

*THROUGH LOCOMOTIVE WORKS.*

BY THE SAME AUTHOR  
—  
AN ELEMENTARY TREATISE  
ON  
THE STEAM ENGINE  
*With Questions for Examination*

—  
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Book

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THROUGH  
LOCOMOTIVE WORKS

*BEING ADVICE  
TO YOUNG MECHANICAL ENGINEERS.*

BY  
RANDAL W. McDONNELL.

AUTHOR OF  
"An Elementary Treatise on the Steam Engine."

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1894.

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TO  
R. E. L. M.

AND  
W. N. S.

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(1888-90)

## P R E F A C E .



*THIS book, which is the production of one who has gone through the trials and pleasures of work-shop experience, has been written in the hope of assisting those who intend taking up Locomotive Engineering as their profession, as well as some of the many young mechanics who are toiling in Locomotive works throughout the Kingdom.*

*R. W. McDONNELL.*

SPRINGMOUNT,

GREYSTONES,

CO. WICKLOW.

*September, 1894.*

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# THROUGH LOCOMOTIVE WORKS.



## CHAPTER I.

TO BE OR NOT TO BE.

**T**HERE is one very sad delusion which many fond parents seem to labour under when they conclude that a keen interest in the Steam Engine in their children's earlier years, a propensity for examining the interior of toys to find out how they work, coupled with unusual powers of destruction, are among the first sure signs of a future Stephenson or an Isambard Brunel. Thus it is we so often hear the expressions, "Jack is a born engineer," or

“Harry has a great mechanical career before him,” applied to boys who turn out afterwards to be most indifferent mechanics, or even clumsy men. Let me therefore warn the ardent youth who desires to follow in the footsteps of the world’s great engineers, to be quite sure that he has the *real taste* for the profession, without which success will be altogether impossible. “I often observe,” writes James Nasmyth, in his delightful autobiography, “in shop windows, every detail of model ships and model steam-engines, supplied ready made for those who are “said to be” of an ingenious and mechanical turn. Thus the vital uses of resourcefulness are done away with, and a sham exhibition of mechanical genius is paraded before you by the young imposters—the result, for the most part, of too free a supply of pocket-money. I have known too many instances of



parents led by such false evidence of constructive skill, apprenticing their sons to some engineering firm ; and, after paying vast sums, finding out that the pretender comes out of the engineering shop with no other practical accomplishment than that of cigar-smoking !”

It is a wise plan to settle upon one branch of engineering and thoroughly master that, instead of knowing a little of several. In a great many of our Engineering Schools the earnest student is taught to be a civil engineer, a mechanical engineer, an architect and a chemist all in one, which results in the yearly production of a large quantity of cardboard engineers who are able to do a little of everything, but can do nothing really well.

Should the locomotive work be decided on, it is essential to serve one's time in

fine engines are turned out; the works of the Lancashire and Yorkshire Railway at Horwich, Mr. John Aspinall, Locomotive Engineer; and at Derby the works of the Midland Railway, presided over by Mr. Johnson, besides many others works throughout Great Britain.

In Ireland there are the Inchicore Locomotive Works outside Dublin, which were brought to a state of perfection by the exertions of Mr. Alexander M'Donnell, who was locomotive engineer to the Great Southern and Western Railway for eighteen years. Mr. H. A. Ivatt is the present engineer.

It not unfrequently happens that the young Engineer is attracted by some special form of locomotive which he has observed at railway stations, and decides to serve his time at the works which produced such an engine.

## CHAPTER II.

### WHAT WORKS TO GO TO—PUPIL OR APPRENTICE.

**H**AVING made up your mind to follow the locomotive work as a profession you must first of all decide at what locomotive works you will serve your time, and secondly, whether you will enter as a pupil or an apprentice. For those living in England there is a large selection of works to choose from. There are the workshops at Crewe on the London and North Western Railway, the largest in England, where Mr. F. W. Webb, of compound locomotive fame, is the superintendent; the Doncaster works, on the Great Northern Railway, where Mr. Patrick Stirling's

All the above-mentioned work-shops are absolutely first-class.

