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MARCH 1972 VOLUME 57 NUMBER 3

Meccano Magazine, founded 1916

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MAP **HOBBY MAGAZINE**

ABC

FRONT COVER

All shone up for a rally is this Aveling tractor which looks as though it started life as a steam tractor and has been converted to represent a showman's engine. Fascinating machines; more about them on page 114-117. *Photo A. C. Muttitt.*

NEXT MONTH

A simple semi-scale sailing model of an eighteenth century revenue cutter will be a full-size plan feature in our next issue.

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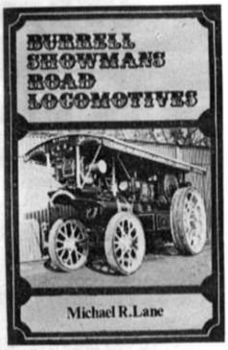
MAP The Finest Range of Model Technical Books in the World!

164 FAMOUS PADDLE STEAMERS

By popular request this well known book by F. C. Hambleton has been reprinted. It covers over a dozen paddle steamers in detail with many others included in its pages. Drawings by the author include paddle wheels, scale views, house flags, and signals, and interesting items of the period covered. Of interest not only to those who wish to model 'paddlers' but to everyone with any affection for this now almost extinct class of vessel.

100 pages 8½ × 5⅞ in. plus fold-out drawing of Royal Eagle. Drawn on card cover in sepia on buff. **60p**

161 BURRELL SHOWMAN'S ROAD LOCOMOTIVES



A *tour de force* by enthusiast author Michael Lane who spent many happy months restoring one to its pristine glory. Not only does he cover his own showman's engine, but deals in depth with the whole family of Burrell showman's engines. Indeed, the original title was to have been "Fifty Years Service in the Tobers" indicating the very special place this engine had for half a century amongst the fairground people. Replete with pictures, ancient and modern, many original drawings, exhaustive tables detailing the fate and present whereabouts of so many engines, and altogether a book that may well be the definitive work on the subject.

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160 AEROMODELLER ANNUAL 1971/2

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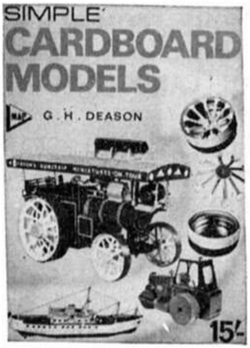

This magnificently-illustrated book deals with working models of Rollers, Road Engines, Ships, Cars, Tracklaying Vehicles, Rail and Tramway models and other working models, including models of *RMS Scillonian* and the *Ruston Bucyrus Excavator*.

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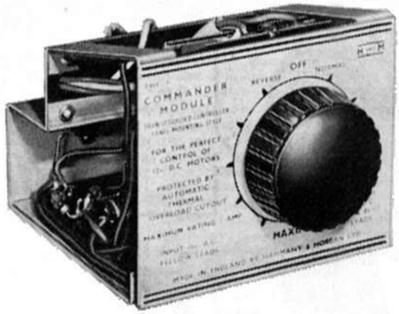

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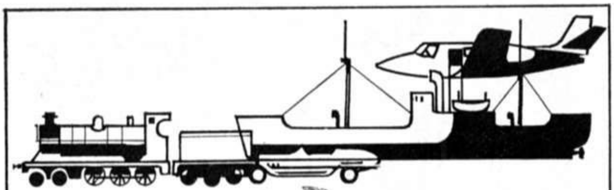

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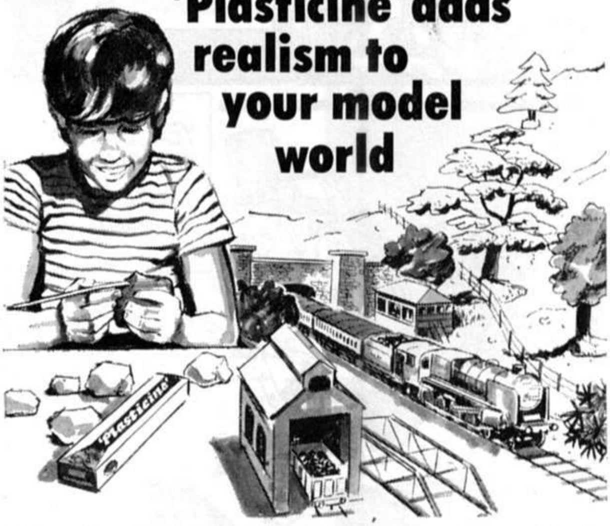

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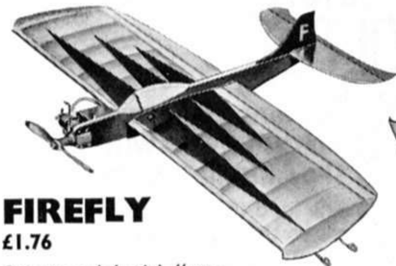

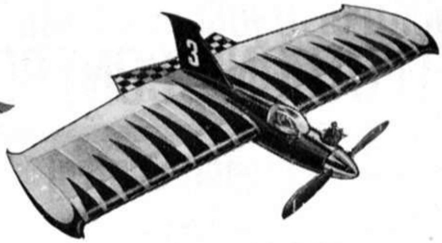

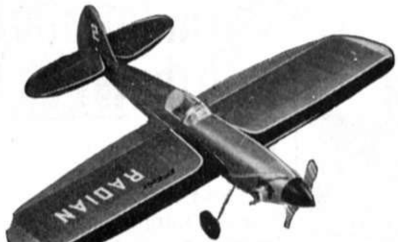

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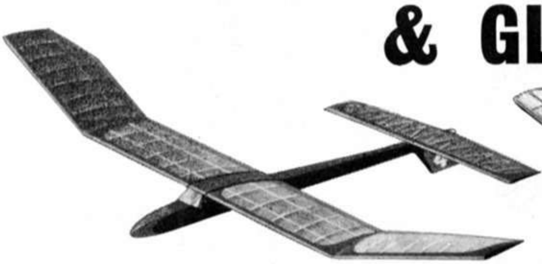

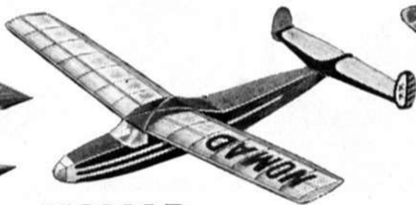

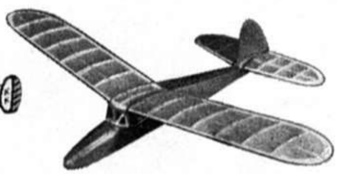

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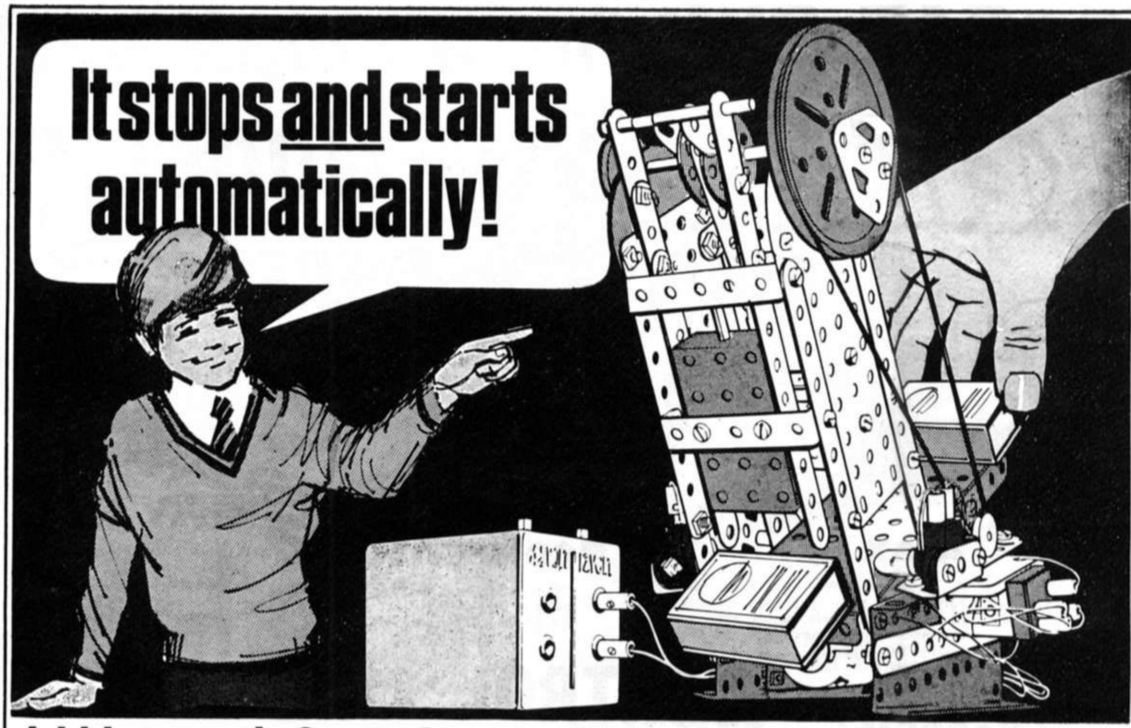

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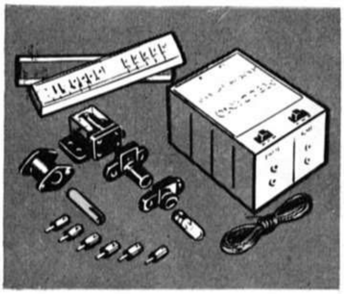
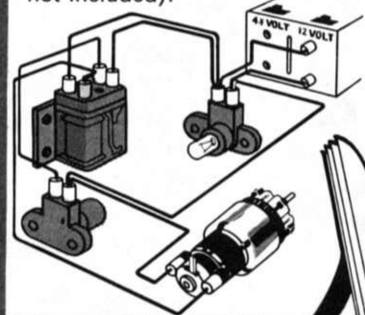


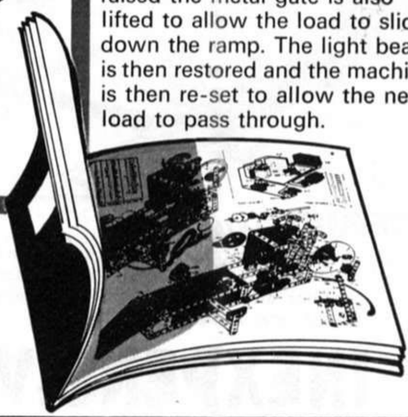
Electronic Control

This set includes a battery control box, an electronic eye that acts as an automatic switch, a relay, solenoid, bulb holder, plugs and wire. (motor not included).



See how Electronic Control works with the Automatic press

The load for pressing is slid down the ramp breaking a light beam as it arrives in position under the press tool. As the beam is broken the motor starts and the press tool descends upon the load, held in place by the metal retaining gate.
As the press tool is automatically raised the metal gate is also lifted to allow the load to slide down the ramp. The light beam is then restored and the machine is then re-set to allow the next load to pass through.



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ON THE EDITOR'S DESK

THE doors are open for the 41st Model Engineer Exhibition as this issue is finalised, and by the way the crowds are pouring in, it could well be a record year. As well as "the year of the big models" it could be the year of the biggest attendance! The "big model" aspect comes from, especially, two large $10\frac{1}{4}$ in. gauge locomotives, the $3\frac{1}{2}$ ton Berkshire type 2-8-4 and the *Royal Scot* from Lord Gretton's Stapleford Park Railway, and a 15 in. gauge 0-6-2 *Dougal* shown by Severn-Lamb Ltd. and built by them for a Bristol railway.

At the other end of the scale are (were, when you read this!) literally hundreds of military miniatures and other tiny items such as scale scratch-built cars only $\frac{3}{4}$ in. long, or a rocking chair made from the wood provided by one match! Regrettably, there was a shortage of Meccano exhibits, which is surprising in view of the number of fine models built in this medium; it seems such a fine opportunity for Meccano enthusiasts to show thousands of people that the system is still fully up to date and capable of producing ingenious and practical models.

This year a highly popular new feature proved to be the use of the swimming pool for demonstrations of electric, steam, and diesel, glow, and petrol powered boats, mostly radio controlled. We also built a flying circle, for electric-powered aircraft, extending the full width of the hall between balconies, and demonstrations included up to four models flying together and streamer-cutting combat.

Next issue will feature photographs of some of the outstanding models; in the meantime, back to answering the hundreds of questions from the visitors thronging the show!

Another Girl Radio Officer

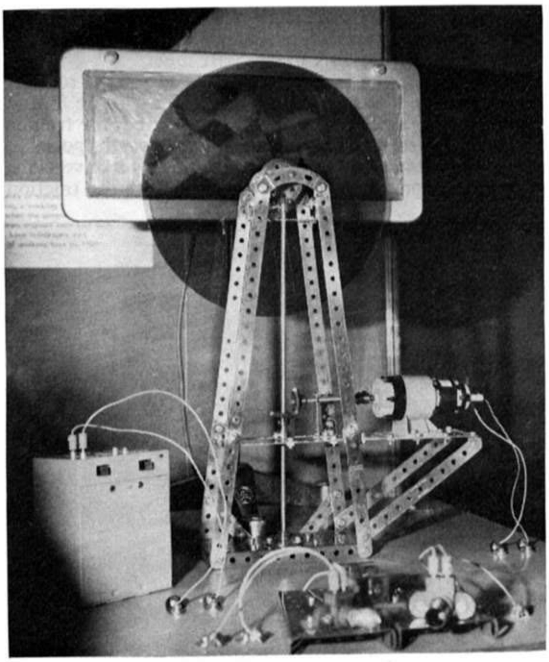
The first woman radio officer in the British Merchant Navy, Dallas Bradshaw, whose appointment was in May 1970, has been joined by Barbara Keating, an Australian 26 year old, who sailed in the 16,000 ton tanker *Border Minstrel* on January 6th. Barbara got her first taste of life at sea in the Norwegian Merchant Service, then studied at the London Electronics College to obtain her certificate as a British Merchant Navy radio officer. She joined Marconi Marine and spent a qualifying six months' sea time (necessary before being allowed to sail in charge of a radio station) aboard the Shaw Savill *Zealandic*.

While wishing the newest radio officer fair seas and the very best of luck, we can't help imagining the reactions of some of the crusty old sea-dogs we've met to what they would no doubt term a "petticoat invasion" of yet another male stronghold!

Science Museum Exhibition

Another exhibition which we found time to visit for its opening just before Christmas was that of Scientific Toys at the Science Museum, South Kensington. Much of this is devoted to toys of the past—an eighteenth century orrery (which shows the paths of the planets etc.) and nineteenth century steam engines, for example. We were gratified to see that Meccano was represented; our picture shows it in use as part of a working display. In the foreground is a light source and a hooded photoelectric cell. By placing a card against the glass of the case, the light is reflected into the cell, which duly switches on the Meccano motor, driving a polaroid disc round via bevel gearing etc. An illuminated screen behind the disc shows patterns produced by polarisation.

There are a number of early model railway exhibits, stationary engines, a "working" engineering shop, a toy brewery, gyroscopic devices, and toys that demonstrate such things as Bernoulli's equation, automatic fountains operated by temperature change, and the like. Although not a big exhibition as these things go, it is fascinating and well worth a visit. The Museum says it will be open "until about March".



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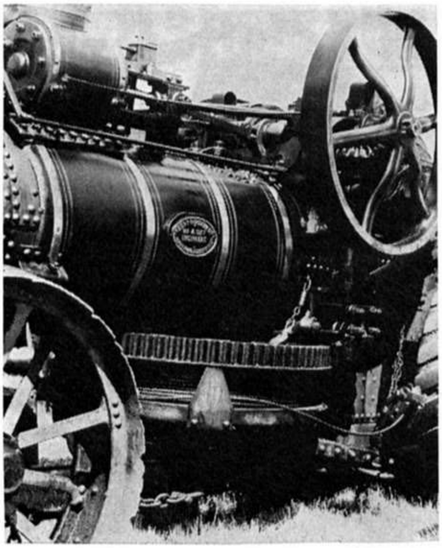


The Glorious Age of Steam

The story of the traction engine and its variants

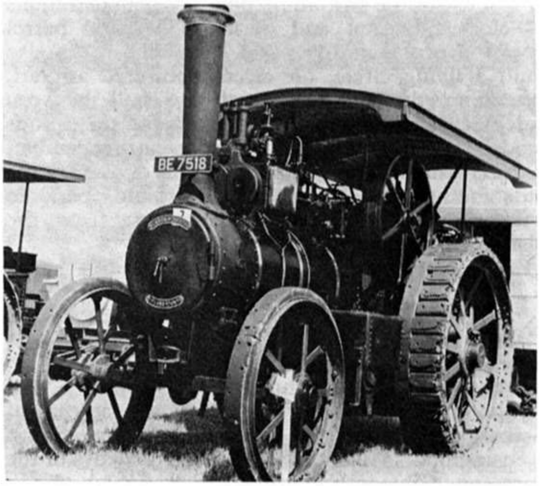
By Alan Pearce

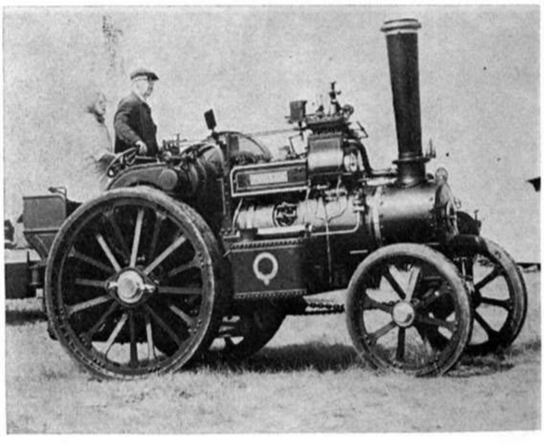
Left, close-up of the winding drum on a Fowler cultivating engine, showing the wire rope used to haul in the plough. Below, a Road Locomotive. This is the McLaren of 1913, weighing 11 tons 15 cwt. Below left, a Steam Tractor—the 5 ton Fowler "Pandora" of 1917. This one was originally used by Herefordshire County Council for local haulage jobs, and could be driven by one man, a decided asset in the type of work for which it was used.

ALTHOUGH August 20th, 1950 is not a date you will find in history books, it is of great historical significance to all who admire the beauty and perfection that was English engineering at the turn of the century.

Indeed, few of the five hundred or so people who turned up at Arthur Napper's Berkshire farm on that summer's afternoon, to watch him and a close friend race their two steam traction engines over a mile long course, could have realised that history was being made before their eyes and they were witnessing the birth of a new leisure time activity—the Steam Traction Engine Rally. Yet, when Arthur Napper's engine, "Old Timer", chuffed across the finishing line ahead of its rival, "Lady Grove", an idea was born in the minds of both owners, and Traction Engine Rallies, from that small beginning, have become an established part of the summer scene, attracting thousands of people wherever these magnificent giants of the past meet.

The story of the traction engine can be said to start in 1858, when Thomas Aveling, a farmer with no formal engineering training, successfully converted, for friends round Rochester, Clayton and Shuttleworth portable steam engines to self propulsion. Early conversions were indeed primitive when compared with the traction





engines that grace the scene today. Although self propelled by means of a chain driving one of the rear wheels from a reduction gear fitted to the crank shaft, a horse was still required between the shafts for steerage.

This was, however, a beginning for the self propelled engine, and from it Aveling designed an engine that was at first constructed for him by Clayton and Shuttleworth until, by 1861, he had accumulated sufficient funds to open his own factory.

The period of the development of the traction engine, as, with various improvements, it progressed from those early primitive models to the magnificent work-horses that we so admire today, was not the prerogative of Thomas Aveling. Contemporary with him were names such as John Fowler of Leeds, Charles Burrell of Thetford, Clayton and Shuttleworth of Lincoln, Robey and Co., Lincoln, Marshall Sons and Co. of Gainsborough, and others too numerous to mention.

In all over ninety firms were concerned in the production of traction engines. The big firms such as those named above turned out these machines by the thousand

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while others, working on a much smaller scale, produced only one or two prototype engines. The heyday of these monsters of steam was for a period of about 40 years from 1890.

Although it is true that, from the First World War, internal combustion engined tractors began to make inroads into the domain of the steam engine, nothing, even into the 1930's, could touch the traction engine for real hard work. They were used by furniture removers, timber hauliers, road builders, general contractors and showmen as well as by farmers, agricultural contractors for threshing and ploughing and, in steam roller form, by everyone concerned with road construction.

There was quite a difference between the engines built for various jobs and although the road roller and cultivating engines are more or less obvious, to the inexperienced eye, the traction engine, road locomotive and tractor appeared very much the same.

The General Purpose Traction Engine was a machine of from 5 to 8 n.h.p. and, as its name implies, used for any job that might arise. Its chief use, however, was in the field of agriculture, where it was the general workhorse of the farm during threshing operations, for driving saw benches and elevators and for general haulage of farm produce.

Although not designed for continuous road usage, having, as it did, only two speeds, the general purpose engine was admirably suited to the needs of short haulage and it found continuing favour with local councils, road construction firms, quarry owners and even furniture removers.

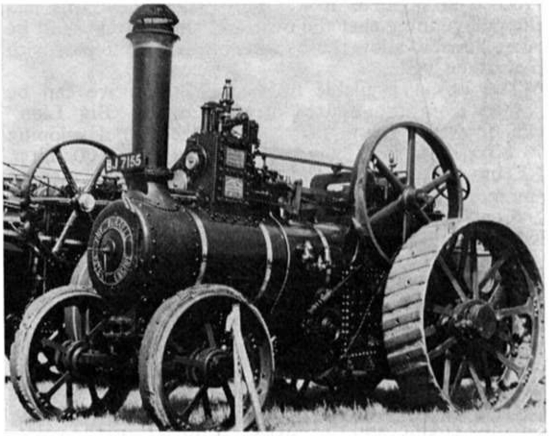
The General Purpose engine, like all other traction engines, has its horse power expressed in n.h.p., Nominal Horse Power, a term that came into use in a deliberate attempt to confuse those opposed to the "huge spitting monsters that tear up both road and countryside alike", as one opponent called them. To pacify those on both the Government and local Councils to whom the horse was the only true form of transport, and who saw in the traction engine, not only a vehicle that would cause expensive damage to roads, but a threat to the very peace of rural England, the makers adopted the ruse of underrating the real horse power of their engines. To show an engine of small horse power was to show a less formidable road damager and hence, the term used by them, n.h.p., was roughly one seventh of the real horse power.

The Road Locomotives, unlike the general purpose traction engines, were built for the specific purpose of road haulage. They were generally of heavier construction, with wider gearing and larger wheels. Often, in order to give an increased mileage, belly water tanks were fitted and the crew were protected from the worst of the elements by a canopy fitted over the engine.

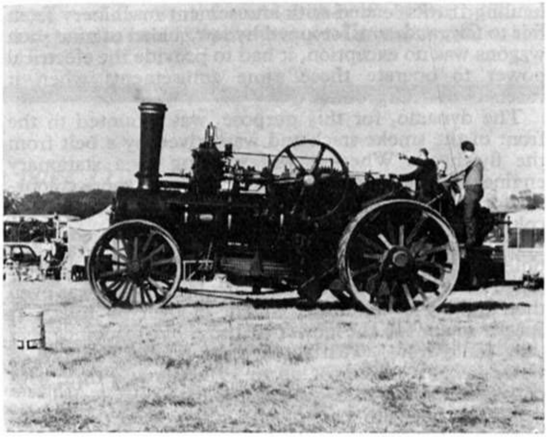
The tasks entrusted to the Road Locomotives were innumerable, but it was when they were required to move loads that were either too bulky or too big for the railways that they really came into their own.

Although such work was well within the mechanical capabilities of the engines themselves, it would cause considerable trouble to their crews. More often than not hedges on narrow lanes had to be cut back to get the road locomotives and their loads through and it was nothing unusual for whole banks to have to be dug away before the transport could proceed.

