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MAY 1970

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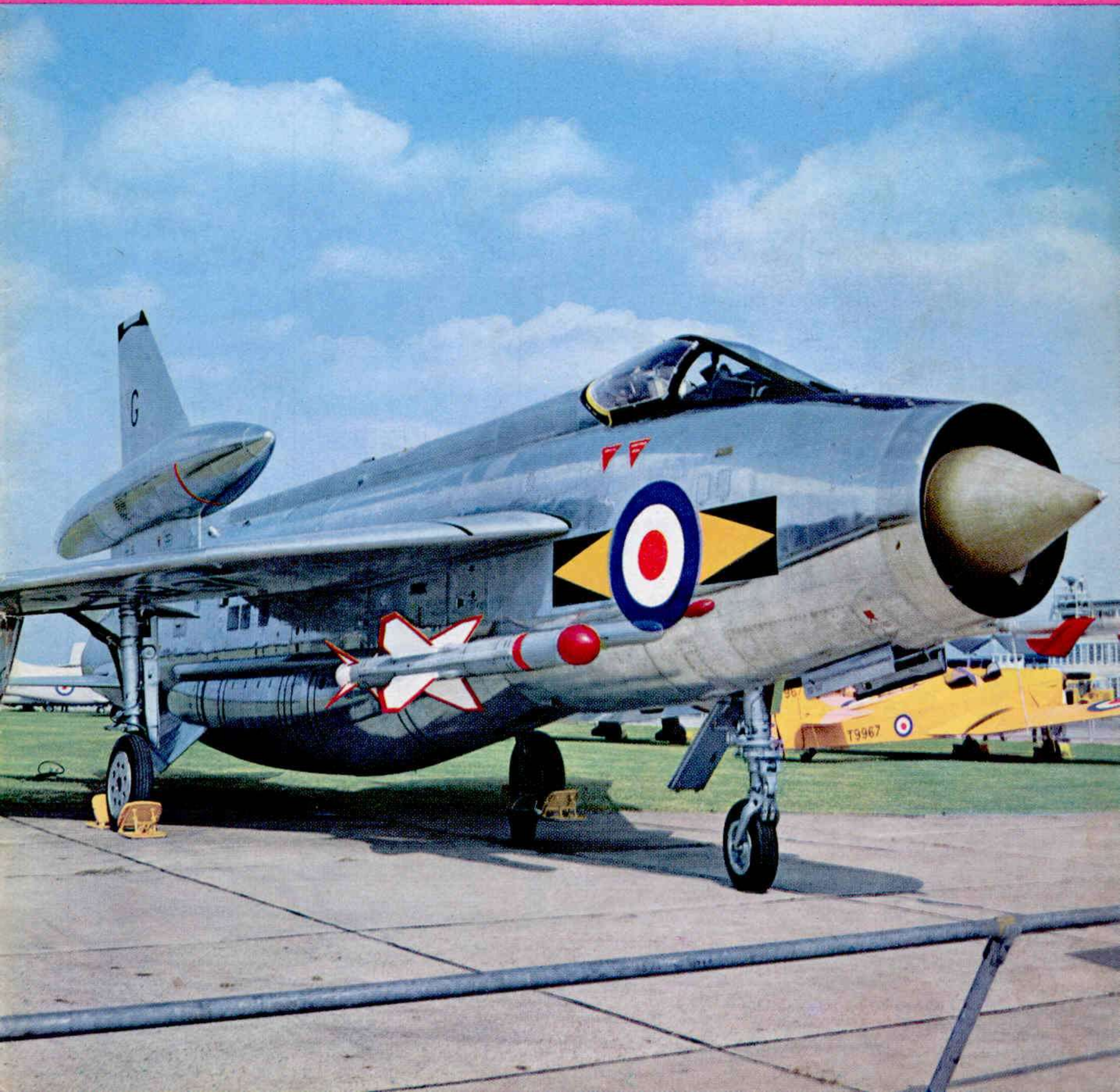

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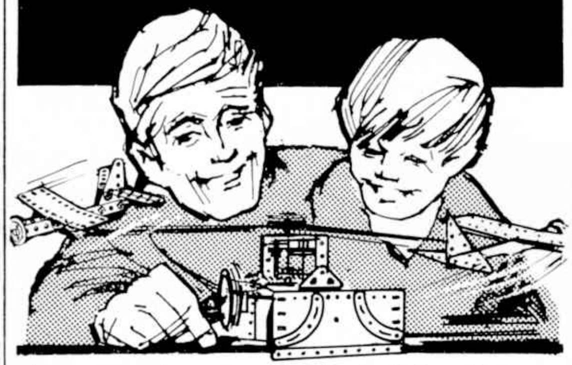

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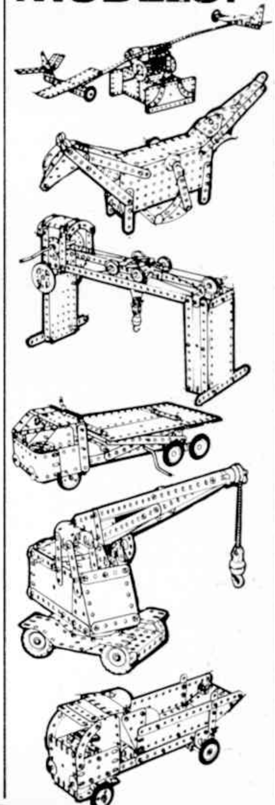

