torical point of view, but quite out of place on a main line fast passenger train.

THE METROPOLITAN DRAINAGE OUTFALLS.

A committee of the Metropolitan Board of Works devoted a portion of last Monday to an inspection of the river Thames at Woolwich. We may consider that very few of her Majesty's subjects, having the day at their disposal, would care to appropriate the happy hours of a Bank Holiday to the task of looking after the metropolitan sewage. The fact that the Metropolitan Board were able to muster a Committee for the purpose says something for the public spirit which animates the body. The visit was paid, and it is reported that the Committee found everything to their satisfaction. The measures of deodorisation recently adopted at the outfalls had proved successful. The water, it is said, "presented its normal appearance." According to the opinion of some people, this is not saying much, so far as concerns the river about Woolwich. But we are assured that "there were no offensive smells on the banks or on the stream." Had the day been any other than a *dies non*, the chances are that certain odours would have manifested themselves on the banks, even if the stream had been innoxious. There is, indeed, a difficulty in determining whence all the unsavoury odours proceed which haunt the banks of the Thames below and about the metropolitan boundary. There are factories on the banks of the river which need deodorising as much as the river itself, and occasionally more so. Possibly these disagreeable places were in a state of quiescence on the day in question. Had the river been foul, its condition would have been detected; and the Committee say they found nothing amiss. So may it ever be. Yet, if we are to believe some eminent authorities, the Thames was in a fearful plight in the early part of July. That such testimony was in some degree true is admitted by the Metropolitan Board. The satisfactory state of the river is attributed to "the measures of deodorisation;" and the explanation is one for which the Committee must be more or less responsible. Besides, it is scarcely to be supposed that the Metropolitan Board would involve themselves in a large expenditure to do something which had no need to be done. The deodorising process has been a costly one, and the Board have committed themselves to its continuance, having established chemical works of their own at Crossness, in order to provide the necessary ingredients.

The Metropolitan Board, it will be understood, have not attempted to purify the London sewage. All they dare to undertake is just to subdue the odious smell which is given forth in hot weather. To do so much as this has been no small undertaking. In a communication addressed to the Home Secretary, the Board state they encountered "great and unexpected difficulty in obtaining an immediate supply of the large quantity of chemicals required." The demand thus made was sufficient to raise the price in the market, and the experience gained has induced the Board to start the Crossness factory. Few people have an adequate conception of the magnitude of the London sewage. A single grain of suspended matter in a gallon of water seems a very small affair. But a grain per gallon in the London sewage represents a total of ten tons per day. Enthusiastic inventors, who propose to treat the sewage at the outfalls with just half an avoirdupois ounce of chemicals per gallon, are amazed to learn that they must provide more than 2000 tons of material per day, or more than 700,000 tons per annum. This likewise shows the enormous mass of suspended matter contained in the sewage of the metropolis. A careful and combined series of tests, devised and carried out by Mr. Dibdin, the head of the Chemical Department of the Metropolitan Board, prove that the average amount of suspended matter in the London sewage is 27 grains per gallon. This of itself represents 270 tons per day, irrespective of matters in solution, and amounts to more than 98,000 tons per annum. Our old friend, the Native Guano Company, which has survived the general smash of sewage adventures, wrote to the Metropolitan Board the other day, stating that it was prepared to enter into a contract to deal satisfactorily with "the whole of the sewage of London," relieving the Board from all further trouble, the contract to be backed up by a substantial monetary guarantee, the company undertaking to "produce a satisfactory effluent without nuisance." Such an offer as this would appear to present a perfect deliverance for the Metropolitan Board. One gentleman, who resides on the summit of Shooter's Hill, and also scents the sewage of London whenever the river is low and the wind is in the north-east, wonders how the Metropolitan Board can refuse such an "efficient and reasonable offer." As it happens, the Board have seen fit to mark the offer as "declined with thanks," and are going to rely upon their own resources. Twelve years ago the Native Guano Company was dealing with a portion of the London sewage at Crossness, with the result that it produced an excellent effluent, but without a sufficient proof as to the commercial success of the enterprise. In the process which the Board are adopting, there is no pretence of profit. Sundry thousands of pounds per annum will be cast into the Thames without the faintest attempt to get any of the money back again. Consequently, lack of profit is no argument against the A B C process, except that no trading company can be expected to work on permanently if all the work entails a pecuniary loss.