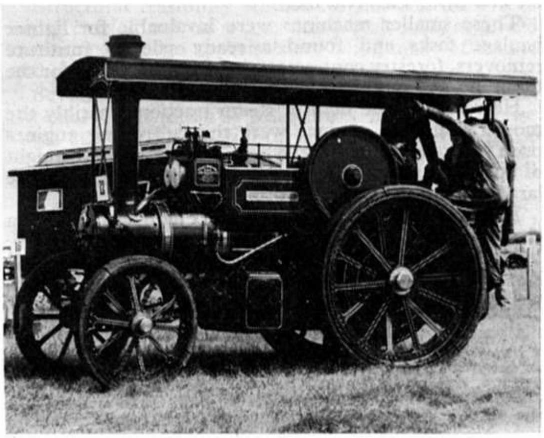
On one such occasion, when two bulky marine boilers were required to be moved, the locomotives could only



A General Purpose Traction Engine. This is the 1909 Burrell with a weight of 9½ tons which was used for agricultural duties



A Fowler cultivator gets up steam again as it proudly enters the ring for an event at a Traction Engine Rally.



Steam Tractor—Aveling and Porter of 1913. It was originally used for agricultural purposes at Yeovil but later saw use as a general purpose machine in the building of army camps at Salisbury during the First World War.

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proceed at night as it was only when the trams had stopped running that the overhead tram wires could be taken down to allow these giants of the road to pass with their huge loads.

The power available in a road locomotive can be judged from the figures of the Fowler "Big Lion" which, with a n.h.p. of 8, was capable of developing 70 b.h.p. and, for short periods, a peak of 100 b.h.p. Its brother, the "Super Lion" would, in cases of emergency, take up to 120 tons.

Small wonder that, for haulage purposes, the road locomotive reigned supreme for so long.

Road Locomotives cannot be allowed to pass without reference to what were, without a doubt, the aristocrats of traction engines, the Showman's Locomotive. With colourful paintwork, polished brass and scrolled decoration, they truly represented those fantastic characters who made up the ranks of the travelling showmen in the age of steam. The men vied with each other to produce a more colourful, more eye-catching engine, and the finished results, from the paint-work through the use of decorated copper and brass, to the mirror bright cylinder blocks, were indeed works of art.

The Showman's Locomotive was, however, more than just an advertisement for its owner for, as well as hauling trucks loaded with amusement machinery from fair to fair, and, until stopped by law, a load of nine such wagons was no exception, it had to provide the electrical power to operate those same amusements when it reached the fairground.

The dynamo, for this purpose, was mounted to the front of the smoke stack and was driven by a belt from the flywheel. When it was working as a stationary engine, the Showman's engine looked even more colourful for, from its own electricity, it illuminated rows of coloured lights round its canopy.

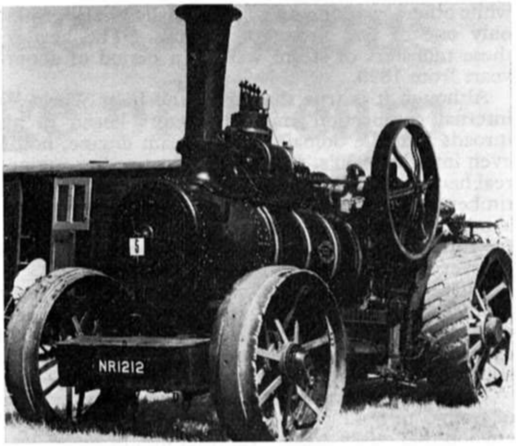
Although, after the change of the law that forbade the pulling of an excessive number of trailers, the load consisted of only four large vans, each locomotive was even then pulling a combined weight of over 35 tons. It speaks much for the power of these old machines that they could travel, with about three hundred gallons of water in their tanks, for up to 15 hours at a time with only the steepest hills causing the load to be split.

At the opposite end of the scale came the Steam Tractor. This was a smaller version of the Road Locomotive, constructed to weigh under 5 tons so that they came under the definitions as laid down in the Light Locomotive Act and could be driven and steered by one man, as opposed to heavier machines that had to be crewed by at least two men.

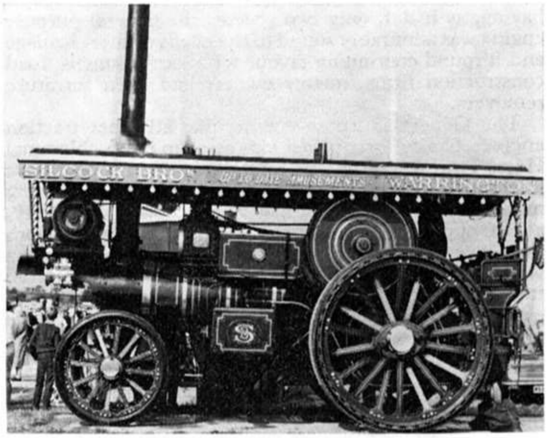
These smaller machines were invaluable for lighter haulage tasks and found a ready sale to furniture removers, forestry contractors, road builders etc., for the thousand and one jobs that occur in light haulage.

However, in the field of steam traction, possibly the most remarkable engines were the cultivating engines used for steam ploughing, which, with an overall weight of up to 20 tons and 275 indicated horse power, were the largest and most powerful of all.

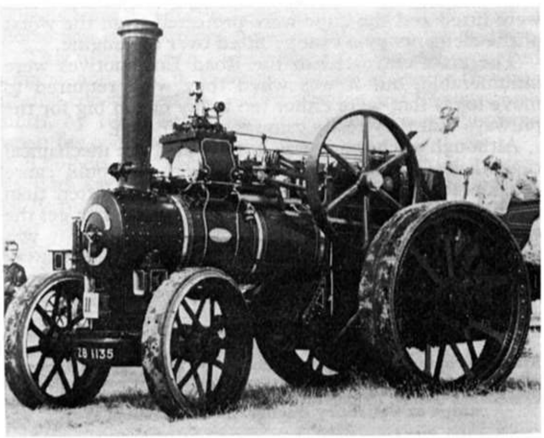
From the very start the steam engine presented a challenge to those concerned with agriculture. Here they had the most powerful and reliable machine known to English engineering and yet, because of its weight, they could not use it for such farming jobs as



A powerful Fowler cultivating engine. Built in 1886, weighing 13½ tons and with a n.h.p. of 12, this was one of a pair of monsters that made light work of cultivating even the hardest ground. The winding drum can be clearly seen beneath the boiler.



The pride of the line—A Burrell Showman's Road Locomotive, "The Bailie" of 1911. This particular engine was used by Silcocks of Warrington round the Lancashire Fairs until 1945. Today it has been restored to all its former glory and, at traction engine rallies all over the country, again supplies power for amusements.



A General Purpose Traction Engine. A Fowler of 1936. 6 n.h.p. weight 12 tons. This was taken to the Cork Agricultural Show in 1936 and sold direct to an Irish farmer from the show. Was used for agricultural work until as late as 1962.

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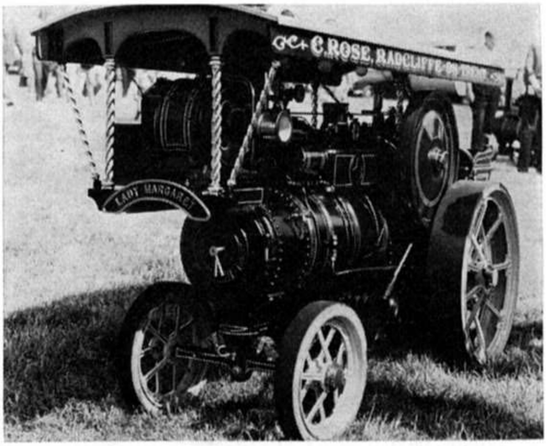
Not a Showman's Road Locomotive but a miniature constructed to include all the details of the real thing. Showing how today, through the work of enthusiasts, the glorious age of steam lives again.



ploughing. Despite various experiments, no really successful method was found until 1861.

In that year John Fowler of Leeds devised a method that used two traction engines, with the plough, attached to a steel wire let out and taken on from drums beneath the engines, drawn across the field.

The plough used to be double sided and, after one engine had hauled it across the field and the engines had moved up for the next furrows, could be reversed and plough towards the other engine.

Each ploughing set was crewed by four men and a boy, two drivers, a ploughman and the foreman in charge. The boy, usually straight from school, was employed as cook and meal relief ploughman.

The work was hard and tough for, during the ploughing season, the teams worked from dawn to dusk and even when they could get home at the weekend, one of the team had to be at the site of the ploughing by 4.30 a.m. on the Monday morning to start the fires in the cultivating engines to get steam up for the drivers as soon as they arrived at 7 a.m.

Today, thanks to Arthur Napper and other enthusiasts like him, the glorious age of steam lives again and in whatever part of the country we live, we can see again these magnificent reminders of one of the greatest periods of English engineering skill in all their glory and, unlike many museum pieces, showing that they are still capable of the work for which they were first built. A true tribute indeed to the greatness of their makers.

OCEAN ENGINEERING *(continued from page 119)*

ments may well be aimed at providing underwater habitats built around well heads and underwater storage tanks so that maintenance crews can be sent down to work at atmospheric pressure.

There are several types of robot craft with manipulating arms which have been developed for underwater tasks. One of these was the CURV, used in the Spanish hydrogen bomb recovery, and others are used in the North Sea for routine undersea maintenance.

Yet another type of underwater system is the sea bed vehicle which is designed to crawl along the sea bottom on wheels and carry out major engineering and construction tasks. The Cammell Laird 50 ton sea bed vehicle is an example of this type of submersible and Lloyd's Register carried out design assessment, strain gauge investigations on the pressure hull, and constructional survey for the project.

The rapid advances made in undersea technology in the past decade would seem to indicate that diving depths of 6,000 ft. will become commonplace for submersibles within the next few years and the need for specialist assessment of the undersea craft of the future will fall increasingly to the ship classification societies such as Lloyd's Register.

The increase of interest in submersibles has led inevitably to the stimulation of associated activities in the fields of underwater television, photography, navigational systems, sonar and communications. Parallel development has been aimed at providing suitable logistic surface support craft and communications and tracking facilities.

In fact exploitation of the natural resources beneath the sea has led to the concept of "Ocean Engineering" which is seen as embracing a very wide range of equipment, including drill rigs, crane barges, supply boats, tugs, workover and production platforms, submersibles, underwater habitats, seabed wellhead equipment, pipelines, single point mooring systems, sand carriers, dredgers and hopper barges.

The Ocean Engineering Group of Lloyd's Register is concerned with all these, offering design appraisal, consultancy, classification, supervision of construction and/or specification requirements and technical inspection.

Lloyd's Register already has wide experience, dating from 1958, of classing drill rigs, including semi-submersible rigs such as "Staflo", "Sea Quest", "Sedneth 1" and "Pentagone 81", as well as self-elevating types, fixed platform tenders, etc..

Structural feasibility studies for new rig designs are being carried out on a consulting basis and, as already mentioned, design appraisals are being made of manned and unmanned submersibles.

Several crane barges, including the Santa Fe International Corporation's "Choctaw", have been classed (with structural appraisal of the cranes) and numerous dredgers, hopper barges, sand carriers, and service and supply boats have been built under survey.

The growing activity in all aspects of ocean engineering is reflected in the changes that have been made in Lloyd's Register's Rules. Rules for dredgers, hopper dredgers, sand carriers, reclamation craft and hopper barges have already been completely revised. The Technical Committee of Lloyd's Register is currently dealing with Provisional Rules for the Construction and Classification of Mobile Offshore Units and similar rules for submersible craft are being drafted, while a working party is formulating draft specifications for underwater routine surveys and damage surveys.

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Ocean Engineering

Modern drilling and underwater techniques require classification of machinery or vessels just as much as ships. Lloyd's Register can do it.

THE sea has been described as the sixth continent and covering, as it does, two-thirds of the earth's surface, it has exerted a powerful hold on man's imagination since the very earliest times of human history. First it was his natural curiosity to know something of the strange life beneath the waves which directed man's interest. Even Alexander the Great was not immune and is said to have sat in a glass barrel for two months observing the creatures of the deep. With the emergence of 20th century 'technological man', faced with a constantly rising population and the consequent pressure on natural resources, interest today is focused on the exploitation of the reserves beneath the sea. Incalculable mineral wealth, oil, fish—these are some of the prizes awaiting the colonizers of the depths.

At present only the continental shelves down to a depth of about 600 ft. are being exploited for their offshore gas and oil and minerals. About 90 per cent of world fish catches come from the waters of the continental shelves, which form only about 7 per cent of the total underwater area.

The next phase of the colonization of the sea lies beyond the frontiers of the continental shelves and deeper into the cold plains and abysses of the true sea bed. In order to reap corn from the depths man must be able to function for long periods thousands of feet below the surface and for this he needs an artificial environment in the form of some kind of submersible. It may be an exploration diving bell or sphere, a habitat complex, a sea-bed vehicle or some kind of free-ranging submersible craft.

There are now about 40 underwater systems and submersibles in operation and the hard facts of commercial life are beginning to impinge on the sea-bed dream.

Underwriters for a start are not notably given to dreaming and before they are willing to insure new risks they require a sound appraisal of those risks. Builders and operators too have an interest in a stable insurance market offering fair terms in a new industry where many questions remain to be answered.

The situation therefore is that before a builder or operator of submersibles is able to buy insurance, his equipment must carry certification from one of the recognised classification societies. This will tell underwriters that the submersible will be safe for operation at certain depths, in prescribed sea states and in designated areas.

Lloyd's Register of Shipping continues to develop its interests in underwater research and submersibles through its newly established Ocean Engineering Group and is able to give advice on design, including the checking of plans, calculations and materials, and will survey the craft during construction. Guidance notes for the classification of submersibles of all types are in preparation and these will deal with the pressure hull, mechanical and electrical installations, buoyancy, life support systems, instrumentation and crew training. An important requirement is likely to be the pilot's certification of the fitness of the submersible to dive together with a maintenance completion certificate and a diving superintendent's log to be seen at intervals by a surveyor. This arrangement would be similar to that used in civil aviation where the pilot decides whether an aircraft is safe to fly and takes it over from the ground crew. The accent on safety is not a bureaucrat's whim, for the underwater environment is a hostile one for man.

Consider the facts of life beneath the waves which have to be borne in mind when designing and operating submersibles. Sea water is 1000 times as dense as air and the pressures at the sea bottom are enormous. For every 33 ft. descended the pressure rises by one atmosphere or 14.7 pounds per square inch. This means that at a depth of 13,000 ft. the pressure is about three tons per square inch—and about half the ocean bottom lies below that depth. The structural problems are obvious.

The fact that the oceans are composed of a salt solution means that everything the designer builds has to operate in a fluid as corrosive as dilute sulphuric acid. This limits the materials he can use. Sea water also acts as an electrolyte so he must be careful when using dissimilar metals or he will find his submersible acting as an electric battery with resulting galvanic corrosion on the hull materials. Communications are a problem because sea water, being a conductor of electricity, cannot be penetrated for any significant distance by radio or radar waves. Only sound waves provide a relatively good means of communication.

The sheer vastness of the sea bed makes any kind of search activity a much slower process than on land and the absence of landmarks requires the establishment of

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artificial landmarks such as acoustic markers. The forces at work in the sea are of considerable magnitude. A one and a half knot current will push as hard on a man as a 50 m.p.h. wind and a two knot current represents a hurricane force wind of 90 m.p.h. Finally, the ocean contains no free oxygen so that man must bring his atmosphere with him when he ventures into the depths.

Apart from the natural hazards of the sea, man's past and present activities add to the dangers when operating submersibles. An enormous amount of debris litters the sea bottom as a result of man's internecine methods of solving his disputes. Over 10,000 ships were sunk during the two World Wars alone. Other relics of naval warfare include live mines, torpedoes, shells, bombs and dumped ammunition. Numerous items occupy a legitimate place in the sea such as bottom-resting or anchored equipment, cables, wires and buoyed equipment. Ships and submarines freely roam the seas and one only has to look at recent events in the English Channel to appreciate the collision risks present. 'Progress' of course leads to new hazards and one could mention the dumping of nuclear waste and lethal nerve and other gases in the sea.

Nevertheless oceanology has developed rapidly and civilian exploration of the ocean took a major step forward with the construction of the bathyscaph FRNS 2 in 1948 by Auguste Piccard. This was the first free and more or less mobile device capable of descending into the deepest ocean abyss. It was followed by the Trieste 1 which in 1960 plumbed the 36,000 ft. Challenger Deep in the Pacific. These bathyscaphs were steel spheres providing the occupants with an environment of one atmosphere of pressure and linked by communications cables to surface support ships. To lighten the bathyscaph, Trieste 1, steel shot was released (ten tons for a 20,000 ft. dive) and to make it heavier, gasoline was released (2,000 gallons for a routine dive).

In 1958 Jacques-Yves Cousteau built the Diving Saucer, a small submersible embodying concepts which have influenced the design of nearly all subsequent submersibles. Its maximum depth was 1000 ft., but among its advantages were ease of transport by road and the fact that it needed only an 80 ft. long support ship. The Diving Saucer has been followed by a host of small submersibles, notable among which are the Alvin, a two man craft capable of descent to 6,000 ft. and the much larger Aluminaut, an aluminium hulled submersible which has dived to 6,250 ft. The Aluminaut and Alvin, together with the robot submersible CURV, played a major part in the recovery of the hydrogen bomb lost off Spain in 1966.

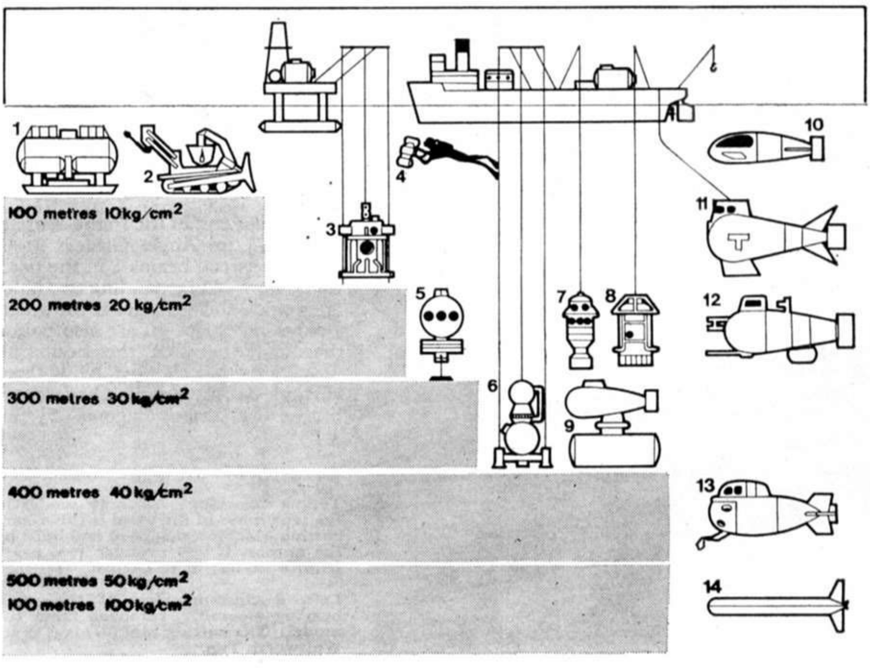
One of the most advanced submersibles today is the United States Navy's Deep Submergence Rescue Vehicle (DRSV-1) which was launched in January 1970. This is one of two systems being developed for rescuing survivors from a sunken submarine. It can dive to 5,000 ft. and cruise submerged for 8 hours.

Working submarines, underwater transfer chambers and decompression chambers are used extensively in the North Sea where the offshore gas and oil industry has to maintain sea bed equipment such as well heads, underwater cables, cable repeaters and pipelines.

Apart from the 'dry' submersibles which provide a comfortable environment for the crew inside a pressure hull, there are 'wet' submersibles for diver transport. These are really nothing more than underwater motorcycles and are limited to the depth tolerable to the diver who is exposed to the cold and pressure of the sea, and who is still required to carry out decompression routines when returning to the surface.

Many countries have built static underwater habitats where men have lived and worked for long periods. In the American Tektite 1 habitat a crew of four stayed down 59 days supplied with a breathing mixture of 8% oxygen and 92% nitrogen from a surface ship. The practical applications of habitats have been appreciated by the offshore gas and oil industry and future develop-

(*Please turn to page* 117)



1 Underwater habitat
2 Seabed crawler
3 Diver's lift
4 Diver
5 Anchored observation craft
6 Habitat lift
7 Observation craft
8 Diving chamber
9 Work chamber sub
10 Wet submersible
11 Towed submersible
12 Dry submersible with divers' exit
13 Dry submersible
14 Unmanned remote controlled sub

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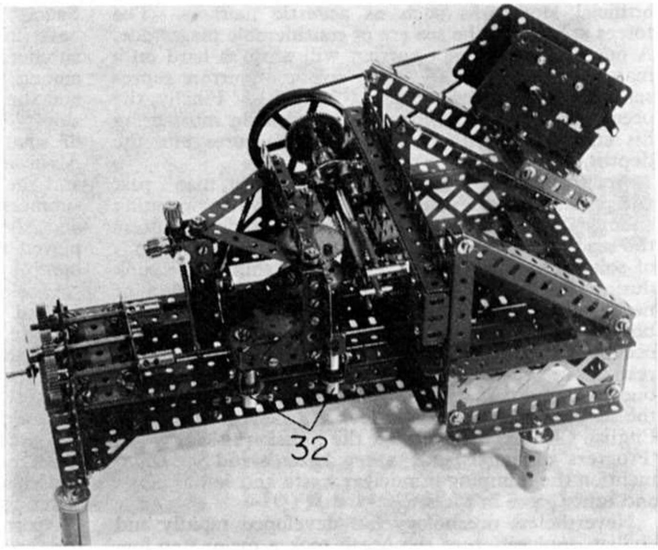
A Meccano Gear-Cutting Machine

By MM reader T. V. Vollenhoven of Eindhoven, Holland



FEATURED here is a Meccano Gear-cutting Machine which not only demonstrates how gear-cutting is done in real practice, but which is capable of cutting real gear wheels in all standard Meccano sizes, using as a "cutting tool" a $\frac{9}{16}$ in. Whitworth Tap, obtainable in every toolshop. The gears can be cut from many different materials such as brass, aluminium, PVC, nylon, etc. and the plastic gear wheels thus made are especially recommended in places where "silent" transmissions are required. In any case, it gives the model-builder—after completing the model—a lot of fun in making an extra supply of gear wheels!

The machine demonstrates the great possibilities of standard Meccano parts for the building of really good working "production machines", provided the builder takes care to make the unit strong enough, in the sense of rigidity against bending. Meccano parts practically never break, but at some loads, they occasionally bend, owing to their flexibility.

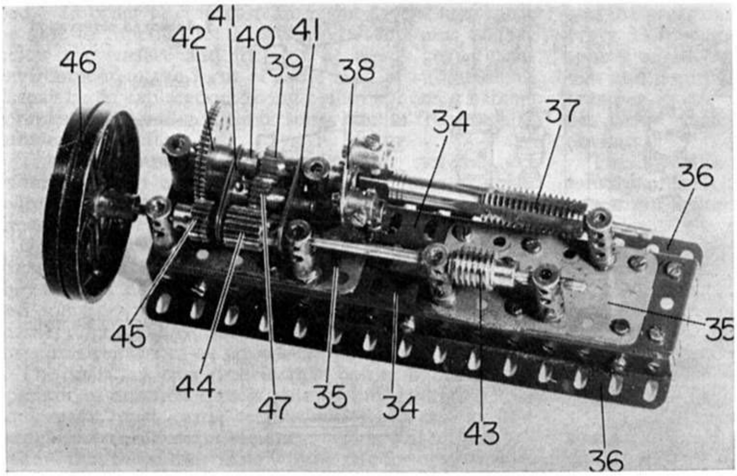
In the relevant accompanying photographs, the machine is shown at work, cutting a 60-teeth gear wheel from a nylon disc, thus proving its success in operation.