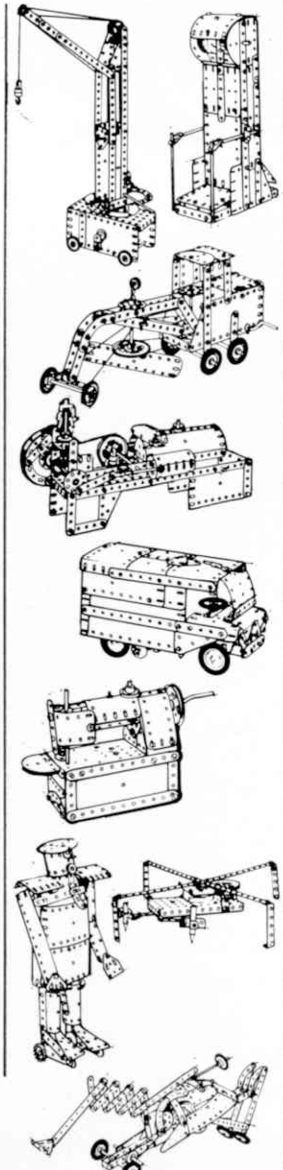

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MECCANO® Magazine

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MAY 1970 VOLUME 55 NUMBER 5
Meccano Magazine, founded 1916.

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MAP **HOBBY MAGAZINE**

ABC

FRONT COVER

Gleaming bright polished metal on the BAC Lightning F6 of No. 11 Squadron Royal Air Force contrasts with the yellow wood and fabric of a 1939 Miles Magister Trainer in the background. The Lightning is serial XS931 aircraft "G" and is of course fully operational. It carries ferry-tanks for increased range on the over-wing pylons. The Magister is a prized possession of the R.A.F. Museum. They were caught together by "Aeromodeller's" camera at the Royal Review, Abingdon in 1968.

NEXT MONTH

The June issue of Meccano Magazine is packed with a variety of selected features on numerous subjects, catering for all tastes. On the general side we have the return of Edyth Harper who presents a feature on the Portobello Road Market, Richard Lee (remember the Fire Walkers and Fortune Tellers ?) who provides another feature on Farm machinery, this time describing Bulldozers and Ploughs.

Popular feature writer Arthur Gaunt presents "Are You Walking on Oil ?" the story of petrol and its production.

This issue sees the return of our Book Review column in which the latest publications are reported on by our staff.

For Meccano lovers, Part V of Meccano Constructors' Guide, a feature now believed to be the most popular of the construction features.

All the regular favourites appear, Air News, Stamps, Great Engineers, On Two Wheels, plus of course many others, making an issue not to be missed.

Advertisements and Subscription Offices: Model & Allied Publications Ltd., 13-35 Bridge Street, Hemel Hempstead, Hertfordshire. Tel.: Hemel Hempstead 2501-2-3.

Second class postage rates paid at New York, N.Y. Registered at the G.P.O. for transmission by Canadian Post. American enquiries regarding subscriptions, news stand sales and advertising should be sent to MECCANO MAGAZINE, Eastern News Distributors Inc., 155 West 15th Street, New York, N.Y. 10011, U.S.A., U.S.A. and Canada direct subscription rates $5 including index.

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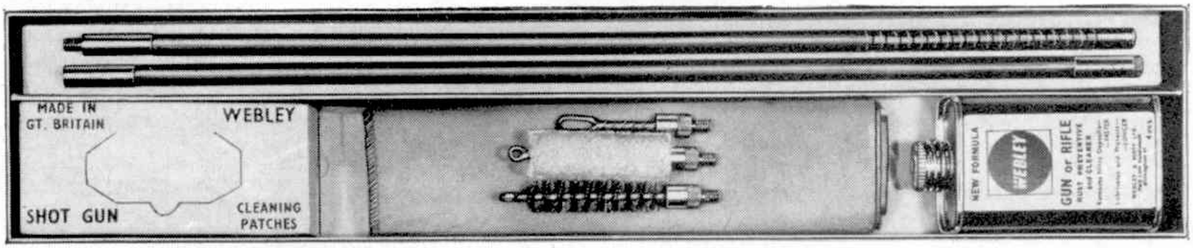

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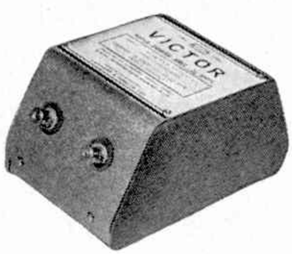

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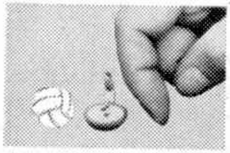

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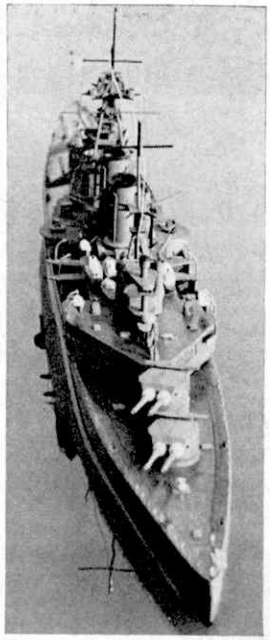

Two models of widely different types (and available in plan form) appear in April Model Boats. One is a 10 c.c. R/C speed model of Italian design, and the other a 31½ in. sailing sloop of semi-scale appearance, by a New Zealand lighthouse-keeper. Measuring ships, a Dutch Fluyt, a model of H.M.S. *Hood*, 1914-18 British Destroyer flotilla leaders, radio in a small model, readers' work, international steering course scoring, and many other features provide a mixed bag of interesting and helpful reading.