The Native Guano Company, it will be understood, proposes not merely to deodorise the London sewage, but to purify it. The precipitated ingredients will be collected in tanks, dried, and sold as manure. The Metropolitan Board intend to have no tanks and no drying process. They will simply dose the sewage with a chemical compound, which shall serve to prevent the escape of noxious effluvia. The sewage, plus the chemicals, will run into the river and take its chance. If precipitation follows, the Thames will be the tank, and sewage mud will be the result. But the Board do not want to precipitate the matters in suspension. Hence their use of chemicals will be moderate, and we may presume that the process will only be carried on when absolutely needed. The Board assert that the river only becomes offensive under the combined conditions of a reduced flow of water and a high temperature. This combination, it is stated, only lasts for a short time, and occurs at distant intervals. From these statements it is evident that the Board intend to do as little as possible. Supposing the Native Guano Company to step in once more, the undertaking would be directed to the production of a good effluent and a saleable manure, the process going on all the year round. On the former occasion the Native Guano Company added so much to the solid materials of the sewage that it more than doubled the weight. If the precipitated matter could be sold at a profit, the larger the quantity the better it would be all round. But if all the suspended matters in the London sewage were thrown down, and if the added weight of ingredients equalled the weight of the suspended matter, the manure would be produced at a rate exceeding 500 tons per day. A few weeks' storage of such an output would be a serious affair, and the preliminary process would demand an immense area for the precipitating tanks. In addition, there would be the drying apparatus, and other paraphernalia. The immense bulk of the London sewage, pouring down day after day, and every day, makes it next to impossible to treat the whole of the liquid with a view to collecting and selling the deposit. Apparently, the most that can be done in that direction is to watch the river and give it a dose of disinfectant when the case requires it. This may be thought a lame and impotent conclusion, and certainly it is, if we are to entertain the idea that there is an available process whereby a crystal effluent may be obtained, and nearly £2000 per day secured by the sale of manure. If the manure can be sold at anything like £3 10s. per ton, on a large scale, the Native Guano Company has a good case. Or, if it can fulfil a more modest *rôle*, and will just make the river as pure as the Metropolitan Board are going to make it, with the additional advantage of producing a profitable manure on a reduced scale, the company will do well. The scheme of the Board may be objected to on the ground that, despite the best of care, there is risk of increased precipitation in the bed of the river. Treatment in tanks, whether by the A B C process or any other, prevents the deposit of mud in the stream, and if this could be made a profitable operation there could be no doubt it would be the proper plan, always providing that no nuisance was created on the land as bad as that which has to be eliminated from the river.

The subject is one which demands consideration at the present time, seeing that the Royal Commissioners who are investigating the outfall question have recently spoken out concerning it in very unmistakeable terms in the shape of a letter addressed to the Home Secretary. Lord Bramwell not only speaks for himself, but commits his colleagues to a statement that the river in the vicinity of the outfalls on a certain day "was in such a state as to be a disgrace and a scandal to the metropolis and civilisation." If the Metropolitan Board could only have obtained their chemicals a little earlier, they might have anticipated the visit of the Sewage Commissioners, and so have made things pleasant. But the Board happened to be a day too late, their deodorising operations commencing on the day after the Commissioners had explored the locality. Lord Bramwell and five of his colleagues went up the river and down the river, and his lordship asserts that they found "ten miles of sewage." Another authority speaks on the subject in the person of Mr. J. B. Redman, member of the Institute of Civil Engineers, who, in a letter to the *Times*, describes the sewage from the outfalls as being driven back by the tide on certain days so as to manifest itself as high up the river as Blackfriars, or even Westminster. Some of the facts narrated by Mr. Redman are consistent with the idea that some portion of the outfall sewage was liberated on the flood tide. Such a circumstance is sure to occur occasionally, the sewage reservoirs being too small for the present volume of sewage. Had the Metropolitan Board been more prompt, and undertaken the enlargement of these reservoirs at an earlier period, they might have accomplished the work before the appointment of Lord Bramwell's Commission, with considerable benefit to the river. The state of affairs has now become critical. Without waiting for the final report of the Commissioners, Sir William Harcourt wrote some days ago to the Metropolitan Board, intimating that, unless they took the requisite measures to improve the state of the Thames in connection with the outfalls, it would become his duty to take action himself. The Metropolitan Main Drainage Act gives the Home Secretary authority for this purpose. But it is fair to notice that the Board commenced deodorising the sewage on the 10th ult., being four days prior to the date of Sir W. Harcourt's letter. As already explained, the deodorising process was also delayed by a practical difficulty. But there is the fact that the Thames becomes highly offensive in certain states of the weather, owing to the volume of sewage poured in at Barking and Crossness. Some remedy must be devised, and the engineer rather than the chemist seems to be required for the purpose. At one time there was room for hope that no very extensive measures would be necessary in order to settle the outfall question. But the trouble presents itself now in a worse form than ever, and the demand for the removal of the outfalls to some point lower down the river is daily gaining strength. The old project of taking the metropolitan sewage to the coast of Essex is again discussed, though the notion of reclaiming the Maplin Sands is scarcely entertained. On the whole, there seems a great probability that the London sewage will have to be carried further away, though deodorisation may be practised for a time. When the Main Drainage Act was passed there was an expectation that ultimately deodorisation would have to be employed, and at this point we have now arrived. But this is scarcely likely to be the goal, seeing how vast is the operation, and how it must be continually extended as the sewage increases in volume.

