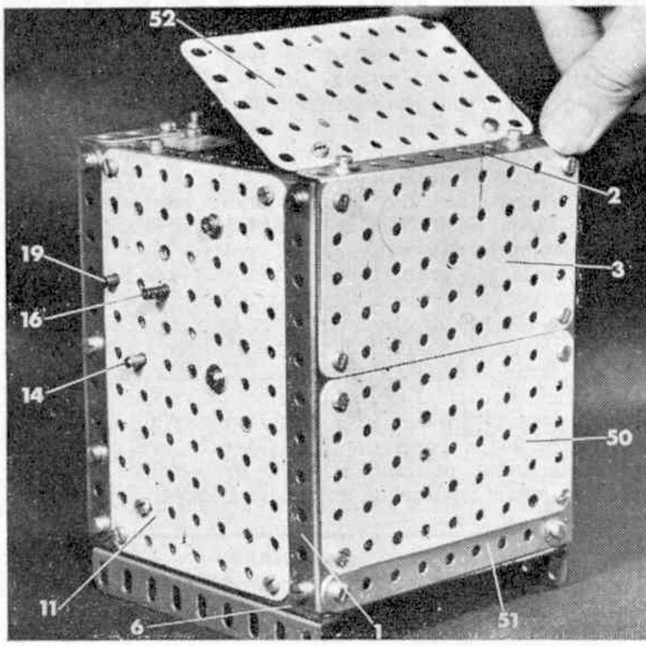
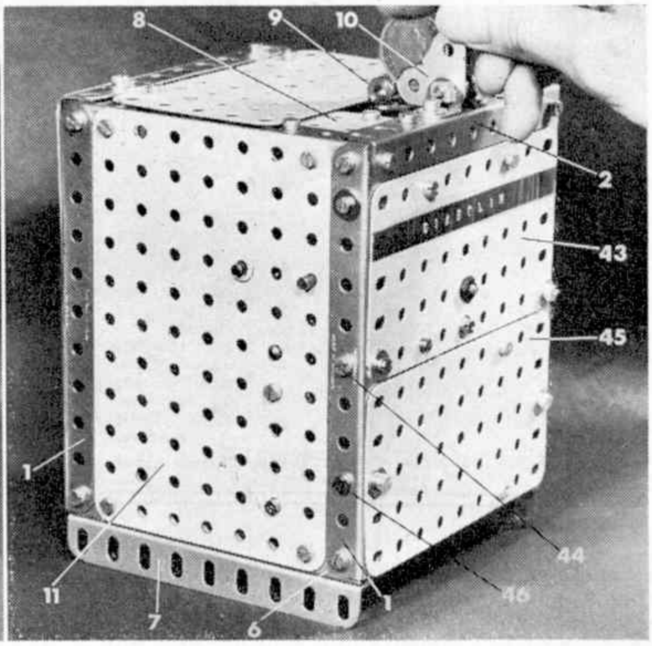


A rear view of the completed model showing construction of the basic " box."



The Meccano " Diabolik "—a mechanical money-box designed and built by Mr. Guiseppe Servetti of Piacenza, Italy.

MONEY GRABBER by Spanner

No problems in saving with this mechanical money-box. Put a coin in the slot and the mechanical hand grabs it tightly

FASCINATING GADGETS a-plenty have been built with Meccano, but few I have seen can match the particular example featured here. For reasons we shall see later it has been christened " Diabolik " by its Italian builder, Mr. Guiseppe Servetti of Piacenza, Italy. It is, in effect, a battery-powered, mechanical money-box, driven by a Junior Power Drive Motor and it's almost impossible to resist feeding it with coins ! Drop a coin in the slot provided and wait. Mysterious grinding noises and metallic rattles emanate from the dark interior of the box then, in due course, a lid in its top slowly opens and a " hand " appears. Almost gently it grasps the coin, pauses hesitantly then, without warning, suddenly whips the coin away to disappear inside the box with a bang—quite startling !