Building the Model

THE FRAME consists of two I-section beams 1, each made from four 12½ in. Angle Girders and one 12½ in. Flat Girder bolted together at regular intervals. At the forward end, the beams are joined together, at the top by two 3½ in. Angle Girders 2 overlaying a 3 × 1½ in. Flat Plate 3, and at the bottom, by a 5½ in. Angle Girder 4, the joins being strengthened by four 1½ in. Corner Brackets. Another 5½ in. Angle Girder 5 is bolted to the spare flange of Girder 4, the securing Bolts helping to fix four diagonal bracing 2½ in. Strips 6 in place between this Girder and nearby Girder 2.

Journalled in Girders 2 are two Axle Rods extended, via Threaded Couplings, by Screwed Rods, as shown, a 1 in. Gear 7 being mounted on the end of each Axle Rod. In mesh with these Gears is a third 1 in. Gear on a centre Rod, an 8-hole Bush Wheel 8, fitted with Threaded Pin, being fixed on the end of the Rod to serve as a hand-wheel. This whole arrangement acts as the horizontal feed for the carriage.

The rear end of the frame consists of five 7½ in. Angle Girders 9, all bolted between beams 1 in the positions shown and extending two holes at one side and six holes at the other. Four 3 in. Strips 10 are also bolted diagonally between the beams to provide further support, while three vertical 5½ in. Angle Girders 11, braced by three diagonal 5½ in.



Top, a "working" Meccano model in the true sense of the word is this Gear-cutting Machine, designed and built by the author. It will produce real gears from a variety of materials.

Left, a close-up view of the main bearing assembly, removed from the model. The cutting tool (37) is a $\frac{9}{16}$ in. Whitworth Tap.

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Angle Girders 12, give support for the main bearing assembly. The ends of upper and lower rear Girders 9 are connected by two vertical 2½ in. Angle Girders, each of these being connected to nearby Girder 11 by a 4½ in. Braced Girder overlaid by two 4½ in. Angle Girders 13. The frame is then completed by a 7½ in. Braced Girder at the rear and a 2½ in. Braced Girder 14 at the front.

Note that the completed frame must be as perfectly "square" and rigid as possible. The I-section beams must be arranged neatly parallel and all Nuts and Bolts well tightened up for heavy-duty work. Legs for the frame are provided by Sleeve Pieces attached to ¾ in. Flanged Wheels.

The model is powered by an E15R Electric Motor, secured to a 3½ × 2½ in. Flanged Plate 15 which, in turn, is bolted to the flanges of another similar Plate fixed between two Girders 12.

The Carriage

Pictured in one of the accompanying illustrations is the carriage as it appears removed from the model. It consists of two U-section girders 16, each supplied by two 4½ in. Angle Girders, the U-section girders being connected by a 3 × 1½ in. Flat Plate 17, a 2½ × 1½ in. Flexible Plate and two 2½ in. Flat Girders, arranged on top of each other as shown, but with the Flat Girders separated by a distance of one hole. Flat Plate 17 must slide with the minimum clearance between beams 1 of the frame, the Flexible Plate giving the carriage a little clearance in the vertical direction.

Spindle 18, vertical when the carriage is mounted in the frame, carries the "leading" Gear Wheel and the disc to be cut. It is journalled in two bearings supplied by Double Arm Cranks, the top bearing being bolted to a 1½ in. Flat Girder which, in turn, is bolted to a 4½ in. Angle Girder 19. Girder 19 is attached to the carriage by ½ in. Bolts and extra Nuts, thus allowing for easy dismantling when setting up for cutting a new gear wheel.

Vertical feed of spindle 18 is controlled by a lever system attached to the underside of the carriage. On the spindle, a Coupling 20 is freely mounted, being held in place by two Collars, one each side of the Coupling, with the spindle passing through the centre transverse bore of the Coupling. Two 3½ in. Strips 21, free to pivot, are held by Collars on two 1 in. Rods fixed in the ends of the Coupling. Bolted to the Flat Girders and Plates underneath the Carriage are two Handrail Supports 22 in the heads of which is fixed another 1 in. Rod, this carrying a Crank 23, five Washers and a Double Arm Crank 24, all free on the Rod. The Rod passes through the boss of the Crank and the circular hole in the arm of the Double Arm Crank.

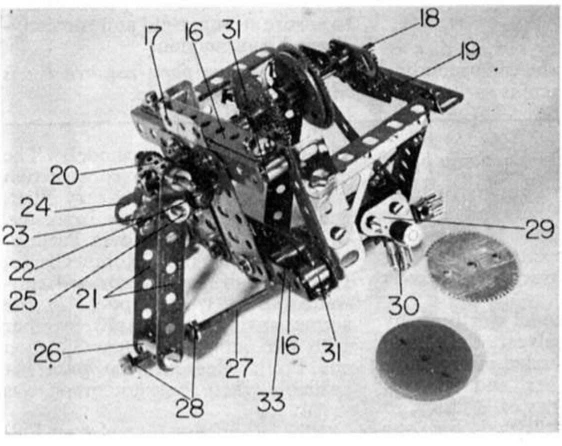
The swivel for the lever is a short Rod 25, passed through the second holes of the Strips 21, the boss of Double Arm Crank 24 and the circular hole in the arm of Crank 23. The Rod is free to rotate, being held in place by Collars.

Loosely mounted on two Bolts between the opposite ends of Strips 21 is a Coupling 26, the centre tapped bore of which carries a 6 in. Screwed Rod 27. This Rod actuates the lever, but excessive movement is prevented by two "stops" 28, each provided by two Nuts locked against a Washer between them. The upper end of the Screwed Rod passes through the centre *smooth* bore of another Coupling, held in the carriage by two short Rods in two 1 in. Corner Brackets 29 bolted to a 2½ in. U-section girder secured, along with a Flat Trunnion, to one girder 16. Fixed on the end of the Rod is a $\frac{7}{16}$ in. Pinion and vertical feed is accomplished by turning this Pinion by hand. However, as vibrations during cutting tend to cause the Screwed Rod to revolve involuntarily, the Rod can be secured for two or three cutting revs. at a time by a second $\frac{7}{16}$ in. Pinion 30, fixed on a Pivot Bolt screwed into one tapped centre bore of Coupling 26.

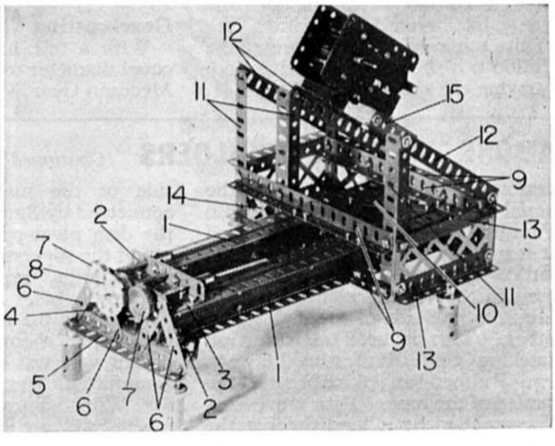
Fixed between the flanges of U-section girders 16 by short Bolts, each fitted with two Washers, are four Threaded Bosses 31. Screwed into these Bosses under operating conditions are four swing-bolts 32, each made up of a Threaded Boss in which a short Screwed Rod is locked by a Nut. A ¾ in. Washer is mounted on the Rod, the "wings" of the bolt being provided by two ½ in. Bolts. These swing-bolts must be firmly tightened during the final vertical cutting so as to obtain the best results. Construction of the remaining carriage framework is clear from the illustrations, but it should be mentioned that the two Screwed Rods providing horizontal feed for the carriage locate in the transverse bores of two further Threaded Bosses 33 secured between the flanges of lower girder 16.

Main Bearing Assembly

Moving to the main bearing assembly, two 7½ in. Angle Girders



The cutting carriage as it appears removed from the Machine. In the right foreground is a P.V.C. disc prepared ready for cutting and a completed gear cut from brass.



A view of the main frame without the cutting carriage and main bearing assembly. The horizontal feed for the carriage appears at the near end of the frame.

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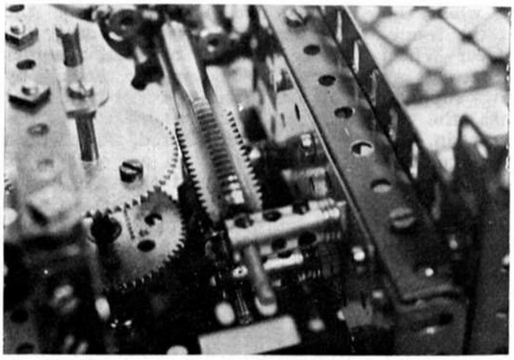

A detailed view of gear-cutting in operation. As the lower Meccano Gear Wheel makes contact with the Worm, when fed in horizontally (from left to right), the Tap begins cutting the upper disc. The Worm and Tap drive are coupled in a 1 :(1) : 1 ratio.

34 are connected together by four 1½ in. Angle Girders and two 3½ × 1½ in. Flat Plates 35, then two further 7½ in. Angle Girders 36 are bolted, one to each Girder 34 to form reversed angle girders. Seven Threaded Pins are mounted in the positions shown, four in one Plate 35 and three in the other Plate, each Pin carrying three Washers and a Coupling. The upper transverse bores in the Couplings provide fine and easily lubricated bearings for Rods carrying the cutting equipment and relevant gearing.

The cutting tool itself is a 9/16 in. Whitworth Tap 37, centred between short and long pointed Rods, the long Rod carrying an 8-hole Bush Wheel 38, to the face of which four Threaded Bosses are fixed by their longitudinal bores. Screwed through their transverse bores are four ½ in. Bolts which hold the squared end of the Tap. The same Rod also holds a ½ in. Pinion 39, a Collar 40, two pairs of two 1½ in. Strips 41 and two 57-teeth Gear Wheels 42, the last face to face for heavy-duty driving.

Running parallel to the cutting tool and shaft is a 5 in. Rod carrying the "leading" Worm 43 and the other end of one pair of Strips 41, being fixed part way in the bore of a ½ × ½ in. Pinion 44. Running free in the other half of the bore of the Pinion is a shorter input-drive Rod, carrying the other pair of Strips 41, a ½ in. Pinion 45 and, on my model, a Meccano Flywheel 46. This last very fine, but long-since obsolete, Meccano part can be replaced by two 3 in. Pulleys with Tyres, if desired. Pinion 45 meshes with Gear Wheels 42.

In mesh with Pinions 44 and 39 is an "idler" ½ in. Pinion 47 on a 1½ in. Rod, held by a Collar in the centre holes of Strips 41. Here, and at all other points double Grub Screws should be used.

When completed the main bearing assembly is bolted to the frame at a somewhat inclined angle, as shown, this being necessary as the tangent to the Worm (and the cutting tool) must be exactly vertical. With Girders 36 bolted to outside vertical Girders 11, there must be *one* hole clear in left-hand Girder 11 and two holes clear in right-hand Girder 11, counting from the top. In other words, upper Girder 36 must be bolted through the second hole of left-hand Girder 11 (furthest in photographs) and the third hole of right-hand Girder 11 (nearest in photographs). With the unit in place, Flywheel 46, or its substitute, is connected by a suitable Driving Band to a ½ in. Pully fixed on the Motor output shaft.

Gear-cutting

With a fine hack-saw, a disc of equal diameter to the corresponding Meccano Gear Wheel is sawn out of the chosen sheet material. A centre-hole of standard shaft diameter is drilled in this and also two holes at ⅝ in., or ½ in. distance from the centre in order to Bolt the disc to a 1 in., or 1⅜ in. Bush Wheel. For cutting in brass, *two* Bush Wheels are recommended, one each side of the disc, and, when cutting a 133-teeth Gear Wheel (the largest possible in the carriage), the largest Sprocket Wheel should be used as a bush wheel.

The leading Meccano Gear Wheel should be located at the centre of Worm 43, but the disc to be cut must be positioned somewhat below the middle of the Tap to allow the Worm and leading Gear to make contact first when feeding horizontally. The horizontal feed must be stopped when the leading Gear cannot be moved further into the Worm, then the swing-bolts are tightened and the vertical feed is begun, moving the spindle in an upwards direction.

Cutting in thick materials would also require "thick" leading Gear Wheels, but it can also be done by repositioning the leading Gear Wheel after reaching half of the vertical feed!

Further developments

By some modifications to the model, it must be possible not only to cut gear wheels of standard Meccano tooth numbers, but also gear wheels of special tooth numbers—say 75-teeth, for example. In this case, a 60-teeth Meccano Gear could still act as the leading gear wheel on the spindle, as before, but the cutting tool (the Tap) must be placed somewhat behind, i.e. not in the same vertical plane as the Worm. The gear-ratio between the shaft carrying Worm 43 and the Tap must be changed from 1 : 1 to 60 : 75 (4 : 5). Whatever is done, however, the model will give good service—provided every care is taken to ensure strong, rigid and correctly-aligned construction.

We regret no parts required list is available for this model.

AMONG THE MODEL BUILDERS

(*Continued from opposite page*)

reasons I shall explain later, the aerial dish is provided by a Bialaddin Paraffin Pressure Stove reflector and it is mounted on a carefully-formed lattice-work of Strips, one of which runs in the vertical plane in a wide arc from one side of the dish to the other. This is used as a vertical tracking guide, and runs between two Rubber-Ringed rollers in the centre of the base. Dish movement is controlled by a handwheel at the side of the main superstructure, connected by Sprockets and chain to the dish pivot-point. Mounted on top of the superstructure are two red lamp bulbs, representing aircraft warning lights.

Although the model was built by the Cubs themselves, the basic design work was carried out by Pack Committee Member and Helper, Mr. Wilfrid Burrows of Whitley, to whom we are indebted for our chance to see the model. The Cubs involved in its construction were Spencer Cobley, Terry Platt, Andrew Barber, Andrew Leicester, Michael Houghton, Kevin Partington, Jonathan Alms, Robin Clarke, Eric Monaghan and Andrew Laithwaite (all of whom appear in the accompanying photograph), together with Ian Scragg, Stephen Simpson and Philip Heesom who were not available when the photograph was

(*Please turn to page* 150)

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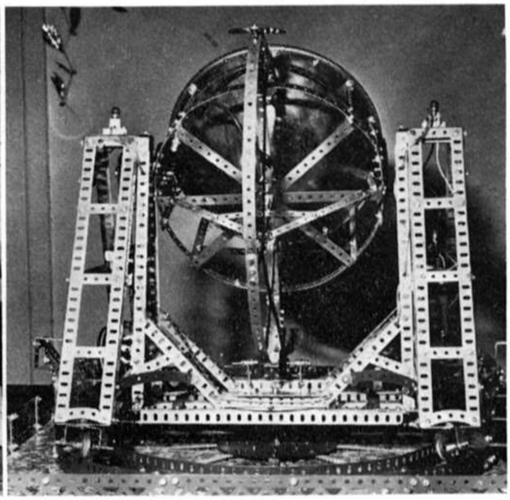


AMONG THE MODEL BUILDERS with 'Spanner'

Top left, members of the 1st Whitley Cub Scout Pack proudly display their intriguing model, structurally based on the Jodrell Bank Radio Telescope. Also in the picture are several Scouts who, as Cubs at the time the model was built, helped with its construction. Committee Member and model-designer, Mr. Wilfrid Burrows, and Akela, Mrs. Laithwaite, appear standing at the rear. Above, a rear view of the model showing the lattice-work of Strips supporting the aerial dish. Below left, a general view of the Jodrell Bank model with the aerial dish pointing vertically upwards. Note the strong superstructure construction. Below, in this general side view of the Cubs' model, the batteries and control switch for the aircraft warning lights can be clearly seen.

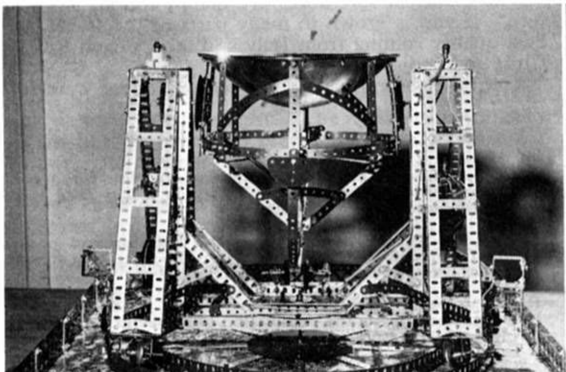
Cubs' Fine Achievement

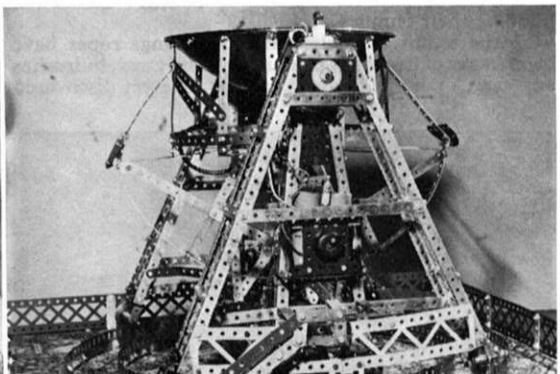
Last December, I and a photographer were privileged to visit the headquarters of the 1st Whitley Cub Scout Pack near Warrington, Lancs, having been invited along to see a Meccano model built by members of the pack and inspired by Britain's famous radio telescope at Jodrell Bank, Cheshire. I must say that the visit was very worthwhile. Not only were we kindly and hospitably received by the young Cubs and their leaders, but also the model itself was most impressive, making the evening both enjoyable from a personal point of view and successful from a business point of view. In consequence, I am particularly delighted to reproduce here a few of the photographs we took during the visit.

Obviously the star attraction was the model and this is worthy of the highest praise—especially in view of the age of the builders, who were all less than 11 years old when it was built! Although not an exact reproduction, it is structurally based on the Mark I Telescope at Jodrell Bank and it also performs the major movements of the original. The whole superstructure, with the aerial "dish", revolves through a full 360 degree circle in the horizontal plane, while the dish itself moves through more than a full 180 degree semicircle in the vertical plane. In other words, the dish can "explore" the whole visible hemisphere from horizon to horizon in every direction!

The revolving superstructure is centrally-mounted on a simple but effective free-moving roller bearing, with positive tracking being achieved by four built-up flanged wheels, mounted one at each corner of the structure and running on a circular rail secured to the baseboard of the model. The structure itself is very strongly built from Angle Girders braced by Strips and Plates. For

(*Continued opposite*)





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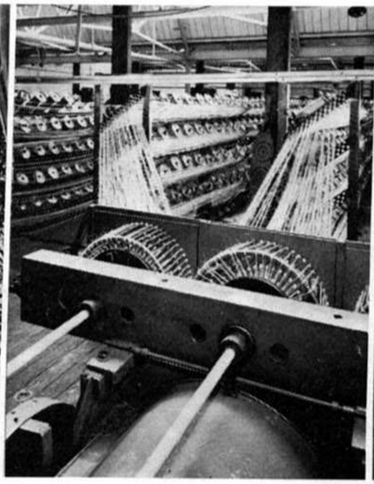
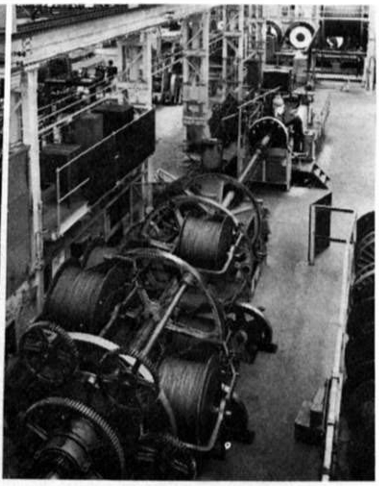



Trevor Holloway describes

THE STORY OF ROPE

Photographs courtesy of British Ropes

IT is difficult to think of many things more widely used than rope. Shipping, mining, engineering, packaging—these are but a few of the large-scale users. The world just couldn't get along without it.

One of man's earliest needs must have been something in the nature of a rope to bind or hold. Possibly it was nature herself who provided the first natural rope in the form of tough creepers. The next ropes were probably made from strips of animal hide.

At a later stage in man's development he discovered that ropes could be made from the tough fibres of coir, hemp and jute. These natural fibres have been used for rope-making down the centuries and, of course, are still used today.

There are several references to rope in the Bible and in the early histories of Greece and Rome. Crude ropes were used in China about 2700 B.C., and early followers of Buddhism used ropes made of women's hair when building their temples.

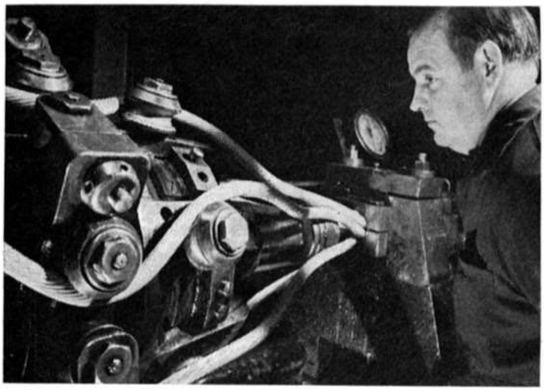
In the tombs of ancient Egyptian kings ropes have been found of flax, date-palm fibre, halfa grass, bulrushes and camel hair. The most ancient rope yet discovered was found in an Egyptian tomb and is now in the Cairo Museum. Made of flax, it is in an almost perfect state of preservation and is about 5,200 years old.

Ropes made of metal wires made their appearance about 1840, and in recent years synthetic fibres (particularly nylon) have been spun into ropes of outstanding quality, but ropes of vegetable fibres still make up a major part of present-day production.

Vegetable fibres are classified as hard or soft. The three best-known hard fibres are manila, sisal and coir. Manila is a brown fibre that comes from a plant similar to the banana plant and is grown in the Philippines, Panama and Guatemala. Sisal is a clean white fibre obtained from a plant rather like the cactus and is mostly grown in Brazil and East Africa. Coir is made from the very short fibres extracted from the husks of coconuts.

The principal soft fibres are hemp, cotton, flax and jute. Hemp is grown in many parts of the world, the best quality coming from Italy and others from Russia, Chile and India.

Until the second half of last century, ropes were still



Above left, Sisal is cut by hand and counted into bundles of 30 leaves before being loaded onto trains which take it to the estate factory for decorticating.

Centre, the yarn is drawn from the bobbins and passes through a machine which twists it into the form of a strand. A rope consists of three or four strands.

Right, a closing machine in British Ropes' production plant in Doncaster, during the production of a special rope for use in pipelaying in Italy.

Left, a final stage in the manufacture of a 5000-foot length of 3-inch diameter wire rope anchor line at British Ropes' Doncaster plant.

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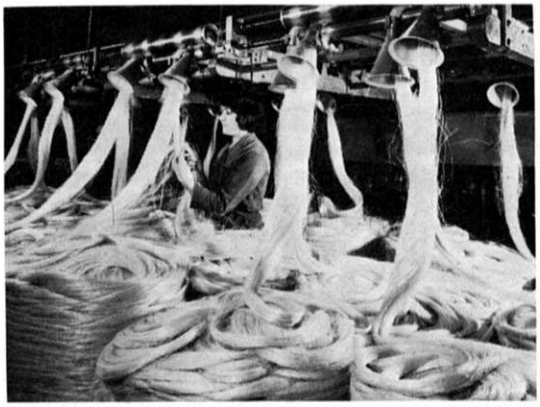
Spinning: Sisal slivers being fed into the spinner—the machine which twists the sliver into yarns.



being made by hand in long narrow alleys called 'rope-walks'. One man, with the raw fibre wound around his waist, would pay out this fibre, walking backwards down a rope-walk that was anything up to a third of a mile in length. Meanwhile, another man or boy would turn a wheel equipped with hooks to which the fibre was attached, and in this way the ropes would be spun. Rope-walks are still in use, but the process is now mechanical.

