John Fowler Memorial Lecture

By D. R. BOM FORD, MIBAE

This lecture was presented to the Institution at the Royal Society of Arts, 6 John Adam Street, London, WC2 at 4 p.m. on Tuesday 16th October, 1956, on the occasion of the Centenary of the first successful application of steam power to cultivation.

In this year 1956 our Institution is paying tribute to the memory of the man who a hundred years ago successfully applied mechanical power to the cultivation of land for the first time in the history of the human race.

John Fowler was born at Melksham in Wiltshire on 11th July in the year 1826. He was the grandson of Robert Fowler who married Rachael Barnard. Robert and Rachael had two sons. Thomas Fowler, the elder son, was the father of Sir Robert Nicholas Fowler, Baronet, and Member of Parliament, who was twice Lord Mayor of London. John Fowler, the younger son; was the father of John Fowler the great pioneer of agricultural engineering who is the subject of our memorial. For this reason we usually find him described as John Fowler, Junior.

It was intended that Fowler should become a corn merchant, and on leaving school he was engaged in the corn business until 1847. But in the mid-nineteenth century there was little likelihood of a man of his enterprise and originality being satisfied by work of this kind. The great adventure of the age was taking shape. The steam locomotive was displacing the stagecoach and the permanent ways of the first main railway lines were being built to provide means of communication never before contemplated. It is not surprising that in 1847 Fowler, at the age of 21, left the corn business to join Gilkes, Wilson, Hopkins & Company of Middlesbrough. They, as constructors of locomotives, viaducts and bridges, were engaged in the growing railway enterprise.

It is easy to imagine how at that age Fowler's interest was captivated by the fascination of the new means of transport, and he might have found a place in history with Brunei, the Stephenson's and the other great railway engineers. But his allegiance to railway engineering did not survive the influence of a visit to Ireland in 1849. Two factors contributed to the change in his career resulting from this visit. One was the condition of Ireland at the time. The other was Fowler's quality of character.

The Irish famine of 1846 and 1847 was probably the greatest tragedy of the century. It is estimated that one and a half million people died or escaped the country. O'Connell, who was the steadying influence among the Irish patriots, was among the dead-and in 1848 with his influence removed the ardently sincere Young Ireland party rose in a rebellion which was easily suppressed. The young railway engineer visiting the country found the surviving remnants of a tragic race at the lowest ebb of despair. Fowler had a sense of social responsibility fostered by a Quaker upbringing, and was by nature a generous humanitarian. When we consider the tenacity of purpose which characterised the rest of his life we can understand what the abandonment of his career as a railway engineer may have cost him. But something had to be done about Ireland. The Irish had starved. They were still hungry. Much of their land was unproductive bog. As an engineer he could see how it might be drained. Thus it was that Fowler forsook railway engineering and began the development of his draining machinery.

It seems likely that in the ensuing years he realised that the problem was of the social and religious incompatibility of the Irish and the English and that it had no engineering solution, but by that time he was too deeply absorbed in the work he had started to be divorced from it.

Mole draining with large teams of horses had been practiced for many years. Even with the largest controllable team power was limited. Small moles only could be drawn and at a limited depth. Fowler thought that if a much larger mole could be drawn at a greater depth drain pipes could be threaded on to a cord attached to the heel of the mole in such a way that they would follow it into the underground tunnel it made. If the cord were attached to the last pipe threaded on to it that is the pipe furthest from the mole, this pipe would push the pipes in front of it into the tunnel in compression and the close abutment of their ends would be secured. The mechanics of this arrangement were the same as those of the modern Bowden cable in which a tension of the inner wire produces a compression of its casing. Fowler developed a means of providing the tractive effort necessary to draw a large mole at sufficient depth. This is shown in Fig. 1. It resembled a ship's capstan in having long capstan bars or levers which could be made to rotate a vertical axis. But unlike a ship's capstan, the vertical axis carried a small bevel pinion, the latter being mounted on a horizontal shaft. The capstan was provided with rollers on which it could he moved which were parallel to the horizontal cross shaft. A grooved pulley was mounted on the cross shaft arranged so that it could carry one complete turn of a rope. The procedure was to lay a rope along the line on which the drain was to be laid. The portable capstan was taken to the end of the rope at which the laying of the drain would begin, and directed so that it would roll forward along the line of the drain with the mole plough attached to the back of the capstan. The mole of the plough was dropped into a hole of the appropriate depth with the chord on which the drain pipes were threaded attached to the heel of it. The far end of the rope at which the lay¬ing of the drain would be finished was anchored to the ground. The rope was given one turn round the pulley on the capstan being led on at the bottom round the top and off again at the bottom. The free end of the rope which came off the pulley was taken back past the plough, hauled tight and also anchored. If everything worked as planned a rotation of the capstan levers would by means of the bevel drive rotate the pulley. The rotation of the pulley would grip the rope and exert a tension on it between the capstan and the anchor at the far end of the rope. This would draw the capstan and the plough attached to it along the rope. The plough would draw the cord with the drain pipes threaded on it into the mole tunnel and the drain would be laid.