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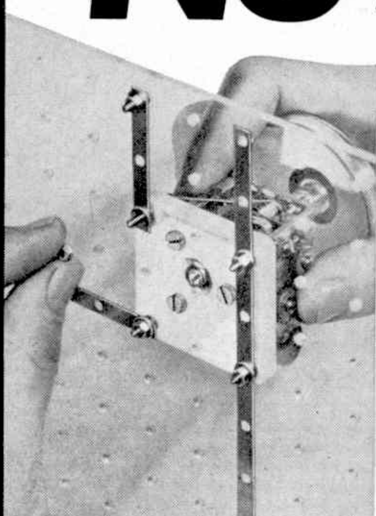

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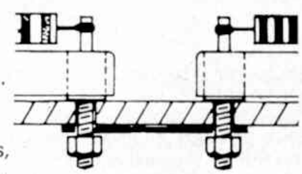

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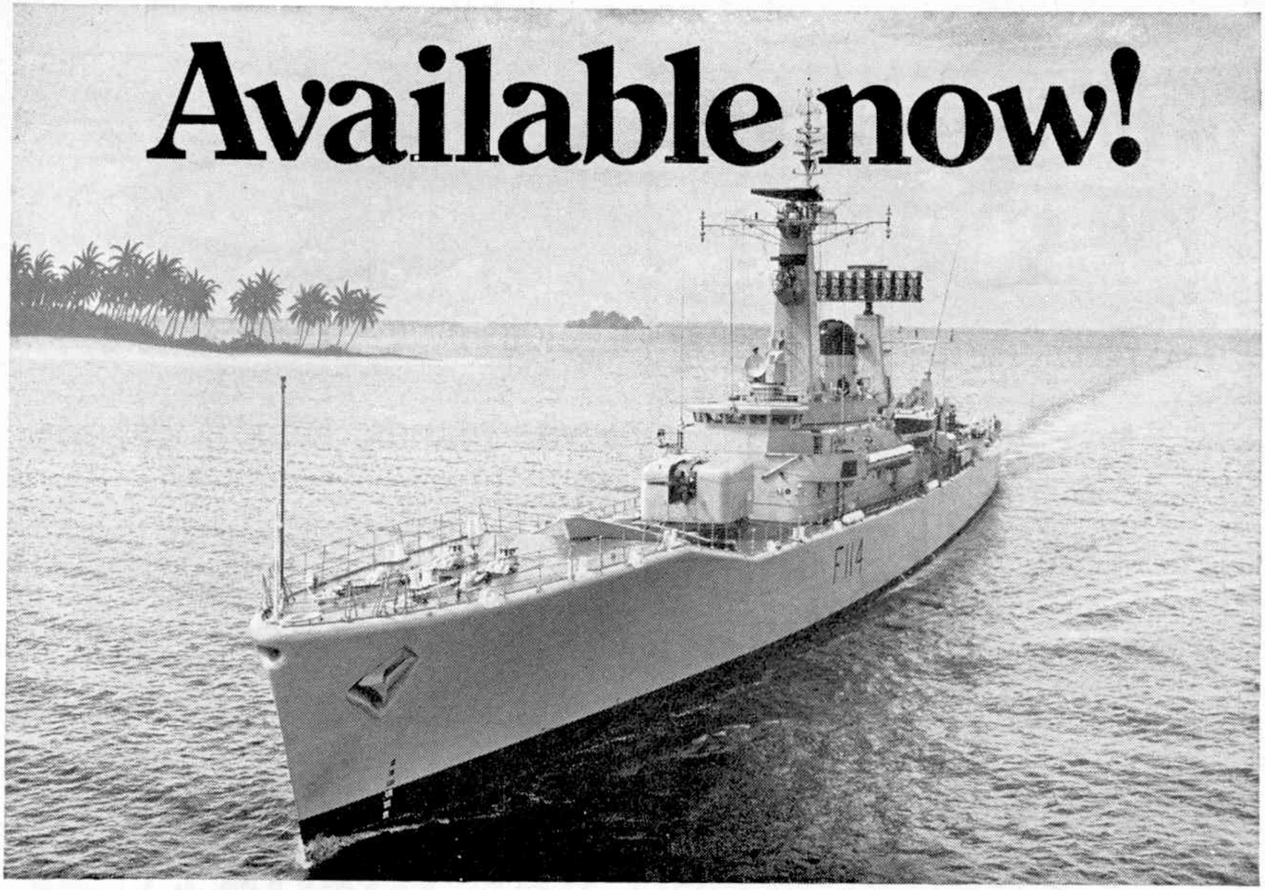

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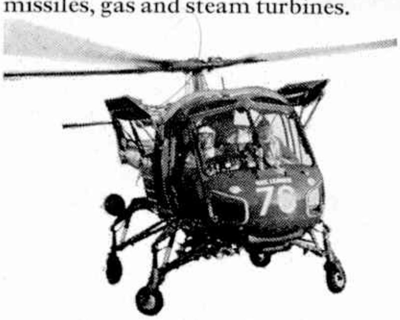

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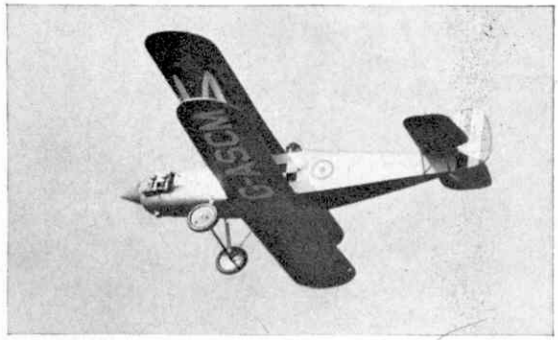

Scale planes, cabs & camels

More data on the Sopwith Survivors with colour information on the Camel. The famous 'Checker' Cab, drawn as a companion to the London Taxi in March issue. More new kits reviewed, with revelations from the recent Trade Shows and another survey of useful reference books. Miniature figure feature and special article on cast figure modifications. Plus a fine intro to the flying scale model.

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ON THE EDITOR'S DESK

Keen Modeller

It's always nice to hear from our readers, especially the younger ones, and last week I received a long letter from 11-year-old David Widdup who lives in Bewdly, Worcester.