Rope-making is a series of spinning or twisting operations. The fibres are received in bales, consisting of bundles (or 'heads' as the rope-maker calls them), which have to be separated before the mechanical process can commence. The bundles of fibre are fed into machines fitted with pins or steel spikes. These comb and clean the fibre so that it leaves the machines in a continuous ribbon or 'sliver' as it is called. This process is repeated several times to produce still finer slivers.

The spinning is done on automatic spinners which convert the slivers of parallel fibres into yarns, with a predetermined twist according to size. These yarns are wound on to bobbins.

The bobbins of yarns are taken to the rope-walk and the yarns are threaded through a metal plate pierced with holes formed in circles. The yarns then pass through a tube in the stationary part of the machine, known as the foreboard.

This combination of yarns which form a strand is attached to the travelling part of the machine which is fitted with a number of revolving hooks. The 'traveller' moves slowly away from the foreboard, hauling out the strand as it goes and giving it the necessary twist.

A rope is made up of strands. This is done by a machine known as a 'topcart'. It travels on rails and as it moves down the rope-walk it twists the strands together to form a rope.

Another method of rope-making is by the use of a machine which coils the rope automatically as it is made. This means that a rope-walk is not required and ropes can be made longer as length is not dictated by the length of the rope-walk.

A *hawser-laid* rope is three strands twisted together; a *shroud-laid* rope is four strands twisted together; and a *cable-laid* rope is made up of three hawser-laid ropes (i.e. nine strands in all) twisted together.

The raw material of wire rope production is the hot rolled steel rod which is received at the wire mill in coils up to 30 cwt. in weight. The rods have to undergo special heat treatment to render the metal suitable for 'drawing' to smaller diameters and to toughen it to withstand the subsequent heavy cold work processes.

Wire drawing is a cold working process resulting in decreased wire diameter and an increase in tensile strength and elastic limit. It produces a combination of properties which would be unattainable by any other known metallurgical process.

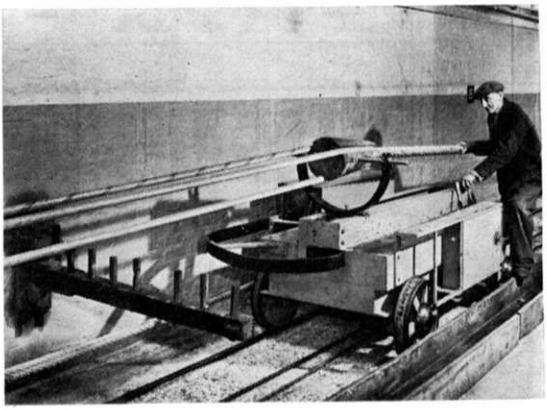
Wire is produced by drawing the prepared rod through a tapered tungsten carbide die of slightly smaller diameter, so making the wire smaller, and at the same time increasing the length. The process can be carried out using successively smaller dies one at a time, or through several dies on a continuous machine.

A wire rope is a combination of wires arranged around a central core. Wires are twisted or 'laid' round a wire or fibre centre to form a 'strand'. The strands are then twisted or closed around a central core to form the wire rope. The number of wires in a strand, or strands in a rope, depends upon the intended end-purpose of the rope.

Many types of wire rope are produced and one type of particular interest is the locked coil rope used extensively as cables for suspension bridges and in mining. It is a smooth surfaced rope composed of concentric layers of wires, the final outer cover being shaped wires. Interior layers are of shaped or round wires around a central core of round wires. The outer layers are made up of wires so shaped as to form a full lock with similar connecting units. Up to four locking units may be used.

The wire ropes produced by British Ropes range from a .375 in. diameter shaped wire rope used in oil well drilling to a 13½ in. circumference rope produced for a Hong Kong slipway. It had a breaking load of 760 tons.

It is interesting to record that the longest wire rope ever spun in one piece is 8.83 miles in length and weighs 28½ tons.!



Here you see three strands being "laid up" or twisted, in the rope-walk to form a rope.

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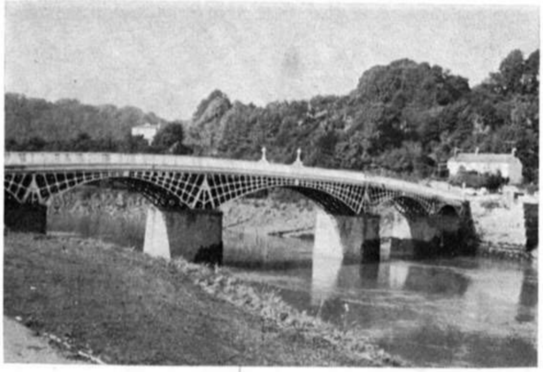


Design and Construction of Bridges

Part Two—Cast Iron Bridges

By Terence Wise

THE modern bridge can really be said to date from the introduction of cast iron to bridge building, instigated in Great Britain in the latter half of the 18th century by Abraham Darby, for this caused the departure from solid arches and the use of cast iron ribs eventually led to the invention of the girder.

The design for the very first iron bridge was by an architect from Shropshire named Thomas Pritchard, who suggested to Darby the use of cast iron ribs to form a support for a masonry arch. This was not adopted, but it gave rise to the idea of forming an iron arch by the casing of a series of arch-shaped ribs, made with hollow spandrels in order to remove much of the weight which was not contributing to the strength of the members. (Spandrels are the part of a bridge between the arch ring curve and the deck.) This design was not taken up either, but a third design resulted from it and this was the one on which the bridge was finally constructed. (*Fig.* 1).

Built by Darby over the Severn River near Coalbrookdale in Shropshire—the place is now named Ironbridge—the bridge consisted of five semi-circular iron ribs cast in ten halves in open moulds. The casting of these main ribs, each one being half the length of the hundred foot six inches span, was a masterpiece of iron foundry work for those days. The rise of the completed arch was fifty feet and the bridge, begun in 1776 and completed by 1779, is still standing to this day.

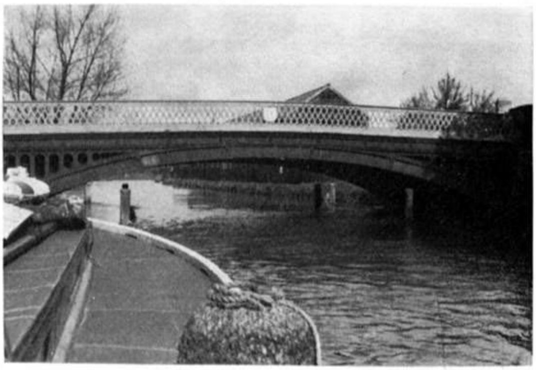
It was not long before the revolutionary new bridge was copied, appropriately by Thomas Paine, himself a revolutionary and author of 'The Rights of Man'. He drew up a design for a second cast iron bridge but he had to flee the country and it was not built until some years later, in 1796. The ribbed arches for this bridge were cast at Rotherham by Robert Wilson and for some time they were exhibited in London as a curiosity. After being returned to Rotherham, the bridge was re-designed by Wilson and erected over the River Wear at Sunderland by Rowland Burdon (*Fig.* 2). The span was a staggering 236 feet, with a low water clearance height of a hundred feet.

A third iron bridge was built in the same year at Buildwas, again over the Severn, by Thomas Telford—a foretaste of the work soon to be performed by this great engineer. The span was 130 feet. A more impressive iron bridge was that built at Southwark over the Thames by John Rennie, being completed by 1819. This bridge had a centre span of 240 feet. It was replaced by a modern bridge in 1921.

Cast iron has two factors that influenced its use in bridge building. Firstly, it had a high resistance to compressive stresses—compare its high compression strength quoted below with those of the earlier materials, shown in last month's article—and it could be cast in very large sections. Secondly, it was extremely brittle. The second factor soon led engineers and iron founders to seek economic ways of producing wrought iron which, being forged or rolled instead of cast, is more malleable and therefore better suited for the tensile, bending and twisting stresses experienced in bridges.

Wrought iron was first produced in great quantities and at an economic price in 1766 by Richard Reynolds, the son-in-law of Darby, but by 1820 the difference in prices was still so great as to restrict the use of wrought iron, cast iron selling at about half the price. It was Telford who first used wrought iron for bridge work, in his construction of Britain's first suspension system for the Menai Straits Road bridge during the years 1819–1825. (This bridge will be covered in greater detail in a later article.) It was used again by him for a second suspension bridge over the Conway River in 1826. However, his choice of wrought iron was dictated by the necessity for tensile strength in the new suspension design.

It was left to Robert Stephenson to select wrought iron for his principal material despite the extra cost when he began work on the 412 foot long tubular girder bridge over the Conway River in 1846. The bridge, completed two years later, served as a proving ground for his next bridge—the Britannia railway bridge over the Menai Straits, which was finished in 1850 and is today safely carrying loads far in excess of those estimated by Stephenson. The wrought iron tubular girders



Remarkable elegance could be captured by bridge designers using cast iron, as these two lovely examples show.

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FIG 1

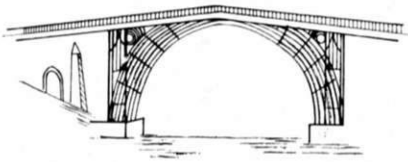


FIG 3

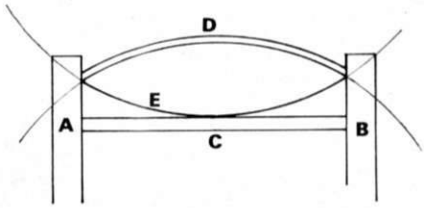


FIG 2

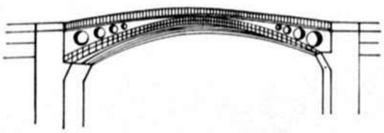
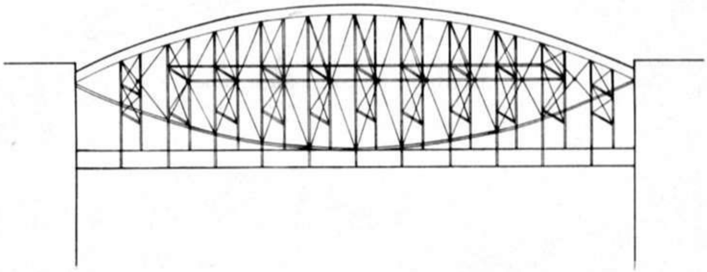


FIG 4



for the latter bridge are each 1,511 feet long and weigh 4,680 tons, the trains running *through* the tubes. The bridge has a total length of 1,380 feet and a high water clearance height of a hundred feet.

But it was Brunel's Chepstow and Saltash bridges that constituted the greatest advance in bridge building, bringing the use of wrought iron to its zenith in the 1850s, for his new designs used the material to its best advantage. The railway bridge at Chepstow provided Brunel with a chance to experiment for the Saltash bridge. The weight of the 300 foot main span was taken by two huge wrought iron tubes resting on rollers on top of iron piers. These tubes lasted a hundred years, being replaced by modern steel in 1962.

Work on his Royal Albert bridge, carrying the railway link between Devon and Cornwall across the Tamar River, was begun in 1853. In his design Brunel tried to combine the best structural advantages of the wrought iron arch and the newer suspension principle. The bridge was based on two great wrought iron trusses with tubular arches and suspension chains, both following an identical line of curvature to form a double convex shape. *Fig*. 3 illustrates this basic principle of the design. A and B are the piers, C the bridge deck, D the arch curve, and E the suspension chain curve. The arch tubes are oval in shape, being 16 feet 9 inches wide and 12 feet 3 inches high. The length of each span is 465 feet, the two trusses meeting on a central pier built on solid rock in mid river after excavating to a depth of 80 feet, with their other ends resting on piers built on the river banks. Each of these giant trusses weighs over a thousand tons.

Fig. 4 is a simplified sketch of the elevation of one span, showing the deck slung from the arch and suspension chains. The suspension links have not been drawn in in order to make the construction of the truss stand out more clearly. Each of the trusses was first built on a platform on the shore, then floated into position on pontoons and jacked to the right height. The bridge, capable of carrying the much heavier loads of today, was finished in 1859.

The Saltash bridge was to be Brunel's last work for he died in September of that year. It was also the last great wrought iron bridge, for in 1855 the English metallurgist Henry Bessemer had patented a process for producing steel from pig iron and within five years—only a year after the completion of the Royal Albert bridge—the new material was being used in the building of bridges.

This brings us to the era of the steel arch, which we shall be covering next month.

COMPARATIVE COMPRESSION & TENSION STRENGTHS OF MATERIALS

Cast iron	3,000 lbs	per square inch in tension
	12,000 lbs	,, ,, ,, ,, compression
Wrought iron	14,000 lbs	,, ,, ,, ,, tension
	14,000 lbs	,, ,, ,, ,, compression in short struts
	12,000 lbs	,, ,, ,, ,, sheer, that is in the perpendicular

Book Review

Model Building in Meccano and Allied Construction Sets by B. N. Love is a unique publication which will appeal to model builders of all ages. The author, who is well known for his feature articles in Meccano Magazine, presents a wealth of information on Meccano models, beautifully illustrated throughout with large pictures of first class mechanisms and working models. This is a long-awaited publication which presents, for the first-time, a collection of some of the work of first-rate adult modellers from many parts of the U.K. Nevertheless, it is written in the author's easy style for young and old alike. A well-produced book which will grace any constructor's personal library shelf and which will prove both entertaining and instructive.

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TOUGH JOURNEY FOR TWO RANGE ROVERS

TWO British Leyland Range Rovers, both considerably modified to tackle what is likely to be one of the toughest journeys ever undertaken by any motorised vehicle, left the Rover Company's Solihull, Warwickshire, plant on Monday, 29th November on the first stage of the five month long adventure.

After leaving the factory the vehicles were driven by their Army crews, led by Captain Gavin Thompson, to RAF Lyneham in Wiltshire, from where, on 1st December, they were flown to Anchorage, Alaska. Within hours of their arrival they set off on the first leg of their drive to Panama City where their itinerary showed arrival on 23rd or 24th December.

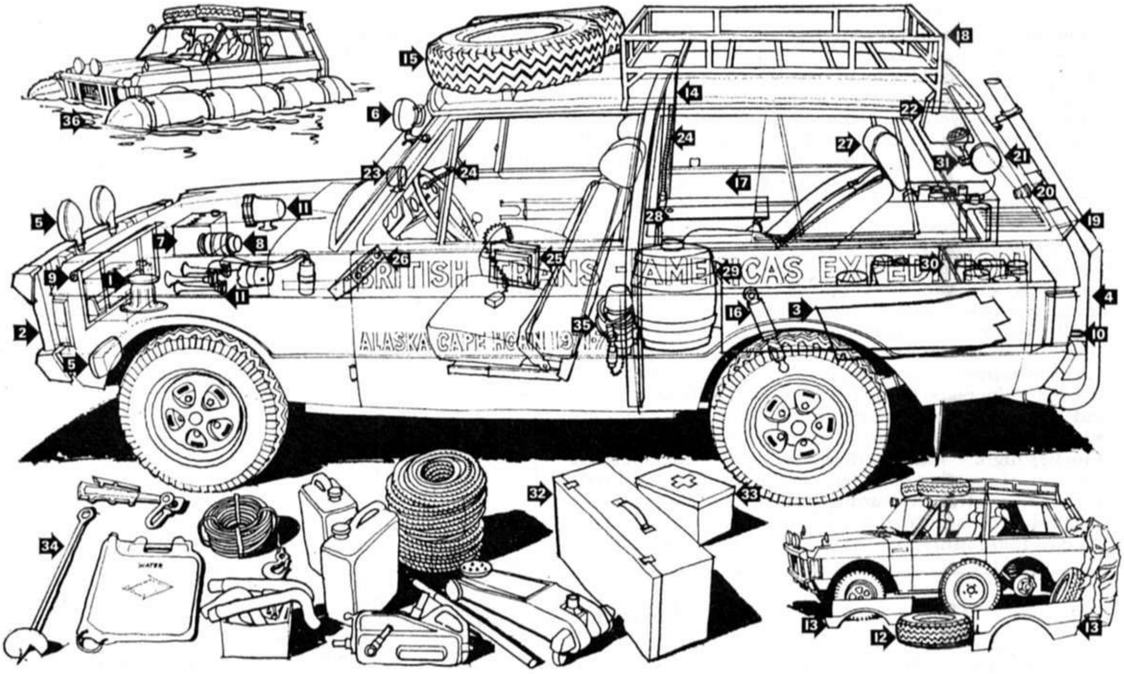
The Range Rovers are being used by a 70-strong team of Army personnel, engineers and scientific observers in an attempt on the first ever unbroken land crossing of the American Continent from Alaska in North America to Cape Horn at the southernmost tip of South America —a 13,000 mile journey which will include a 250 mile stretch of dense jungle, swamp, ravines, rivers and mountain ridges in Panama and Colombia.

This area, known as the Isthmus of Darien, represents the last unconquered obstacle to completion of the Pan-American Highway. At present the highway runs from Alaska almost to the Isthmus of Darien and then continues on the other side down to Chile.

The main purpose of the expedition is to try to open and chart a possible route through the Darien Gap, to enable the possible eventual continuation of the highway. Work has been going ahead adding many modifications to the two Range Rovers to enable them to cope more adequately with the extreme and widely varied conditions that will be encountered on the gruelling trip. Through the Darien Gap the Range Rovers will use special wide 12 in. × 16.5 in. swamp tyres to reduce the ground pressure as much as possible. To allow sufficient clearance the wing panels will have to be removed while the tyres are in use. Reinforced front bumper/cow catchers have also been fitted to protect the front of the vehicles from damage by dense undergrowth when forcing a way through the jungle. Other exterior changes include the fitting of roof racks which will carry, among other things, two large inflatable rafts for ferrying the vehicles across rivers that are too deep to ford or too wide to bridge. Both the Range Rovers have been fitted with two-way radios to enable the crews to talk to each other without having to stop their vehicles, while stereo tape players and radios have been provided for use during the more tedious stretches of mile upon mile of dead straight highway.

Many other changes are incorporated, including the fitting of winches, extra spot and fog lamps, additional instrumentation, partitioned stowage lockers and a special water keg to carry 5 gallons of drinking water for use in the jungle areas.

Among the equipment carried in the vehicles are hand winches, spares, extensive tool kits, a comprehensive first-aid box, including snake bite and malaria antidotes, etc., shovels and ground anchors for recovery work, officers' dress uniforms for publicity through the United States and, of course, food and clothes for the various temperatures to be encountered en route.



1 Front mounted capstan winch 3000 lb capacity
2 Reinforced bumper/cow catcher guard
3 Petrol tank undershield
4 Raised exhaust extension
5 Four Quartz-Iodine spot & fog lights
6 Two swivel spot lights
7 Split charge two battery system
8 Heavy duty alternator
9 Radiator muff
10 Four extra towing eyes
11 Sirens and air horns
12 Swamp tyres
13 Removable wing panels
14 Roll-bar
15 Roof mounted spare wheels
16 Special low-temperature shock absorbers
17 Insulated body panels
18 Roof rack
19 Steps on tailgate
20 Power point in rear of vehicle for cooker etc.
21 Heated rear screen
22 Wiper/washer equipment for rear screen
23 Extra instruments—tachometer, oil pressure and temperature gauges, ammeter for split charge system.
24 Map reading and interior lights
25 Two-way vehicle radio
26 Stereo-tape player and radio
27 Reclining seat with full safety harness and headrest
28 Built-in safe
29 Water keg
30 Partitioned stowage lockers
31 Inspection light, 26 ft. lead
32 Fully comprehensive tool kit
33 Medical supplies
34 Extra equipment, hand winches, ground anchors, cable, tow ropes etc.
35 Coffee maker
36 Floatation bags & outboard motors

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For readers who have built model aircraft before, full-size plans for a fine flying model

Messerschmitt Bf 109

By F. Hawkins

IF you want a tough little control-liner for .5–.8 cc here's a scale WW.II fighter that has no claim for being a stunt model, but will give a most lively performance. The original flew with a D.C. Merlin and apart from lengthening the drop-out undercarriage and shortening the carburettor intake, is true to scale. It's a pity that the engine cylinder should have to stick out like a sore thumb: but until we can get the manufacturers to squeeze power out of a thimble size unit, this is one problem we cannot overcome!

Begin by cutting wing panels from hard $\frac{1}{16}$ inch sheet. Then cut out the wheel wells in the under surface panels. Take one half of a 1 inch celluloid wheel, the type moulded from thin sheet, and cut it diametrically. Stick the pieces over the wheel well, packing round with scraps of balsa. Stick the tapered leading edge and the ribs to the panels and join at the centre line with plenty of glue, allowing $\frac{5}{8}$ inch dihedral under each tip.

Make up the control plate assembly from $\frac{1}{16}$ inch ply and cement it to the bottom wing panels, together with the push rod and lead out wires. Install the undercarriage tubes in the leading edge with plenty of glue and add the top sheeting, bevelling to fit the leading and trailing edges.

Cut the motor plate from $\frac{1}{8}$ inch ply. The bolt holes shown are for the Merlin. Press studs are sewn to the plate via two small holes. Attach F1 to the plate. Assemble the fuselage dies to F2, 3, 4, 5, 6, and attach to the wing by sliding down the push rod. Now install the tank—any 15 cc Team Race tank will do. Use polythene tubes led through F2 and the $\frac{1}{2}$ inch soft block forming the fuselage decking. Later a small piece of tightly fitting celluloid is slid down the tube, stuck to the fuselage and the tube cut off flush. The tailwheel should be well glued to the lower fuselage block before assembly.

Now build the cowling from block balsa, C1 and 2, cutting back to clear the motor. The other half of the fixing press studs are sewn to small pieces of $\frac{1}{32}$ in. ply which are glued in place in the cowling, then attached to the fuselage and the whole left to set. The same method is used for attaching the front half of the spinner, made from block, to the ply backplate.

Stick the tapered tail leading edge and bottom block to the fuselage, noting the scale degree of offset, and attach the elevator horn to the push rod. Sandwich the pieces of tape between the halves of the stabiliser and slide the fin sides down the stabiliser, over the horn, and into position against the fuselage. Now stick the halves of the elevator on to the tape and the horn.

Give the model two coats of dope and thinner 50/50, with talc stirred in. Rub down, and cover with light tissue, doped on. Add wing and fuselage blisters, bomb rack, radiators, exhaust with card fairing, oil cooler and then give another two coats of talc and clear dope all over. Add seat, joystick and dashboard to cockpit and fold the canopy from celluloid. Ailerons etc., should be marked by carving a shallow V with a sharp knife.

Place the legs in the wing tubes and solder on the spreader bar and wheels. Stick the ply fairings to the legs with polystyrene cement.

Many alternative colour schemes are available. The original was painted pale blue underneath, and medium grey and green mottle on top with black and white crosses and swastikas and a white band round the rear fuselage.

Fit a Frog nylon 6 / 4 prop. and 25 ft wire lines, choose a calm day, hand launch or take off from drop out undercarriage. Hold your hat—the performance will surprise you!

