanish which will be found of great use if he goes abroad.

I might be allowed to advance a few general remarks which should be applicable to every calling although perhaps more particularly to Civil Engineering. First, I would impress upon you the necessity, if you desire to succeed, that you must take a real pride and glory in your work that will ensure that you will consider both quality and quantity. I was brought up in the country where the most respected ploughman was the man who could plough a straight furrow and also willingly do a full day's work.

When I started work more than fifty years ago I really think that people took a greater interest in their work than they do now. Then, their work was their chief consideration, while sport and amusement were merely recreations—now I am afraid with a good many it is the other way round, and work is looked upon as a necessary drudgery to be got through anyhow. The law of the Universe is that the race is to the swift, and the battle to the strong, so success ought to be the reward of perseverance, energy and grit.

Secondly, I would impress upon you a strong sense of duty. If you are receiving a salary from an individual, company, or corporation that is your means of livelihood, and you are under a moral obligation to do your best for your employer. This must take precedence over all kinds of recreation no matter though the particular work you are engaged on may be monotonous or even distasteful. Do your duty, and you will be respected and trusted, but neglect your duty and you will never succeed.

I would rather employ a mediocrity whose limitations I knew than a brilliant man that I could not trust to do his duty.

Thirdly, I would strongly advise you to keep clear of alcohol. Don't touch it while you are young, and when you grow older and wiser you will probably leave it alone altogether, or you will only take it in strict moderation. My first eighteen years were spent in the employ of John Waddell, the Contractor who built the Mersey tunnel, Putney Bridge, and other important works. A few years ago I met the man who had been for many years

his secretary. We discussed old times and tried to trace the history of the Engineers who had been in that employment at the same time as myself, that is from 36 to 54 years ago. He knew them all having been in the Head Office and visiting the various Branch Offices from time to time. We jotted down fifty names in all, and after carefully tabulating them, we found that about 25 per cent. had become very successful men who might be said to have reached the top of the tree or in financial parlance "four figure men." There was Donald Matheson, already referred to, who became General Manager of the Caledonian Railway.

David Simson, Bob Lyell, and Alex. Renton, who became Chief Engineers to the Argentine Railway Companies. Archie Anderson, chief Government Engineer on the Gold Coast. T. D. Weir, who filled a similar position in Nigeria. George Porteous, Engineer in Spain to the Rio Tinto Company, and so on. The second 25 per cent. had been moderately successful, well up the tree and earning probably £500 to £1,000 a year. The third 25 per cent. comparative failures having a hard struggle to make both ends meet, partly no doubt, through incompetence but chiefly through faults which had not been conquered, and had become bad habits.

The fourth 25 per cent. were complete failures due in every case to drink—that is a rather startling statement, but you must bear in mind that the Civil Engineer frequently leaves home early, and is exposed to greater temptations than most.

I have merely given you an outline of the training that would be required. So far as special school training is concerned this must depend on the facilities that are available and the interruptions that might be caused to the regular routine of study. This no doubt differs in various schools and must be arranged with the various schoolmasters. Particulars of the University course can doubtless be secured from the different Universities, and are of course, designed to give the necessary theoretical training. I have a printed statement from the Institution which gives in general terms the requirements for the Corporate Membership of the Institution, and this I will

gladly show to any prospective student, and shall be pleased to answer any questions or grant an interview to any parent, or to any boy who wishes to become a Civil Engineer.

I will conclude my remarks with a little information and a few yarns about the men with whom you will come into contact if you adopt this profession.

The Public Works man is quite different from those engaged in somewhat similar undertakings. A main line engine driver would not feel at home on a contractor's locomotive and a house carpenter is not a suitable man for Public Works, while the real navy is in a class by himself. I have had a great deal of experience and formed a high opinion of him not only as a workman but also as a real good sort.