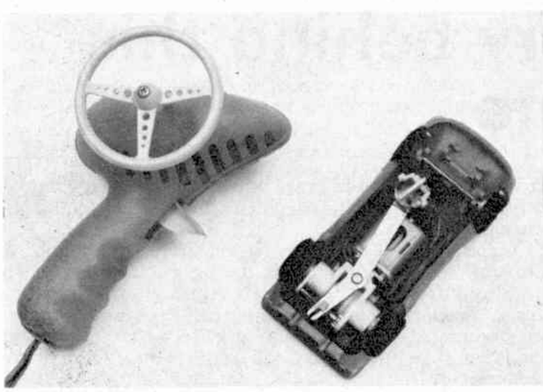
David who is a very keen Meccano modeller, is also a member of our "Radio 4-2" club and is at present busily constructing the model boat Corker between Meccano models.

A few weeks ago the local newspaper visited David's school whilst he and his friends were constructing a model with Meccano and took the photograph reproduced below. David is in the middle, to the left of the girl with the long hair.

Thanks for the photograph and letter David, and good luck with your modelling !

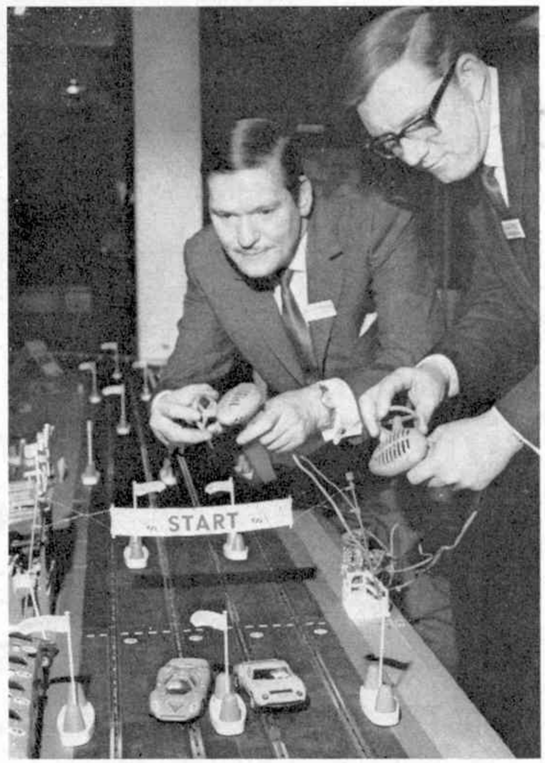
New from Scalextric

Not released yet, but well on the way is a brand new slot car development from Scalextric. Entitled "You-Steer", this system puts directional control right in the hands of the driver. A small steering wheel is fitted to the side of what otherwise is a conventional hand controller, and turning it moves the car racing around the track from side to side, negotiating various obstacles included in the outfit. Sets for converting existing "ordinary" Scalextric layouts and the special cars will of course be available when "You-Steer" is launched.



The secret of the new Scalextric system lies in the controller and the car. When turned, the steering wheel moves the car guide arm to one side causing it to "steer." The photograph opposite taken at the recent Tri-ang Toy Fair shows how the cars can manoeuvre.

I had the opportunity to have a go at the system at the Triang Toy Fair a few weeks ago, and reckon it to be the greatest thing to have happened to slot car racing since its introduction. As soon as "You-Steer" is released we will give readers a breakdown on it in a special one-page feature, meanwhile, we'll have to wait !



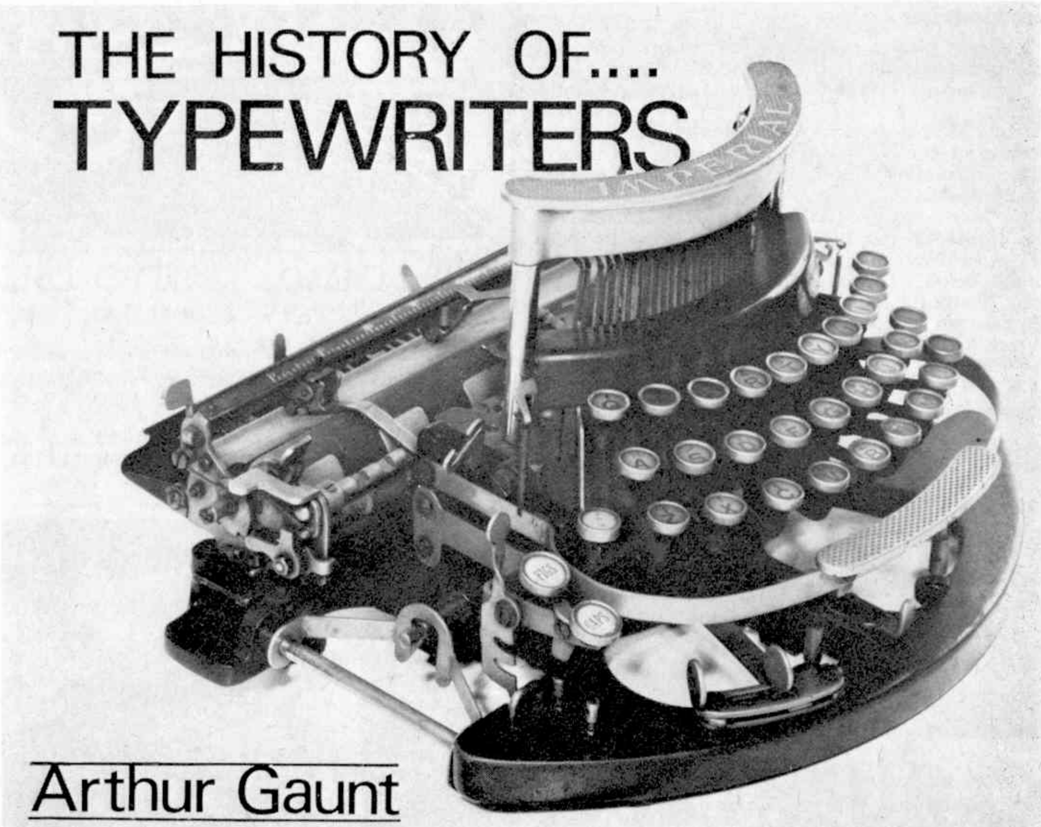
Mr. M. Hodder

A few days ago I heard the sad news of the death of Mr. Maurice C. Hodder who was leader of the Exeter Meccano Club for almost forty years.