A pioneer in any branch of agricultural engineering must have a little optimism in his make-up. But when we consider the difficulties Fowler must have encountered in the practical application of this apparatus it is almost unbelievable that at the meeting of the R.A.S.E. at Exeter in 1850, where he first demonstrated in public, he actually laid a drain at a depth of 2 ft. 6 ins. in heavy clay. Two horses were used so the capstan levers and the rate of movement of the capstan and the plough along the rope was 9 feet per minute. From this it is possible to make some interesting deductions. The normal output of a horse is 33,000 foot pounds per minute. The two horses would have a normal output of 66,000 foot pounds per minute. A movement of 9 feet per minute would therefore in the absence of friction result in a tractive effort of rather more than 7,000 lb. We know that this tractive effort is unlikely to pull a mole at a depth of 2 ft. 6 ins., it is therefore probable that the horses, working for short periods only, were exceeding their normal output, and we may assume a tractive effort of about 12,000 lb. or a little more than 5 tons. This would be a full load for a modern;-in. diameter steel rope with an ultimate tensile strength of 28 tons. There was no suitable steel rope in 1850. Fowler tried hemp. It was not strong enough and would not grip the pulley, probably because stretch loosened the tension on the anchored tail rope. He tried chains, which were discarded as too heavy. He eventually worked with iron wire rope. An iron rope would have had less than half of the ultimate tensile strength of the present-day steel rope. It would have been quickly subject to fatigue due to alternate bending and straightening, and its softness would have made it subject to rapid surface wear. The greatest of Fowler's difficulties during the first seven years of his experimental work were due to his having to use iron rope.

He had only wood, cast iron and wrought iron for his capstan. When his portable capstan method of hauling a mole drain plough was on trial at the R.A.S.E. meeting at Exeter in 1850 the bevel gear broke when two horses were substituted for men on the capstan levers. In spite of this the judges were impressed. In their own words, "The performance was far better than anticipated," and a silver medal was awarded for the plough and capstan and for a machine evolved by Fowler for making the drain pipes he used. These were of wood. The whole apparatus formed the subject-matter of his first patents.

He was soon dissatisfied with this arrangement. Difficulty was experienced in maintaining sufficient tension on the tail rope to prevent its slipping on the pulley, and rope deterioration was excessive. By using a stationary rope and hauling his capstan along it he had avoided the surface wear which would occur with a live rope being dragged over the soil, but it is likely that the stationary rope tore itself at the point at the bottom of the pulley where the lead on and the lead off of the rope crossed. This probability is confirmed in his next design, shown in Fig. 2, in which the capstan was provided with a drum on a vertical axis driven from the capstan levers by spur gears. The whole of the rope was wound on the drum. The capstan with the rope-carrying drum was usually called a windlass. This windlass was anchored in the corner of the field at the end of the headland along which the laying of each of the drains would be finished. The rope from the anchored windlass was taken along this headland, round the sheave of an anchored pulley block, led off the pulley block at right angles and thence taken across the field and attached to the draining plough. By moving the anchorage of the pulley block for each drain, parallel drains were laid across the field. On the completion of the laying of a drain the mole plough with the rope attached to it was hauled back by horses to the point from which the laying of the next drain would begin.

This must have been a simple, workmanlike contrivance with no possibility of rope slip. It was demonstrated in the agricultural implement section of the first international exhibition in 1851 under the auspices of the R.A.S.E. The spectators were impressed. Not many of them could see the rope. What they saw was a mole drain plough with no visible means of propulsion moving across a field and drawing a long snake of threaded drain pipes into the ground behind it. After the laying of the drain the soil over the pipes was dug out to expose them, and their laying and abutment were found to be beyond criticism. The judges awarded an "honourable mention" and acknowledged progress made since the Exeter Show in the previous year. They criticised the lack of uniformity of the grading of the drain, which tended to follow surface contours. This was then and has ever since been a characteristic of most mole drain ploughs, and the criticism seems a little unkind to Fowler, but he nevertheless proceeded to develop a means of depth control which would meet their criticism.

Fowler demonstrated the same arrangement with a strengthening of both the windlass and the mole plough at the R.A.S.E. meeting at Gloucester in 1853. By using four horses he was able to increase his working depth to 3 ft: 6 ins. The judges awarded another silver medal. Again it is surprising that using a single iron rope Fowler was able to increase his depth to 3 ft. 6 ins. The tractive effort may have been as much as 20,000 lb. He had no coiling gear. Twenty years later the first generation of steam-ploughmen knew how quickly a steel rope would deteriorate unless properly coiled. There are indications that Fowler, in the absence of any coiling gear, had evolved a laborious method of making the rope coil by hand.

He demonstrated in 1853 the same machine in a strengthened form as he demonstrated in 1851. It was unusual for him to make no fundamental progress in as long a period as two years, but during this time he had attempted the application of a steam engine for the first time and had failed. [n this experiment, shown in Fig. 3, he reverted to an arrangement similar to his first capstan equipment in which the capstan was drawn along a stationary rope. His steam engine had a rope-carrying drum attached to its front end and a mole plough attached to its back end. The engine and plough were taken to the starting end of the new drain. An anchor with a single-sheave pulley block was fixed at the other end of it. The rope from the drum on the front of the engine was taken across the field to the anchor, round the sheave, back to the engine and was fixed to it. In this way a tractive effort equal to twice the tension on the rope was transmitted to the engine. The machine was ingenious. Eccentrics on the crankshaft were arranged to drive the drum by a pawl and ratchet gear. In this way a wide ratio transmission was obtained without the use of spur or bevel gears. Similarly a pawl and ratchet gear revolved two of the land wheels on the engine to enable it to return itself from the end of one drain to the beginning of the next. There was one fundamental mistake. The weight of the power unit when used. in a stationary capacity was an asset, providing anchorage to resist the reaction of the soil resistance to the mole plough. Hauled across the field with the plough, the engine's rolling resistance became a liability. Fowler quickly saw his mistake and abandoned the arrangement. He had entered it for the meeting of the R.A.S.E. at Gloucester in 1853, but he withdrew it and demonstrated only his four-horse capstan and mole plough.