Whatever you do be sure and avoid second-class work-shops where inferior engines are turned out. I remember the description that was once given to me by a workman who had been in the shops of one of the worst managed lines in Ireland. The chief parts of the locomotives were brought over from England and then put together, and painted and passed off, I expect, as original work. There were no overhead gantreys to lift the engines, and so a couple of days used to be occupied unwheeling one. At this rate they took about three years to make one engine, and then I suppose the Directors gave a dinner to the Shareholders in honour of the event. The narrator informed me, with a twinkle in his eye, that there was a rigidly enforced rule that no visitors were to be shown

around the "works." This struck me as the best part of the management, and showed a genuine spirit of thoughtfulness on the part of the Directors, who may possibly have concluded that to some who had seen the magnificence of Crewe, the system at Horwich, or the workmanship and cleanliness of Inchicore, the shock of inspecting their "system" might have proved too much.

One is often asked the question :— "Shall I go as a Pupil or Apprentice?" and the answer is simply this—what can you afford to expend on learning your profession? Go as a Pupil by all means if you can afford the fee, if not, you must be content to serve your time as an Apprentice.

The advantages and disadvantages are as follows :—The engineer whose pupil you are, naturally looks after and takes

an interest in you which he never would if you were only an apprentice, and is more likely to get you something to do when your time is up, though none of them, I think, absolutely promise this. A pupil may be permitted to escape coming to work in the early morning, and not appear until 9 o'clock, but under no circumstances (except in the case of recent illness) will this liberty be allowed to an apprentice. But in return for these advantages you pay £100 a year for the number of years you may be serving, and during all this time you receive no pay in return.

The apprentice on the other hand pays only about £40 for his whole apprenticeship, and receives wages to the amount of 5s. a week, increasing 2s. a week in each succeeding year, while his time is being served. To become an apprentice however, it often happens that your name

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must be a long time on the books of the Company before your turn comes to be received into the shops, while with a pupil there is no such disadvantage. You are generally allowed one month's trial in the shops before paying your fee, in case you should change your mind, and not wish to go on at the work. In order to fully serve one's time, five years is the space allotted, but many engineers consider that three years are quite enough for a diligent workman to acquire a sufficient knowledge of this branch of practical engineering.

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## CHAPTER III.

### GETTING LODGINGS, ETC.

**Y**OU can obtain lodgings near the works, either in houses belonging to the Company or in those of private individuals. The former are generally the cheapest, and the prices vary from 5s. to 14s. weekly. Try and get as near to the works as possible, for the hours given for meals are very short, and so the less walking you have to do the better. Be sure and find out if there are any children in the house, and if so, flee away. Children make a noise when you want to read in the evening, and when you are away in the daytime they



crawl up to your room, turn everything upside down, and have doll's tea parties with the things in your cupboard. So take my advice and avoid houses containing children. Having found suitable lodgings, your next step will be to procure your "working clothes," which are more generally known by the name of "slops." The suit I would recommend would be a pair of white linen trousers, worn over an ordinary pair, and a blue serge jacket and waistcoat, with a thick flannel shirt underneath. As the white trousers and blue jacket will not remain spotless long, a clean change will be required at the end of each week; so get two sets of "slops," and have them made a little too large for you at first, as they will shrink considerably afterwards in the washing.

When making these purchases you might also procure a good loud alarum

clock and a methylated spirit lamp and small kettle in which a tea-cup full of water may be boiled in a few minutes. The use of these last two purchases will be shown in the following chapter.

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## CHAPTER IV.

### KEEPING GOOD TIME.

**W**HEN the long and toilsome years of your apprenticeship are over, and you are endeavouring to obtain some post on a railway or elsewhere, one of the most important questions that will be asked concerning your past career is this—"Did you keep good time when you were going through the works?"