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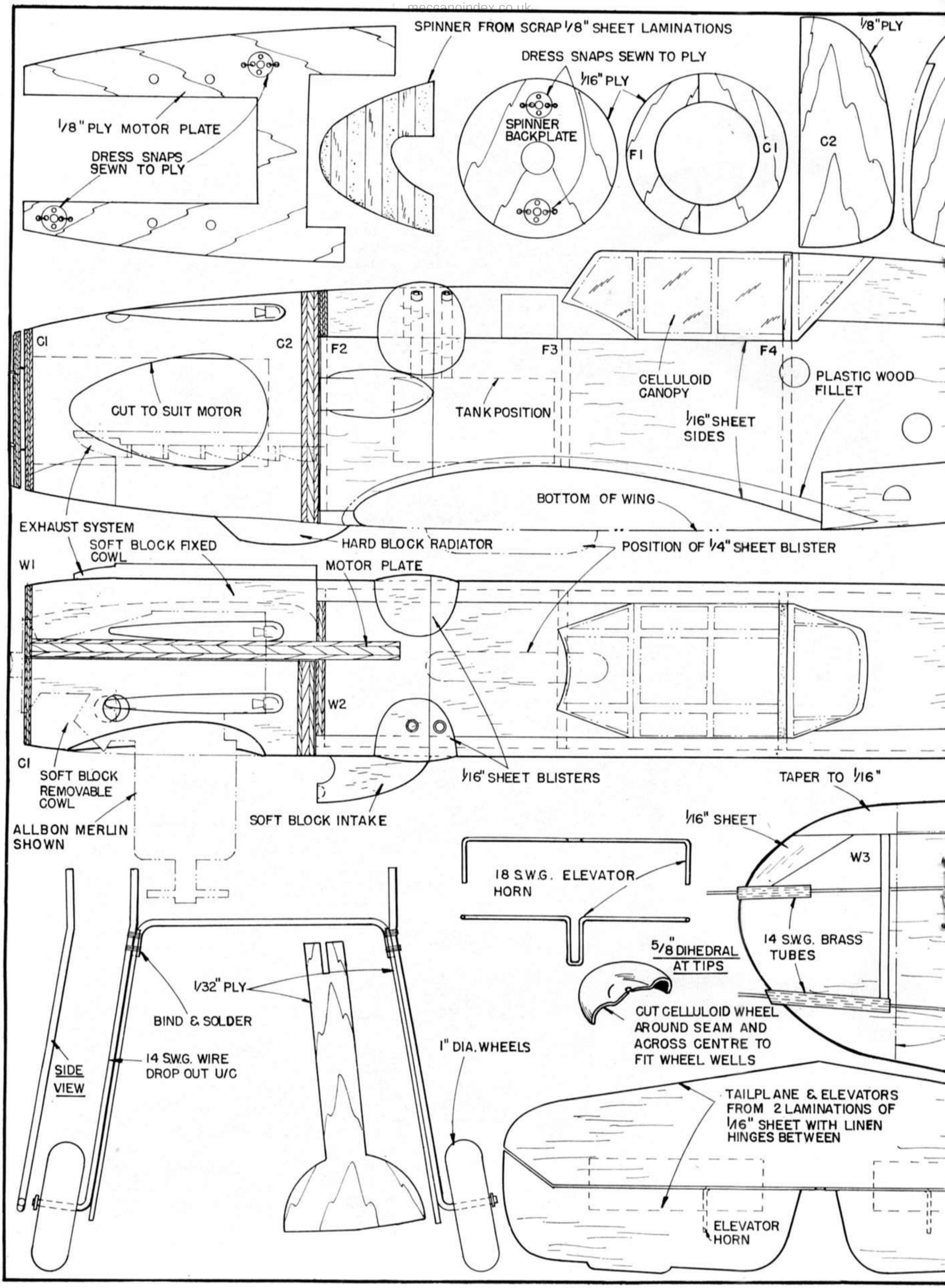

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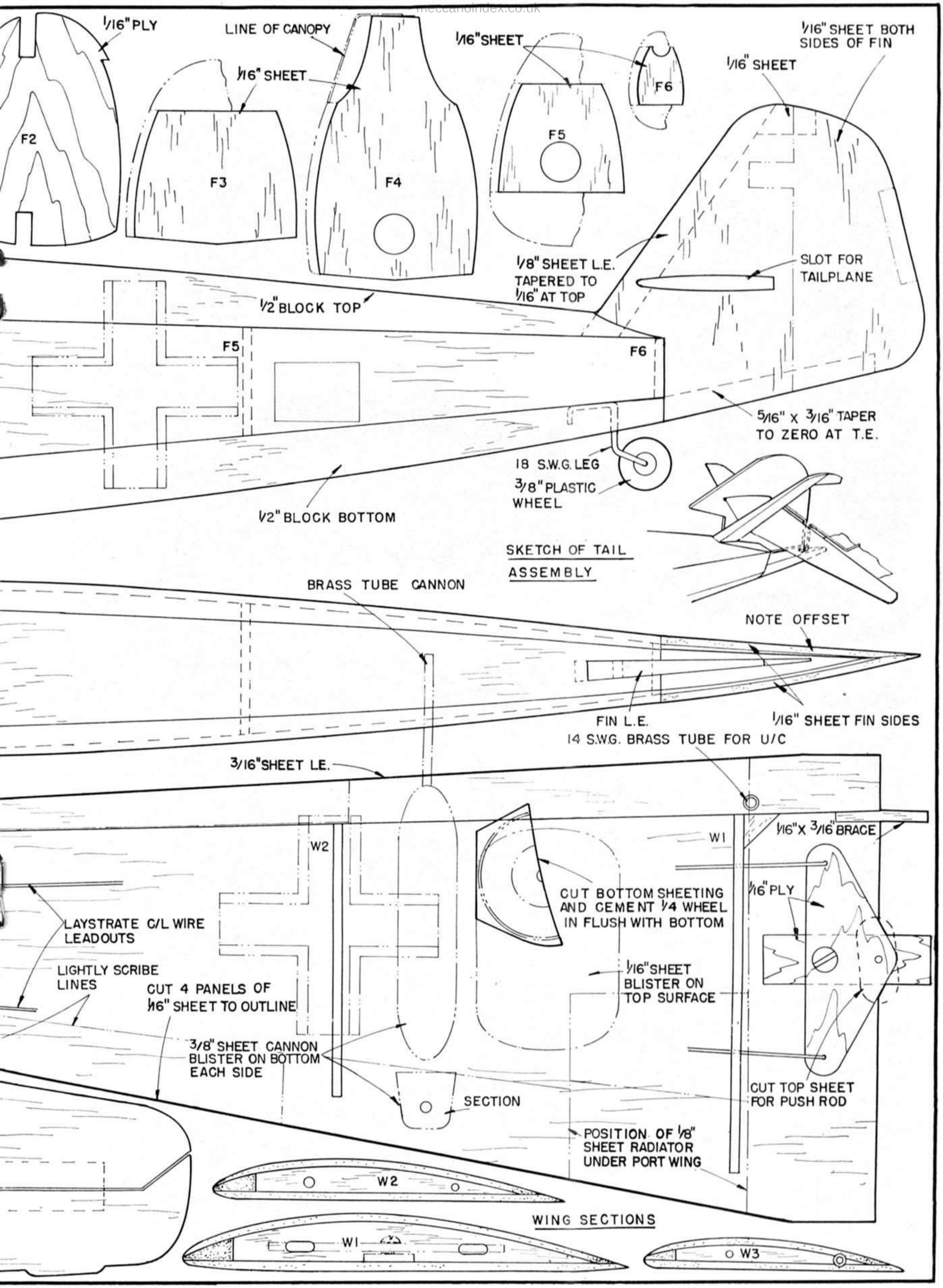
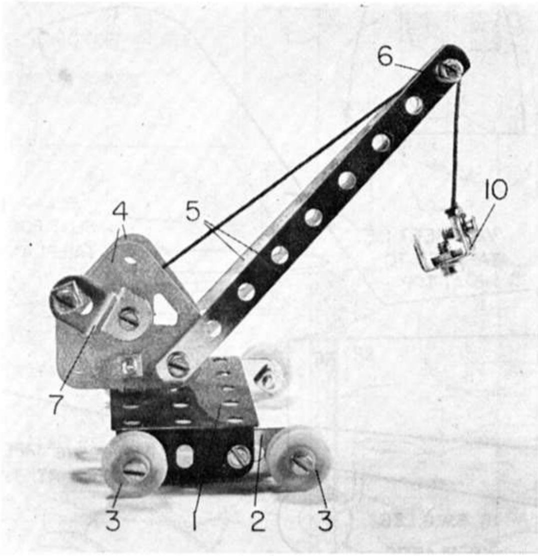




Entered in Section 2 of the recent Pocket Meccano Competition, this Mobile Crane was built by 12-year-old Philip Clarke of Braunston, Nr. Rugby.

MORE FROM POCKET MECCANO

BY 'SPANNER'

CONTINUING, as promised, our series of interesting models entered in last year's Pocket Meccano "Build-a-Model" Competition, I am pleased to feature here three more constructions, chosen at random from the hundreds of entries received. These actually make up the third batch of models to be described, but they differ somewhat from the two previous groups in that none of them is a prize-winner. All the models so far described have won a prize of some sort, yet those illustrated here have not. Why feature them then?

To answer this question, I would like to refer back to the article in January's M.M. announcing the winners of the Pocket Meccano Competition. At the time I remarked on the high quality of entries in the Competition and mentioned the fact that very many unsuccessful models were well up to prize-winning standard. I do not hesitate to say now that these three offerings are, in my opinion, three of those up-to-standard models and I am quite sure that, if there had been more prizes to go round, all three would have stood excellent chances of netting something for their builders.

As it was, of course, the number of prizes was naturally limited and, as a result, many possible winners were just beaten into the "losing" category. When prizes are limited, there *must* be losers, but there is nothing to suggest that some of those losers should not be featured in these pages. Many unsuccessful entries were worthy of mention and so, by way of a change, we have chosen the three models for this month from among those entries. They are, as a glance at the pictures will show, a Mobile Crane, a Helicopter and a Dodgem Car and I think you will agree that, although losers, they are all interesting models in their own right.

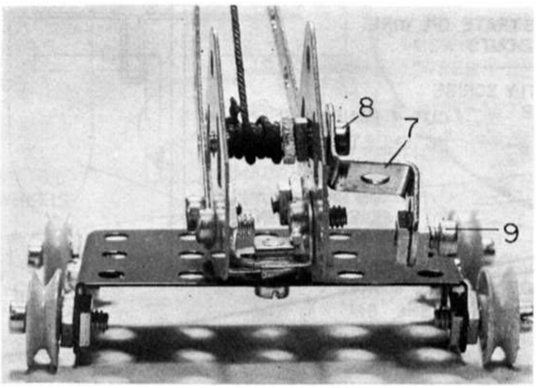
Mobile Crane

Beginning with the Crane, this is a delightful working model designed by 12 year-old Philip Clarke of Braunston, Nr. Rugby, Warks. Fitted with four wheels, it is fully mobile and it also has a rotating jib allowing even greater versatility. Its most interesting feature, however, is a working winch—quite a noteworthy feat on such a small model!

The mobile chassis consists quite simply of a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flanged Plate 1, each flange of which is extended one hole forward by a Fishplate 2. Firmly held by Nuts in the forward end holes of the Fishplates and in the opposite end holes of the Plate flanges are four ½ in. Bolts, on each of which a ½ in. Pulley 3 is mounted to serve as a wheel. Lock-nutted to the top of the Flanged Plate through its rear row centre hole is a compound double bracket built up from two Angle Brackets. This built-up double bracket should revolve freely, but not sloppily, on the Plate.

Tightly fixed to the vertical lugs of the double bracket are two Flat Trunnions 4 secured through their centre base holes. These Trunnions serve as the Crane body, the Crane jib being supplied by two 4½ in. Narrow Strips 5, bolted to one set of base corner holes of the Trunnions. The top ends of Strips 5 are connected together by an ordinary Bolt 6 passed through the end hole in one Strip and fixed by two Nuts in the end hole of the other Strip. This leaves a short length of Bolt Shank clear between the inner Nut and the opposite Strip, and it is over this exposed shank that the winch Cord will later be passed.

The winch itself is supplied by a ½ in. Reversed Angle Bracket 7 which is secured by a Nut on a 1⅛ in. Bolt 8. The shank of the Bolt is then passed through the centre hole of right-hand Flat Trunnion 4, where it is lock-nutted in place with the end of the Bolt just protruding through the centre hole of the left-hand Flat Trunnion. The Bolt



A close-up rear view of the Crane body showing the hoisting winch.

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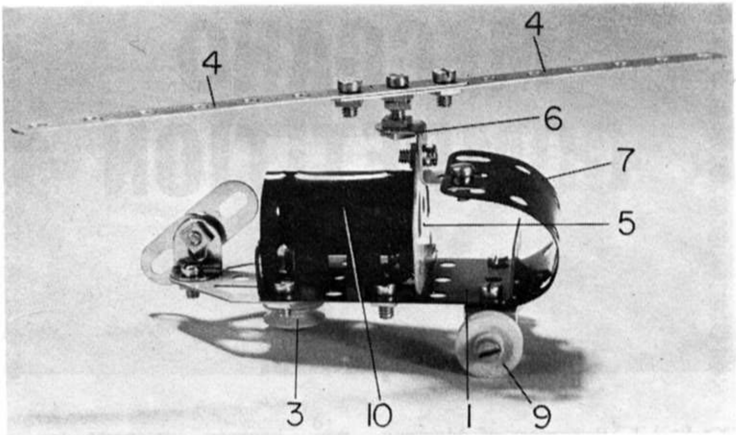
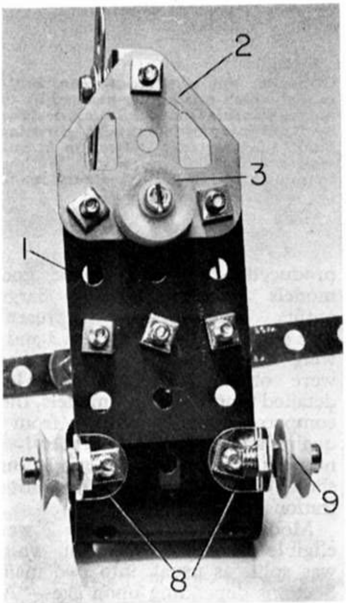
Also entered in Section 2 of the Competition was this little Helicopter, designed by S. R. H. Gregory of South Nutfield, Surrey.



must be free to turn in the Trunnions, controlled by the crank formed by Reversed Angle Bracket 7. A handle for the crank is supplied by a Bolt 9, locked by Nuts in the spare lug of the Reversed Angle Bracket. The shank of Bolt 8 serves as the Crane winding drum, the hoisting Cord passing from this, over Bolt 6 to be finally tied to a "hook" 10 supplied, in our case, by a compound double bracket built-up from two Angle Brackets, bolted together. The finished model is a



neat example of a fine little working production.

PARTS REQUIRED

2—10	25—37a	1—51	1—125
4—12	11—37b	1—111	2—126a
4—23	1—40	4—111a	2—235d

Helicopter

Moving onto our second model, we come to the Helicopter—the pleasing work of 12 year-old S. R. H. Gregory of South Nutfield, Surrey.

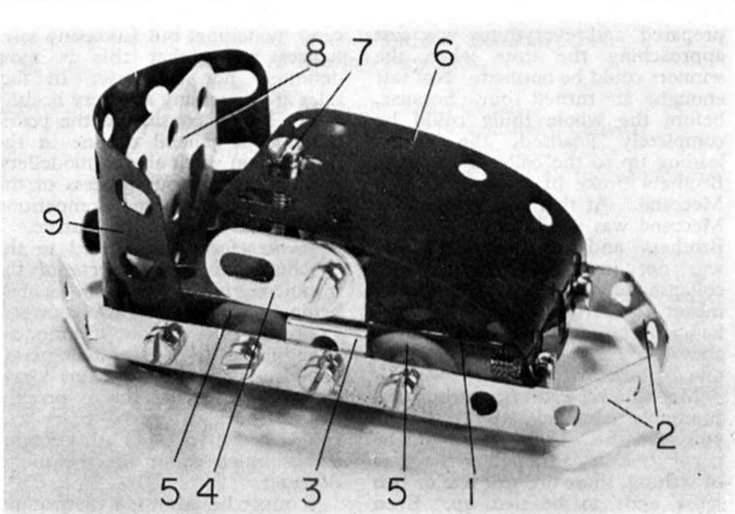
Helicopters have long been popular subjects for Meccano modellers and, in fact, a large number of different versions were entered in the Pocket Meccano Competition. Master Gregory's version, illustrated, is just one of many and I have chosen it, not because it is necessarily better or worse than the others, but because it was the first to really appeal to me when I was looking for models to feature.

As regards construction, the main body section is supplied by a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flanged Plate 1, the tail section being represented by a Flat Trunnion 2, bolted to the underside of the Flanged Plate. Passing through the centre base-hole of the Trunnion and Plate 1, is a $\frac{3}{4}$ in. Bolt which carries two $\frac{1}{2}$ in. Pulleys 3 to act as the tail skid. The rotor blades are constructed from two $4\frac{1}{2}$ in. Narrow Strips 4, overlapped three holes. A Flat Trunnion 5, separating the tail section from the rest of the fuselage, is attached to the centre of Flanged Plate 1, by an Angle Bracket. A $\frac{1}{2}$ in. Reversed Angle Bracket 6 is then secured by its centre lug to the apex of Trunnion 5, thus forming an upper and lower flange. The rotor blade is lock-nutted to the upper lug of Bracket 6 by a $\frac{1}{2}$ in. Bolt which passes through the centre hole.

The front of the cockpit is made from a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Plastic Plate 7 which is bolted to Flanged Plate 1, along with two Angle Brackets 8 at the corners. Two $\frac{1}{2}$ in. Pulleys 9 are secured to these Brackets by $\frac{1}{2}$ in. Bolts, completing the wheel assembly. The Plastic Plate is then bent round and bolted to the lower flange of Reversed Angle Bracket 6. Finally, a second $2\frac{1}{2} \times 1\frac{1}{2}$ in. Plastic Plate 10 is curved to shape and the ends located in the slots in the heads of Bolts secured in the top of Flanged Plate 1 to hold it in place. This completes the model and, at the same time illustrates an excellent way of saving parts!

(*continued on page* 151)

Above, an underside view of the Helicopter showing the simple undercarriage.



Right, this delightful Dodgem Car was entered in Section 3 of the Competition by J. Spriggs of Spalding, Lincs. A very appealing model!

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MECCANO COMPETITION NEWS

By 'Spanner'

REGULAR readers of Meccano Magazine may vaguely remember that, in the January 1971 issue, we launched a Meccano model-building competition in which entrants were required to build a model from a specific current Meccano Set. Readers who actually entered the contest will, I am sure, be wondering what on earth became of it, as no announcements have been made since the contest closed! An explanation is called for and I am at last able to offer the explanation, although this will not appear until the March issue. (As I write, it is the beginning of December, 1971!).

The competition was run by Meccano in Liverpool and, as already mentioned, it closed at the end of last April. In due course, judging took place, although this was a little later than planned, and then the judging itself took quite some time to complete which resulted in a further delay. Eventually, however, the winners were chosen, the necessary lists and paperwork prepared and everything was fast approaching the time when the winners could be notified. Not fast enough, it turned out, because, before the whole thing could be completely finalised, the events leading up to the collapse of Lines Brothers broke in a storm around Meccano. At that time, of course, Meccano was a subsidiary of Lines Brothers and, although Meccano was not itself in difficulty, the collapse of the parent Company meant that certain Meccano matters had to be temporarily held in abeyance. The competition was one of those matters.

Meccano was, and is, a strong and profitable company. By the time you read this, its future should be perfectly clear, although at the time of writing, there are still one or two loose ends to be tied up. Even now, however, prospects are so bright for an extremely successful future that the competition has been given the green light to proceed. I am therefore delighted to report that the winners have now been notified and, indeed, when you read this they will have long since received their prizes! A list of the winners is given below, but, before coming to it, some comments on the competition itself are in order.

To begin with, the number of entries received in the contest was disappointing. I do not have an exact figure to quote, but I have no hesitation in saying that it was almost certainly the lowest entry ever received for a Meccano competition. Indeed, some of the sub-sections into which the competition was divided did not attract a single entrant, while, in others, there were not sufficient models of prize-winning standard to warrant the presentation of all the allocated prizes.

I did wonder if all this indicated a decline in the popularity of Meccano modelling, but Company sales figures prove that this is most definitely not the case. In fact sales are increasing at a very healthy rate! I then considered the possibility of a general decline in the competition spirit among modellers, but the tremendous success of the recent Pocket Meccano Competition proves this idea to be untrue. I have therefore been forced to the conclusion that the course of the trouble lay in the particular Contest being somewhat different from past Contests by calling for outfit models, as opposed to "unlimited parts" models. Past competitions have generally laid no limits on the quantity or variety of parts that could be used, and this makes things much easier for the model designer.

It must be admitted that, at the time the contest was planned, we did feel an "outfits-only" rule might cause problems. I remember saying in the Magazine announcement last January (1971) that it is a lot harder to produce a model from a specified number of parts than from an unlimited stock. I also said that this increased the challenge and it most certainly did—so much so that the challenge appeared to be too great for a lot of would-be competitors who didn't even enter!

Having said all this, I should now like to congratulate those competitors who did meet the challenge by entering the contest and I must say that, considering the problems imposed by being limited to a particular Set, some very good models were produced. Nor were these good models exclusive to the larger outfits. A number of very presentable constructions from Sets 3 and 4 were entered and, although these were obviously considerably less detailed than the larger models, they compared very favourably from a quality and design point of view. A number of prize-winning models are shown in the accompanying illustrations.

Models from outfits 1 to 7 were eligible for the competition, which was split, as usual, into two major Sections depending upon age—"A" for competitors under 14 and "B" for competitors aged 14 and over. Each Section was in turn split into seven Sub-sections, numbered from 1 to 7 and determined by the outfit from which the model was built. Three prizes were offered in *each* Sub-section: cash for 1st place, a Meccano Set for 2nd place and Meccano Parts for 3rd place, with Sub-sections 3, 4 and 5 receiving the largest prizes. The winners were as follows:

Opposite, not a prize-winner, but a model which was highly praised by the judges was this Dumper Truck, designed by B. Comley of Northfield, Birmingham 31 and entered in Section A, Sub-section 7 of the Competition. We hope to publish full building instructions for the model in a future M.M.

Opposite page, built with Meccano Set No. 5, this well-proportioned Dragster netted 1st Prize in Section 1, Sub-section 5 of the Competition. It was designed and built by Martin McCrorie of Hailsham, Sussex. Far right, Second Prize in Sub-section 7 of Section B was won by Mr. Colin Hoare of Beaconsfield, Quebec, Canada with this Snowmobile which incorporates working skid steering.

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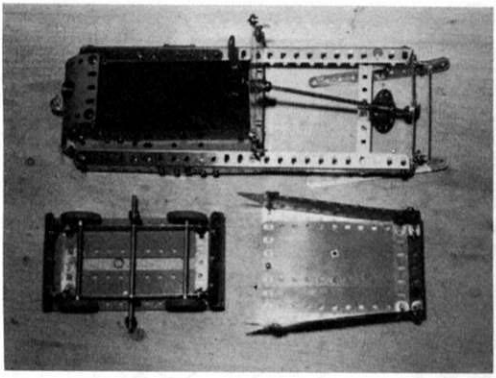
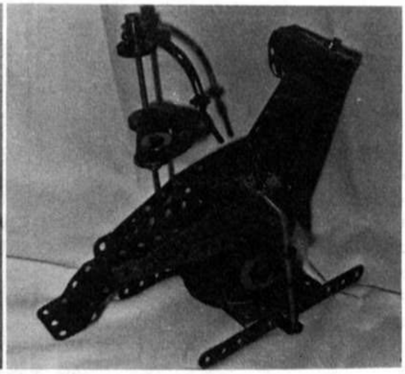
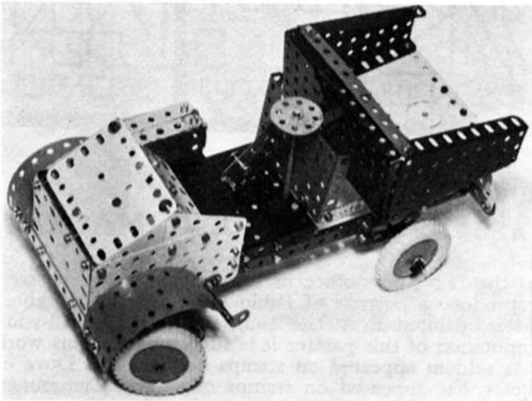
For the picture on the right, Mr. Hoare's Snowmobile (see photo below) has been broken down into sections to show its simple yet sturdy construction.