THE PROSPECTS OF YOUNG ENGINEERS.

In our last impression we indicated some of the causes which render it all but impossible for young men who have received an engineer's education—so called—to obtain work. We now proceed to consider the nature of the defects in teaching which conduce to so deplorable a result. It may be worth while before going further to summarise what we have said. It amounts to this—that young engineers do not get work because there is not work for them which they can do. There are far too many in the profession, and yet it is perfectly understood by employers that at no time was it more difficult than it is now to find really useful men. At first sight this appears to be remarkable, because very great pains have been taken to educate young men up to a high ideal standard. But a little enquiry among employers will suffice to prove that there is a radical defect in the whole system. The ideal standard of perfection is not the true standard. The education of mechanical engineers is not just what is wanted. At the risk of offending the prejudices of many excellent people we assert that in the present day, and for some time past, far too much importance has been attached to what is called a scientific training. We can only estimate the good or bad qualities of any system of education or training by its results. The mechanical engineers who are making money are not, as a rule, scientific men, save in a very limited sense of the term. But they are profoundly versed in the practical knowledge of their business. A young man attends science classes; or he goes to a science college, and spends two or three years in learning all that can be taught him. At the end of that time we shall suppose that he gets, by good luck or favour, a berth as manager, we shall say of a department, or even of works of moderate dimensions. Before a week has passed away he finds that all his scientific training is entirely useless to him. It is valuable, no doubt; so was the bag of doubloons, found by Robinson Crusoe on his island. His scientific attainments will not procure him a salary. We have no desire to disparage scientific training; for certain purposes it is invaluable. To the young mechanical engineer it is of no bread-and-cheese-earning value whatever. Out of his college he finds himself in another world. He sees things done and results arrived at apparently by intuition. He finds theoretical knowledge of all kinds at a discount. He learns that precedent is the great rule of life, modified and adapted to circumstances by the brain power of one or more individuals. He sees, if he is observant, things done, which for the life of him he could not do either with his head or hands; and he finds that if he is to be a mechanical engineer, earning a salary either as a head draughtsman and designer, or as a works manager, he must begin to learn all over again. It would take up much more space than we have at command to give many illustrations of what we mean. It may be useful, however, to give one or two. Let us suppose that the scientific young man is called on to design a crank axle for a locomotive. The dimensions of his cylinders and the pressure is given him, and he goes to work. He knows all about moments, and the calculation of strains, and the strength of materials. The chances are a hundred to one that he designs something which no locomotive engineer in his senses would think of using. He will find almost at the outset that his calculations give him dimensions which are too small—a margin has to be added for safety. How much margin? He examines drawings of engines already made, and he finds that the margin is such that the shaft may be said to be all margin. His calculations are practically of no value whatever. How, he may ask, is it that certain sizes are found to be right? We answer that these proportions have been arrived at by a long process of trial and error; and that the crank shaft of a modern locomotive is the result of the accumulated experience of half a century. Furthermore, all his information about the strength of steel or iron is useless to him in this connection, because the shaft that is strong enough to-day is too weak in a year, or it may be in ten years. Our young engineer will be better prepared to design a crank axle after one hour spent with rule, calipers, and note-book in a locomotive repair shop than he would be after six months' study in a college. Again, no subject has been more elaborately treated from a high scientific and mathematical point of view than the steam engine. To the steam engine maker such investigations have proved absolutely barren of result. They have simply done nothing to improve the steam engine. The whole principle of steam engine economy may be summed up in a sentence or two:—Keep your cylinder hot. Let the initial pressure be as high and the terminal pressure as low as it can be consistently with the conditions of size and power to be complied with, and with the first condition. Here is the whole secret. Pages of formulæ, the differential and integral calculus, and all the resources of science, cannot advance us one jot beyond this point. We might pursue this line of illustration, as we have said, but only at the risk of being wearisome. Many of our readers can supply for themselves what we omit.