He is rather a rough diamond, but good hearted and always willing to assist a mate. If a navy is going round looking for a job he can always depend on a night's lodgings and a few shillings to help him on his way. I was standing talking to the timekeeper on the Glasgow aqueduct when a couple of men came along the track. They asked the gaffer for a start, but he did not require them, then they spoke to one of the men, evidently an old friend, who came over to the timekeeper and asked for a 10/- sub ticket to give them. I found that he would have less than £1 to draw for himself on the following Saturday, and I am quite sure that all his earthly possessions could be conveyed in the proverbial handkerchief.

I was walking along the street one evening at Peterhead and met an old navy who had worked with me on other contracts. "Hullo Pat," I said, "where have you come from?" "Shure," he said, "I've been working for six months on the Boddam Railway, and I thought I would come along and see could I get a job on the Dock here." I told him there would be no difficulty about that, if he could come down next morning he would find several gaffers he knew there, Hugh McCann, John Ross, etc., who would be glad to give him a start. "Ach now," says Pat, "I know them both well, and I'll be round in the morning, but shure now Mr. Brodie,

there isn't a man in all Scotland I'd sooner borrow a shilling from than yourself."

These men are not only good hearted but they are always fond of a joke. They live pretty well from hand to mouth, get paid weekly, and frequently require a sub in the middle of the week. On a Railway Contract in Yorkshire, the cashier used to go along the line on Wednesdays to sub the men. He came to a cutting where there was a big gang at work, and as he reached them he heard a man use the word "devil." "Now then, Kelly, you musn't use that word; didn't you know that the devil was dead." The rest of the men had a laugh at Kelly, then they pressed round the cashier and presented their sub tickets for him to cash. When he thought he was finished and was about to close his bag he noticed Kelly standing with a ticket in his hand. "Are you wanting a sub, Kelly?" he said. "Yes sir," says Kelly. "Come along then and let's have your ticket: what are you staring at?" "Shure, sir, I was looking at you and wondering why you were not in mourning." "Why should I be in mourning," says the cashier. "Arrah now, arn't you just after telling us that your father was dead." The laugh was now on the cashier.

Talking of subbing reminds me of another contract where there was a navvy missionary and a mission room with services on Sundays, but during the week the room was used for recreation purposes and as a rule we had a sing-song on Saturday night to keep the men out of public houses if possible. At these concerts the staff used to assist and one of the engineers was really a good comic singer and a great favourite as such. One evening, however, when we were rehearsing, this man declared that he wasn't going to make a fool of himself any longer, and he would sing a sentimental song. We tried to dissuade him as we knew he was no good as a singer, but he insisted on having his own way, got a song-book and selected a song called "Some Day." Perhaps you know it. I think it begins "I know not when the day may be," not the sort of song he should have sung, but the more we tried to dissuade him, the more determined

he was to sing it. Unfortunately he caught a very bad cold just before the concert, but even this would not stop him. His appearance on the platform was the signal for a burst of loud applause, and the men settled down for a hearty laugh as usual, but when he began "I do dott whed the day bay be," a look of bewilderment passed over their faces until he came to the refrain "Sub day, Sub day," then the cheers rang out and poor Bicknell collapsed and never tried a sentimental song again.

I was walking along a Railway Contract once with the timekeeper and we noticed an elderly man coming towards us whom we both recognised as Andrew Cameron, a gaffer who had worked with us on other contracts. We stopped to chat a bit, and presently the timekeeper said, "Last time I saw you Andrew was in Dundee one Saturday night." "Now, now, Mr. Walker," said Andrew, "This is a new contract; let us have new stories." Andrew started work there: he was a bachelor, and his sister Sarah kept house for him—a very decent old couple—they took a nice cottage with dormer windows in the roof and a rustic porch in front, and Mr. Walker the timekeeper went to lodge with them. Sarah was one of the old school and liked to lock up every night about 9 o'clock, but Mr. Walker had a sweetheart and did not go home until late which meant that Sarah had to rise and let him in. So one night when he was rather later than usual he climbed up the porch and got into his bedroom by the dormer window. This adventure being successful it was repeated, but one night when he was about to step on to the roof Sarah appeared in her nightcap and called out, "Come down you crawling creature, you go out of my house three times a day and only come in twice." This story got round and Mr. Walker was called "the crawling creature" ever afterwards.