It is a right thing that great importance should be placed on your reply, for the mechanic who is punctual in his attendance at the shops, and never loses a "quarter," will generally be found to have his heart really in the work, and

you require heart very much at times. The method of registering your attendance is known as the "Scrip System." A small plate of brass, with a certain number (say 115) stamped upon it, is given to you out of a window of the Time Office, as you pass in to work, and on leaving the works at meal time you return your "scrip" at the same window, and in this way your attendance is recorded. In order to be a good time-keeper, it is essential to get to bed early. You should go at 10 or 10.30, for you will require to be up at 5.30 next morning to be in proper time for work at 6 o'clock. Sleep you must have if you want to keep in proper health and do your duty, and late hours mean "first quarters" lost, or else your health severely injured. The alarum clock I mentioned before will assist your getting up at the above-named hour, but if you can get

some one to call you every morning, so much the better. Where I served my time there used to be a man who tapped every morning at my window at 5.30 with a long pole, and remained tapping until answered from within, which valuable service he rendered for the modest sum of 3d. weekly. Unlike my alarm clock, he never failed to waken me, but I am afraid that I was not always very grateful for his services, and often felt inclined to strangle him as he roused me with his tapping from my warm bed on those bitter winter mornings.

The moment you get up you should light your methylated spirit lamp and boil a cupful of water in the kettle which should be ready by the time you are dressed. You can then make yourself a cup of cocoa or coffee, cocoa is the most convenient, as it can be made so quickly. Never go to work in the early morning

without something hot to drink with a piece of bread and butter. Always leave your house in plenty of time to walk to the works, and reach the Time Office before the bell stops ringing. Make a rule of never running in the early morning in order to be in time, for it is a far better thing to lose the first quarter than gain your scrip at such a cost. I used to run hard sometimes and reach the window just before it closed and get my scrip, and used to be well paid for this foolish performance by feeling ill for the remainder of the day. The hours in Locomotive Shops are pretty much the same everywhere. Work from 6 o'clock until 8.15, when the bell rings for breakfast ; then work again from 9 o'clock until 1 p.m., then dinner hour and back to work at 1.45 until 5.15, when your day's work is over.

If you are late for the first quarter in

the morning you will be allowed in after breakfast at 9 o'clock, but if you are late at 9 o'clock you will not be allowed to enter at all for that day. When a workman persists in keeping bad time, and not appearing in the morning quarter he is punished by being given a lead scrip instead of his brass one, which means that should he fail to turn up in the first morning quarter he will not be permitted to enter the works at all during the day, and so loses that day's wages. So be careful never to let yourself be dishonoured by a leaden scrip. I still preserve my old brass scrip (No. 115) in remembrance of those years of toil. I wonder how many thousand times I took it out and put it back into the office window through the piercing cold of winter and the heat of summer days.

The first quarter in the morning is the hardest time of all the day to work

in, especially in winter time, when the very touch of the cold steel chills you to the bone. It is the quarter when the worst work and the least work is done, and I trust that the day is not far distant when it will be abolished altogether in Locomotive Works, and everywhere else. I hope that employers will find out this truth—that they will get better work done by letting a workman have a hearty breakfast at 7.30, and begin to work at 8 o'clock, than by pulling him up at an unearthly hour in the morning. It would be found, I think, that this small reduction of the working hours would be amply compensated by superior workmanship and the more rapid execution of the work.

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## CHAPTER V.

### GETTING ON WITH THE MEN.

**O**NE great advantage that you gain in serving your time in the shops is the knowledge you acquire of the characters of the workmen round about you. Should you ever reach a post of authority it is a good thing to understand how to rule the workmen under you in the most judicious manner, and a sad ignorance on this subject has been the cause of failure to many an engineer.

It is very important for you in the shops to get on smoothly with the men. Remember that when you enter the works you enter there as an ignorant mechanic, but desirous, let us hope, for an increase in knowledge in practical

work. But from whom will you gain this knowledge? From the men, of course, who are all better workmen than you are, and who, if you treat them properly, will gladly help you to acquire their skill in the use of tools. Now the best piece of advice I can give with regard to this matter is as follows :—When you enter the door of the workshop be sure that you leave conceit outside. You may be a very smart young man in your own opinion, and may possibly think that because you have been better educated perhaps than the men with whom you associate, you have a right therefore to look down upon them and patronize them, and put on “side.” Well, if you do think thus, let me gently warn you that this is a horrible mistake, and if you refuse to believe it I think the British workman will soon enlighten you on the subject.

