

makers, including those who made the Crown Street engine, and those who made, in sixty days only, an emergency engine at Botany (to be presently referred to), it appeared that machinery had been ordered by wire from a firm of pump-makers who were known in the engineering world principally by their advertisements, and who had lately introduced a new type of pump which claimed to be, and no doubt was, economical of fuel, but was still no better than others, while it was yet in the experimental stage. Curiously enough, these same Worthington pumps were at first specified for the North Shore engines, and when so specified, it was without any consideration or restrictions of any value to protect the purchaser. They have also been specified for several other Government works.

That North Shore specification was afterwards amended so as to enable other firms to tender; but as he saw it, the pump contractor must, under the conditions, guarantee that another contractor's boiler and furnace will not consume more than 100 lbs. of coal while 90,000,000 lbs. of water are pumped a hundred feet high with his engine. In other parts of the world where the engineer does not make the boiler he is held responsible for the lbs. of steam used in his engine, and the consumption of coal used in raising that quantity of steam is considered as representing the efficiency of the boiler and not of the pumping engine. There was no difficulty in seeing how, with a little management or mismanagement, under this condition, a contractor could be easily ruined with the test proposed, especially as £150 is to be the penalty for every 1,000,000 lbs. of water the pump delivers short of the 90,000,000 specified.

In 1886 the Botany engines were still working and wasting fuel just as when they were reported on in 1880, and the new engines recommended were never ordered (although they would have paid for themselves in four years); the reason, as it would appear from the printed reports, being that the Council had been officially informed in 1880 that the Nepean supply would be ready in two and a half years. But, as they knew, after six years from that date, the Nepean water was not delivered at Crown Street, and the old machinery having been working all the extra time, there were some doubts expressed in the City Council as to the condition of

the boilers, then over thirty years old; and this led to an inspection of them by the Engineer Surveyor of the Marine Board, our President, Mr. Cruickshank.

In consequence of that officer's report, and to provide against the risk of a breakdown, the writer was instructed by the then Mayor of the city, Mr. John Young, to prepare a design for emergency engines, that would deliver $1\frac{1}{2}$ million gallons per day from Botany to Crown Street Reservoir, and to be quite apart in all things from the old engine.

The design adopted was precisely the same one on a smaller scale as had been submitted to the Council in 1880 for the Crown Street to Waverley supply; but being now only intended for temporary and emergent purposes, the engines, although compounds, were not made condensing. They were, however, so designed as to be suitable for pumping from Crown Street to the higher city levels when no longer required at Botany. Public tenders were invited, and the Atlas Company undertook to make these pumps, with boiler foundations and buildings all complete, in sixty working days for £3,498. The contract was accepted on March 26th, 1886. The engines were started on May 24th, and the Mayor and aldermen opened them officially on June 28th of the same year; and in thirty-five years' experience of practical engineering the author never saw a work carried out so quickly or so well for the time it occupied, although of course a few improvements would be made for permanent work.

These engines would easily do their day's work of one and a half million gallons in twenty hours instead of twenty-four, and they would run at a piston speed of 300 feet per minute, or, say, twice as fast as the Worthington pump, the type being one that had been adopted at the Paris Waterworks and other places on the European continent. It appeared that these emergency pumps had never worked but for their trial, so they were still new. They were powerful enough to raise to Woollahra from Crown Street as much water as Mr. Clark allowed in his report for the whole of the higher levels. They were specially adapted for that work, and they could be removed from Botany and set to work in about three weeks or a

month, if it was desirable to relieve the scarcity existing. They could be made condensing at any time if thought desirable. The pumps themselves, apart from the steam engines, were of a much higher and more scientific type than the Worthington pumps, such as proposed for the North Shore station, as they would run at a much higher speed without shock. If those pumps and engines were not large enough for the prospective requirements of the city's higher levels, they could be used for the present, and in the meanwhile designs could be prepared for similar pumps with a still higher type of engine, and with the latest improvements for saving fuel, with triple or quadruple expansion. Perhaps he spoke plainly, and it was certainly in a way he would rather not do, but he could not see why colonial-made pumping engines should be lying useless at Botany, while the high levels—for which the same engines were specially adapted, and in fact were designed, for supplying—were short of water. Unless there was a powerful prejudice against colonial work somewhere, it was hard to understand how an order for pumps was rushed off by cable when colonial firms had shown what they can do in an emergency, and why should Messrs. Worthington have an order for pumping engines without competition with other American or European makers of water-works engines of greater reputation? Professor Unwin's recent tests of Worthington pumps notwithstanding. Among the Sydney engineers, Mort's Dock Company and the Atlas Engineering Company had already shown that they are able to turn out such work to stand every test.