He quickly retrieved the failure of his first experiment with steam. It is interesting that his next move was almost the same as in the case of his improvement on his first horse capstan. The arrangement is shown in Fig. 4. Just as he moved the portable capstan, which in his first experiment had been attached to the mole plough to a stationary position at the corner of the field, so his steam engine and windlass were moved to the same corner at the end of the side of the field on which all the drains would be finished. Again an anchor was used at the finishing end of each drain. This was the main pulling anchor, and a secondary one placed on the other side of the field at the beginning of each drain enabled the raised plough to be hauled back from a finished drain to the beginning of the next one. The windlass with two rope-carrying drums on a horizontal spindle was so arranged that it could be belt-driven by any of the so-called portable engines which by this time were coming into use to drive threshing machines. These engines were mounted on un-driven wooden wheels and were hauled into position by horses. Fowler was always conscious of the farmers' difficulty in finding capital for investment in machinery. There is evidence that at an early date in his experiments he appreciated the mechanical advantages of combining engine and windlass in a single unit, but he was not convinced that the cost of a specialty designed engine for draining only was justifiable if a threshing engine could be used. The main anchor at the finishing point of each drain carried two sheaves arranged in tandem. The rope from the larger drum of the windlass was taken round the sheave nearest the main pulling anchor, led at right angles across the field to the mole plough, round a sheave on the front of the mole plough and back across the field to the main anchor where it was fixed. Once again the tractive effort on the plough was twice the tension on the rope. The rope from the smaller drum on the windlass was taken round the second sheave on the main anchor across the field at right angles, round the shcave on the secondary anchor and back to the plough where it was fixed. This rope was used for pulling back the raised plough to the starting end of a new drain.

Although this was not in the ordinary sense an application of mechanical power to land cultivation, it was the first successful application of mechanical power to any land process.

It was first demonstrated at the R.A.S.E. meeting at Lincoln in 1854. An application of a similar system to land cultivation had been in Fowler's mind for at least two years. The Lincoln demonstration suggested the possibility to other people. The judge’s comment at Lincoln was, “Surely this power can be applied to more general purposes” Fowler demonstrated two other similar arrangements at Lincoln. It has not been found possible to describe more than a selection of his experiments in this paper. Those described are as far as possible characteristic of selected stages of progress.

Fowler had hesitated to apply to general cultivations the principles he had developed for draining. He realised that whereas deep mole draining could not be done by the direct draught of horse teams, ploughing and other cultivation's could. In introducing steam to these cultivation's he would be in competition with the low cost of established and traditional horse work.

In 1852, two years before his successful demonstration of steam-draining at Lincoln, he and William Worby had met on <r July evening on the beach at Brighton. Worby was “manager and implement expert” at Ransome and Sim's factory at Ipswich, Two hours' discussion and calculation on the beach convinced them both that ploughing could never be done by anything but horses or oxen. It would appear, however, that there were some second thoughts because Worby says that they met frequently after this, and that the possibility of ploughing and other cultivations by steam was always the subject of their conversation.

It is likely that Fowler's success with his steam-draining machinery in 1854 influenced the Council of the R.A.S.E. in making their offer of a prize of £200 for “The Steam Cultivator which shall in the most efficient manner turn over the soil and be an economical substitute for the plough or the spade.” Wisely they based their two requirements on soil inversion and competitive cost. The offer was made for their meeting at Carlisle in 1855. Fowler showed his steam-draining machinery, but did not compete for the cultivation prize. The three entrants who did compete were unsuccessful. But Fowler was busy considering the design of cultivating implements which could be used with the arrangement of machinery which he had developed for draining. In the middle of January, 1856, he was again in consultation with Worby. By this time they had accepted the possibility of cultivation by steam and were discussing means of reversing ploughs at the ends of furrows in such a way as to lay all furrows in the same direction. Worby was considering the possibilities of the Kentish turn-wrest principle. Fowler had discussed the problem with David Grieg, an impetuous red-bearded Scot who was farming in Essex, and who after Fowler's death played a leading part in the further development of steam ploughing. Grieg and Fowler had conceived the idea of the right- and left-handed balanced plough which was destined to be used for cable ploughing for the succeeding 80 years and which is still in use for direct traction ploughing on the Continent. In general the design is that of a frame mounted as a "see-saw" on a two-wheeled axle. One side of the "see-saw" carried right-hand plough bodies, the other side left-hand. In use the frame was never turned round, but always hauled too and fro on the rope with one or other of the ends of the "see-saw" down with its plough bodies engaging the soil. To make this possible on a low axle it was necessary to make the frame with a bend across its middle so that when the two ends were level they were rather higher than the middle where the axle supported the frame.

By moving the plough in one direction with the right-hand bodies engaged and in the other direction with the left-hand bodies engaged it would be possible to turn all furrows in the same direction. At their mid-January discussion in 1856 Fowler explained the idea to Worby. It seemed to him to have greater possibilities than the turn-wrest principle he had been planning. Worby undertook to investigate the possibilities of the balanced plough. He and Fowler were expecting to have a further opportunity for discussion at a meeting of the Society of Arts about a fortnight later, on January 30th 1856, at which Fowler was reading a paper on the possibilities of cultivation by steam.