The habit of giving nick-names is very common on Public Works where a man is named from his appearance—Slen, Fat Harry, Punch, Nobby, Darky, Ginger, Pretty Bob, etc. From his native town—Beverley Tom Bristol Bill, Coventry Charlie, and so on or from his

character—Sulky Sam, Contrary Billie. I must tell you a characteristic story about Contrary Billie. He was an old stager and one day he was deputed along with a young raw hand to empty a wagon of lime. It was a windy day and Billie knew what to expect, so he borrowed a piece of muslin from his landlady and tied it round his head. After dinner the raw hand appeared with a piece of muslin round his head so Billie took his off.

I could go on for hours telling you stories of this kind, but my time is up and I am afraid your patience is nearly exhausted.

APPENDIX C.

A GEOMETRICAL SOLUTION OF THE LABOUR PROBLEM.

THE geometrical solution of the Labour Problem (illustrated by the diagram) has been worked out with a view to securing a uniform basis applicable to every employment and every district in the country. Taking as a base line the latest pre-war rates, the following rules have been adopted:—

FIRST.—Recognising that the lower rates were not sufficient to provide anything beyond the bare necessities of life, it is proposed to curve the wages line outwards from £200 a year, so that the labourer who received 6d. an hour shall have an increase of 25 per cent., and it is proposed that this increase shall be *permanent*.

SECOND.—Recognising that the said labourer cannot economise, it is proposed to add to his pre-war rate the full percentage due to the increased cost of living, and to allow half the increased cost to the man whose pre-war rate was £5 per week; these two points are then joined by a curve tangential to the original base line. In the diagram submitted here these percentages have been

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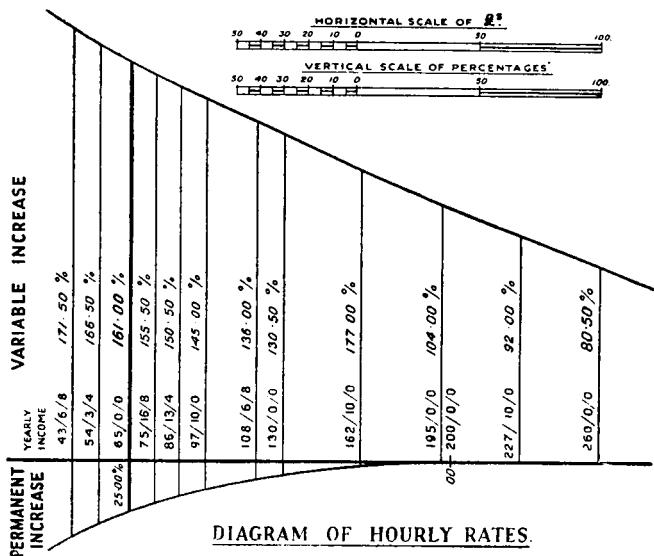
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taken at 161 and 80½, giving increases to-day of £104 13s. and £209 6s. per annum respectively, which, of course, will *fluctuate* as the cost of living rises or falls.

THIRD.—Recognising that hours ought to be reduced, it is assumed that a reduction of one hour per day, or 6 hours per week, should be agreed and allowance is made



for this in fixing the hourly rates, 50 hours per week having been assumed as the average time worked by a casual labourer throughout the year.

By adopting this solution, the proper rate can immediately be ascertained for any conceivable case, and it will be possible to secure universal agreement. At the present time, there is no systematic working. One trade is fighting another, and districts are competing against each other. The result is uneconomic confusion, which will undoubtedly lead to curtailment of enterprise and subsequent unemployment in the near future.

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There are also glaring inequalities which will certainly upset the economic balance before long. Before the war, the labourer's rate was about 6d., and the tradesman's about 9d. an hour, a difference of 50 per cent., and there was a strong inducement to youths to learn a trade. To-day the building trade are claiming rates respectively of 2s. 9d. and 3s., a difference of only 9 per cent.