Is it possible, we may be asked, that a high scientific training is of no value to the mechanical engineer? We assert nothing of the kind. We do assert that it alone will not enable a young man to earn his bread as an engineer; and we add that most of the time spent in acquiring it is thrown away, whenever it prevents the acquisition of practical information. Let us, however, look at the other side of the picture. Let us take the man of middle life, who, established in his own offices, discharges the duties of a consulting engineer. To such a man scientific training is simply invaluable. Not only can he find a use for it, but he cannot do without it. He is no longer a manufacturer. It is not for him to deal almost exclusively with pounds, shillings, and pence. He is consulted because difficulties have arisen which experience does not suffice to solve. Such men represent in one sense the brains of the profession. But even such men ought to possess sound practical knowledge as well. If they do not, they will be certain to make very serious mistakes. The truth is that in mechanical engineering there are many departments, and the man who attempts to fit himself to fill every position will be almost certain to fail to do anything well. There is this advantage about a scientific training—that a man who receives it can hardly help learning a good deal. On

the other hand, it is quite possible, nay, it is very easy, for a youth to pass through the shops and the drawing office and learn nothing. We have been surprised by the absolute, dense, ignorance of men who have served an expensive apprenticeship. The fault does not lie with the masters. It is, no doubt, within the experience of many of our readers that the same shops will turn out ignoramuses and consummate engineers. The first go through life with their eyes shut; the others always keep them open. Nothing that goes on around them escapes them. If they are erecting an engine, let us say, every dimension of every part that they can get at, finds its way somehow into a note-book for future reference. If a thing is weighed, and they get a chance of finding out, they will ascertain what it weighed. They are careful to ascertain how many hours are required to do any given job on the lathe or the planing machine. Such men, too, cultivate with great care the art of freehand drawing. This is entirely neglected by most pupils and students. It is never properly taught. We do not refer to landscape drawing, but to skill in sketching on paper parts of engines and machines. The man who can draw nothing without the aid of a set-square and scale, will find when he is called upon to design that he is miserably deficient in detail. He cannot design a cylinder and valve chest that can be moulded; he does not know what a practical crosshead is like; a feed pump is something quite beyond him. The man who has never missed a chance of making an accurate freehand sketch will, on the contrary, not be at a loss for a moment, even if he does not directly use what he has in sketch-book. The practical training which he has given himself will stand him in good stead. He will find himself, so to speak, steeped in the art of putting things together.

Lastly, we would point out that the mechanical engineer is born, not made. No amount of training—scientific, theoretical, or practical—will supply brains, and tact, and the art of doing the right thing at the right time. Very many young men become engineers, not because they are fitted for the business, but because they think they are. They find this out in the first year of their apprenticeship, and would change if they could; but they cannot. Our advice to most young men who wish to become engineers is like that given by *Punch* to those about to marry: "Don't." The exceptions are those whose fathers are engineers, willing and able to supply that special training which can hardly be obtained for love or money by those whose first connection with the profession in any shape or way takes place when their indentures are signed.

NORTHERN MANUFACTURED IRON.