Some people say that conceit often arises from nervousness, and cannot be controlled, so if you happen to be one of these afflicted ones, you had better explain your case to the workmen around you, and ask them for their sympathy but do not hold me responsible for any language that may ensue.

I think that you will generally find in your experience of the pupils and apprentices in the shops, that the man who is always swaggering about and talking of what he can perform seldom makes his mark afterwards in the world of engineering, while it is the unassuming quiet worker who will do something worth recording in the after years.

You sometimes meet with people who are always grumbling about the harsh treatment they receive from the men in Locomotive Shops, but for my own part I can only state that my experience is

very different. When I went first, of course I had to put up with the chaff and practical jokes that all newcomers are treated to, but these soon ceased as I settled down into the ways of the shop, and any unpleasant remembrances I may now recall of those days of early rising and fatigue fade away before the recollection of a thousand kindnesses.

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## CHAPTER VI.

### AT THE BENCH.

**W**HEN you first come to the shops you will most likely be placed at one of the motion-benches, and before many days have elapsed hints will be thrown out by the men at your bench of a desire that you should pay your "footing." Which in plain language means that being a new member you are expected to place some ten or fifteen shillings at their service, in order that they may have a carousal at your expense. Should you refuse to comply with this demand, things are made pretty hot all round you, and your whole existence rendered perfectly miserable. And as in any case the com-

mencement of life in a workshop is not altogether sunshine, it is a somewhat unwise proceeding to call down thunderstorms upon your head which may possibly be avoided.

There is at the head of every bench one man called a "charge hand," who receives higher wages, and supervises all the other men. It is to him you must apply for a supply of work, and all directions with regard to it. A good deal depends upon your "charge hand," and if he is the pleasant sort of man who gladly assists you when you show yourself eager to learn, you are sure to progress.

You will probably be first taught how to "arras" some simple piece of work, that is to take the rough edges off it, and for this purpose you will make your acquaintance with that most important tool—the file.

In doing simple work like this you will not find much difficulty in using your file, but when you come to try your hand upon flat surfaces, you will find out that a good workman can always be distinguished by the way he handles his file, and that you will require plenty of steady practice to acquire proficiency in the art.

In the first place you will be shown that no pressure is ever put on the file during the backward stroke, as this would break and blunt the teeth, and that work is therefore only done during the forward stroke, but you will find that your chief difficulty lies in trying to avoid filing everything round. However a skilful workman will show you more about handling your file in ten minutes than any writer could with pages of explanation.

You will be taught here how to chip

metal with your hammer and chisel, and will commence very probably by occasionally missing the head of your chisel and "barking" your knuckles badly. But with practice you will soon cease inflicting these misfortunes on yourself.

When you commence you will find yourself looking at the head of the chisel with cautious awe each time that you deliver a blow with the hammer, but after a while it will appear quite a wonderful thing to you how you always hit your chisel fairly without keeping your eye upon it at all. I would here advise you to try by all means and learn left-handed chipping and filing. You will not find it of any use to you at the bench, where you can arrange your work at the vice in the most convenient position, but afterwards, when you get shifted to the repairs or the new engines,



it will become of great service in resting you when you are tired of the right-handed movement, and when working in some awkward positions underneath the engine you will find it absolutely indispensable.

You will learn here also how to use the scraper, and how to form true surfaces with the surface-plate, how to use the taps, stock and dies, and many other appliances of a similar kind.

You will be given a drawer with a lock and key beside your vice to keep your tools in. Try and have them neatly arranged, and keep them always in good condition.

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## CHAPTER VII.

### AT THE LATHES.

**W**HEN you have been for some months at the bench, and have thoroughly mastered the art of chipping and filing, you should endeavour to get shifted to the lathes, for it is of great importance to obtain some experience in the art of turning metal. If possible, commence on a lathe for turning cast iron, wrought iron, and steel.

When you have gained sufficient experience in this kind of turning, try and get to one of the lathes for turning brass, where the smaller and the nicer work is

done—such as the different parts of the injectors and steam whistles.

At the lathes you will be shown how to fix different kinds of work in the proper position for turning, as well as the use of the different chucks and carriers.