Far right, as always, originality of subject was a factor ever in the minds of the judges. The originality of this Dentist's Chair was enough to win 1st Prize in Sub-section 5 of Section B for Mr. Bob Boundy of Christchurch, New Zealand.







Section A

Sub-section 1:
No entrants

Sub-section 2:
No entrants

Sub-section 3:
1st – Miss L. Robinson, Wilmslow, Cheshire.
2nd – S. L. Houghton, Kendal, Westmorland.
3rd – M. Park, Dorchester, Dorset.

Sub-section 4:
1st – A. Atkin, Rotherham, Yorks.
2nd – P. Mead, Bridgewater, Somerset.
3rd – M. Fairman, Trowbridge, Wiltshire.

Sub-section 5:
1st – M. McCrorie, Hailsham, Sussex.
2nd – S. Cummings, Horsham, Sussex.
3rd – None.

Sub-section 6:
1st – A. Saul, Handsworth Wood, Birmingham.
2nd – R. Hamlin, Basildon, Essex.
3rd – None.

Sub-section 7:
1st – S. Ashford, Cookham, Berks.
2nd – P. Garfield, Bournemouth, Hants.
3rd – N. Pluck, Christchurch 2, New Zealand.

Section B

Sub-section 1:
1st – P. D. Hancock, Edinburgh.
2nd – J. E. Smith, Southall, Middlesex.
3rd – None.

Sub-section 2:
No entrants

Sub-section 3:
No entrants

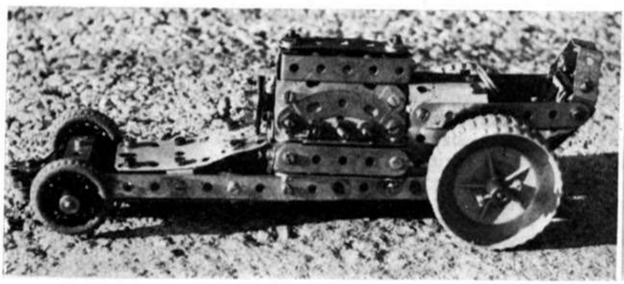
Sub-section 4:
1st – P. Owens, Seven Kings, Essex.
2nd – A. C. Dexter, Horley, Surrey.
3rd – None.

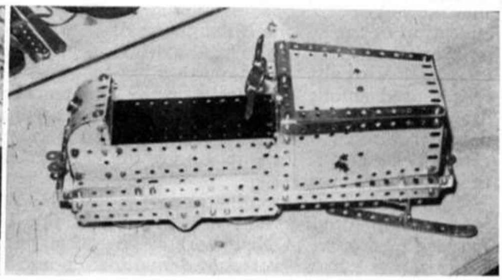
Sub-section 5:
1st – R. Boundy, Christchurch, New Zealand.
2nd – J. R. Crocker, St. Ives, N.S.Wales, Australia.
3rd – H. Kronberg, Odense, Denmark.

Sub-section 6:
1st – J. G. Burke, Cardiff, Glam.
2nd – C. Warrell, Eltham, London, S.E.9.
3rd – A. Bentley, Newcastle, Staffs.

Sub-section 7:
1st – E. Amirault, Sask., Canada.
2nd – C. G. D. Hoare, Beaconsfield, Canada.
3rd – J. C. Palmer, Droitwich Spa, Worcs.

My sincere congratulations go to all the winners for a job well done!





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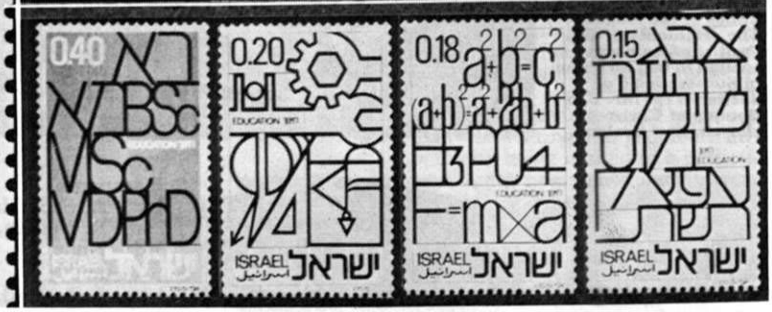

EDUCATIONAL STAMPS

BY J. A. MACKAY

EDUCATION is one of the great themes in stamp collecting. Every aspect of the subject, from kindergarten to university, has been featured on stamps and there seems to be no limit to the scope for new stamps. The year 1970 was designated International Education Year and many countries released stamps for the occasion. Rather disappointingly the majority of these stamps were satisfied with showing the United Nations educational emblem and few of them took the trouble to depict schools or aspects of education in individual countries. It is particularly regrettable that Britain let the occasion pass unnoticed, despite the fact that 1970 was also the centenary of Foster's Education Act which established free and compulsory education in England and Wales.

Britain made up for this, however, with an attractive set of stamps last year featuring modern university architecture. The stamps depicted Aberystwyth University College (3p), the University of Southampton (5p), Leicester University (7½p) and the University of Essex (9p). If you missed getting these at the time they were issued you can still obtain them from the philatelic counters in London and other major cities, or from the Philatelic Bureau 2–4 Waterloo Place, Edinburgh EH1 1AB.

In November 1971 the United Nations issued three stamps in honour of the International Schools in Geneva and New York. These schools were set up for the education of the sons and daughters of United Nations personnel stationed at the headquarters in New York or Geneva. Virtually every nationality in the world is represented among the pupils, while the teachers are drawn from varying backgrounds and nationalities in order to eliminate language barriers and create a spirit of camaraderie and fellowship among the children during their formative years.

Two stamps, in denominations of 8 and 21 cents, are inscribed in English and are on sale at the United Nations post office in New York. The other stamp, in French, is a 1.10 Swiss francs denomination and is sold at the U.N. post office in Geneva. All three stamps reproduce a portrait of Pablo Picasso of his daughter Maia, painted in 1938. Considering the world-wide reputation of this painter it is surprising that his work has seldom appeared on stamps before. His Dove of Peace has appeared on stamps of several Communist countries, while his painting of Guernica, after it was destroyed by bombing in the Spanish Civil War, has appeared on a stamp in Czechoslovakia. The painting of Guernica is now in the Museum of Modern Art in New York. The portrait of Maia is still in Picasso's private collection. The painting was adapted for stamp reproduction by the Danish artist, Ole Hamann and the stamps printed by the Swiss firm of Courvoisier.

Israel has always set great store by education and has now issued a set of four stamps to publicise the government's educational programme. Education is free and compulsory up to grade 9 (approximately age 15) and plans are in hand for extending this up to grade 12 (age 18). Israeli schools range from the kindergartens and pre-school play-groups attached to the communities known as kibbutzim, right up to university level. In between there are trade and agricultural schools, schools for handicapped children, special facilities for immigrants who have a language problem, junior and senior high schools and teacher training colleges. Israel has the highest literacy rate in Asia and still has the fastest expanding education programme anywhere in that continent.

The four stamps have symbolic designs. The 15 agorot stamp shows the letters of the Hebrew alphabet and symbolises elementary school education. The descriptive tab attached to stamps in the bottom row of the sheet has a quotation from the Book of Proverbs: 'The beginning of wisdom is this, get wisdom'. The 18a stamp features mathematical formulae symbolising secondary education and the tab, also from Proverbs, reads 'Train up a child in the way he should go'. The 20a value depicts spanner, cog-wheel, plumb-line and

(*Continued on page* 145)

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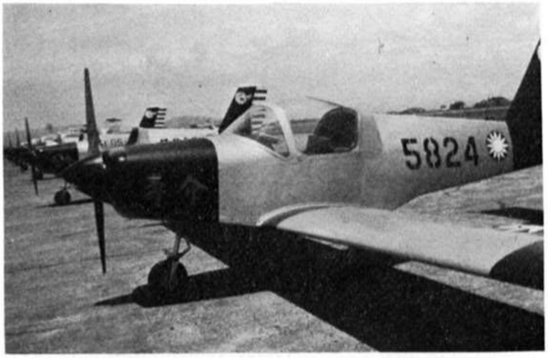
AIR NEWS

BY

JOHN W. R. TAYLOR



Taiwan's Trainers

The Chinese Nationalist Air Force, in Taiwan, is kept well supplied with combat aircraft by America, but its leaders have longed to set up an aircraft industry of their own for many years. Their hopes are being fulfilled at last.

As a first step, they looked around for a simple, modern, easy-to-fly trainer that could be built by relatively unskilled workers in an Aero-Industry Development Centre (AIDC) established by the Air Force at Taichung. They settled finally on the PL-1, an all-metal side-by-side two-seater that had been designed in America, by Ladislao Pazmany, for construction at home by amateurs.

The prototype PL-1 had been flying since March 23, 1962. Its original test pilots included Richard Gordon, better known as one of America's Gemini/Apollo astronauts, and the total of more than 1,300 flying hours logged by the prototype in eight years offered adequate proof of the soundness of the design. So the Chinese Air Force simply followed the lead of 375 other customers by ordering a set of PL-1 drawings from Mr. Pazmany.

Under the supervision of General K. F. Ku and Colonel C. Y. Lee, personnel of the Air Force's Aeronautical Research Laboratory built the first, slightly modified PL-1A in a record 100 days. It flew for the first time on October 26, 1968, and was presented to Taiwan's leader, President Chiang Kai-Shek, to mark his 81st birthday five days later. Two more PL-1As were completed in June 1969.

Extensive flight testing of these little aircraft convinced the Chinese Air Force leaders that the PL-1 would make a first-class basic trainer for their cadet pilots, and they decided to build 35 more. Mr. Pazmany had fitted a 95 h.p. Continental C90-12F engine in his original prototype, but made the design strong enough to permit both aerobatic flying and the installation of more powerful engines. Thus, the Chinese had fitted a 125 h.p. Lycoming O-290-D in the PL-1A and now decided to use the still more powerful Lycoming O-320-E2A, of 150 h.p., in production aircraft, which are re-designated PL-1B. Other changes include slight widening of the cockpit and an increase in rudder area. VHF radio is installed as standard equipment.

The Taiwan-built PL-1B spans 28 ft., is 19 ft. 8 in. long, has a loaded weight of 1,440 lb., maximum speed of 150 m.p.h. and range of 405 miles at 115 m.p.h. Among those who learn to fly on it are high school and college students in the 18 to 28 age range who belong to the Chinese Youth Flying Club at Tainan. After passing a rigorous medical examination, these young men take a three-hour-a-week, five-month course of classroom instruction and flying training for which they pay only a nominal fee of £35. After logging 20 hours of dual instruction in the air, the students are allowed to fly solo; after 50 flying hours they can apply for a licence to pilot single-engined light aircraft of all types.

Nor is the Pazmany PL-1B the only aircraft to have passed through the growing factory at Taichung. In 1969, the Chinese concluded a licence agreement with Bell Helicopter Company of Fort Worth, Texas, under which an initial batch of 50 Bell UH-1H twelve/fifteen-seat helicopters is being built there for the Chinese

Above, students take a five-month course in aircraft such as the Taiwan-built Pazmany PL-IB, six of which are seen top right. Right, the prototype PL-IA built in Taiwan was presented to General Chiang Kai-shek.

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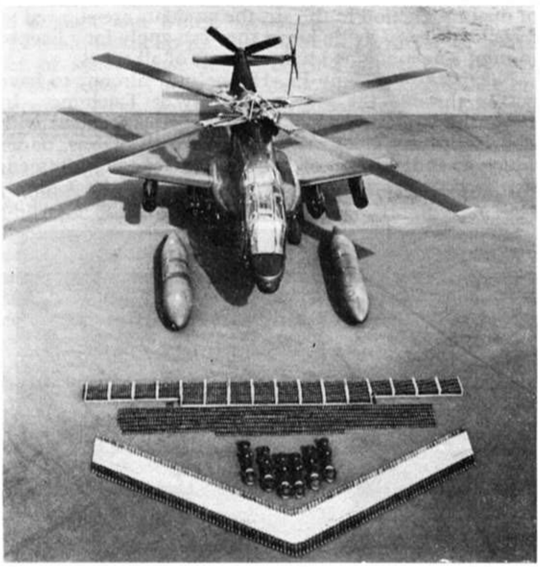
Army. The first four UH-1Hs, delivered in mid-1971, underwent only final assembly and painting by AIDC personnel. Phase 2 of the programme involves assembly at Taichung of certain major structures, such as the cabin and tail-boom. Phase 3 will include local manufacture of a number of detail parts.

This easy and economical method of starting an aircraft industry seems to have inspired other nations. Already the South Vietnamese are reported to have acquired a licence to build the Pazmany PL-1.

Spud Spies in the Sky

If you have a potato patch in your back garden, beware of letting it get too large! Question time in the House of Commons revealed a few weeks ago that the Potato Marketing Board uses a light aircraft to track down people who are evading the Board's marketing scheme by growing more "spuds" than they should. The Parliamentary Secretary to the Ministry of Agriculture, Fisheries and Food commented that he could see no difference between such aerial reconnaissance and the use of private detectives against pilferers in stores.

In a world that is short of food and cannot afford aircraft for essential military duties, one might be excused for thinking that the Department of Trade and Industry is not the only government department that appears to be DOTI.



Left, the first UH-IH assembled at Taichung, Taiwan.

Putting the Chop in Chopper

Although helicopters have been known as "choppers", for many years, it is only recently that they have begun to carry such heavy armament that the nickname has taken on a new meaning. Most formidable of all is Lockheed's AH-56A Cheyenne, which can carry the wide range of weapons shown in the illustration on this page.

Nearest the camera is a Vee-shape row of 2.75-in. rockets, followed by six TOW anti-tank missiles, seven rows of 40-mm. grenades, and hundreds of 30-mm. cannon shells. Pods for the rockets are hung on the outboard racks beneath the aircraft's stub-wings, and the TOW missile launchers are on the inboard weapon stations. The belly turret, armed with a 30-mm. automatic cannon, has a 360-degree field of fire, and the grenade launcher is in the nose. Just in front of the aircraft are two jettisonable fuel tanks that can be

carried on long-distance ferrying and combat missions.

The Cheyenne is fast as well as formidable. Last Autumn it clocked 266 m.p.h. during a test flight, which is more than 45 m.p.h. faster than the official world helicopter speed record. At the moment, Lockheed have no production order for the helicopter, but several Cheyennes have been taking part in an important US Army research and development programme.

Heathrow Arms Haul

While on the subject of armament, it is interesting to note that anti-hijacking security measures at Heathrow have yielded a fine collection of lethal weapons, removed from prospective airline passengers. One recent collection from travellers, most of whom had no illegal intentions, included 32 tear gas dispensers, mostly carried by ladies for personal protection, 12 imitation guns, ten flick knives, ten knuckledusters, an imitation Mills bomb and eight assorted chains.

German "Jump-Jet" Flies

The VAK 191B single-seat V/STOL strike and reconnaissance aircraft began its flight test programme on September 10 last year, after extensive ground and tethered flight testing. The accompanying photograph shows it airborne shortly after the first take-off at

Left, the Cheyenne and the formidable array of armament it can carry. Above, first flight, of the V/STOL VAK 191B prototype in September.

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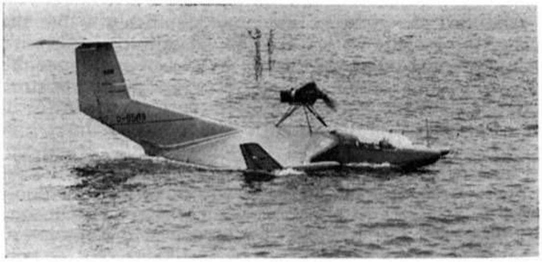
No doubt about the vertical flight capability of the VAK 191B, seen in the right-hand column. Below, is the X-113, seen here at Lake Constance, an aircraft?

Bremen Airport, Germany, at 6.12 p.m. A safe vertical landing was made after a three-minute jet-borne flight at an altitude of about 100 ft. The pilot was Ludwig Obermeier.

VFW-Fokker designed the VAK 191B originally to meet a Luftwaffe requirement for a subsonic aircraft to replace the Fiat G91. In the mid-sixties, the project was so promising that the German and Italian Governments decided to develop the aircraft in partnership, as a second-generation follow-on to the British Harrier. Rolls-Royce was brought in as supplier of the two RB.162-81 lift-jet engines, mounted vertically in the fuselage, aft of the cockpit and wing respectively. With MTU of Germany, Rolls-Royce was also made responsible for the 10,150 lb. thrust RB.193-12 turbofan to be used for forward propulsion.

As in the Harrier, the main turbofan is of the vectored-thrust type, with rotating nozzles which enable it to

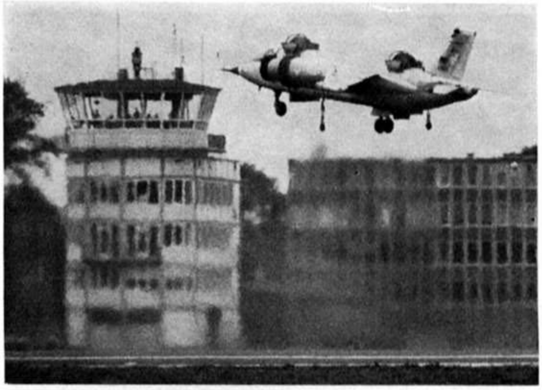


supplement the lift-jets during vertical and hovering flight. The RB.162s themselves develop a total of 11,155 lb. of thrust; loaded weight of the aircraft is 16,535 to 19,840 lb. according to equipment or weapons carried. It is 53 ft. 7 in. long but spans a mere 20 ft. 2½ in.

The Italian Government withdrew from the VAK 191B programme in 1968, but Fiat of Italy continues to share manufacture of the aircraft with VFW-Fokker. Present plans envisage the completion of only three prototypes, which will be used to flight test systems and equipment intended for the Anglo/German/Italian Panavia Multi-Role Combat Aircraft (MRCA).

When is a Plane . . . ?

When the first Hovercraft, or air-cushion vehicles, were built, they were given aircraft registrations.



Nobody could decide whether or not they were aeroplanes, or boats, or what; but they clearly spent most of their operational life airborne.

Eventually it was agreed that they should not be classed as aircraft, which seemed to settle the matter; but the arguments are certain to begin again following the unveiling of the X-113 Am Aerofoil Boat built by Rhein-Flugzeugbau of Mönchengladbach, West Germany. The X-113 has a shape more reminiscent of an aeroplane than a boat. It is powered by a 40 h.p. Nelson H63-CP four-cylinder, two-stroke aero-engine, driving a tractor propeller. Its constructors are primarily aircraft manufacturers, and its designer is the great Dr. A. M. Lippisch, the pioneer of delta-wing aircraft configurations and designer of the wartime Messerschmitt Me 163 rocket-fighter.

Even with such a parentage, the photographs on this page might not suggest anything more than a "surface skimmer"; but other pictures have appeared in the German press showing the X-113 banking steeply at a considerable height above the waters of Lake Constance, where tests have been under way since October 1970. So the dividing line between "skimmers" and aircraft is becoming very thin.

The present X-113 is a single-seater, built of a special glass-fibre sandwich with a core of tubular or foam plastic. It spans 19 ft. 3¾ in., is 27 ft. 8 in. long, and has a maximum take-off weight of 760 lb. Reports of much larger craft of the same type, already under development in Russia, suggest that the X-113 may be the first of an entirely new species of aircraft that could revolutionise cross-Channel ferry services and perform a variety of important military duties.

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FOR THIS RELIEF MUCH THANKS

By W. L. D. Bayley

GALE force winds ripping up the Bristol Channel buffet the coast of South Wales; angry seas swirl round the rocky base of Lundy Island. At the two light-houses, Lundy North and Lundy South, the Trinity House keepers listen anxiously to the radio weather forecast, for today is Relief Day, and one watch is due to go home.

Outside, waves crash against the landings, bearing out the forecaster's warning of Force 8 winds. It is obvious that the weather is quite unsuitable for the tender to work; her boats would be smashed to match-wood on the rocks and no one could board or land without sustaining serious injuries.

Oddly enough, the homeward-bounders pay no attention to the wind reports, but smile when "moderate to good visibility except in rain squalls" is forecast. One keeper looks out of the window, and cheerfully estimates the height of the cloud base as 800 feet. Going to his store cupboard, he takes out the last packet of tea and whistles happily on his way to the galley for his last 'brew-up' on Lundy for a month.

The wind whistles and the waves crash outside. Old keepers tell the youngsters that when *they* were young, they had been marooned on the lighthouse for weeks on end, until the weather moderated sufficiently for the relief to be made by sea. Although cannibalism wasn't actually mentioned, dark hints were dropped about the fate of plump young Assistant Keepers when the store cupboards were finally emptied with the wind still howling in from the Atlantic and no relief tender in sight.

The Assistant Keeper going to leave picks up his cup of tea, checks that his kit is stowed nearby near the door, and switches on the radio-telephone. He listens intently for the message he knows will come very shortly.

"Lundy North, Lundy North—this is helicopter Charlie Bravo. Do you read me? Over!"

The keeper give a thumbs-up sign to his mates, and picks up the transmitter hand-set.

"Helicopter Charlie Bravo; this is Lundy North. I read you loud and clear. Over!"

"Lundy North, this is Charlie Bravo. You are loud and clear also. We shall be taking off from Swansea Airport in about twenty minutes bound for your station. What is your weather, please? Over!"

The lighthouseman gives the helicopter pilot the information he requires, and then settles down to wait as patiently as he can. Patience is a virtue soon learned in the light-house service.

On windswept Swansea Airport, the helicopter pilot watches the refuelling of his aircraft. Lighthouse keepers beginning their turn of duty on the Lundy lights load the plastic dustbins containing their stores into the cabin of Charlie Bravo. Once a month, Trinity House, the world's leading lighthouse and pilotage authority, charter a Westland 'Wessex' heli-copter to relieve some of the Welsh island lighthouses. Two days ago, Charlie Bravo flew across Britain from her home heliport of Great Yarmouth to Holyhead, and relieved the Skerries and Bardsey Island. Yester-day, South Bishop Light, Skokholm and the Smalls were served from a pad on St. Ann's Head at the entrance to Milford Haven. Today sees the last of the reliefs; the Lundies, Flatholm and then back to Great Yarmouth in time for supper.

Above left, recovering the crewman at Lundy North after slipping the net. A Force 9 gale was blowing at the time.

Left, Charlie Bravo takes the weight on Lundy. One of the buoyancy floats can be seen on the port landing wheel.

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Pushing Charlie Bravo to the refuelling point at Swansea Airport before the day's work begins.

Approaching Lundy South. The landing pad for cargo and winchees is on the little hill to the right of the lighthouse.

The Keepers going out to the light-houses are responsible for packing and loading the dustbins, weighing them and reporting their weight to the helicopter crew. Once the muster has taken place, it is no use remembering that all your eggs for a couple of months are on the kitchen table at home! Each dustbin is clearly marked with the symbol of the light-house for which it is intended . . . dustbins must not be allowed to get out at the wrong station!

Once he is satisfied that the total weight of stores and passengers is well within the safety limits laid down for his aircraft, the pilot gives a very short briefing. Every-one is told exactly what he intends to do, and great stress is laid on the fact that this is a routine operation, with safety as the prime factor. As the Winchman muttered, "We want to die old, not bold!"

The 'Wessex' is an ideal helicopter for marine work such as this. Her two gas turbine engines give an impressive safety reserve, for each engine singly is powerful enough to keep the helicopter in flight and under full control. Buoyancy floats are attached to the landing wheels, and there is a large, inflatable buoyancy bag in the tail. In the unikely event of a 'ditching', Charlie Bravo would float on an even keel, and float for quite a long time, too. In the cabin is an inflatable dinghy and, of course, individual lifejackets for the passengers. The crew of three—pilot, winchman-engineer and crewman—all wear Mae West lifejackets with lights and radio-beacons. Crash helmets—"bone domes" to the crew—are worn by passengers and crew when winching and, as in all aircraft, "Fasten Seat Belts and No Smoking" notices are illuminated during take off and landing.