Mr. Hodder started the Exeter Club in 1919, shortly after retiring from the First World War, and took an active interest in its development up through the 1960's.

I know that readers, and especially the older ones, will join me in offering my deepest sympathy to his widow and family.

THE HISTORY OF.... TYPEWRITERS



Arthur Gaunt

It is almost one hundred years since the first practical typewriter was produced and this feature outlines the history behind this invaluable machine.

APART FROM THE TELEPHONE, no invention has influenced office routine as much as the typewriter. Its development accelerated record-keeping and letter writing, hitherto carried out tediously by patient clerks who, like the immortal Bob Cratchett in Dickens' Christmas Carol, spent weary hours as "pen pushers" in dim-lit business premises and counting houses. Handwritten letters were in fact general until less than a century ago. Although a commercially useful typewriter was built in the U.S.A. as long ago as 1872, the mechanisation of office duties did not become popular until some misgivings were overcome. Clerks feared dismissal and there were threats of strike action if typewriters were widely introduced. Employers were unwilling to buy comparatively costly machines when transcribers could be engaged cheaply.

Indeed the typewriter story is an account of frustrations and difficulties dating back to the early 18th century. In 1714 Queen Anne granted a patent for a machine that could impress lettering on paper or parchment so neatly and precisely that the results could not be distinguished from print. Oddly, the designer of the contraption did not foresee it as an ordinary office appliance but as a means of preventing the forgery of legal documents and public records. He emphasised that the impressions were too deep to be erased and counterfeited without discovery. Another early idea for a typewriter was to establish a machine which would produce raised characters that blind people could read. Neither of these two inventions was successful commercially, and the same fate befell a number of other attempts to market weird and wonderful typewriting machines.

America's first typewriter patent was granted in 1829 to William Burt, of Detroit. His was a table model rather like a present-day pin table for gaming. Again a novel machine failed to earn acclaim and never went into production. The only picture of Burt's "typographer," as he called it, is in the patent files of the U.S.A. A further abortive effort to build a marketable typewriter was made by Charles Thurber, of Worcester, Mass., in 1843. Although it was never built in numbers, it did incorporate one feature (the roller platen) familiar on typewriters today.

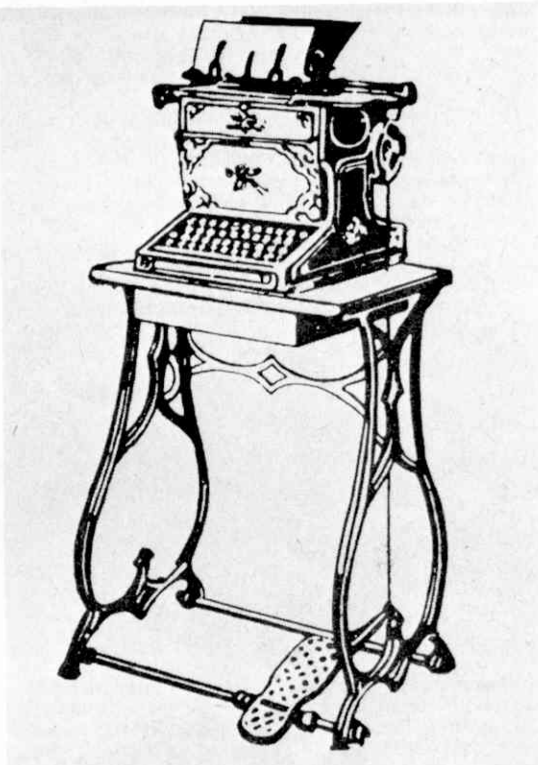
The break-through in producing and selling typewriters for office use occurred in the early 1870's when a Wisconsin editor, printer, inventor, and student of politics, Christopher Latham Sholes, made such a machine and was supported by two friends to improve and refine it before putting it on sale. They realised that to make the machine commercially successful they needed a manufacturing firm able to produce small, intricate, and accurate parts in considerable quantities. The pioneers' quest ended when they approached the already well-known firm of E. Remington and Sons, in the Mohawk Valley, New York. From being gunmakers during the Civil War this concern had turned to manufacturing agricultural implements and sewing machines. The influence of the last-named was plainly evident in the first typewriter model built by them.

This original Remington went into production in 1873, and was on a stand much like that of a sewing machine. Also like them it had a pedal—in this instance for returning the carriage after the end of each line. One thorny problem was the arrangement of the letters on the keyboard. The first suggestion was to have them in strict alphabetical order. But fuller consideration vetoed the plan. With the regular A-Z set-up, the letters most often used were not the most accessible. Also the type bars often collided. Experiments with other arrangements produced the one used today. Only the punctuation marks and little-used characters such as fractions have since been redistributed.

A few other manufacturers have attempted to introduce a different arrangement, but sales have been hindered because typists were accustomed to the original placement of the characters. "Touch typing," used by thousands of typists today, demands uniformity no matter what make or model of typewriter is used. But in other directions typewriter manufacturers have exercised a good deal of variety.