You will here learn the use of that beautiful invention the slide-rest, and by carefully studying the change wheels of your lathe you will soon master the art of screw-cutting, and be able to produce screws of any size and pitch that you may desire.

You will learn how to sharpen on the grindstone or the emery wheel the different tools belonging to the lathe which are used for different forms of work and different materials. In short, let us hope you will become a fairly competent turner, without having received any injuries to your limbs by foolishly playing with the



## CHAPTER VIII.

### AT THE REPAIRS.

**T**O get shifted to the engines, either to the repairs or the new engines, is the young mechanic's great ambition. At the bench, when the repetition of the same kind of work is beginning to pall upon him, or when the lathe work grows somewhat monotonous, his heart becomes cheered and grows strong again as the time for his remove draws near.

At the benches and lathes you only see the fashioning of the different parts of the locomotive, but at the engines you see the taking asunder and the entire construction of this wonderful machine.

Working at the repairs is not so pleasant as at the new engines, for at the former the locomotives are brought in from running, and are in a dusty and greasy state, while at the latter every part of the engine is clean and brand new. Sometimes after a hard day's work at the repairs, in the pleasant occupation of stripping a smoke-box, your own friends would scarcely recognise you as you make your exit from the works, your appearance being more like that of a christy minstrel than of the smart mechanic who went to work spotless on Monday morning. The work is sometimes very tedious here, as you have frequently to "face up" worn out parts of the locomotive, such as the "horns" in which the axle boxes slide up and down, and when they come in with a thick hard skin on them formed by the friction of the axle-boxes, the

removal of this is enough to break one's heart.

In filing up horns, fitting on axle-boxes, big-ends, eccentrics, and work of that kind, there are always two men working together as "mates," and if you are fortunate in getting a good workman for your companion you are sure to gain a lot of valuable hints in the construction of the locomotive.

Here you will learn how new cylinders are put into the engine to replace the old pair worn out, perhaps, or cracked. You will observe the method employed in unwheeling the engine, and wonder at the ease with which the overhead gantrey, or travelling crane, holds the monster in mid air. You will learn how the different parts of the motion are repaired, and how the worn out tubes in the boiler are replaced. In fact you will gradually see the helpless cripple

that first came in renewed in every limb,  
and soon able to do good work upon the  
road once more.

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## CHAPTER IX.

### AT THE NEW ENGINES.

**W**HEN you get to the new engines you will there see the entire construction of the locomotive, from the laying of the frames to the last finishing touches before she is sent to the paint shop to receive the colours of the company.

You will see how the frames are first placed in a convenient position upon wooden blocks over one of the pits (being held together by temporary cross-bars) and then properly levelled; how the cylinders are placed in exact position (with the aid of stretched wires) and bolted on to the frames. The foot-plate is next secured to the frames with bolts,

and the motion-plate and stay-plate riveted to the frames in their right positions. Then the huge boiler is lifted by the overhead gantrey and placed in position between the frames; the boilermakers put up the smoke box in front and fit on the doors. When the locomotive has reached this stage she will probably be placed on a set of old wheels, a temporary chimney put on, and the engine run out into the yard in order that the boiler may be tested.

When this is finished, and she is back again in her old place in the shop, the boilermakers will soon have the cab and the splashers for the wheels fitted on, while one fitter is putting up a new chimney, and another fitting up the slide-bars. Others are engaged facing up the horns, or fitting the axle-boxes, big-ends, and eccentrics on to the wheels, and the ash-pan underneath the fire-box.

The wooden lagging is now put on the boiler and the steel covering put over it. The engine is wheeled, the frames and boiler being lifted up by the gantrey and then lowered on to the wheels, care being taken that the axle-boxes slip properly into the descending horns.

The outside rods are connected to the wheels, and the motion underneath put up.

Then the injectors and other foot-plate mountings are fixed in their respective places, the dome covering put on, hand rails fixed in position, and the final touches given. The locomotive is then sent on her trial trip before proceeding to the paint shop.

When you are at the new engines never, if you can help it, stick to one job of the same kind, but try and get work upon every part of the engine. Your

charge-hand, however, has, of course, the power of employing you wherever he chooses. When I served my time, and was at the new engines, I had the good fortune to be under one of the most good-natured of men and one of the best mechanics in the Kingdom, and it is to him alone my gratitude is due for any knowledge of locomotive construction that I may now possess.