Worby undertook to report on his investigations at this meeting. It was during the discussion following Fowler's paper that Fowler gave Worby instructions to build a set of steam-ploughing tackle with a Ransome & Sim's portable engine driving a stationary double-drummed windlass and hauling a balanced plough. It was an eventful order, resulting in the first successful application of mechanical power to land cultivation. It is of interest to us as an Institution that at this meeting of the Society of Arts in John Adam's Street. Mr. Allan Ransome was in the chair. When we remember the severe limitations of manufacturing facilities, and indeed of communications of those times, we may well wonder at the speed at which these men worked. The order was given on 30th January, 1856. On 10th April, 1856, the machinery was working at Nacton and ploughed an acre in an hour. Fowier's father, John Fowler, Senior, and J. A. Ransome were both present on this occasion. The arrangement was similar to that of Fowler's first successful steam-draining machinery. It is shown in Fig. 5. A portable engine with a belt drive to a stationary anchored windlass was set in a corner of the field to be ploughed. The windlass had two drums on the same horizontal axis. The windlass was set so that the direction of the ropes as they left the drums was along one of the headlands of the ploughing. There were three pulleys on separate anchors, one was anchored immediately in front of the windlass. This was a permanent fixture during the whole ploughing process. The other two were temporarily anchored and were moved along opposite headlands as ploughing proceeded. One rope from the windlass was led round the temporarily anchored pulley on the same headland as the windlass and thence across the field to the plough. The other rope was led from the windlass round the permanent pulley in front of the windlass, diagonally across the field to the pulley on the opposite headland, round this and back to the plough where it was fixed. By this means it was possible to work the balanced plough in both directions. The plough was steered by a man who walked beside it with a long pole used as a lever.

The possibility of ploughing by steam was proved, but the digging of holes for successive positions of anchors on both headlands was hardly tolerable. In the case of the draining machinery it was worthwhile digging anchor holes at both ends of each drain because it saved the labour of hand digging the whole length of a drain. In the case of draining, the machinery was in competition with very laborious handwork. But in the case of ploughing it was in competition with horse work only, and if the machine required the assistance of much handwork its claim to have lowered costs was unlikely to be established. Because of this Fowler made movable anchor carriages in time to compete for the prize offered by the R.A.S.E. in the game year, 1856. The offer of £200 made in 1855 had been increased to £500 in 1856. The anchor carriages were carts full of earth. Each cart had four disc wheels and wooden rollers to prevent the disc wheels from sinking too far into the ground.

Thus, while only rolling resistance was offered to a forward movement of the cart, the cutting of the disc wheels into the ground created considerable resistance to any lateral movement. A sheave for the rope was provided underneath the frame of each cart. The tackle was rearranged as shown in Fig. 6. A cart anchor was placed on each headland at the side of the field on which ploughing would start. They were directed so that they would roll along the headlands.

The portable engine and belt-driven windlass were set with the windlass anchored at the middle of the opposite side of the field, this being- the side on which ploughing would finish. The windlass carried two drums on separate vertical axes. The rope from one drum was taken across the field to one cart anchor, round the sheave and to the plough. Similarly the rope from the other drum was taken round the sheave on the other disc anchor and to the plough where both ropes were fixed.

The cart anchors were moved along the headlands by ropes which led, one from each anchor, along the opposite headlands. Each rope passed round an anchored pulley at the end of the side of the field on which the windlass stood and were led to the windlass. It seems likely that there was a mechanism on the windlass which enabled the power of the engine to be used to haul on these ropes and move the anchors into line with the direction of haulage of the plough as work progressed.

There was a mechanical heresy in this arrangement of which Fowler must have been aware. It assumes that the reaction to the tension of the ropes is in line with the lateral resistance offered by the anchors. The reaction to this tension is actually along a line bisecting the angle between the rope leading onto the sheave on each anchor and the rope leading off it. Fowler must have decided to risk the mal-alignment of this reaction, but a later arrangement embodied a correction of it. It seems that the risk he took was to some extent justified because his first arrangement of the disc-wheeled cart anchors was entered for the £500 prize offered by the R.A.S.E. at their meeting at Chelmsford in 1856.

During the Show Fowler's plough was working at Romford and turning four furrows at a time. Decision on its merits by the R.A.S.E. judges was postponed for further trial on August 14th and 15th. A few days before the trial an acre and sixteen perches had been ploughed in an hour. The judges were apparently satisfied with the quality of the work, but not with its economy. They estimated the cost of ploughing by Fowler's tackle to be 7/2½ an acre and that the cost of ploughing the land with horses might have been 7/- an acre. Because of this no award was made. But although Fowler failed in the year 1856 to secure the prize offered by the R.A.S.E., he succeeded in demonstrating that ploughing by steam had passed the stage of theoretical development and established itself as an applied process with an assured future. It was also in 1856 that he filed his patent on the double-engined system of steam ploughing which was destined to become the only acceptable means of mechanical cultivation for more than sixty years. As many of us remember, this consisted of two engines each with a built-on drum carrying rope. The engines moved along opposite headlands and pulled the plough alternately between them by means of their ropes. Although Fowler foresaw the future use of the double-engined system he continued the development of ploughing tackle based on the use of a single engine. There is evidence that he regarded the capital outlay on two steam engines for one plough as being too high for many farmers and also that he disliked the idea of an arrangement in which one of the two engines would always be idle. So it was that although he took a double-engined set to the Salisbury meeting of the R.A.S.E. in 1857, he decided in view of the working conditions to demonstrate instead a set with a single engine with two built-on drums on separate vertical axes and a new type of movable disc anchor. In this arrangement, shown in Fig. 7, the drums were mounted underneath the boiler. The rope from one drum was led direct to the plough. The other rope was led across the field round the sheave on the movable anchor on the opposite headland and back to the plough. Both the engine and the anchor were fitted with a rope by which they were able to haul themselves forward to each new working position. Each of these two ropes was led forward along its headland and anchored at the end of it.   On both the engine and the anchor was a small drum on which these ropes could be wound. In the ease of the engine by its own power, in the ease of the anchor by a transmission from its sheave.