Again, why should Worthington's have the privilege of supplying their pumps without any test or guarantee whatever, and other makers be called upon to be responsible for the coal consumed under boilers they had nothing to do with? As regards the great interest which appeared to have been set up in influential quarters to use only the Worthington pump, and the evidence lately given before the Public Works Committee, which would imply that Worthington was the only maker of Duplex pumps and other improvements, it would be as well to say, what many knew, that there were numbers of makers of Duplex pumps equally as good as the

Worthington, such as Blake, Knowles, and others, in America; and a great London firm of fire-engine builders had been making them for more than twenty years past. The air compensating cylinders on the principle lately introduced by Worthington, and so much pushed by advertisement, were old devices in themselves. They had been known for twenty-five years, but there was no evidence yet of how they answered after years of work as a substitute for the much-despised fly-wheel in water-works engines; and although no doubt there were some of them working in long oil lines in America, it was under totally different conditions to ordinary water-works pumps. If Worthington had recently made his pumps give double the duty they did before, as stated, it would imply that they must previously have been very bad ones indeed. The following table, from an American author—Fanning—gives the duty of Worthington pumps without compensating rigging, and other types in use in America:—

Cambridge, Mass. Compound Direct ...	71,278,486 lbs.
Newmark, N. J., Duplex Compound ...	77,157,840 „
Providence, N. J., „ „ ...	53,528,110 „
Philadelphia, Pa., „ „ ...	54,416,694 „
In comparison with this the “Leavit” Engines at	
Lynn, Mass, American Type ...	104,000,000 lbs.
And at Lawrence, Mass., American Type ...	98,000,000 „
And the Simpson Engine at Lowell, Mass.,	
English Type ...	93,000,000 „

Instead of from fifty to seventy millions.

In October last Professor Unwin, of London, made an exhaustive test of a New Compound Duplex Worthington Pump with all the latest improvements of compensating cylinders, erected at Hampton, on the Thames, to supplant the Bull Engines which the speaker remembered the erection of thirty-five years ago, and had more recently, in 1885, seen at work: and what do they find? The result of all the advantages of modern science, best coals, and twenty-four hours' trial and unlimited advertising, is to give these much-advertised and favoured engines a duty of 106,010,000, with 112 lbs. of coal. But with certain corrections

to make ordinary work clear of special conditions of the trial, it was expected the duty would be 111.5 millions, the horse-power being 255 and the piston speed being 124 feet per minute.

Mr. E. A. Cowper had also recently tested similar engines of Worthington's at the New River Waterworks, Stoke Newington, and made the duty 106.5 millions, or, allowing for temperature of feed water, 109,000,000.

On the page 10 of the present volume of "Engineering," they would see the comparison of Worthington engines, which were made by Messrs. Simpson, side by side with the Lambeth Waterworks engines, made by the same firm about 1854, and tested in 1857 by the late Joshua Field, of Maudslay, Son, and Field. Their duty was 112,600,000.

The West Middlesex engines, at Hammersmith, gave a duty, years ago, of 118,000,000, and 117,650,000.

From Mr. Wicksteed's celebrated work, published nearly *fifty years ago*, it was found that the Fowey Consol's engine, with only 94 lbs., or a bushel of Welsh coal, No. 112, gave a duty of

...	116,248,384 lbs.
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Or, if reduced to 112 lbs. coal, say	138,000,000 „
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Now, seeing that "Worthington" had fifty years' advantage in experience and appliances over the Cornish engine, thirty-five years over the Lambeth Waterworks engines and those at Hammersmith, it was difficult to see where this excitement in their favour was to come in when their duty was not yet up to the antiquated (?) machines, for if experience was to be any criterion of direct-acting pumps, they would be on the scrap heap when the Lambeth and Hammersmith engines, in spite of their half-century's start, had a good term of life still left in them.

To take another view. High economy of fuel means high speed of piston, high pressure, high grades of expansion, and triple or compound series of cylinders.

Worthington's pump speed is put down at 124 feet per minute, and steam pressure 80 lbs., expansion in compound cylinders; but the Atlas engines at Botany could run at 300 feet per minute,

or more than double the speed, without any trouble. It was, therefore, not very difficult to see that if they were to construct a triple or quadruple expansion engine with, say, 140 lbs. pressure, and a piston speed of double that of Worthington's, some of our Sydney engines might yet get a duty that the great advertising pump-builders have not yet attained. Half the internal friction of an engine has been shown to be caused by the crank-shaft bearings and fly-wheel. It was not proposed to show how to remove that from colonial pumps.

There was no doubt from information contained in American papers that the new Worthington pump had been rejected quite recently at Chicago, Boston, Jersey City, and quite a number of other American cities in competition with other makes. It had been shown also in these papers that Worthington's had two prices for their pumps, and plainly implied (making every allowance for the tone of the American press) that the business of that firm was to sell pumps at as high a price as they could get for them. After having been designing pumping engines for thirty years past, being acquainted with nearly every type in use, and having seen many of the principal pumping stations in the world, it was singular that about the worst pump for the work it had to do, tested by him, was a "Worthington" recently put up by Government, although it was a very good pump of its sort, apart from its place. It had been stated before the Public Works Committee, on the 28th September, 1888, that the pumps which the Atlas Company made for Botany in sixty days, and for which they cast from forty to fifty tons of metal, were imported from California by Mr. Selfe. Well, he wished to state that he had no idea how such an erroneous idea could possibly have arisen; that the engines were ordered from California, shipped, received, erected, and started in sixty days, as the efforts which the Atlas Company made to carry out their contract in the specified time, and the steps they took to keep their men at the pattern-making by boarding and lodging them in the shop till they were finished, were much talked about at the time. A complete set of the working drawings, prepared by the author, of which copies are before you, were in the possession

of the City Engineer with the specification. By the unfortunate mistake (which, he was sure, was quite unintentional on Mr. Jones's part), a great reflection has been cast on the engineering establishments of Sydney, and an injustice has been done to them, in implying that they undertook to make the pump, and then supplied an imported article; and further, as he (Mr. Selfe) neither dealt in pumps or imported them from America, although he designed them, the reference to his having brought them from California was not only mysterious, but positively without a shadow of foundation.