Framework

A rectangular box framework is constructed from four vertical $5\frac{1}{2}$ in. Angle Girders 1 joined at the top by four $4\frac{1}{2}$ in. Angle Girders 2, the securing Bolts holding the rear Girder also fixing a $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 3 in position. The side Girders 1 are joined at their lower ends by a special built-up base consisting of a $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate and two $4\frac{1}{2}$ in. Flat Girders 4 and 5. Each end of these parts is sandwiched between the horizontal flanges of two $4\frac{1}{2}$ in. Angle Girders 6, placed one inside the other with their vertical flanges pointing upwards, while the securing Bolts fix a third $4\frac{1}{2}$ in. Angle Girder 7 in position with its vertical flange pointing downwards. Note that Flat Girder 5 is not bolted in position but must be left free to slide in the groove supplied by the horizontal flanges of the two above-mentioned Angle Girders. The Flat Girder will later serve as the access hatch for the battery.

Bolted in the top front corners of the framework are two $1\frac{1}{2} \times 1\frac{1}{2}$ in. Flat Plates 8 connected by a $2\frac{1}{2}$ in. Insulating Flat Girder to the centre of which a Collar 9 is fixed by a Bolt screwed up into one of its tapped bores. This Bolt also fixes a $1 \times \frac{1}{2}$ in. Angle Bracket by its long lug to the underside of the Insulating Girder with its short lug towards the front and pointing downwards. A guide slot is then provided by two 1 in. Corner Brackets 10, separated by two Washers and mounted with further Washers on a $\frac{1}{2}$ in. Bolt fixed in two Angle Brackets bolted to front Girder 2. The Corner Brackets must not touch Collar 9. Each side of the framework is enclosed by a $5\frac{1}{2} \times 3\frac{1}{2}$ in. Flat Plate 11.

Drive mechanism

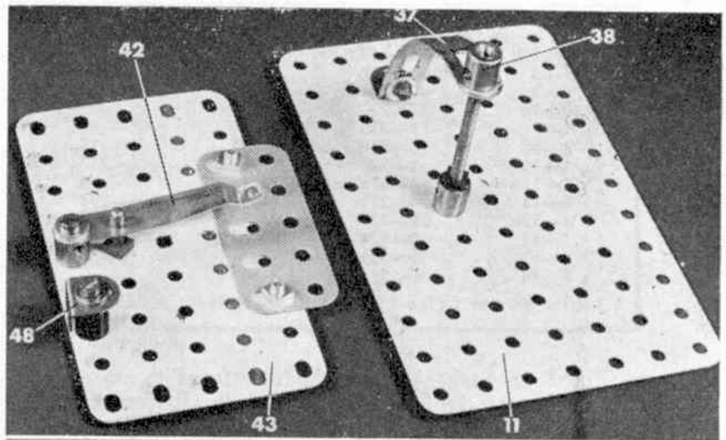
A Junior Power Drive Motor carrying a Worm on its output shaft is bolted to the base of the unit as shown. Engaging with the Worm is a 57-teeth Gear 12 fixed, together with a $\frac{3}{4}$ in. Pinion 13, on a 5 in. Rod 14 held by a Collar in Plates 11. In mesh with Pinion 13 is a second 57-teeth Gear 15 *loose* on an off-set 5 in. Rod 16, but with its boss fixed in one end of a Socket Coupling also loose on the Rod. Fixed in the other end of the Socket Coupling and loose on the Rod is another $\frac{3}{4}$ in. Pinion 17, the whole assembly being held in place by a Collar 18.

Mounted on a third 5 in. Rod 19 are two 8-hole Bush Wheels 20 and 21, a Collar 22, a Threaded Coupling 23, a 50-teeth Gear 24, in mesh with Pinion 17, and a second Collar which is spaced from Plate 11 by suitable small-diameter non-Meccano washers to prevent it catching on Gear Wheel 15. These washers are readily obtainable from most hardware stores and electrical-spares dealers. Held by Nuts in adjacent holes in the face of Bush Wheel 20 are a $\frac{3}{8}$ in. Bolt 25 and a Rod Socket, while a $\frac{1}{2}$ in. Pinion 26 is mounted loose on a $\frac{3}{4}$ in. Bolt held in the face of Bush Wheel 21. An ordinary Bolt is screwed into one tapped bore of Collar 22.