At this Salisbury meeting in 1857 the R.A.S.E. again withheld the prize. of £500 on the grounds that the economy of steam ploughing still remained unproved, and it was the Highland and Agricultural Society who in October of the same year made the first practical recognition of the establishment of steam power for land cultivation by awarding Fowler a prize of £200. The trials were held at Stirling, and the award was for “The practical application of steam or water power to the ploughing or digging of land.” Although there had been several other competitors for the prize offered by the R.A.S.E., Fowler was the only competitor when he received his award from the Highland Society. The ploughing tackle which he demonstrated was the single engine and movable anchor set which he had shown at Salisbury in the same year.

For several years Fowler had been working to secure the production of a rope which would reduce the troubles he continually experienced with iron wire ropes.In 1857 he succeeded for the first time in obtaining steel wire ropes. It is a tribute to his memory that steel rope used for many purposes other than ploughing is still known as plough rope.

In 1858 Fowler was once more competing for the R.A.S.E. award at Chester. The tackle demonstrated consisted of a self-moving engine on one headland and a disc anchor with a rope haulage mechanism on the other. The two drums on the engine as shown at Salisbury had been replaced by an arrangement of driven pulleys which gripped the rope, one end of which was taken directly. to the plough. The other end was taken across the field round the sheave on the self-moving disc anchor and back to the plough. There was no rope-carrying drum. Fowler had evolved a method of adding or removing lengths of rope to allow for varying distances between the engine and anchor. A finer adjustment to maintain tension on the rope was obtained by winding unwanted rope onto a drum on the plough. He had three competitors: Boydell's traction engine, which ploughed by direct haulage; Rickett's locomotive engine to drive revolving cultivators, and Howard's stationary engine and windlass. The judges estimated that the cost of ploughing with this tackle was 5/6 an acre and that the cost of ploughing by horses would have been 7/- After careful consideration the judges, withholding their decision until the autumn of 1858, awarded the prize of £500 to Fowler. It was said that by that time he had spent about £5,000 on his experimental' work. Eighteen fifty-eight was the first year in which he used an engine which would propel itself along the headland and from field to field by revolving its land wheels. This engine was steered by one or two horses in shafts in front of it. Also in1858 the plough frame was supplied with scarifier irons which could be fitted instead of the plough bodies. This implement was the forerunner of the famous steam cultivator which ultimately became the implement most used with steam ploughing engines for work in dry land conditions. In this year Fowler published his first catalogue of steam ploughing machinery.

During the following six years he continued his experimental work with characteristic vigour. Many different systems of cultivation by rope haulage were developed and used. In 1863 the R.A.S.E. held its annual meeting at Worcester. Here Fowler demonstrated a double-engined set of steam ploughing tackle. The two engines had one drum, each carrying a full length of rope and mounted on vertical axis studs underneath the boiler. The drums were fitted with rope coiling gears. The engines propelled themselves and were steered by a man on the engine. This set demonstrated all the fundamental principles of the sets which for the next half-century were to maintain the prestige of steam ploughing as the only economical and efficient means of mechanical cultivation. Steam ploughing was at last firmly established, but still Fowler was not satisfied. In 1859 he had filed a patent on a device known as the clip drum. In this the flanges of a sheave were made in short sections. These sections were independently hinged in such a way that the radial pressure of a rope drawn tight round the sheave caused each pair of opposed sections to converge and grip the rope. This clip drum or sheave took the place of the rope-carrying drum and was rotated by the power of the engine. At the Newcastle meeting of the R.A.S.E. in 1864 Fowler exhibited a double-engined set with clip drums. One rope only was used. One end was attached to the plough. The rope was then led round the clip drum of the engine on one headland across the field and round the clip drum of the engine on the other headland and back to the. plough where it was fixed. As in a previous arrangement, tension was maintained by inserting or removing lengths of rope and by winding shorter lengths of slack rope onto a drum on the plough. Sufficient tension was maintained on the rope to enable the power of both engines to be used at the same time. The result must have been spectacular. Each of the engines was rated at 7 nominal horsepower and the set using a four-furrow balanced plough worked eight acres in ten hours. The working pressure was 100 lb. per square inch, and the surprisingly low coal consumption of 188 lb. per acre is recorded. The occasion was competitive, and Fowler also demonstrated a single engine with clip drum and movable anchor as well as numerous other pieces of equipment. As usual, he received significant awards. They were: first and second prizes for “the best application of steam power to the cultivation of the soil”; first prize for “the best application adapted to small occupations” ; first prize for “the best plough for steam power”; first prize for “the best cultivator for steam power”; the prize for the best windlass and a high commendation for a rope porter. It was a great achievement, but it was his last. On December 4th of the same year, at the age of 38, he died as a result of tetanus following a hunting accident, but his work went on.

In the early years of his development work he had been in partnership with Albert Fry, and his early windlass machines were manufactured by Fowler & Fry. At the time of the development of the balanced plough he was working with William Worby of Ransome & Sims. Ransome & Sims made some of the early engines and ploughs. Engines were also built for him by Clayton, Shuttleworth & Co. and by George Stephenson & Co. In 1862 he was being supplied by Kitson and Hewitson of Leeds, but they were unable to supply his full requirements, and in 1862 he went into partnership with William Watson Hewitson under the name of Hewitson and Fowler. Hewitson died in 1863, and in that year steam ploughing machinery was made for the first time by John Fowler and Co. of Leeds. The partnership became a limited company in 1886, and the tradition of high-quality high-powered agricultural machinery is maintained by the company today.