Swansea Tower gives permission for Charlie Bravo to lift off. Once over the foam-streaked waters of the Bristol Channel, the pilot sets course for Lundy, using a Decca Flight Recorder to guide him. Down below the passengers can see the lightships, bucking at their anchors in the rough seas. Soon, they too will be fitted with helicopter platforms, but there is no relief for them today. The tender is weatherbound, sheltering and waiting for the winds and seas to moderate. It looks like being a long wait.

Lundy is in sight ahead, and contact is again made by radio-telephone. The Keepers have all done this drill before, and everything moves with seamanlike precision. Lundy North is the first to be relieved.

On a bare plateau above the lighthouse a ragged windsock streams in the wind. A small circle is marked out with whitewashed stones, and, standing at the open door, the winchman talks the pilot down over this circle, using the intercom. As soon as the helicopter touches down, the keepers who have struggled up the narrow path from the lighthouse help their joining colleague to transfer all the Lundy North stores into a big cargo net spread out on the ground by the helicopter. When this has been done, the relieved Keeper climbs into the cabin, the crewman shackles the net to the strops under the helicopter and signals to the pilot to lift off. When the helicopter is airborne and he is satisfied

Transferring the Lundy North gear into the cargo net. The code marking on the plastic dustbins can be seen clearly.

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Above, "up and away". Charlie Bravo carries Lundy North's stores in the underslung net.
Left, keepers loading up their stores. The hydraulic winch is above the cabin door and the underslung net gear can be seen behind the cabin step.

that the net is safe, the crewman is winched back into the cabin.

The winch is right over the cabin door. Hydraulically operated by the winchman, it can lift a load of 600 pounds and its reel holds between 60 and 100 feet of wire. Winching distances are usually much less than this, however. The crewman, always first down and last up, wears a 'bone dome', Mae West and a special overall with built in harness for connecting to the hook. Lesser mortals make do with a canvas strop slipped under the arm-pits.

Charlie Bravo hovers over the tiny cargo landing pad adjacent to the lighthouse, taking care to keep above the level of the lantern top. The winchman stands at the open cabin door, safety-belted to the inside of the aircraft. The crewman sits on the cabin step, hooked on to the wire. The pilot cannot see what is going on behind him, so the winchman keeps up a constant patter of information on the intercom, relating the height and position of the wheels to the small circle marked out below. The pilot is talked down until the cargo net rests in the circle; then the crewman is winched down on the wire until he can unshackle the load. Once this is done, he is hauled up again and the helicopter speeds away to the other end of the island, to Lundy South.

Here, the wind rushes over a vertical cliff face, creating an air turbulence that requires all the pilot's skill to counter. A small circle is marked out quite close to the lighthouse, into which stores and keepers are all winched down in turn while the pilot maintains a hover height of around ten feet. All goes with the precision of a well-learned drill, the crewman being winched down first and recovered last of all. The relief is made, and twenty-five minutes after leaving their lighthouses, the keepers are back home in Swansea.

They were all most enthusiastic about the helicopter. For one thing, they could guarantee being relieved on the proper day, just so long as the visibility was more than half a mile and the cloud base above 300 feet. Sea, swell and wind no longer exercised their ancient power over the rock-lightmen. The other great advantage lay in the speed with which they were ferried from mainland to light and back again. In the old days, relief by the tender meant a protracted cruise round all the other lighthouses and lightships on the vessel's duty round. Now, instead of days, the trip takes minutes.

Of course, the tender is still needed to carry the bulky stores; water, coal and oil. But, with less work to do, the Master can pick his time to operate, knowing that a delay of a day or two—or even a week or two—will not bring hazard and hardship to the guardians of world shipping, perched on their lonely rocks, tending the guiding lights.

"Charlie Bravo, this is Lundy South. Thank you very much for the relief. See you again next month. Lundy South signing off!"

Continued from opposite page

Mountain, one of the major problems is the loss caused by eagles at lambing time. Not only will they frequently kill a ewe that is down by tearing a hole in her side, but some eagles take to killing lambs. If those particular birds are not destroyed, they will keep on killing until the lambs are quite big, and the losses can be very serious. I have at times seen an eagle strike a lamb and then continue on to attack others, apparently for sport."

The Governments of both Western Australia and Queensland have both been concerned with the destruction wrought by the Wedge-tailed Eagles. In 1961–62 Queensland authorities paid out bounties on 11,563 Wedge-tailed Eagles, and in 1964 Western Australia paid out 1,817 bounties.

Bounty hunters have found the eagle's main weakness is his liking for dead meat. A kangaroo carcase can be stuffed full of strychnine and still Wedge-tailed Eagles are unable to resist the temptation to gorge themselves to the limit. A record kill of thirteen eagles from just one poisoned carcase has been reported.

In early settlement days the Wedge-tailed Eagles were called "Bold Vultures" and "Mountain Eagles".

John Gould, the ornithologist of last century, summed up the giant eagle of Australia in a way which most Australians would still agree with . . . "All that has been told of the courage, strength and rapacity of the Golden Eagle, applies in equal measure to the Wedge-tailed Eagle."

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The Eagle of Australia

By Frank Madigan

THE Wedge-tailed Eagle, or Eaglehawk, is the largest bird of prey in Australia, having a wing-span sometimes reputed to be eleven feet, though the largest museum record is that of a Tasmanian bird with a wing span of nine feet four inches.

However, the average wing span is considered to be seven feet six inches. The Wedge-tailed Eagle ranks as the fourth largest in the eagle world, two sea-eagles and the monkey-eating eagle of the Philippines being even larger.

Young Wedge-tailed Eagles have rich brown plumage, but these feathers darken as the bird grows older to dark brown almost bordering on to black. There are some ginger-coloured feathers to be found on the back of the neck. The shape of the tail is that of a perfect wedge, which makes it a simple task to identify the bird as it flies overhead. A mature bird measures between 35 and 42 inches in length and weighs from 8 to 12 pounds, and its main food is rabbits and carrion.

The eyrie is usually found high up in a tree, and is made of sticks and lined with gum leaves. Sometimes the Wedge-tailed Eagle uses the same nest year after year, when the nest becomes about six to eight feet in depth and around the girth. Odd blotches and smears of brown mark the two dirty-white eggs the hen lays.

When the young eagle is about forty days old he begins to fly. One naturalist believes that they are taught by their parents, but the generally accepted feeling is that they fly instinctively. Even young birds which have been kept in laboratory tubes before they began to fly have been proved to be as capable as others.

From observations carried out by the naturalist David Fleay on his famous 'Horatia', the Wedge-tailed Eagle he trained as a rabbit-hunter, film star, photographic model and foster-mother, it was proved that 'meat' is an essential part of the diet for young eagles. David Fleay reported thus:

"Perhaps the most interesting observation made at this time was the foster-mother's method of feeding slivers of rabbit flesh to the fledglings, while simultaneously her saliva dripped over the morsels and into the eaglets' beaks. In this way we learned that for the early weeks of their lives young Wedge-tails are aided by the parent in the vital matter of breaking down meat protein."

The naturalist Graham Pissey, observing the feeding of eaglets in an eyrie in their wild state, graphically describes in his book, "A Time To Look", what happens next . . . "The actions of the old eagles after this feeding were always the same. Having seen the young so stuffed with food that they were limp and helpless, they would start to feed themselves, and having cleaned up the remaining meat around the rabbit's forelegs and saddle, would seize one of the hind legs with their beaks and tear it out by the roots with one twisting wrench of the head. They would swallow it whole, choking over it, their throats distended, their great talons clamped across the limp paunch."

It is their uncanny skill in finding ways of securing that valuable meat protein that makes the Wedge-tailed Eagle such a menace to graziers. For undoubtedly they use their brains, with all the wisdom of the wild, to hunt down the irquarry. One only has to watch a pair of Wedge-tails in action, as they attack and kill a kangaroo. They work in unison, one each side of the hapless kangaroo. Alternately they swoop from each side, in turn attacking the animal until he is no longer able to stand. Before he has time to try to rise from the ground they both swoop in for the kill. The creature's jugular vein is often severed, and his side badly injured.

The cunning Wedge-tails use a scientific method for the killing of the young joey. Two birds attract the attention of the doe, and then separate her young from her. Then one of the birds encourages the baby 'roo to brush its face with its pinions, and just at that precise moment the other Eagle rests for a fraction of a second on the joey's shoulders. But that is long enough for it to sink its talons into the animal, thus pricking the spinal cord, and paralysing the baby 'roo' Then it is at their mercy.

The Eagle's quick wit in solving a hunting problem was reported by Jack Hyett in his book, "A Bushman's Year" . . . "I saw a pair of Wedge-tails hunting a hare. The hare cleverly ran close behind a wire fence until the eagles could not pounce for fear of damage to their wings. Finally, one flew ahead and perched on a fence post. As the hare approached it spread its wings threateningly. The hare broke away from the fence, the eagle which had followed it dived, and the heart-stopping scream of a dying hare pierced the silence of the plains."

With great shrewdness eagles have been known to chase animals towards the edge of a cliff-face, then to swoop down and attack them, until the creatures roll over the cliff and are killed in their fall. Then the birds of prey enjoy a feast.

Naturally, such a cunning killer has found that slaughtering lambs was simply child's play, as the following report shows, from a farmer in East Gippsland, Victoria . . . ,'On a property such as ours at Black

(Continued on opposite page)

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PHOTOGRAPHY IS EASY No. 5

THE WORLD IN CLOSE UP

BY

PETER WILKES

SOONER or later most camera owners come up against the problem of trying to take a picture closer than the focusing distance of that camera will allow.

It may well be that the satisfaction of perfection in model building drives the proud creator for his camera, or the beauty of a spider's web in close up, or the wish to record with lasting permanence the fragile grace of a tenderly reared bloom in the garden. Whatever the reason, in many cases, when the camera is used in close up, the results disappoint and the sadly disillusioned owner considers that photography in close up is just for the professional.

Nothing could be further from the truth. Close up photography presents no real difficulties; what it does do is to open up an entirely new world to the man who appreciates beauty in texture and form.

It is obvious that if a camera which has a minimum focusing distance of 3 ft. is used only six inches from the subject then the result will be an out-of-focus blurred image.

What is required is an accessory that will permit the camera user to approach nearer than the normal focusing distance of the camera. Such accessories come in three forms.

For the man who owns a reflex camera—one where the actual scene in front of the lens is transmitted by a mirror to the viewfinder—with facilities for interchangeable lenses, the work is easy.

Manufacturers have designed, for these types of camera, both EXTENSION TUBES and BELLOWS EXTENSIONS.

The first named, extension tubes, are screwed into the camera between the lens and the body. The tubes usually come in sets of three which permit the use of the camera, where all are used in combination, at distances as close as two inches from the subject.

BELLOWS UNITS are, in effect, a flexible extension tube enabling the focusing to be done by adjusting the movement of the lens until the required size is obtained.

However, close up photography is not restricted only to those who use a camera with interchangeable lenses. For the vast number of us restricted to a camera with fixed lenses, this work is done by the use of CLOSE UP LENSES.

These are pieces of optically ground glass that fit into a holder and screw or push on to the end of the camera lens.

These CLOSE UP LENSES, or SUPPLEMENTARY LENSES, as they are sometimes called, have a number of advantages even over the means described for reflex cameras. They can be used on any type or size of camera, they are simple to work with, they are small, light and portable, and, possibly one of their most important advantages, they are relatively inexpensive.

Supplementary lenses are available in strengths indicated in DIOPTERS,—+1 diopter, +2 diopter, +3 diopter, etc., and are accomplished by a table giving the actual distance that the camera has to be from the subject for any distance the focusing scale of the camera is set to.

Supplementary lenses can be used either singly or in combination and, by this means, can cover areas from 30 square inches down to 3 square inches.

Heading, even a simple camera, with a close up lens, and using the frame, can be used for copying old photographs etc., providing that diffused daylight is used, or the subject to be copied is illuminated by one lamp either side of it.

Left, a straightforward photograph of a plastic model showing result of using frame described in text and close up lens on a simple camera.

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Showing the frame described in the text in use on a simple camera.

The distances at which subjects can be photographed again depends on the strength of the close up lens in use and varies from 1 ft. 6 in. with a +1 diopter lens to under 4 in. with a +10 diopter.

Naturally at such close distances the depth of field is slight but, in this type of photography, the subject before the camera will be confined to one limited plane so that, if the supplementary lenses are used as per the tables, the whole subject will be sharp.

A problem that does cause concern to those trying close up work with a camera other than a reflex type is actually knowing the picture area covered by the lens as, in close up work, the viewfinder cannot show the area of the picture that will appear on the film. This can be overcome by making your own framefinders for the distances you find you use most.

The easiest way of making such a frame is from that most common of household objects, the metal clothes hanger.

The camera should be positioned on a tripod with the supplementary lens in place. Open the back of the camera and put a piece of ground glass or tracing paper across the film plane. Open the camera shutter by using the time exposure setting.

If you look through the paper or ground glass at the back of the camera, you will see the view that would be recorded on the film if you were in fact making an exposure.

If a piece of paper is pinned to the wall it is a simple matter, once the camera has been positioned at the working distance with the supplementary lens in place, to mark out the "field of view" of the lens.

With this "field of view" drawn on the paper in the form of an oblong, all that is required is for the coat hanger to be opened out, shaped with pliers so that it covers the marked outline and then fixed to the tripod bush in the bottom of the camera by means of a screw available from any camera dealer.

In use the framefinder is simplicity itself and makes close up work as easy as any other branch of photography. The frame is screwed into the tripod bush in the bottom of the camera, the supplementary lens fitted on to the front of the camera lens, the focus set in the position it was when the test was made to find the coverage of the supplementary lens, and the frame then held over the subject to be photographed.

One type of camera that presents a slightly different problem in close up photography is the twin lens reflex. This popular type of camera has a viewing lens showing the picture to be taken, over the taking lens.

It is obvious here that if the close up lens is first put on the viewing lens to focus on the subject and then transferred to the taking lens, the camera position has to be changed to allow for the difference in position between the two lenses.

Here supplementary lenses are first fitted into the viewing lens, the picture composed and focused, the lens transferred to the taking lens, and the camera lifted by using the movable centre column of the tripod a distance equal to that between the centres of the two lenses.

Close up work is, without doubt, one of the most fascinating branches of photography that can be tackled with ease with even the simplest of cameras, if the steps as outlined are followed.

In the case of this type of photography with an interchange lens reflex, exposure does present a problem because of the fact that the lens, when extension tubes or a bellows unit is fitted, is itself extended. However, this is another case where the makers of the units purchased come to the aid of the user and supply tables giving details of the exposure differences to be given at the varying positions of the units.

Close up photography offers one great advantage to those who wish to try it for the first time. No expensive equipment is necessary for the first exploratory steps into this fascinating new world. Even the owner of an interchangeable lens reflex who has at his disposal the useful extension tubes and focusing bellows can, in the first instance, start with the inexpensive supplementary lens fitted over the camera lens and only when he has explored its potential, graduate to the more expensive equipment made for his camera.

STAMPS—*continued from page* 136
other symbols of vocational training and the tab, quoting from the Book of Aboth, reads 'But all study of the Law without labour comes to naught at the last'. The 40a stamp is inscribed in Hebrew and English with the names of University degrees symbolising academic learning, and the tab has a quotation from the Book of Joshua: 'But you shall meditate on it, day and night.'

Symbols and formulae are also featured on two stamps issued by New Zealand last November in honour of Lord Rutherford, father of nuclear physics, who was born at Spring Grove, Nelson Province in 1871. The 1 cent stamp shows the track of alpha particles passing near an atomic nucleus, while the 7c stamp gives the formula indicating a nucleus of a nitrogen atom of mass 14 when struck by a helium nucleus of mass 4 (an alpha particle) is changed into an oxygen nucleus of mass 17 and a hydrogen nucleus of mass 1 (a proton) is emitted. Lord Rutherford's portrait, by Sir Oswald Birley, appears on both stamps.

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MECCANO PARTS AND HOW TO USE THEM—PART 3

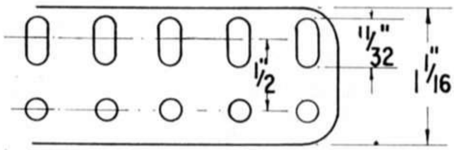


FIG.1

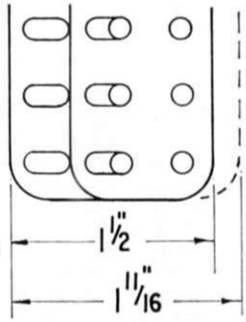


FIG.1a

GIRDERS

BY B. N. LOVE

Strength is a prime consideration for any structural engineer, but so is lightness and economy. Frank Hornby was fully aware of these principles and since he started off with tinplate, design of his basic parts was critical if they were to prove durable. Fortunately the simple process of putting a right-angled bend into a strip of metal alters its characteristics to suit the engineer admirably. Take any strip of notepaper, for instance, which is quite unrigid and floppy and then put a fold down the centre of its length. The strip is still flexible but not so floppy as before. Now open out the fold to a Vee shape and you have instant rigidity along the length of the strip. You have, in fact, formed an elementary girder! It really is as simple as that.

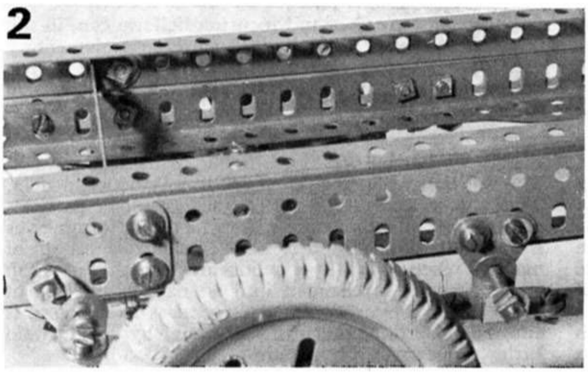
Angle Girders came into the system very early on in its history when the name "Meccano" was rapidly being established as an international household word and its design, being so fundamentally simple and satisfactory, has hardly been altered since. This is certainly true of the Angle Girder which forms the rigid framework of so many Meccano models. Most readers are familiar with its properties but the manufacture of the Angle Girder is a story of its own. Strip steel, $1\frac{1}{16}$ in. wide and $\frac{1}{32}$ in. thick, is passed into a piercing press from which it emerges in a continuous length punched with the familiar pattern of holes shown in Fig. 1. A second machine 'crops' the continuous lengths into standards as required for the full range of Angle Girders and a further machine puts the right-angled fold into the finished parts before the cleaning and plating process.

In its unfolded form, the Angle Girder is known as the Flat Girder (which is really a contradiction in terms.) It should be more properly named the "Wide Perforated Strip" as it possesses no rigid properties of its own. However, when it is combined with the standard Angle Girders as shown in Fig. 2, it provides a strong web for the compound channel girder thus formed. Flat Girders came on to the Meccano scene as a standard part at about the time of the First World War. They were listed as a part number in $5\frac{1}{2}$ in. length only but were not even included in the top set of the day, Outfit No. 6. Consequently, they seldom featured in the manuals of instructions but they did appear in the first advanced model of the famous Meccano Loom, (beyond the scope of the No. 6 Outfit) in 1919, if not earlier. Since that time they steadily became a popular choice for the model-builder as their versatility was disclosed and exploited. The basic dimensions of the Flat Girder are shown in Fig. 1.

Elongated slots are the key to the versatility of the Flat Girder although 'centre line' dimensions of the holes still conform to the half-inch standard. Fig. 1a shows the 'spread' available when a pair of Flat Girders are lapped over each other and this can be extended by lapping slot to slot. Since Flat Girders are available in ten sizes from $12\frac{1}{2}$ in. downwards, the Meccano constructor has a whole range of adaptable plates at his disposal.

The chassis members of Fig. 2 show one aspect of the Flat Girder

2



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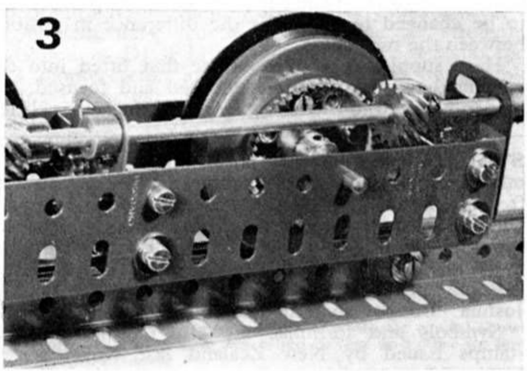

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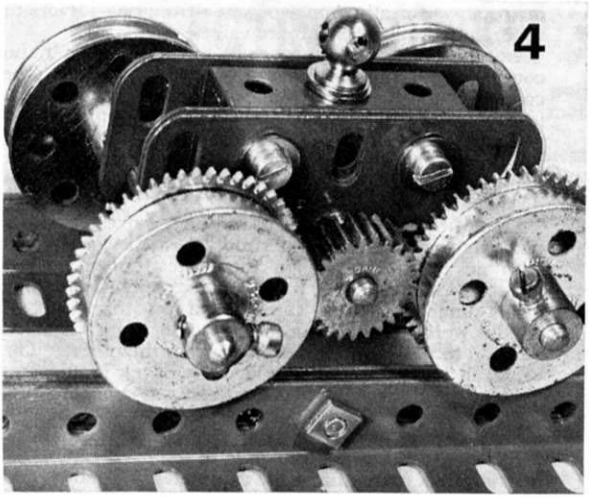
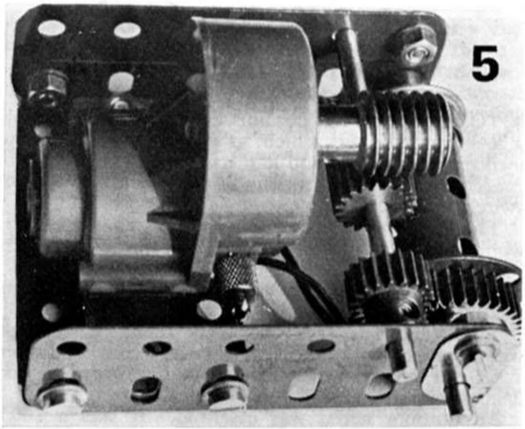


The versatility of Flat Girders is demonstrated especially well in Figs. 4 and 5; both use the elongated slots to maximum advantage.



in its use as a web joining standard Angle Girders to form channel girders, but Fig. 3 shows that the Flat Girder can also act as a framework with simple bracings of short Double Angle Strips. Its latitude of adjustment allows an unorthodox meshing of a small helical Gear with a Contrate Wheel in a power-driven crane bogey, short Flat Girders mounted vertically forming the off-set bearings required.

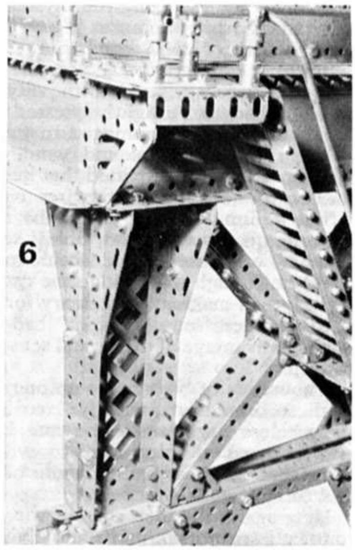
Fig. 5 shows a further example of the Flat Girder's adaptability. In this case a pair of Flat Girders act as the side frames for the lower portion of a light trolley hoist in which the winding drum gear is a 1 in. Gear Wheel. This will not mesh with the ½ in. 19-teeth Pinion shown at standard spacing, but when the Pinion is off-set in the upper row of holes in the Flat Girder, ½ in. inwards from the end, the 1 in. Gear Wheel may be lifted into mesh by securing its shaft in the round holes of a pair of Fishplates mounted at each side of the trolley frame. The resulting drive is a very satisfactory and rugged one, nicely scaled. Bracing of the Flat Plates is done by a 2½ × 1½ in. Flanged Plate which forms an admirable base (adjustable in height by virtue of the slotted holes in the Flat Girders) for the electric motor and its Worm drive to the central 19-teeth Pinion shown.