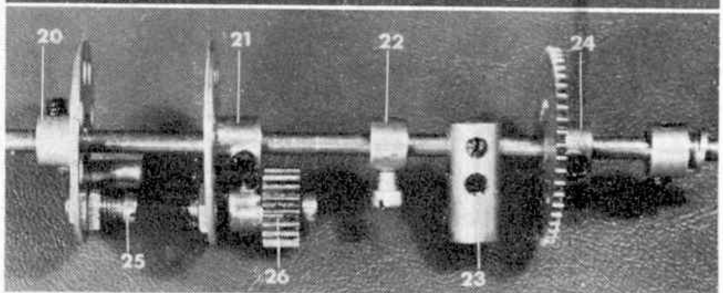
Hand and counterweight

Because it is equipped with four "fingers" and a "thumb," I feel I should call the actual coin-grabbing mechanism a "hand," although I must confess it looks more like the death-dealing claw of some diabolical monster. (Hence Mr. Servetti's title !) All the fingers are supplied by Pawls without boss 27, the middle, third and little fingers being mounted on a $\frac{1}{2}$ in. Bolt fixed to an Angle Bracket. A washer separates the middle finger from the lug of the Bracket while two Washers separate the third finger from the middle and the little from the third. Note, incidentally, that the securing Bolt passes through the second hole in the "little finger" Pawl, but the first hole in the other two Pawls. The "index finger" Pawl is fixed on a Bolt held by a Nut in the second hole of the middle finger.

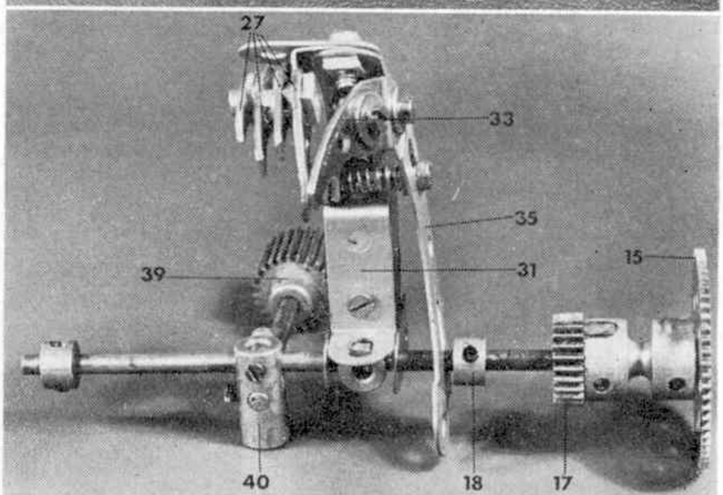
The Angle Bracket is bolted to a 1 in. Corner Bracket which is in turn bolted to one end of a bent $3\frac{1}{2}$ in. Strip 28 forming the "arm." At its opposite end, this Strip is bolted, along with a $1 \times \frac{1}{2}$ in. Double Bracket 29, to a Threaded Coupling 30, the securing Bolt being screwed into its threaded longitudinal bore. (When the mechanism is finished, Rod 16 will be fixed in the opposite end transverse smooth bore of this Coupling.)

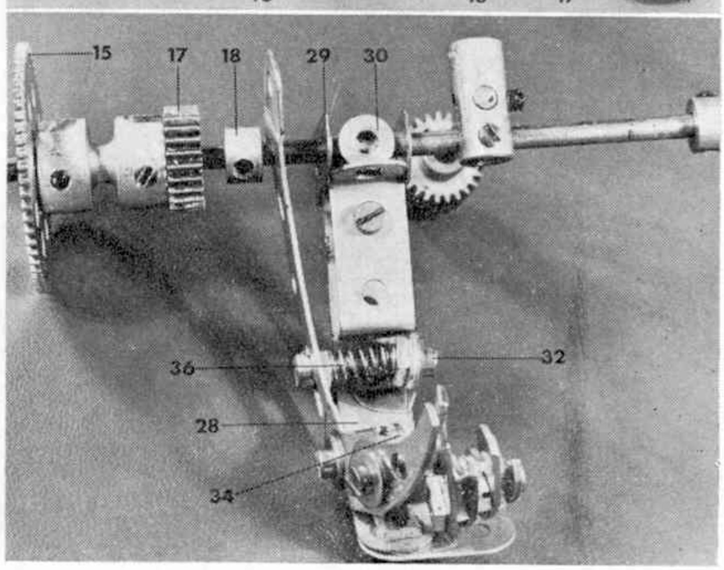


Top right; plates 11 and 43 removed from the model to show construction of "thumb" controlling guide and battery contact points.



Next; The movement operating rod or camshaft, removed from the model.