John Fowler had laid the foundations on which a great business was built. For more than fifty years after his death steam ploughing machinery was supplied not only to the farmers and contractors of the British Isles, but to many parts of the world. Boiler pressures were increased. Cast iron parts were replaced by steel. Wheel diameters were increased. The single-cylinder engines gave way to compound engines with balanced crankshafts and high piston speeds. But fundamentally the design remained the same as that of the engines demonstrated by Fowler at Worcester in 1863.

What then is his true measure as an engineer? The immense amount of experimental work which Fowler did was crowded into fourteen years. No man can experiment on this scale without making mistakes. But Fowler was never obstinate. He was quick to see his mistakes and to retrieve them. Although he made inevitable small mistakes, his capacity for being right in broad decisions of design was unsurpassed. His competitors worked on direct haulage and rotary tillage. Fowler never wavered in his conviction that the implement must be rope hauled. He knew and said that lighter power units would some day make direct haulage and rotary tillage possible, but he also knew that with the materials of his time these things were not good subjects even for experiment. After his first mistake in experimenting with steam he realised that the high weight to power ratio of the power unit could be turned to advantage if it stood still to pull and made use of its weight to provide anchorage. The temptation to abandon the rope must have been great. Although he obtained steel ropes in 1857, it was not until the year of his death that he obtained a rope which was uniform and satisfactory. Trouble with iron ropes was persistent, but Fowler never wavered in this decision. We find an analogy in the power-unit weight problem faced by the railway engineers of the same period. Because of their weight locomotives had to run on metal rails and on accurately-levelled permanent ways. But the early locomotive engineers were guided by experience derived from earlier railways on which trains were horse-drawn. There was no precedent for Fowler. He could draw on no previous experience. He was perforce in every way a pioneer. It is not difficult for us in our time to realise what this lack of precedent involved, nor can we easily appreciate how meagre were his means of production and his available materials. But his technical ability alone could not have accounted for the brilliant achievement of his short life. His ability was fortified by rare tenacity of purpose and courage which enabled him to overcome financial as well as technical difficulties. At his death his business had just begun to be profitable.

We may well claim that as an engineer he was the equal of the greatest of his time, and his contemporaries in shipbuilding and railway engineering were indeed great.

But in seeking and finding the engineer we find also a man of fine quality of character and endearing personality. There can be little doubt that loyalty to his memory contributed greatly to the success of John Fowler and Company after his death. Max Eyth, the philosophic German, destined at a later date to become famous in his own country, met Fowler in 1861. He seems to have formed an immediate determination to work for him. All Fowler could offer him was 30/- a week and a workbench, but Eyth, who was a professionally trained engineer, accepted. Later, when sent to Austria by Fowler, Eyth left his disputed patent claims in Fowler's hands saying, “ I would trust the man with my salvation.” This trust was universal among both his colleagues and his competitors. The news of his death reached the Smithfield Show on its opening day in 1864 and cast a gloom over the whole proceedings. Eyth, writing from Egypt, where Fowler had sent him, expressed a grief bordering on despair, and other tributes to Fowler as a man and as an engineer were overwhelming.

Now, after a hundred years, we of this Institution add our tribute to his memory.

John Fowler Memorial Lecture

By D. R. BOM FORD, MIBAE

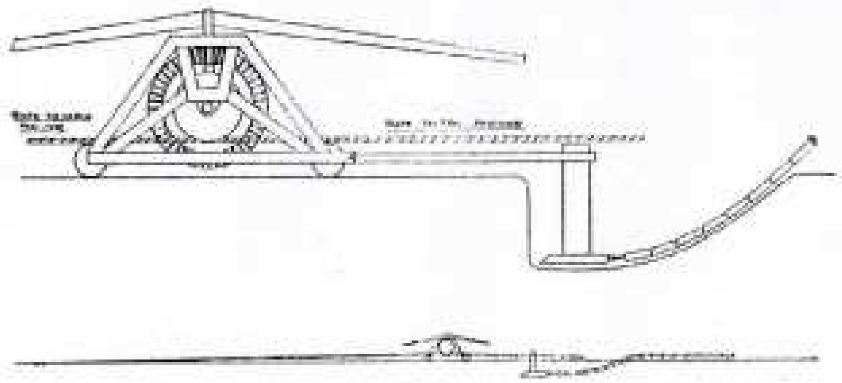


FIG. 1. *Diagram of probable design of drainage capstan or windlass. Shown at the Royal Show, Exeter, 1850*