THE manufactured iron trade of the North is one in which we have the advantage of frequent official statistics. The last of these brings our knowledge of the state of the trade down to the end of the half-year. It shows that to that time the trade continued to decline both in volume and in value. In all there was a production of 68,829 tons of manufactured iron in the last two months of the half-year, and the average price of the whole was £5 5s. 5d. In the preceding two months the quantity was 75,044 tons, the average price being £5 8s. 11d. This decline in two months is very heavy in proportion, and it brings down the price to what is the lowest that has been known for many years with the exception of one quarter about five years ago. But the extent of the production cannot be well compared with that of the time named, because the number of the firms associated together is greater now than it was. Looking at this fact, and remembering that the value of the iron trade may have further fallen since the time to which the return brings us, we may not unfairly believe that the deepest depths of the depression have been about experienced now. At the same time, as about 80 per cent. of the total production is in the form of angles and plates, principally for shipbuilding, it can be scarcely expected that there will be any early recovery. A few orders given out for new vessels will only keep up the trade to its present extent, and it can scarcely be expected that there will be any very early revival in the shipping trade, though the dullest point may have been reached. At the same time the loss will go on, and replacement to some extent will be known, but not until there is a better state of the shipping industries will there be any large orders given out for new vessels to benefit the iron trade.

LITERATURE.

Pocket-book of Electrical Rules and Tables, for the use of Electricians and Engineers. 1884. Griffen and Co., London. By J. MUNRO and A. JAMIESON.

THIS book, which is printed and arranged in the same manner as Molesworth's "Pocket-book of Engineering Formulæ," is, to the best of our knowledge, the first of its kind published in England, the nearest approach to it being the appendix by Mr. Jamieson to the sixth edition of Rankine's "Rules and Tables;" also published by Messrs. Griffin and Co. It contains an exceedingly useful collection of electrical information, commencing with units of measurement, and giving the formulæ and a short description of the various tests employed in both telegraphic and electric light work; tables of conductivities of the different kinds of wire employed; methods of jointing and insulating joints; data on electro-metallurgy, batteries, dynamos, motors, and electric lighting generally, and concludes with a table of logarithms, natural sines, cosines, and tangents. Some of the information in it might, however, have been omitted, and advantageously replaced by more information on other subjects. For instance, there is only one page devoted to photometry, a subject that could well be expanded to several pages. Again, if we turn to the subject of dynamometer tests, we find the only dynamometer mentioned is the Prony, and there is no information about any power transmission dynamometer. Transmission of power is, indeed, disposed of in one page. As regards telephonic instruments, we would suggest that in the next edition skeleton diagrams of the connections of the various forms of transmitters should be given, with hints on their adjustment.

On the whole, we can say that this is an excellent little compilation, and will in a second edition prove very useful to all connected with the various branches of electrical engineering. We must, however, point out that in a book which is obviously a compilation, and one on a comparatively new branch of practical knowledge, it would not only be to the credit of the authors or compilers, but a matter of much convenience to those who use the book, if they would credit those from whom they have taken much of their information, and give the references to the sources, so that any user could when necessary refer to the original. This has been but sparsely done, though one of the compilers seems to have been much afraid he should not get all the credit due to him. This course would also have prevented a good many mistakes in the book, as the compilers would probably have seen that in some cases they have given the same thing under different terms and units, and have copied the errors of their authorities. Errors of much importance are also made in the values of practical electrical units, and these are inexcusable, as several books have been published giving all in a concise form, such as Swinburne's "Electrical Units." There are numerous little mistakes in the book, but it may be expected that the authors have taken this first edition as a set of revise proofs.

Mineral Resources of the United States. By ALBERT WILLIAMS, Jun. 8vo., pp. 813. Washington Government Printing Office. 1883.

IN the newly-organised United States geological survey, provision has been made for the publication of a series of statistical papers having special reference to the mineral resources of the United States, and a special division of the survey has been formed for mining statistics and technology, under the charge of the author, whose first report is contained in the volume under consideration. This contains an estimate of the output of the mines and furnaces of the United States for the year 1882, the chief items of which are summarised as follows:—