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## CHAPTER X.

### ATTENDING SCIENCE CLASSES.

**T**HERE are, in connection with most locomotive works, evening classes held upon certain days in the week, from October to April, to prepare candidates for the Kensington Science and Art Examinations. It is impossible to attach too much importance to your diligent attendance at them, for with their aid you can largely increase that theoretical knowledge which, together with the practical knowledge gained in the shops, tends to form the perfect engineer.

The first and most important subject for you to take up is that of "steam."

In your first year you will go in for

the elementary examination, and try to obtain a first-class pass. In your second year you will try your hand at the advanced stage of this subject, and if you prove successful, in your third year you should study hard and present yourself for honors. Should you manage to get honors in this subject you may arrive at the conclusion that you know something about the steam engine.

The second subject I should recommend is machine drawing and design, which you will speedily master by diligent attendance at the night classes, and by presenting yourself for examination each year in the elementary advanced and honor courses.

For your third subject I advise you to take up applied mechanics if you are a fair mathematician, but if you are not it would be better to take up pure mathematics instead. I am sure

that, with your practical work, you will find these three quite enough to attend to, and remember it is far better to thoroughly master three subjects than to have a smattering of half a dozen.

In the Summer time, when the classes are over, and you have plenty of spare time in the evenings, you should take up the delightful study of chemistry, for this science, especially with regard to metals, is of great importance in your profession.

Of course your great difficulty will be to get any practice in a laboratory, but, still, if you had an outhouse with a few dishes and testing tubes, and would carefully read up Professor Emerson Reynold's "Chemistry for Junior Students," you would acquire no mean knowledge of this most important subject.

## CHAPTER XI.

THE PATTERN SHOP, FOUNDRY, DRAWING  
OFFICE AND FOOTPLATE EXPERIENCE.

**I**T is the good fortune of every pupil to be allowed to serve part of his time in the above mentioned departments, a privilege which is only upon the rarest occasions extended to an apprentice.

In the pattern shop you may see all the wooden patterns made for the different castings which are to be executed in the foundry. You will gain here some experience in wood turning and in carpenters work of the most delicate description.

After some time you will proceed to



the foundry to gain useful knowledge in the art of moulding, and enjoy yourself in a constant atmosphere of black sand.

It is rather a difficult thing when engaged in the foundry work to make your friends believe that you really have heard of that useful commodity called soap. The sand seems to get into every part of you where it is not wanted, and is terribly hard to get rid of. A moulder's life, I am afraid, like a policeman's, is not a particularly happy one.

You will learn here how the sand is placed in boxes and the mould constructed with the aid of the wooden patterns mentioned above. You will also see how the liquid metal is discharged into the moulds—in the case of small castings from a hand ladle, and in the case of a large casting, such as a pair of cylinders, from a huge iron basin supported by a crane.

You will notice that in cooling, the metal contracts considerably, and for this reason the wooden pattern is always made somewhat larger than the required casting.

When the time comes for you to go to the drawing office you will have the pleasure of putting by your "slops" for some time, and appearing once more in respectable garments. You will commence here on some simple work, such as copying tracings, and afterwards, when you have shown yourself to be a fairly competent draughtsman, you may be allowed to do some designing in a small way.

When here, you may be occasionally sent to take indicator diagrams from new engines, or report on matters down the line.

In recalling the years I spent at locomotive work, I think the happiest

period of all were the days I spent on the foot-plate in learning how to fire.

To leave town with the Mail upon a summer morning, and dash out into the fresh, sweet, country air, and watch the smoky city fading in the distance; to go out upon the framing and to watch the moving Motion flash like a sea of silver as the cranks went spinning round—to feel the rush of air around you—that was life, indeed, after the daily routine of the shops.

You should try and get experience in firing upon different classes of engine. Commence if possible on a pilot engine, then on the goods, passenger, and mail trains.