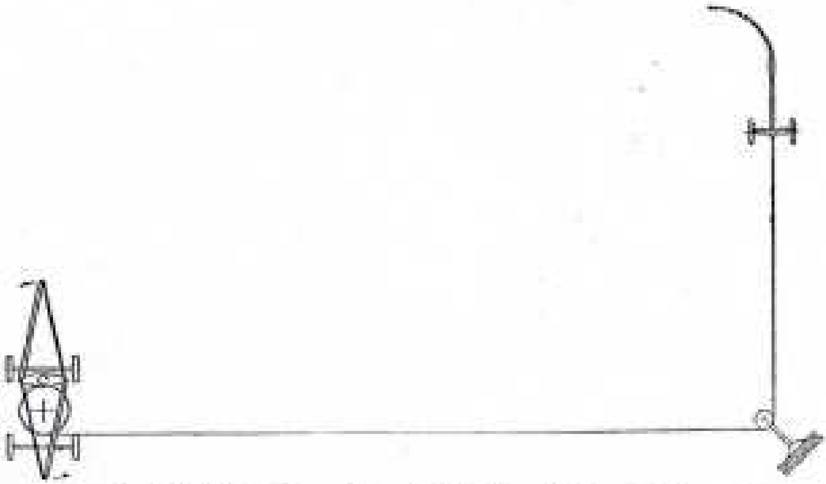


FIG. 2. *R.A.S.E. International Exhibition 1851 and Gloucester 1853*

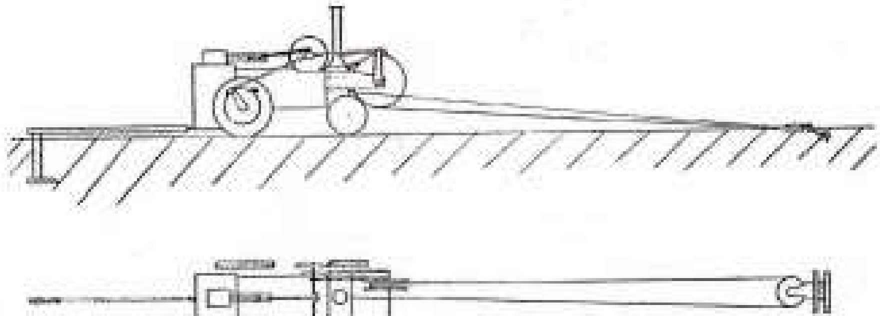
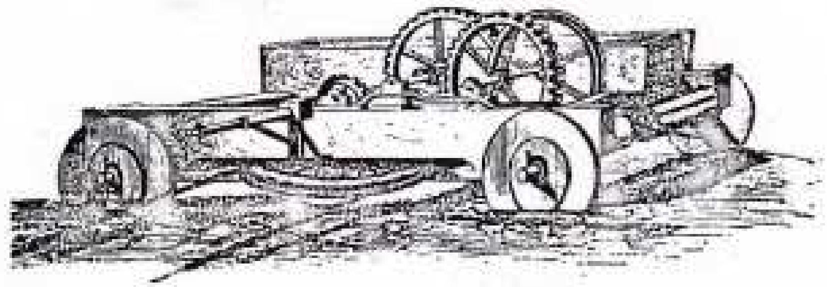


FIG. 3. *Probable design of Fowler's first attempted application of steam*



Fowler's selfmoving windlass and anchor pulley

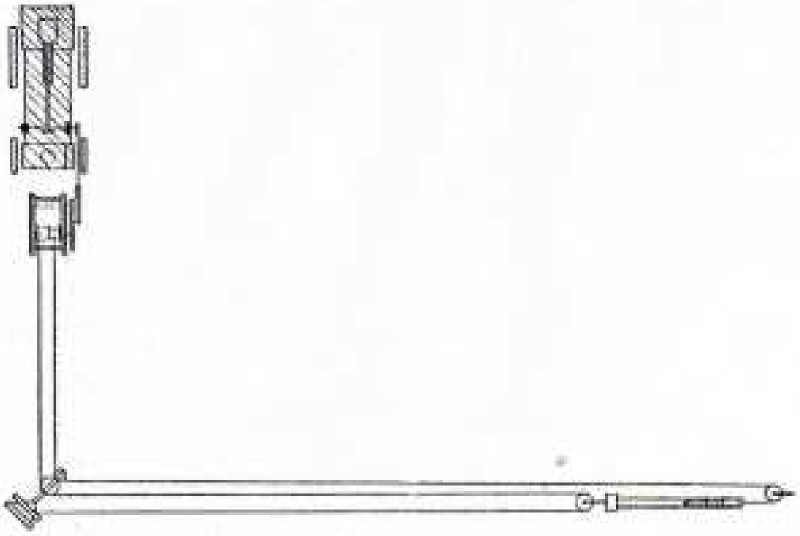
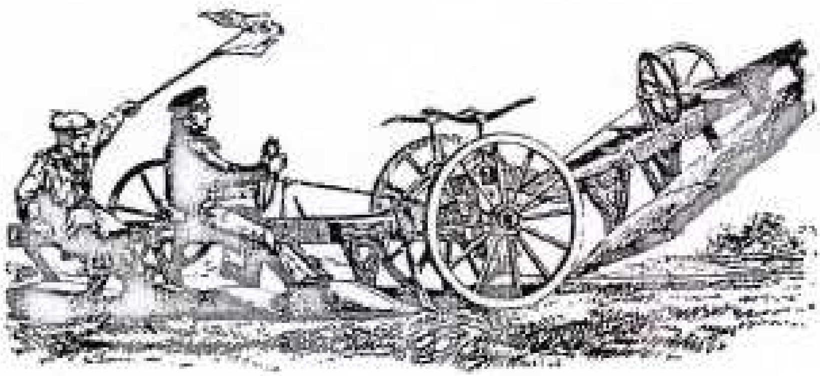