Lastly; Two views of the "arm" and "hand" with the mounting rod removed from the model. Note that, when the unit is in place, the Gear/Socket Coupling/Pinion arrangement is in contact with Collar 18.

PARTS REQUIRED			
2—2a	2—25	3—63c	1—115
1—3	1—25b	1—63d	1—120b
4—9	1—26	13—64	1—124
10—9a	1—27	1—72	3—133d
1—9c	1—27a	2—74	5—147c
1—9d	1—27d	1—81	1—171
1—10	1—32	2—89a	1—212a
1—11a	60—37a	2—103c	1—215
6—12	54—37b	1—103f	1—507
1—12b	25—38	2—111	1—533
3—15	2—52a	2—111a	1—564
1—17	6—53a	1—111c	
2—24	6—59	2—114	
1 Junior Power Drive Motor.	1 2½ in. Strip adhesive tape.		

Fixed to Strip 28, but spaced from it, as shown, by a Short Coupling, is a 1 × ½ in. Reversed Angle Bracket 31. This is not bolted to any other part, but it serves as a strengthener, being wedged between Threaded Coupling 30 and an Angle Bracket bolted to Strip 28. A Bolt 32 carrying a Washer and a Nut is fixed to the free lug of this Angle Bracket.

Turning to the thumb, this also is represented by a Pawl 33, but first a Threaded Boss 34 is mounted loose on the shank of the second Bolt securing the Corner Bracket to Strip 28, the Bolt passing into one transverse tapped bore of the Threaded Boss. The " thumb " Pawl is then bolted to a bent Fishplate which is in turn bolted, along with a 3 in. Stepped Curved Strip 35, to the end of the Threaded Boss. A Bolt is held by a Nut in the nearby elongated hole of Curved Strip 35, this Bolt lying opposite Bolt 32. A Compression Spring 36 is slipped onto the shanks of both these Bolts and the resulting pressure on Strip 35 causes the thumb to close against the index finger. With the mechanism in position, Rod 16 passes through the free elongated hole in Strip 35.

A curved guide controlling the sideways movement of Stepped Strip 35 as the " arm " is raised, is provided by a Formed Slotted Strip 37, one end of which is fixed by an Angle Bracket to appropriate Flat Plate 11. Its other end is held by a Threaded Boss 38 and a Nut on a 2 in. Screwed Rod locked by a Nut in a second Threaded Boss bolted to Plate 11.

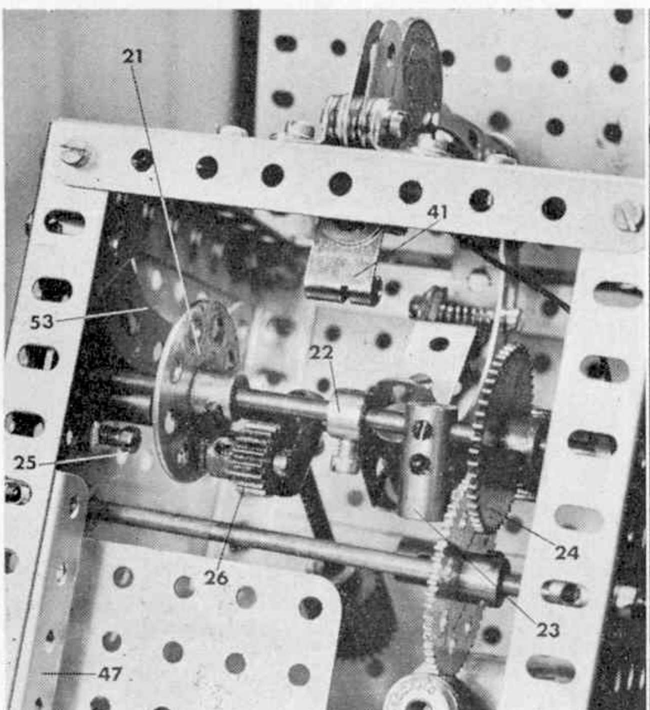
The counterweight for the hand consists of a ¾ in. Pinion 39, with a ¾ in. face, which is mounted on the end of a 2½ in. Rod, fixed in the central transverse smooth bore of a Threaded Coupling 40. This Coupling is mounted as shown on Rod 16.