From the foregoing it would be seen that one who had for thirty-three years past been closely in communication with the principal engineering manufacturers of the city, and was quite disinterested in his remarks, could with a clear conscience call attention to the fact that a wrong has been done, not only to the engineering branch of colonial industry, in not giving colonial manufacturers an opportunity to supply the pressing wants of the high-level service, but to the citizens generally, in the hasty rushing after a new-fangled American novelty at what would, possibly, prove a very great cost to the colony, and further, in not utilising colonial pumps now lying idle that would supply, at any rate, the quantity which the great authority, the late Mr. Clark, set down as sufficient for the high-level entirely.

From evidence given before the Kenny Hill Commission, it would appear that the new machinery for Crown Street was to cost £24,000. The probability was that with buildings it would cost £40,000. All of that money could certainly be kept in the colony, and perhaps to the colony's great advantage.

In conclusion, it is to be hoped that when Mr. Henson undertook the irrigation of the Nepean Valley he would at least give the poor colonial engineers a chance; and lest any misunderstanding should arise from some of the preceding remarks, he would wish it clearly understood that none of them were intended in any way to reflect on his friend Mr. Trevor Jones, Engineer to the Water and Sewage Board. It appeared that in the matter of this sudden ordering of the Worthington pumps on insufficient knowledge or half

information, not only for Crown Street and North Shore, but for other places, Mr. Jones was not the leading spirit, and as the author would be extremely sorry to hurt his feelings in this way, he enclosed some time back the substance of these remarks to him, with an explanatory letter. What the reason actually was, however, for this sudden affection for Worthington, the author did not know, and it was to be hoped some inquiring spirit in the ensuing Parliament would have it investigated to the bottom. If he had gone rather out of the beaten course the interests of their common cause in this colony as engineers, and the public weal, was far more than sufficient excuse for the plain speaking.

Mr. Auldjo wished to know whether it was a fact that the pumps were made by the Atlas Company, or were they imported.

Mr. Selfe said the drawings were made for the whole of the machinery, and the Atlas Company tendered with the intention of making it, but they found two cylinders in the city that would fit in with the drawings; and, as they had such a short time in which to finish the work, they purchased them. But the main question at issue was the pumps, and the company made them entirely. He would point out that the pumps were conoidal, and while the piston moved three feet the water moved only eight inches.

The President said that Mr. Henson deserved the thanks of the Association for the trouble he had taken in preparing his paper. He had the pleasure a few days ago of visiting the locality under notice, and had never seen in his travels—and he had travelled over all the colonies—a more favoured district, and if the Government would take into consideration the necessity for irrigating the Hawkesbury district, it would be the forerunner of irrigation in many other parts of the colony. With regard to Mr. Selfe's paper, it would be remembered that a short time ago the Association passed a resolution affirming the desirableness of Government work being thrown open to general competition, and Government officers should not be exempted from the competition. At the present time it was evident that the various engineering firms of the city were making desperate strides to increase their business and to improve their methods of work, so as to secure a

high standard of efficiency. He could bear out what Mr. Selve had said with reference to the pumping-engines for the Ryde Station. He (Mr. Nelson) tendered for these engines, and found that the Worthington people had two prices. They had tendered for two kinds of pumps, one type of which was as efficient as the other, but at a much lower price. He totally failed to see why this should be so; the only reason that he could see being that some Government officers must have had a pressing desire to introduce this particular kind of pump into the colony. He had been under the impression that the Atlas Company's pumps, which were made for the Sydney City Council, had been brought into the colony for a special purpose, and that the special purpose was the fulfilment of the above contract. However, he was pleased to know that the pumps were manufactured in the colony, and the disagreeable impression that had rested upon the transaction was entirely removed. He had never heard the statement refuted before, and was extremely glad to hear that the Atlas Company had carried out their contract to such a successful issue in such a short time.

Mr. Henson said that, as there was no criticism on his paper, he had nothing to reply to, and he thanked them for the attention with which they had received the paper he read at the last meeting.

The great objections to this system are that it invariably causes a nuisance at the outlet, and, as venting shafts are required for main sewers and soil pipes, there is a continual discharge of sewer gas, which must contaminate the atmosphere. Localities where large quantities of night-soil are piled or discharged into water are invariably rendered unhealthy on account of the air and water becoming contaminated with the poisonous gases, disease germs, etc., given off from it. For this reason the present sanitary arrangements may be said to only remove a nuisance from one locality to another, and before a perfect sanitary system can be obtained a means must be devised for the effectual annihilation of these objections.