To an outsider it would seem rather a simple affair to throw coal on to a Locomotive fire, but when you come to try it yourself it is surprising what a lot of skill is required to use your shovel

properly, and you will find that some time will elapse before you can properly satisfy your driver with your performance. For, indeed, as you will soon learn, to keep up a high steam pressure in a Locomotive doing heavy work, most constant and accurate firing is required.

You will learn how and when the injectors are worked, how to lubricate the different parts of the motion and axle-boxes, and a careful study should be made of the meaning of the different signals.

You should always be down at the Running Shed at least half an hour before your engine leaves.

When you commence this work you will go with an assistant fireman, and should you prove yourself a smart man in this department, after some time you may have the honour of travelling as fireman on your own account.

## CHAPTER XII.

### CONCLUDING ADVICE.

**I**N all the different departments where you work, be sure and always have your pocket book handy, and not only take down notes of what you do, but practice freehand drawing, and learn to make rough sketches of the different machines and the different parts of the locomotives in the shops.

Remember to always carefully study any books that you can get hold of which will increase your knowledge in this branch of engineering, and, indeed, I think you will find every want supplied by those admirable "Text Books of Science" published by Messrs. Longmans, Green & Co. In that series let

me recommend you to obtain C. P. B. Shelley's "Workshop Appliances," which will prove of great assistance to you in your practice in the shops; also Part II. of Cawthorne Unwin's "Elements of Machine Design," and George C. V. Holmes' Treatise on the Steam Engine.

To this small library you should add, if possible, Professor Jamieson's larger text book on Steam and Steam Engines published by Messrs. Griffin & Co., M. N. Forney's "Catechism of the Locomotive" and volumes IV and V. of Smiles' Lives of the Engineers.

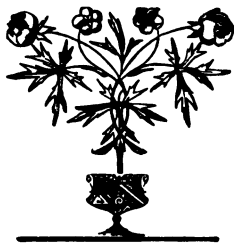
It is rather a lonely thing to live in lodgings by yourself, so if you know of any pupil or apprentice who could live in the same house it would add considerably to your enjoyment. But be sure that he is a man you are likely to get on well with, and one who is really

keen about his profession and anxious to progress—a man who is able to interchange ideas with you on one of the grandest of all subjects—locomotive engineering!

When your time is finished at the shops, take any work you can get in preference to being idle, and if, as the years pass by, your progress in your profession seems somewhat slow, do not waste loud lamentations on your own misfortune but try and bravely learn that lesson which the Poet teaches—for some the hardest lesson in the world :—

“ To labour and to wait.”

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*Price 3s.*

AN ELEMENTARY TREATISE  
ON  
THE STEAM ENGINE  
WITH QUESTIONS FOR EXAMINATION

BY

RANDAL W. M'DONNELL

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DUBLIN: WILLIAM MCGEE, NASSAU STREET.

LONDON: SIMPKIN, MARSHALL, HAMILTON, KENT & Co.

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*OPINIONS ON THE WORK.*

“We have read through with the greatest interest a copy of the above work. We cannot say that we have seen any work on the same subject that can compare with this before us in point of accuracy and conciseness. Not like many of the musty works on the same head in the market—this is quite up to date. The hand of the *practical* man, as well as that of the scholar, is here throughout visible. With what is known as the Board's treatise on “Heat and the Steam Engine,” many of our readers are but too familiar—the wretched diagrams, &c., in that antiquated edition have turned away in disgust both teachers and pupils from the study of what ought to be one of the most interesting, as it

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" This little work is a concise treatise on the elementary studies involved in the Steam Engine, and is suitable for young students or the casual intelligent reader who is desirous of gleaning a general idea of the subject at issue. The brief dissertation is divided into three chapters, devoted to stationary, locomotive and compound steam engines respectively, the elements of which are explained in simple language with reference to numerous diagrams.

" The frontispiece of the book comprises a folding plate of the passenger locomotive, No. 87, of the Great Southern and Western Railway of Ireland, which we gather was built at the Inchicore Works, Dublin. This engine has driving wheels 6ft. 6in. in diameter, and cylinders of 18in. by 24in. stroke. Not the least useful feature of this little book are the examples, questions, and exercises appended at the end of each chapter.

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*This book has been placed on the authorised list of the Commissioners of National Education.*