Electrical system

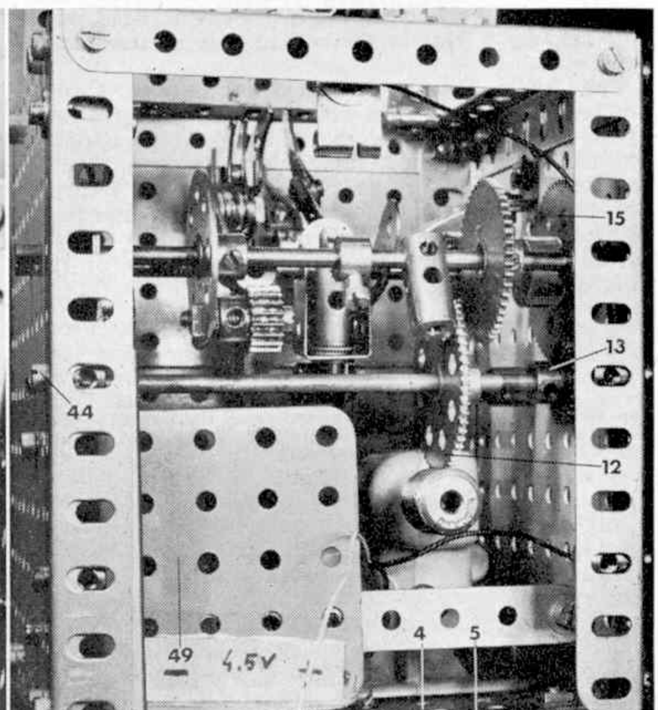
Before going any further with the Diabolik, it is best to complete the electrical system. A right-angled Rod and Strip Connector 41 is bolted to the short lug of the 1 × ½ in. Angle Bracket fixed to the underside of the earlier-mentioned Insulating Flat Girder. In contact with the front face of this is a 2 in. Wiper Arm 42 (Elektrikit Part No. 533) bolted to a Threaded Boss which is in turn fixed to a 4½ × 2½ in. Flat Plate 43. This Plate is removable and is held in position by Bolts screwed into the transverse bores of two Threaded Bosses fixed one to each front Girder 1 by Bolts 44. Another 4½ × 2½ in. Flat Plate 45 is similarly held in position, Bolts 46 securing the Threaded Bosses to Girders 1. Note that, with Plates 43 and 45 in position, the securing Bolts at one side fix a 3 in. Angle Girder 47 to one Angle Girder 1. This serves as a guide for the battery, another guide being provided by a second 3 in. Angle Girder bolted to the inside of Plate 45.

Secured to Plate 43, in addition to the Wiper Arm, is a 2½ in. Flat Girder, which slots behind front Girder 2, and an Insulating Spacer (Elektrikit Part No. 564) to which an Angle Bracket 48 is bolted. Wiper Arm

A close-up view of the movement controlling rod showing the positions of the parts when the arm is fully raised.



In this view of the model the front Plates have been removed to show the layout of the drive mechanism operated by a Junior Power Drive Motor.



42 is prevented from turning on its Threaded Boss by a Threaded Pin projecting through the second hole in the Wiper. This Threaded Boss and Angle Bracket 48 form the contacts for the Motor's power source which in this case is a $4\frac{1}{2}$ volt Ever Ready 1289 or equivalent " flat " torch battery. A backing plate for the battery is provided by a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 49 attached to a $4\frac{1}{2}$ in. Strip which is in turn attached to Plates 11 by Threaded Bosses.

When fitting the battery, the positive (short) terminal must make contact with the Threaded Boss, while the negative (long) terminal makes contact with Angle Bracket 48. Actually, the Angle Bracket and Threaded Boss do not lie above the centre of the battery, therefore you will probably find it necessary to bend the battery terminals to the appropriate side so as to make good contact. The wiring of the model itself is simple. One Motor lead is connected to Angle Bracket 48, while the other lead is taken from the Motor and connected to the $1 \times \frac{1}{2}$ in. Angle Bracket to which Rod and Strip Connector 41 is bolted. The battery is held in position by Flat Girder 6.

To complete the model, the back is enclosed by a $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 50 and a $4\frac{1}{2}$ in. Strip 51. Another $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 52, attached to nearby Girder 2 by Hinges, acts as a lid for the box. It is controlled by a 3 in. Stepped Curved Strip 53 loosely attached to a Threaded Boss fixed to front, left-hand Girder 1. The forward movement of the hand also helps to open the lid, therefore it is very important that a strip of Sellotape be fixed to the underside of Plate 52 to provide a " slipway " for the hand.