In 1903 a Spanish-American enthusiast named Moya set out to popularise typewriting at a low price. His first model was marketed at five guineas. He was also able to develop a good market overseas, one of the Moya machines' advantages being the ease with which they could be adapted to different languages. The letters were on a type sleeve which could be easily changed. Nevertheless there was some opposition to typewritten correspondence in high quarters as well as among business concerns. Queen Victoria refused to read anything typed by a machine, although typing was introduced into the Buckingham Palace business offices before she died.

One of the regular users of an early typewriter was the American humorist and novelist Mark Twain. He produced the first book-length script to be typewritten,

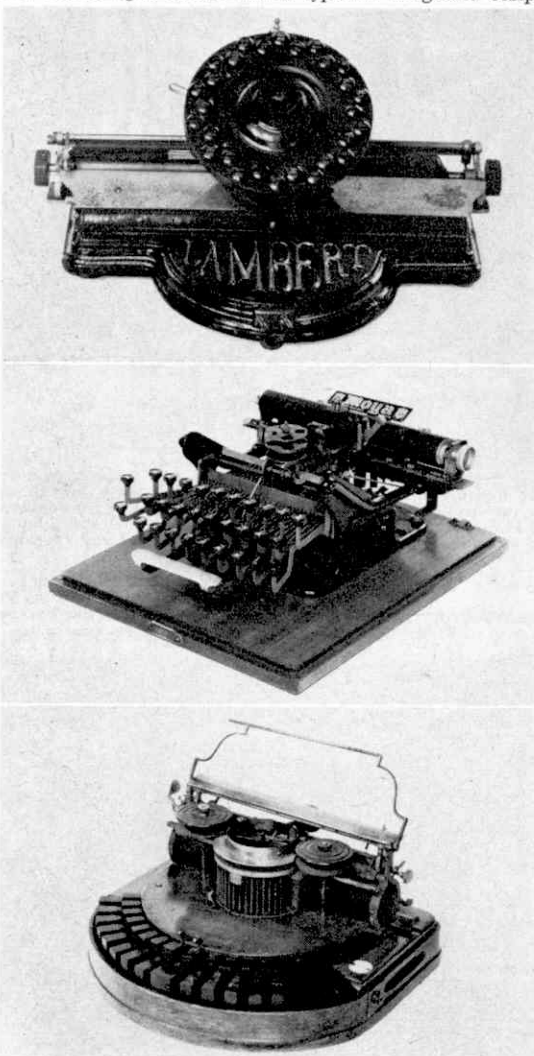


The first practical typewriter for office use. It was built by the Remington firm, and its design was plainly influenced by the sewing machine already being produced by the concern in 1873. Notice the pedal, a feature increasing the resemblance to a sewing machine. Foot pressure returned the carriage at the end of each line typed.

Embellishing typewriters with floral designs was one means of making the machine acceptable to office workers.

"Life on the Mississippi," and also typed most of his correspondence. The snag was that recipients of his letters wrote back for details of his machine. The time he saved by using a typewriter was swallowed up by answering queries of that kind !

During the last 100 years or so many devices and improvements have been introduced. One strange idea was to substitute the conventional finger-tip keys with some resembling piano keys. The Hammond typewriter, marketed in 1884, had the keys in an arc at the front, instead of being in banks or tiers as today. As in the Moya, the machine could be easily adapted to give a large range of type faces and alphabetic systems. Some Hammond examples are still in regular use, including a model which types in longhand script



Top: One of the most ingenious typewriters was the Lambert of 1896. It sold fairly well, and in addition to being made in the U.S.A., it was also manufactured in France and Germany. Centre: The first Moya typewriter was developed in 1903, at Leicester, and pioneered the present extensive typewriter industry there. The machine was priced at five guineas. Lower: The Hammond "Ideal," introduced in 1884, had a semi-circular keyboard originally, but later models were fitted with the "Universal" layout.

and gives a less formal look to private correspondence.

America dominated the typewriter market until 1889, which saw the introduction of the first model in all essentials to be regarded as British. This was the Maskelyne and it incorporated a number of advancements. They included a shift mechanism which could be operated by hand or foot at the discretion of the buyer. It was a visible writer, the typescript being in view as the user typed. Early models of other firms required the roller to be lifted to see the results. But the most remarkable feature of the Maskelyne was its differential spacing. It enabled each character to occupy a space appropriate to its width, as in printing.

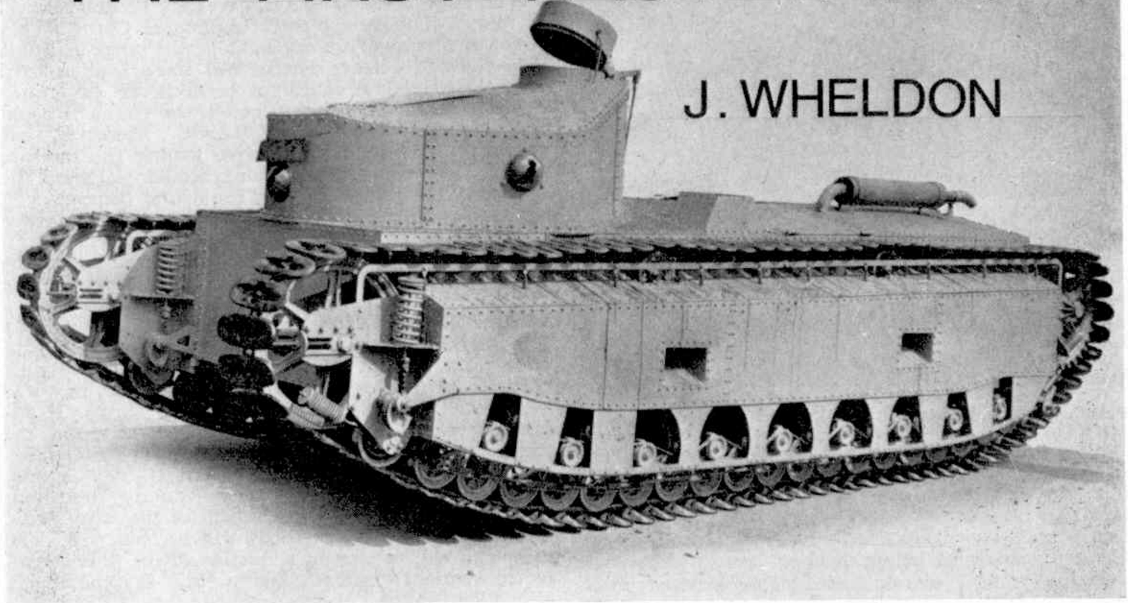
The noiseless typewriter made its commercial debut in 1917, after several years' research and experiments. The noisy action of other machines was overcome by making the merest tap on the keyboard send the type-bar forward. A precisely calculated weight then completed the split-second action by quietly pressing the type against the paper. The same principle is used today, and tests have shown that a noise reduction of only 15 per cent in a busy typewriting office cuts typing errors by half.