Metallic Products.	Weight.	Value. Dols.
Pig Iron	4,623,323 gross tons	106,336,429
Silver	—	46,800,000
Gold	—	32,500,000
Copper	45,823 net tons	16,038,091
Lead	132,890 ,,	12,624,550
Zinc	33,765 ,,	3,646,620
Mercury	2,017 ,,	1,487,537
Nickel	138 ,,	309,777
Antimony	60 ,,	12,000
Platinum	—	1,000
Total of metallic products		219,756,004
Non-metallic Products.	**Weight.**	**Value. Dols.**
Coal, all kinds except Pennsylvania anthracite	57,963,038 tons	76,076,487
Coal, Pennsylvania anthracite	29,120,096 ,,	70,556,094
Crude petroleum	30,123,500 barrels	23,704,698
Lime	3,100,000 tons	21,700,000
Building stone	—	21,000,000
Salt	896,732 ,,	4,320,140
Cement	325,000 ,,	3,672,750
Limestone for iron flux	1,950,000 ,,	2,310,000
Phosphate rock	332,077 ,,	1,147,830
New Jersey marl (fertilisers)	1,080,000 ,,	550,000
Crude borax	2,118 ,,	338,903
Mica	37 ,,	250,000
Crude barytes	20,000 ,,	160,000
Chromic iron ore	2,500 ,,	100,000
Steatite	6,000 ,,	90,000
Manganese ore	3,500 ,,	52,500
Asbestos	1,200 ,,	36,000
Graphite	212 ,,	34,000
Sulphur	— ,,	21,000
Cobalt ore and regulus	— ,,	15,000
Precious stones (rough)	— ,,	12,500
Asphaltum	3,000 ,,	10,500
Corundum	500 ,,	6,250
Pumice stone	70 ,,	1,750
		726,156,402
Other minerals estimated at not less than		8,000,000
Grand total		453,912,406

The total value of the minerals produced is, therefore, rather more than £90,000,000 sterling. In these figures are included everything of mineral origin, even to bricks and tiles, grindstones, lime, &c.; and, therefore, some deduction would have to be made in comparing them with the returns made for other countries.

The above figures are taken from the introductory summary, the data upon which they are formed being contained in the detailed chapters devoted to each mineral. These are all interesting, though of unequal merit, one of the best being that on coal by the editor and Professor Ashburner, of the Pennsylvania State Geological Survey, the latter dealing with the anthracite districts. A classified list of mineral localities in the United States, the work of several contributors is especially valuable as showing in a compact and concise form the principal occurrences of minerals of industrial importance, as well as indicating whether they are or are not being utilised. Such lists have long been wanted as forming the first step towards a proper mineral geography.

In addition to the proper subject of the volume, there are sundry articles printed under the head of miscellaneous contributions, which are certainly a little mixed. Thus we have a paper on electrolysis in metallurgy side by side with one on the divining rod. The particular purpose of the latter is not apparent.

Scattered through the volume will be found numerous technical papers on the metallurgy of the different metals, and a good market review of the trade is given for each of the principal metals in connection with the statistical part. A point worth notice is the extreme cheapness of the volume. It is a large octavo, the page measuring 9in. by 5½in., nearly 2in. thick, in a serviceable cloth binding, and is sold for 50 cents, or two shillings.

TEXTILE EXHIBITION.—An exhibition in connection with the great textile trades was opened in the Agricultural Hall, Islington, on the 4th instant, and closes on the 20th of September. It includes—machinery in motion, cotton spinning, cloth weaving, rhea fibre dressing, hosiery manufacture, silk weaving, dyeing and printing, English and foreign fabrics, costumes of all nations, raw materials, and mill fittings and appliances.

RICHARD GARRETT.

WE announce with sincere regret the death of Mr. Richard Garrett, of Saxmundham.

Richard Garrett was born at The Works House, Leiston, on the 22nd July, 1829, the twin and eldest son of Richard Garrett, the then proprietor, sometimes called the Founder of Leiston Works. As a matter of fact, however, there were at that time living four owners of the now famous name of Richard Garrett, of whom each had been, or was to be in turn, at once the senior partner of Leiston Works—which was founded in the year 1778—and head of the Garrett family. The Leiston Works then consisted of an ironfoundry, a smithy peopled by a strong band of those invaluable mechanics who still pass by the name of "country blacksmiths," men who, with the assistance of the third department, viz., the wheelwrights' shop, represented in embryo the engineers and machinists of agricultural engineering in the present day.

The Richard Garrett whose memoir we are now writing was educated at a good old-fashioned private school at Woodbridge, where he attained a popularity which still survives him. A boy of unusual personal attractions and influence, untiring energy and courage, his school life was in itself a little history upon which those who participated in its events still look back with pride and pleasure.