Quite compact forms of travelling bogies can be made from Flat Girders, as illustrated in Fig. 4 where the principle of double-layer Strips for axle bearings, mentioned in Part 2, is clearly shown. This time a Channel Bearing, Part No. 160, provides full rigidity for the bogey and additional grip for the Bolts is provided by Washers as mentioned in Part 1 of this series.

If a fully compensating bogey is required, one pair of the driven flange wheels shown should be capable of independent movement to accommodate irregularities in rail surfaces or heights. In this case the Flat Girders should be turned with the slotted holes at the bottom and the forward axle should be stabilised by a pair of Fishplates as was done in Fig. 5. The rear axle should then be located in a central swivel bearing to allow the axle to 'ride' in the slots of the Flat Girder. Note, once again, the happy complement of Flat and standard Girders, this time the Angle Girders forming substantial rails for the bogey. Long Angle Girders, sandwiching the heavier-gauge Perforated Strips (7½ in. and upwards in overlapping staggered sections) provide a really strong flat-topped rail suitable for the heaviest of model drag-lines or excavators.

The standard Angle Girder of course, has a hallowed place in the outfit (if not the heart!) of the Meccano enthusiast. He is somewhat prone to classify his Meccano status by the number of Angle Girders he has; the longer and more numerous the better, rather like the chieftain who bases his status on the number of goats he possesses! There is no doubt about it though, the Angle Girder is the 'corner post' (in more senses than one) of the Meccano system, although no lad must ever be discouraged by not having them in his outfit. Thousands of excellent and advanced models have been made which do not use a solitary Angle Girder. However, they certainly look an impressive sight on the old familiar shipyard cranes, etc.

Finally we can see the result of combining those elements of the Meccano system form to the rigid tower structure of a recent model Giant Block-setting Crane as shown in Fig. 6. The upper portion of the tower is surrounded by massive deep webbed girders formed from 12½ in. Strip Plates and Angle Girders. Sturdy 'legs' run to the base of the model where Braced Girders form double webs for compound girders, but utilise the lightweight technique. Channel girders appear again as the combination of Flat and Angle Girders forming rugged tower bracings and bottom rails. Note, also, the use of Washers wherever slotted holes are encountered to ensure a good grip for Nuts & Bolts.



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WHEN RADIO TOOK OVER THE DINING TABLE

BY E. VANNER

NOWADAYS we do our listening-in on portable transistor sets which, as you know, contain their own aerial, batteries, and loudspeaker. They reproduce speech and music surprisingly well at the touch of a switch, and require no outside aids to do so.

Things were not always so easy. Have you ever wondered what pre-transistor radio was like, or what sort of equipment was necessary in the early days of radio, something like 50 years ago, when broadcasting was in its infancy?

The scene was vastly different then. Listening-in was a quite complicated performance, requiring not only a set but several accessories in addition, plus a good deal of operational skill and patience.

An outdoor aerial was essential. It was a 100 ft length of wire slung between two chimney stacks, or from one stack to a high pole at the bottom of the garden. A down lead from this wire entered the house through a hole in a window frame. In older houses you may still see the hole, or at least where it had been filled in.

Within a few years of the start of broadcasting in 1922, every house had its aerial. Streets were festooned with hanging wire, looking rather like high altitude clothes lines.

The aerial was only half of the outdoor fixturing. An earth connection was needed too. This wire was often taken out of the house through the same window frame and clipped to a poker like metal rod driven into the earth. If no garden was available, the earth wire could be fixed to the nearest water pipe. Those were pre-plastic days, remember, when pipes were always of metal.

Both aerial and earth were indispensable to good reception. That no such cumbersome arrangement is needed for modern transistor sets is a tribute to the advances made in radio technology.

Simplest of the early receivers was the little crystal set, consisting of nothing more than a coil or two of wire and a small metal cup holding the crystal. This was usually a piece of bornite, about as big as a pea, and possessed the property of conducting minute electrical impulses better in one direction than the other.

A fine wire spring, known very aptly as the cat's whisker, had to be lightly pressed against the crystal, and if the operator managed to find a 'sensitive spot' on its surface, then sound would come through his earphones, always provided that he had remembered to connect his aerial and earth wires to terminals on the set.

The volume was not great, the range not wide, but the tone quality was good, unless someone in the room coughed or caused some accidental vibration—which could be enough to dislodge the cat's whisker from the crystal, thus making it necessary for the user to re-prod until another 'sensitive spot' had been found. One distinct advantage of the crystal set was that it needed no batteries.

Thousands of boys made up one variation or another of these simple sets, usually from instructions given in the wireless magazines of the time, but the limited range and faintness of volume led to eventual demise of the somewhat erratic crystal in favour of the more positive—and complicated—valve sets.

Here again, the then current wireless magazines went to town in printing circuits and giving detailed assembly instructions for all manner of sets—from one-valvers to super-sets using four or more valves.

In every town, shops opened for the sale of radio components—coils, bobbins of wire, fixed and variable condensers, rheostats, terminals, ebonite panels, batteries, valves and valve holders, and a host of similar parts.

They did tremendous business with hundreds of thousands of do-it-yourself home constructors but demand eventually fell away and most of the shops disappeared.

One of the most popular of the early valve sets was a one-valve receiver. It was simply a small wooden box with an ebonite panel on top instead of a lid. A variable condenser was fixed to this panel, its moving vanes underneath, its tuning dial on top. A pair of coils were mounted in a special holder which enabled one coil to move towards or away from the other. The valve, in its holder, stood above the panel, its filament glowing faintly when the accumulator was connected up.

Judicious use of the moving coil enabled the operator to increase volume, but it was a tricky business to manipulate. If swung too close to the fixed coil, aerial reaction took place, filling the earphones with howls and whistles. These oscillations produced a like response from other listeners in the area, who heard the howls on their own sets and promptly retaliated with howls of their own. Listening in peace was not possible until tempers cooled off!

It was not enough to have a set. Batteries were needed, three of them, each connected to the set by a pair of wires. They were not built-in, but stood around the set on—very often—the dining table.

One was an accumulator for lighting the valve filament. As with all accumulators, it had an unfortunate habit of running down every now and then, usually at the wrong moment, thus putting an end to the evening's listening and causing domestic friction, unless a spare was on hand. Local electricians did a thriving trade in recharging.

The other two were dry batteries. One was a nine to twelve volt grid bias battery, the other a heavy and rather expensive tension battery of 100 or more volts. Both batteries had several tappings into which wander plugs connected to the set could be inserted, the trick being to find by experiment which tapping produced the best results.

Finally, for family listening, several pairs of earphones were required. They were connected to terminals on the set and had the effect of tethering listeners to it by means of the cable. If mother jumped up suddenly to answer the door she might well bring earphones or set crashing to the floor.

Loudspeakers came along later, based originally on the style of gramophone horns. In tone they left a lot to be desired but at least listeners were no longer chained to the set. Later, cone type models appeared, the forerunner of today's comparatively small and efficient speakers.

To boost up signal strength in order to supply enough power to the speakers, amplifying units were built into sets, thus adding to the number of valves and making construction more intricate.

Despite all this, boys became adept at reading circuit diagrams and assembling even quite complicated sets. For a year or two wireless topics were more a subject for conversation that pop or football is today.

It was a wonderful time. The thrill of hearing music and speech on a set of one's own making was indeed quite exciting. If mother grumbled at the litter of apparatus on the table, at least she forgot her complaints when some favourite comedian or dance music from the Savoy Hotel came through those earphones. It was magic!

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COLLECTING DINKY TOYS BY FRANK LOMAX

ALMOST everybody has, at one time or another, tried his hand at collecting as a hobby. Cigarette cards, coins, stamps and matchboxes are just a few of the more popular subjects which people choose, but, in fact, virtually anything is "collectable". Railway enthusiasts will travel far and wide in the hope of purchasing discarded porters' lamps or obsolete timetables and many an old schooner's figure-head has ended up decorating a suburban dining room. The book collector dreams of finding a "gem" amongst mounds of cheap periodicals and obscure volumes, while the autograph hunter will wait patiently—for hours in the rain, if necessary—outside the stage-door for the latest manifestation of the pop scene.

I could continue giving examples 'ad infinitum', but I think it is true to say that one of the most popular branches of the collecting hobby is die-cast models. Much is said in our modern age about the dangers of the automobile to the environment—traffic—congested city centres, noise, toxic fumes contaminating the atmosphere, but, valid as this may be, it tends to overshadow the motor car's inestimable practical value and the history surrounding its development. Many books have been written—and are still being published—on the history of the motor car, and it would undoubtedly take a lifetime of study to read them all. This, of course, is not necessary, but it is wise for the young man interested in model car-collecting to read some volumes on the subject to supplement his hobby, and at the same time, to increase its interest.

The question of what particular brand of models to collect deserves serious contemplation. This can prove a difficult problem as there are several manufacturers involved in the production of model cars. The choice must depend on the type of collection you wish to compile. If, for example, a collector is only interested in Fire Service vehicles, he is presented with a wide range of possibilities from a number of manufacturers. If, on the other hand, he wants to create a collection which reflects the overall history of the motor car, then his natural choice should be Dinky Toys.

Over 1,000 Dinky items have been produced, the majority of the models being based on actual vehicles. Even more important, from the collector's point of view, is that they represent the longest unbroken run of die-cast models still being made.

The age at which one begins to collect model cars is of no real importance, but it is usually the case that the collector who started when he was a boy is today's connoisseur with an extensive and interesting range of vehicles. Many of the early Dinky Toys are much sought-after by serious enthusiasts who are often prepared to pay quite high prices for them and it is wise when travelling around the local market or junk shop, to keep a keen eye open for these small die-cast models.

I believe that almost every collector has a main interest in a particular type of model. Probably the most popular are the military and commercial vehicles, buses and aeroplanes. There are, however, collectors who specialise in farm vehicles, Police vehicles, sporting models—in fact, the list is almost endless!

Why do people collect Dinky Toys? An authority on the subject has described it as a "pure nostalgia for childhood's toys". I think this is partly true, but there is also something of the dreamer in the collector of models. He may not be able to own an actual pre-war Bentley Coupe or a Lamborghini Marzal, but he can purchase models of them and eventually build up a collection which inspires interest and admiration from his friends and colleagues.

468,592,413,563 ÷ 9076 —IN YOUR HEAD, PLEASE

BY F. VANSON

IF, at the age of ten, you had been asked to work out the compound interest on £4444 for 4444 days at 4½% per annum, it is possible that you might have produced the answer. But could have you found it in your head in two minutes?

Could you, at eleven, have divided 468,592,413,563 by 9076, and found the correct figure in one minute? These are a couple of representative problems posed to young George Parker Bidder, one of the most extraordinary arithmetical geniuses known to history, a boy who grew up to be a great civil engineer and the brain behind the construction of what was then the world's largest dock.

Bidder was born in 1805 at Moreton Hamstead in Devon, the son of a stonemason. Though he had no formal schooling as a child, he could, by the age of eleven, perform these astonishing feats of calculation quite readily. Even at the age of four he had gained a local fame for his skill and was shown off by his father as an infant prodigy. This was the more remarkable because until he was six he had not learned to count the numerals up to ten!

Most of his time as a young boy was spent in the company of the village smith. One day at the forge he overheard some dispute in reckoning. At once he piped up with the correct answer. At this he was posed further questions of increasing difficulty, all of which he answered with astounding accuracy and speed. At this time, it is recorded, he could not, on paper, multiply more than two places by two places (up to 99 times 99).

By casual means however he acquired over the next few years a working knowledge of notation up to millions and was able to apply it to a vast range of arithmetical problems, all of which he executed in his head with astonishing speed and infallible correctness. Eventually he could multiply 12 places of figures by 12 places, though he admitted that this was not too easy!

His father, scenting that there was gold in his son's great gift, began to tour the country with him, and the venture proved very profitable, So much so that Bidder Senior firmly resolved that his boy was too good a source of income to be sent to school! Thus at the age of sixteen George Bidder could barely write, and had great trouble putting down his monster sums on paper. But this did not stop him answering some pretty formidable questions. Here is an example:—

How many times will 1728 occur in the cube of 36? Or again:—

A 170 gallon tank is filling at the rate of 54 gallons a minute, and losing its contents at the rate of 30 gallons a minute. How long will it take to fill?

These questions it is true would not baffle the grammar school boy of today, but remember that George Bidder had had no school education at all and was nearly illiterate. Such problems as these he answered correctly in seconds.

Many eminent mathematicians and philosophers saw

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young Bidder perform and all urged upon his father the need for the young genius to be formally educated. At last, after a plea by the great astronomer Herschel in 1817, the boy was belatedly sent to begin his lessons. After a time he had progressed so far that the services of a private tutor were needed. He proved to be a truly brilliant pupil.

Within five years of beginning his academic education he had carried off the mathematical prize of Edinburgh University. At first he was employed by the Ordnance Survey, and later worked for the Institution of Civil Engineers.

In his adult life Bidder's early fame as an arithmetical prodigy was largely forgotten. He became one of the greatest engineers of the nineteenth century. As we have seen above his most enduring monument is perhaps the vast Royal Victoria Dock on the Thames, at that time the world's largest, but he was also a great railway builder.

Bidder became a highly educated man and his powers, (unlike those of some boy geniuses) increased with his age. It is interesting to compare two problems set for him, one at the age of twelve, and the other sixty years later, only two days before his death.

In 1817 Sir William Herchel asked him the following question:—

> Light travels from sun to earth in eight minutes. Assuming the sun to be 98 million miles away, if light took 6 years and 4 months to travel from the nearest star, how far away is that star?

Bidder answered correctly 40,633,740,000,000 miles.

Almost at the end of his life he was asked by a friend:—

> If light travels at 190,000 miles per second, and the wave length of red rays is 36,918 to the inch, how many of its waves strike the eye in one second?

He replied at once 444,433,651,200,000.

It would seem that Bidder though an excellent all-round mathematician showed exceptional skill mainly in questions involving multiplication and division. He himself left an interesting account of his own mental development, and the accounts of his boyhood genius are well authenticated. He died at Dartmouth in 1878, aged 72.

George Parker Bidder Junior (the 'Younger Bidder') the son of the engineer, was born in 1837, and inherited his father's genius for figures. He too could quite easily multiply 387,201,969,513,825 by 199,631,057, 265,413. He could play two games of chess at once, blindfold! At Cambridge he was a brilliant mathematician, but he was never really interested in the subject! He took up law and had a distinguished career at the Bar, becoming a well known Q.C. Had he been really interested in the world of numbers he would quite possibly have excelled even his famous father.

Both however remain marvellous examples of the incredible capacity of the human mind. Even the electronic brain would be hard put to it to beat them for speed and accuracy.

MODEL BUILDERS

(*Continued from page* 122)

taken. Since the model was built, some of the boys have entered the Whitley Scout Troop, as is evident from the different uniform worn by several of those in the photograph, but they were all Cubs at the time of construction.

I have been asked to stress that, while the model was inspired by the Jodrell Bank Telescope, it is *not* itself a Radio Telescope. It looks like the original and reproduces the original's movements, but it does *not* perform the radio-telescopic work of the original. Nonetheless, it is still much more than a purely mechanical model; it actually serves as a receiving aerial for household radio and television broadcasts!

It is, of course, to achieve this unique result that the special "dish" is required. The metal bowl collects and concentrates the radio or T.V. waves, which are then picked up by an aerial "feeler" projecting through the centre of the bowl. This feeler is connected by screened aerial cable to a radio or T.V. set in the normal manner to complete the chain.

In operation, with everything connected and the set switched on, the model is manipulated, the dish searching the air until the clearest and loudest results are achieved. Obviously the best results will come when the dish is aimed directly into the path of the broadcast waves and this fact also enables the model to be used as a direction-finder as well as an aerial. At peak reception, the dish will point in the direction of the broadcasting transmitter when receiving direct waves and will also indicate the general direction of the transmitter when receiving waves reflected off the "Heavyside Layer" of ions surrounding the Earth. In the latter case, the dish would point skywards to pick up the reflected waves, but in most cases it would be angled skywards, rather than point vertically upwards, and this angle would still indicate a ground direction.

It is clear from all this that the model has many fascinating possibilities. I was certainly impressed by it when I visited the Pack at Whitley and I should now like to take this opportunity of congratulating the Cubs on their achievement. I should also like to thank the Cubs and all who made us welcome during our visit, especially Mr. Burrows and "Akela", Mrs. Laithwaite, who was also the Pack Founder. Thank you all—and we did find our way back safely!

Self-searching Model

Quite coincidentally, I am able to report—briefly—on another model inspired by Jodrell Bank Radio Telescope, this one built by Mr. A. Lindsay Greer, of Ballymena, Co. Antrim, Northern Ireland. As with the Cubs' version, however, it must be stressed that Mr. Greer's model is purely a model and is *not* a radio telescope. In fact, as I understand it, the model reproduces only the shape and movements of the original. It does not serve as a radio or T.V. aerial, as does the Whitley-produced version, but it does incorporate a highly-commendable self-searching feature which makes it worthy of special note.

Unfortunately, I do not have a photograph of the model to reproduce here, but Mr. Greer kindly gave me a clear description of the model's principles which, I think, explains the situation admirably.

"For a birthday present", he wrote, "I received the Meccano Electronic Control Set. To utilise this, I built a model which was inspired by both the Jodrell Bank Radio Telescope and a French solar power station, of which I had an illustration. When switched on, a reflecting dish revolves, at the same time tilting up and down, both movements being automatic.

"On the end of the 'needle' inside the dish is the L.D.R. (Photo Cell) of the Electronic Set, this being wired in the appropriate circuit with the Relay, Motor and power source. By covering the Photo Cell with a filter, it can be made to switch the motor off when it is pointing at the sun or at a light bulb. In this way, the machine searches the sky until it finds the sun, at which point the Motor switches off, leaving the

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Photo Cell pointing at the sun. When the sunlight moves away fıom the Photo Cell, the Relay switches the Motor on again, driving the model until the Photo Cell again points at the sun. Thus the dish follows the sun across the sky".

I think all readers will agree that both the models described here offer something really different from a Meccano point of view. They certainly illustrate the versatility of the system!

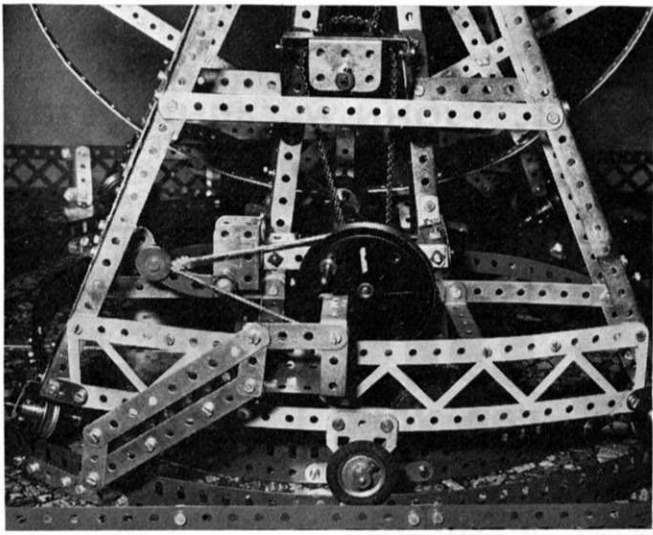
T.V. Appearance

Before finishing this month, I would like to draw attention to the remaining photograph, reproduced here, which we have included to let enthusiasts know that Meccano is still receiving plenty of good publicity. It won't take modellers long to recognise the Meccano Blackpool Tower in the picture—and it won't take T.V. viewers long to recognise the two men either! They are, of course, popular British comedians Mike and Bernie Winters, and the scene is taken from the London Weekend Television show "Mike and Bernie's Christmas Cavalcade" which was broadcast during the Christmas period.

I should say, I *hope* the show was broadcast and I *hope* the scene was included, because, at this moment as I write, I do not know—Christmas is still a couple of days away! The show, however, has just been recorded in advance and London Weekend have kindly sent me the photograph, so I am assuming everything went as planned. If it did, no doubt many readers saw the programme, therefore the photograph will, I trust, bring back some happy festive memories.

Incidentally, the model trains in the picture look like old Hornby O-gauge Clockwork Trains, once made by Meccano. I wonder if any member of the Hornby Railway Collector's Association can confirm this . . . ?

Below A close-up view of the control handle and Sprocket drive providing vertical dish movement on the Jodrell Bank model. Note the band brake which locks the dish at the chosen altitude. Right. Meccano Blackpool Tower meets Mike and Bernie Winters! See text.



POCKET MECCANO *(Continued from page 133)*

PARTS REQUIRED

2—10	24—37a	1—111	2—126a
4—12	14—37b	1—111a	1—194
4—23	1—51	1—125	2—235d

Dodgem

Lastly, we have the Dodgem Car which is a nicely-proportioned and realistic little model designed by 13 year-old J. Spriggs of Spalding, Lincs. The chassis is built up from a 2½ × 1½ in. Flanged Plate 1, to the sides of which two 4½ in. Narrow Strips 2, bent to the shape shown, are attached by Angle Brackets 3 to represent the bumpers. The flanges of the Plate project downward and note that the Angle Brackets are fixed to the underside of the Plate, the securing Bolts in each case also fixing a further Angle Bracket to the top of the Plate. A Fishplate 4 is bolted to the spare lug of each of these additional Angle Brackets.

For mobility, the Dodgem is provided with four wheels, each supplied by a ½ in. Pulley 5 on a ½ in. Bolt, tightly fixed in one or other Narrow Strip 2. The Pulleys are free to turn on the Bolts, but are held in place by two Nuts locked together on the end of each Bolt.

The main body fairing is represented by a 2½ × 1½ in. Plastic Plate 6. When fitting this Plate, however, it is best to first fix a 1⅛ in. Bolt 7 by a Nut in one centre end hole of the Plate, the lower end of the Bolt shank then being locked by two Nuts in the second row centre hole from the rear end of Plate 1. The other end of Plate 6 is curved round and bolted to the forward flange of Plate 1. Bolted to the rear flange of the Plate, by its apex hole is a Flat Trunnion 8, serving as the seat-back, the model finally being completed by a second 2½ × 1½ in. Plastic Plate 9, curved as shown and bolted between the third holes of Narrow Strips 2. This adds the final touch to a very pleasing little model!

PARTS REQUIRED

2—10	25—37a	1—111	2—194
4—12	11—37b	4—111a	2—235d
4—23	1—51	1—126a	

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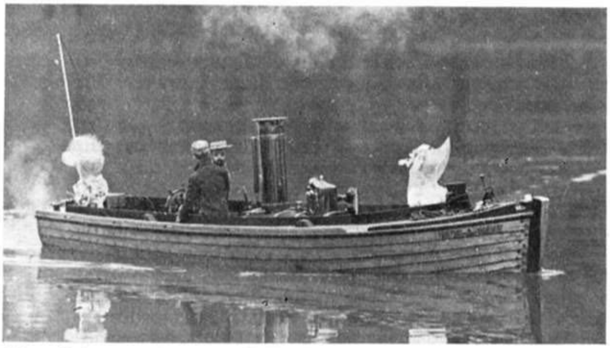

The February issue of Model Boats includes the first of a short series of articles on an Edwardian steam launch with sufficient information being presented in the series for anyone to make a similar model without plans. Scale ships include H.M.S. Chester cruiser, the coastal tanker Anonity, H.M.S. Hood in tinplate, the Brazilian battleship Minas Gerais, a Dutch 60-gun ship of about 1800 and the inter-island steamer New Fawn. There is more on fitting and rigging the 42″ radio-controlled yacht Star-C, notes on multi-racing, reader's models and letters etc.

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19 'Churchill Mk I' – 1940/41 (UK); Vickers MBT 'Vijayanta' 1963 (UK); Heavy Tank M 6 – 1940/41 (US); Armoured Car 'AMD Panhard et Levassor 178' (FR).

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