HOURLY RATES.

Pre-War Rate per hour.	Permanent Increase.	Variable Increase	Increased Rate per hour (50 hour average).	Equivalent Rate per hour (44 hour average).
0 4	34-09	171-50	1 0 ³ / ₄	1 1 2 ³ / ₄
0 5	29-45	166-50	1 3	1 1 5
0 6	25-00	161-00	1 5 ¹ / ₂	1 1 7 ¹ / ₂
0 7	21-04	155-50	1 6 ¹ / ₂	1 1 10
0 8	17-44	150-50	1 9	2 0 ¹ / ₂
0 9	14-20	145-00	1 11 ¹ / ₂	2 2 ¹ / ₂
0 10	11-32	136-00	2 1	2 4
1 0	6-56	130-50	2 4 ¹ / ₂	2 3
1 3	1-87	117-00	2 8 ¹ / ₂	3 1
1 6	0-03	104-00	3 1	3 6
1 9	—	92-00	3 4	3 10
2 0	—	80-50	3 7	4 1

DAILY RATES.

Pre-War Daily Rate.	Permanent Increase.	Variable Increase.	Increased Daily Rate.
2 6	36-11	174-00	7 9 ¹ / ₂
3 0	33-00	170-00	9 1
3 6	29-50	166-00	10 4
4 0	26-00	161-50	11 6
4 6	23-00	158-00	12 8
5 0	19-59	154-50	13 8 ¹ / ₂
6 0	16-00	146-50	15 9
6 6	13-50	143-00	16 8
7 6	9-50	137-00	18 6
10 0	2-58	120-00	22 3
12 6	0-03	104-00	25 6
15 0	—	89-00	28 4
20 0	—	63-50	32 8 ¹ / ₂

WEEKLY RATES.

Pre-War Weekly Wage.	Permanent Increase.	Variable Increase.	Increased Weekly Wage.
15 0	36-11	174-00	2 2 6 6
17 6	33-12	170-50	2 13 1
1 0 0	30-27	167-50	2 19 6
1 2 6	27-56	164-00	3 5 7
1 5 0	25-00	161-00	3 11 6
1 7 6	22-58	158-00	3 17 1
1 10 0	19-59	154-50	4 2 3
1 15 0	16-11	145-50	4 11 7
2 0 0	12-43	142-50	5 2 0
2 10 0	6-56	130-50	5 18 6
3 0 0	2-58	120-00	6 13 6
4 0 0	—	99-00	7 19 2
5 0 0	—	80-50	9 0 6

YEARLY RATES.

Pre-War Yearly Wage.	Permanent Increase.	Variable Increase.	Increased Yearly Wage.
50 0 0	31-00	168-00	149 10 0
60 0 0	27-00	163-00	174 0 0
65 0 0	25-00	161-00	185 18 0
70 0 0	23-00	158-00	196 14 0
80 0 0	19-00	153-50	218 0 0
90 0 0	16-00	149-00	238 10 0
100 0 0	13-72	144-00	257 14 5
125 0 0	7-50	133-00	300 12 6
150 0 0	3-43	122-00	338 3 0
175 0 0	1-00	111-50	371 17 6
200 0 0	—	102-00	404 0 0
225 0 0	—	92-50	433 2 6
250 0 0	—	83-50	468 15 0

Under these conditions it cannot be expected that the necessary supply of tradesmen will be maintained, and with a shortage of tradesmen, there will be a super-abundance of labourers, producing a further cause of unemployment.

If we are to be saved from chaos, it can only be done by concerted action on these lines and by "pulling together," a course which will benefit equally the employer and the employed. At present enterprise is being suspended in every direction, but if economic rates can be established, confidence will be restored, prices will be regulated and prosperity will follow.

The tables on p. 105 have been worked out to show the numerical results in accordance with the diagram.