In recent years a wide range of typewriters for special purposes have come into operation. One model is fitted with a Braille scale to help a sightless typist in producing normally spaced letters. Another innovation is a typewriter which produces master sheets for spirit duplicators and obviates the handling of hectograph carbon peper. In this scientific era there are models built specially for scientists. Instead of the usual alphabetical characters, these machines are fitted with science symbol type. In other fields, the greatest change in recent years has been the ever-increasing demand for portable typewriters. They are used not only for home use, but also serve as standbys in large offices. One leading British typewriter manufacturing concern now produces more portable models than standard ones.

Altogether about 1,400 separate parts are needed in building a portable typewriter. A standard model requires 1,000 more. Robot-typers are used to test new machines. Operating 24 hours a day at a speed of 110 words a minute, they bring every mechanical movement through exhaustive trials. After each test period, a close examination for wear and distortion is carried out. British-built typewriters now go to more than 100 countries, and to deal with some of these markets entails more than changing the type faces to foreign alphabets. Thus typewriters for Arab countries require the roller carriage to travel from left to right instead of from right to left. Bringing the typewriter's history bang up to date is the application of such machines to electronic computers. In order to produce the results in an easily readable form, electric typewriters are fitted as an integral part of the big computing machines used by industry and commerce.

Since its "sewing machine" ancestor appeared nearly a century ago, the typewriter has become an indispensable instrument of commerce and industry. World trade, requiring quickly produced and easily read records of transactions, and needing a means of speeding-up correspondence, could not function effectively without the "typographer", as it was once called. Collections of early or otherwise noteworthy typewriters can now be seen in a number of places. Some manufacturers present displays of early models, and local museums exhibit them. Probably the most absorbing collection is at the Science Museum, South Kensington, London, where the development of "mechanised writing" is demonstrated.

THE FIRST FAST TANK



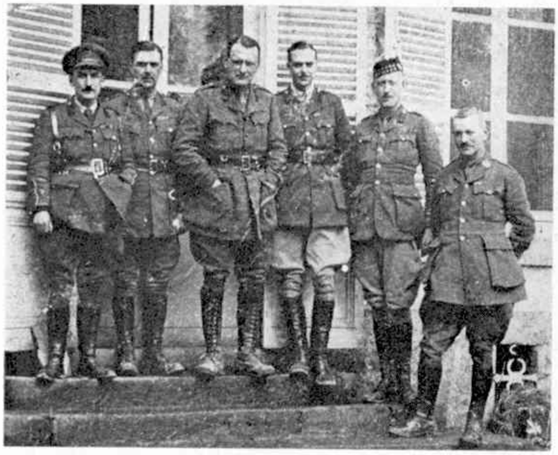
J. WHELDON

THE CHIEFTAIN is the main battle tank of the British Army today. It is a powerful machine, and if you sit inside it, you can sense this. The electronic communications and navigation equipment makes the turret interior resemble a space capsule, but there is also something no space vehicle can carry; a cannon which can score first-time hits on targets at the very limits of vision.

Colonel (later Major-General) J. F. C. Fuller.

But when the 50 tons of Chieftain are set in motion, the tank seems very sedate by modern standards; rather less than 30 m.p.h. on level going is all that it can manage. So although the Chieftain shows immense progress over the primitive machines of World War One in protection, communications and gunnery, it shows none at all in the sphere of basic power of movement.

How is this? Surely, the tanks of World War One were really very slow? Well, of those actually in combat service, the fastest was the British 'Whippet', which could do all of 8 m.p.h. on smooth level going, but it is a little known fact that the British Tank Corps was doing secret research on a high-speed tank as early as 1917, and by 1918 they had ordered its construction with a view to using it in a highly secret special operation in 1919, aimed at ending the war with one stroke. This tank, the 'Medium D', was to have a maximum speed of 20 m.p.h. plus a circuit of action of more than 200 miles—an immense step forward from the types of tank then in use. The step was possible because the Tank Corps fighting in France had set up a research department, in touch with all new developments, and quick to provide practical answer to the tank troops' problems. This was "No. 3 Advanced Workshops" under Major Philip Johnson, who combined engineering skill with tank combat experience. His department soon produced devices for "unditching" tanks, and for helping them across extra-wide trenches. By early 1917 Major Johnson was undertaking research in spring-suspension design, with a view to speeding the tanks up. This work started as a protective measure, the slow unsprung tanks were easy targets, and their parts wore out quickly, but the possibility of higher speeds and extended circuit of action was in full accord with Tank Corps policy, which, under General Hugh Elles and Colonel J. F. C. Fuller (his chief 'planner') aimed at thorough penetration of the German defence system with a view to operating against it from the rear—and



Principal figures (left to right): Col. Fuller (Chief of Planning), Major Uzzielli (Q), General Elles (Head of Tank Corps, France).

so speeding its collapse. The possibility of realising this aim with the original type of tank seemed to be receding. A new type was wanted—for the decisive battles of 1919! Tank Corps H.Q. could not rely on Germany collapsing before then.