Operation

When a coin is placed in the slot it makes contact with Collar 9 and Corner Brackets 10 thus completing the circuit to the Motor which begins to operate. The drive is transferred through the relevant Gears and Pinions to Rod 19 which rotates clockwise when viewed from the right. As Bush Wheel 20 revolves Bolt 25 acts against Curved Stepped Strip 53 which pushes open the lid. As this is taking place, Bush Wheel 21 is revolving so that Pinion 26 presses down on Threaded Coupling 40 causing the " arm " to rise As it does so, Threaded Coupling 23 acts against the side of Stepped Curved 35 keeping the " thumb " and " index finger " apart until, at the very top of the hand's movement when the thumb and finger are one each side of the coin, the Coupling disengages the Strip. Immediately, the action of Compression Spring 36 causes the thumb to close on the coin and, as the cycle continues, the arm pulls the coin from the slot.

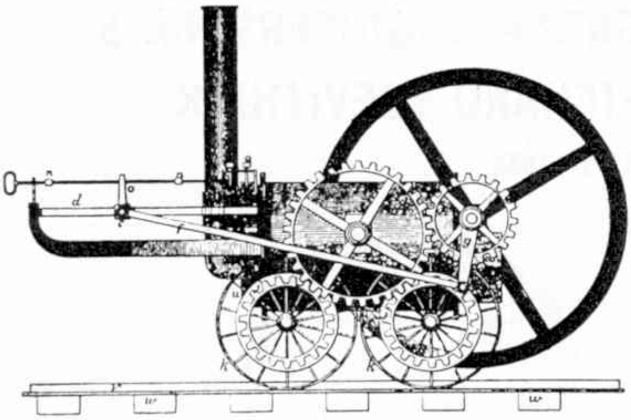
While all this has been going on Collar 22 has been rotating. At the beginning of the operation, the Bolt in the Collar should have been holding Wiper Arm 42 away from Rod and Strip Connector 41 so that the coin was essential to complete the electrical circuit. However, as the Collar revolves, the Bolt eventually moves away from the Wiper Arm thus allowing it to make contact with Rod and Strip Connector 41 which in turn completes the circuit and enables the Motor to continue running. The arm begins to withdraw with the coin until, when Pinion 26 leaves Threaded Coupling 40 the counterweight comes free and drops causing the arm to shoot into the box. As it does so, guide 37 presses against the side of Strip 35 and opens the " thumb " to release the coin. Almost immediately the Bolt in Collar 22 contacts Wiper Arm 42 lifting it clear of Rod and Strip Connector 41 to break the circuit, and complete the cycle of operations.

GREAT ENGINEERS No. 5
RICHARD TREVITHICK
(1771—1833)

THIS MECHANICAL inventor, almost unknown outside the engineering field, was a man with a consuming desire to achieve his objects, but a person with little ambition or ability as a business man. At school his teachers classed him as slow, obstinate or disobedient. Yet he developed an insatiable urge to achieve whatever he set out to do, and was a " veritable volcano " of inventions, some of his ideas predating engineering progress by years. He was born during early stages of the Industrial Revolution when steam was making its impact on the affairs of the country. This was due mostly to James Watt, as he improved the steam engine so much its power gave it a major " part " in the Industrial Revolution.

Watt's first engines were atmospheric engines, but later he employed low pressure steam. Trevithick's engines used high-pressure steam and they proved far more economical. Known as " puffers," they were applied to many duties, including passenger cage winding in mines.

William Murdock, one of Watt's mechanics and another great inventor, constructed a small steam-driven carriage in 1786, but for some reason this was not developed and his experiments were forgotten. Trevithick took up this subject and was trying out a steam carriage in late 1801, with some success, since he and his cousin, Andrew Vivian, took out a patent in 1802 for " Improvements in the Construction of Steam Engines." John Vivian,



son of Andrew, was about 19 at the time and drove one of these carriages in the streets of London during 1803. In his biography on Trevithick he said: ". . . the engine had one cylinder, and three wheels; the two driving wheels behind were about 8 feet in diameter. The boiler and engine were fixed just between those wheels. The steering wheel was smaller and placed in front. There were some gear wheels to connect the engine with the driving wheels. One or two were made in Tottenham Court Road, and in Euston Square. . . .