At the age of fourteen, however, Richard Garrett left school to embark, under formal indentures of apprenticeship, upon that best of all educations for an engineer, the post of apprentice-assistant to his enterprising father, who, in his own brave battle forwards in the development of Leiston Works, stood in urgent need of such assistance. It need scarcely be said that the influence of so promising a pupil-son soon took effect at Leiston Works, and at an age when most lads can be scarcely said to regard life seriously, Richard Garrett the younger, was to all intents and purposes works' manager; a position of which he took formal occupation on the completion of his majority in 1850. In 1853 he became a partner with his father and younger brother, John D. Garrett, who seceded from the businesss in 1860; and on the death of his father in 1866, Mr. Garrett succeeded to the position of head of the Garrett family and senior member of the Leiston firm, in partnership with his two brothers, Henry Newson Garrett—who also seceded from the business in 1878—and Frank Garrett, between whom and the subject of our memoir there existed bonds of close attachment.

Richard Garrett may be stated generally to have devoted his life to the construction and development of the thrashing machine—first as a horse-power implement, and later as the finishing machine, otherwise termed the combined thrashing, dressing, and straw-shaking machine, and the merits of his celebrated invention, patented in combination with the late James Kerridge, the then foreman of the thrashing machine department at Leiston Works, under date 18th January, 1859, No. 153, still finds high appreciation in all quarters of the globe. Under this arrangement the wind employed for the two or three blasts necessary at different intervals in the preparation of the grain for market by the combined machine is produced by one fan, which is keyed upon the same spindle as the thrashing drum, and the blast is conveyed to the needful points of contact with the grain through wooden channels. The advantage of such a system—which was probably suggested to the inventors by the arrangement adopted in all large smithies for the blowing of the fires by one large fan instead of by a multiplicity of bellows—is so apparent that it only needs to be added that the practical difficulties attending the application of the invention were completely mastered, in order to make its value understood.

Next to the thrashing machine the portable steam engine may be said to have been the object of Richard Garrett's engineering life; and perhaps no man living had a more thorough knowledge of the subject. Resolute in all his dealings and opinions, a most careful and trustworthy mechanic, and a perfect manager of workmen, firm and just and charitable, it is difficult to say whether he was most beloved or respected by his men; and the old hands are still working at their benches at Leiston who helped him to carry the Leiston portable engine forward through its multiplicity of stages to its present prominent position. We have spoken of the resolution of Mr. Garrett's opinions, and this resolution was applied with characteristic vigour to matters of mechanical construction, and nothing would induce him to adopt a form of construction in his designs because it was simply "fashionable." As an instance of this characteristic we may allude to one point in particular, in respect to which the Leiston engines differ from those of most other leading makers. Nothing would induce Mr. Garrett—at one time even at the risk of a most valuable connection—to construct the commercial portable engine, in which the steam is only used expansively to a very limited extent, with a steam jacket. Mr. Garrett had satisfied himself that a steam jacket was under such conditions misapplied, and consequently he refused to sacrifice his conviction upon the altar of fashion. He was also much opposed to automatic expansion as applied to portables, and to the undertype of semi-portable, and these forms of construction he never hesitated to condemn. Of the compound system of expansion in double cylinder portable engines he was as resolute an advocate; and although the credit of instituting this arrangement may be directly attributable to his brother and surviving partner, still the enterprise was undertaken under the highly interested approval and advice of Richard Garrett.

As already stated in our issue of the 1st inst., Mr. Garrett was a member of the Institution of Civil Engineers, to which position he was elected on the 30th October, 1877, at the instance of the late Mr. Amos, who acted for so many years as consulting engineer to the Royal Agricultural Society of England, supported by the following other members of the Institution:—Messrs. Edward Easton, James Easton, W. Menelaus, Ewing Matheson, W. Anderson, J. E. Gwynne, Peter Bruff, B. Samuelson, M.P., and Robert C. May. Upon this qualification Mr. Garrett set great store. He was also a member of the sister Institute of Mechanical Engineers. We have thus treated of Mr. Garrett in his capacity of an engineer and employer of labour, and on this head we have only to add that in such business capacity he was latterly strongly opposed to the fashionable tendency in his branch of engineering to a never ending system of over-production and over-speculation, and for this reason he would not consent to any material further extension of Leiston Works, although commercial openings for such enterprise were never wanting. In his private capacity, Mr. Garrett was very prominent as a sportsman and an agriculturist. As a young man he rode to hounds regularly twice a week throughout the season. He was also a great advocate of pugilism in the days when there was no discredit attached to the prize ring, and as an amateur he is said to have had no equal, even Tom Sayers being stated to have admitted the superior science and endurance of Mr. Garrett. In his later years Mr. Garrett devoted all his