FIG. 4. *R.A.S.E. Lincoln 1854*



Fowler's steam plough

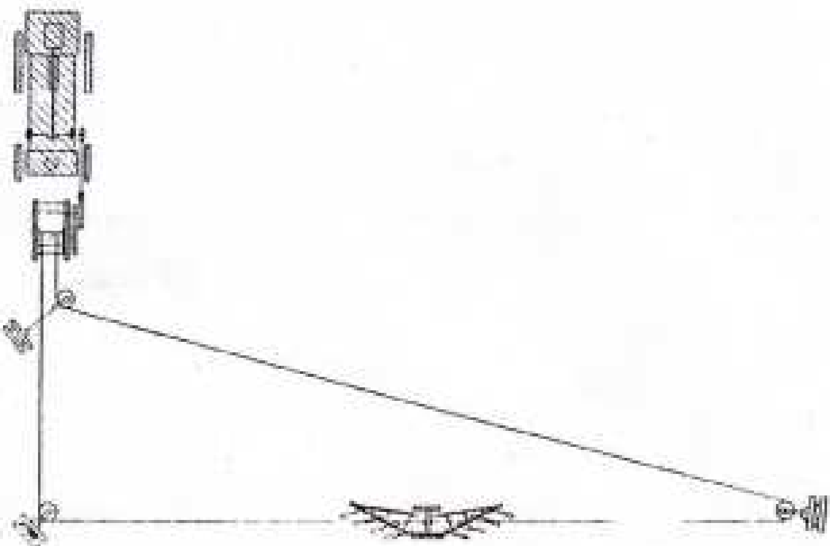
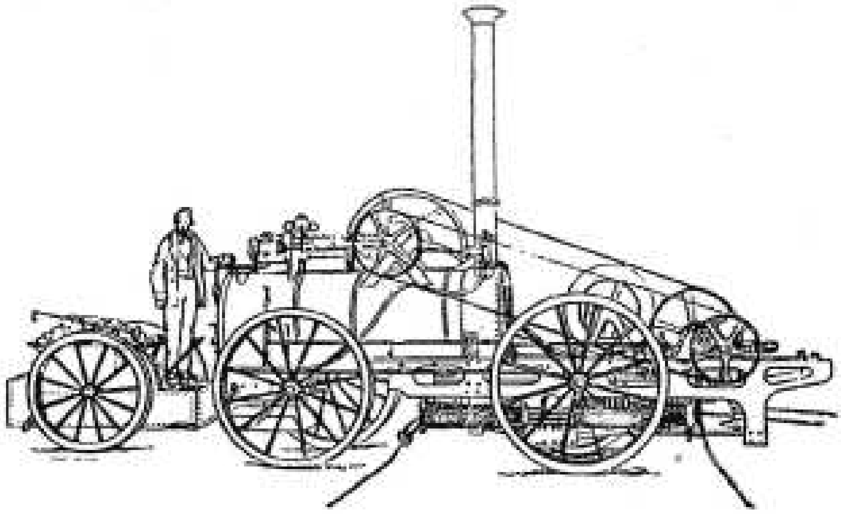


FIG. 5. *First application of steam to cultivation, 1856*



Fowler's engine

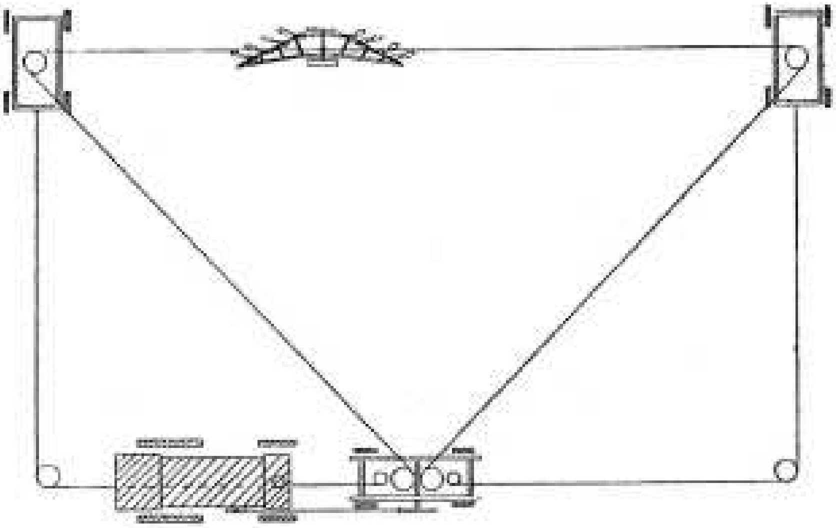


FIG. 6. *R.A.S.E. Chelmsford, 1856*

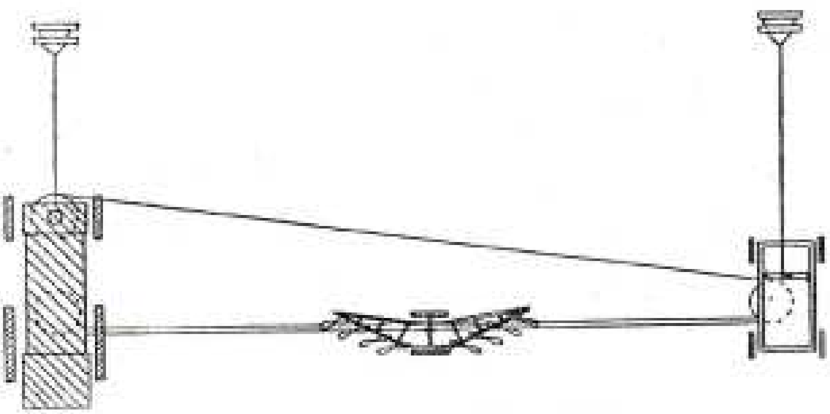


FIG. 7. *R.A.S.E. Salisbury 1857*