"I was steering, Captain Trevithick came alongside me and said 'She is going all right ?' 'Yes,' I said, 'I think we had better go on to Cornwall.' She was going along five or six miles an hour, and Captain Trevithick called out, 'Put the helm down, John,' and before I could tell what was up, we were tearing down six or seven yards of railings from a garden wall. A person put his head from a window, and called out 'What the devil are you doing here? What the devil is that thing!'"

During 1802 Trevithick constructed what was probably his first tramway locomotive, for the Pendarran Ironworks in Wales. This locomotive looked something like the line drawing illustration, although it may not be absolutely correct. Trevithick gives the following information: It weighed 5 tons. The cylinder was $8\frac{1}{4}$ in. diameter, with a stroke of $4\frac{1}{2}$ ft. and it hauled a gross load of 25 tons at the rate of 4 miles an hour over a rough track with sharp curves and steep incline. Without load the locomotive could attain a speed of 16 m.p.h.

There is no direct evidence that Trevithick made any other locomotives until 1804 when he built one for Newcastle upon Tyne. In appearance it was similar to the Welsh locomotive, but more superior in detail. For some reason it did not attract much interest and was eventually relegated to the work of a stationary engine.

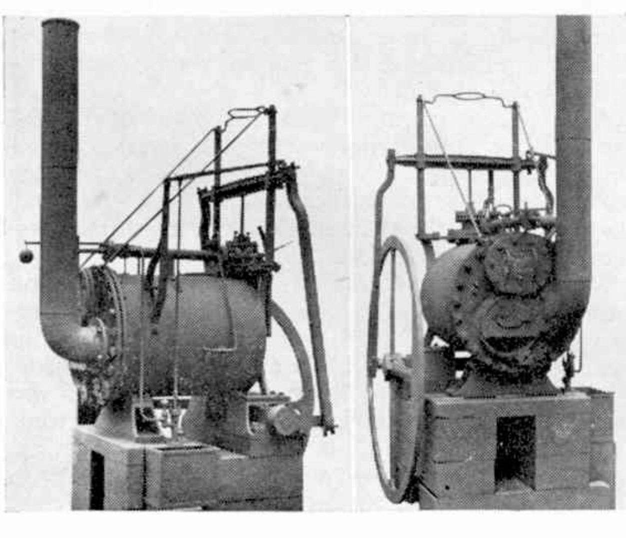
In 1808 he made his last attempt to popularise the steam locomotive, by building a circular railway track near the site of the present railway station at Euston. Admission, including a ride for those brave enough to risk it, was 1s. The show ran for a few weeks but the engine toppled over and brought the venture to a close.

Trevithick had many other activities and locomotives were but a side-line. At the time of the Napoleon scare (1804) he was suggesting a steam-driven fire ship to destroy the Emperor's invasion fleet at Boulogne, and he was prepared to captain it. Two years later he was offering the Trinity Board a steam-driven dredger to scoop ballast from the Thames. Then he became involved in another Thames scheme—the attempt being made to drive a tunnel across the Thames at Rotherhithe. The tale of the failure and ultimate success of this project is a long story. An unsuccessful attempt had already been made before Trevithick came on the scene, but it was he who almost completed a pilot tunnel before water burst in and flooded the workings. He then constructed iron tanks for the storage of cargo and water in ships, and set up a factory to make them at Limehouse. The project fell through and he returned to Cornwall in 1810, more or less a broken man, but he soon revived and was in great demand as a consulting engineer. He also developed a number of improvements for steam engines and boilers, and advocated steam-driven plant for agriculture.

In 1816 Trevithick sailed for Peru to manage the installation of steam engines in silver mines there. Unfortunately the area became involved in revolt, the mines rendered worthless and the machinery completely destroyed. He returned home without a thing, but the local church bells greeted his arrival.

Then followed a period of further inventions and patents, and his scheme for a cast-iron column 1,000 feet high to mark the passing of the Reform Bill, but his sudden death in 1833 put an end to this. At this time he was also pursuing an invention at Hall's Works, Dartford, Kent, where he now lies in a nameless grave.

So passed one of Britain's greatest engineers, a man who gave much for science and industry, yet received nothing in return!



At top of page, Trevithick's Penydaren railway locomotive constructed during 1804. At left, two views of Trevithick's high pressure engine and boiler made during 1805. This is now preserved and on view in the Science Museum.