By early 1918 Johnson had designed a new type of spring suspension, suitable for a tank of about 15 tons, and a new type of track which would run swiftly over the ground without collecting mud and without wearing out quickly. He wrote about this in a memo to his superiors dated 29th March, 1918, mentioning speeds of about 15 m.p.h. His proposals were discussed with Fuller, and a Tank Corps Staff conference was called for a month ahead. In the interval, Johnson was to perfect his engineering proposals, and Fuller was to devise an offensive scheme which would utilise a really fast tank to the best advantage.

The importance of this can scarcely be exaggerated. It was as if today the Royal Armoured Corps should seriously discuss a 100 m.p.h., 200 mile range machine. The German defence system was some 7 miles deep in early 1918, and could not be decisively penetrated by slow tanks and infantry before the Germans could reinforce the point under attack. Moreover, the German anti-tank defences were getting the measure of the slow tank. If fast tanks could penetrate the system with air support, they could find themselves in virtually undefended territory—for there was no answer to an armoured fire-platform moving freely at 20 m.p.h. across country. Before resistance could be organised, the fast tank would have destroyed the organisation. Fuller saw this clearly, and wrote a scheme, which he later called "Plan 1919", whereby the British Army could paralyse the Germans with one stroke instead of fighting prolonged "killing" battles. As the territory behind the defence lines was (on both sides) considered safe, so Army Headquarters were sited only about 20 miles from the trenches. A force of fast tanks could visit the German Army Headquarters before breakfast—the German rearward organisation would be utterly destroyed. Fuller said "The H.Q. is the will of the army body. Destroy the will and the body will be paralysed. The campaign will be won in a fraction of the time needed by conventional methods and we can say the enemy will collapse almost at once from Strategical Paralysis."

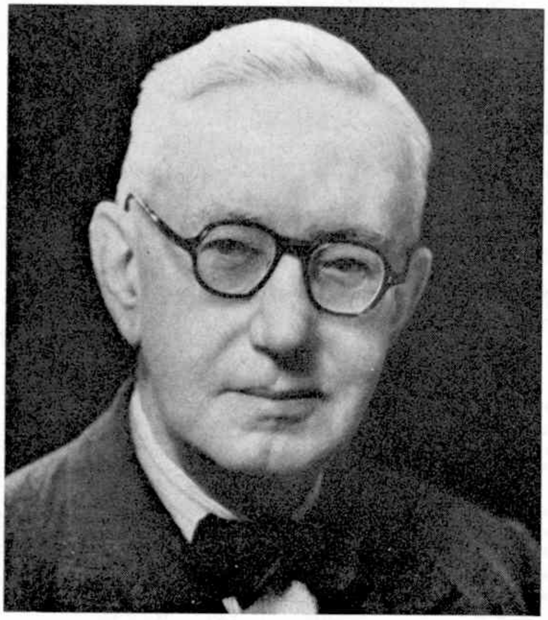
This idea, based on Johnson's concrete proposals, was upheld at the Tank Corps H.Q. Conference on 29th May 1918. War Office approval of Johnson's tank specification was secretly obtained, and the engineer went to England to get a prototype built. For security reasons the title "High Speed Destroyer Tank" was dropped, and it became known simply as the "Medium D".

But Germany collapsed through physical exhaustion before Johnson's tank was completed, and the daring principle of Plan 1919 remained as yet untested.

* * *

The war over, Johnson's secret work became the "Department of Tank Design and Experiment", under the Master General of Ordnance. The tempo of work slowed down, and the first of 3 prototype 'D's' was not demonstrated until 29th May 1919—a year and a day after the decisive Tank Corps conference.

It was a peculiar machine. It was long, so that it could cross trench systems. It was low in front, to give the crew vision, but high at the rear so that it could climb obstacles in reverse. The turret did not revolve, and as the main armament was in front, the driver was perched in a cupola at the turret rear! The 240 b.h.p. aero engine gave an ample reserve of power and was in a separate compartment behind the fighting chamber. 28 m.p.h. was attained on a slight downgrade, and 17 m.p.h. was held on a long climb that would have brought the earlier tanks down to 2 m.p.h. It had a range of action of 200 miles. The tracks were of an open type, did not collect mud, did not wear out quickly, and could adapt laterally to irregularities, and thanks to its spring suspension, the tank could pass at full speed over a railway sleeper without any shock being felt inside. The epicyclic transmission gears gave agile and reliable steering, and servo assistance reduced driver fatigue. It was in most respects an exceedingly advanced machine for its period, and it was soon made mechanically reliable. But it had two serious defects, and these proved fatal.



Colonel Philip Johnson (ret), designer of the world's first high-speed fighting tank.

The first was the spring gear. This was very simple. A wire cable was stretched along each side of the tank, being anchored to a powerful coil spring at one end, and rigidly at the other. Each bogie unit had a pulley on top, which bore up against the cable. Between the bogies, pulleys were fixed to the hull, preventing the cable from rising freely. When the tank passed over an obstacle, each bogie in turn pushed the cable up between the fixed pulleys, thus tensioning the spring. This system gave a soft, undulating ride and a man could rock the tank by heaving down on its nose. But the cable's life was very short—and as soon as it broke, the suspension collapsed and the tank was immobilised! It would have served Plan 1919 adequately, but it was no use for general service. The second defect was the fixed turret, which caused duplication of weapons and crew and delayed target engagement. Again, this was acceptable for Plan 1919 —but not for post-war development.

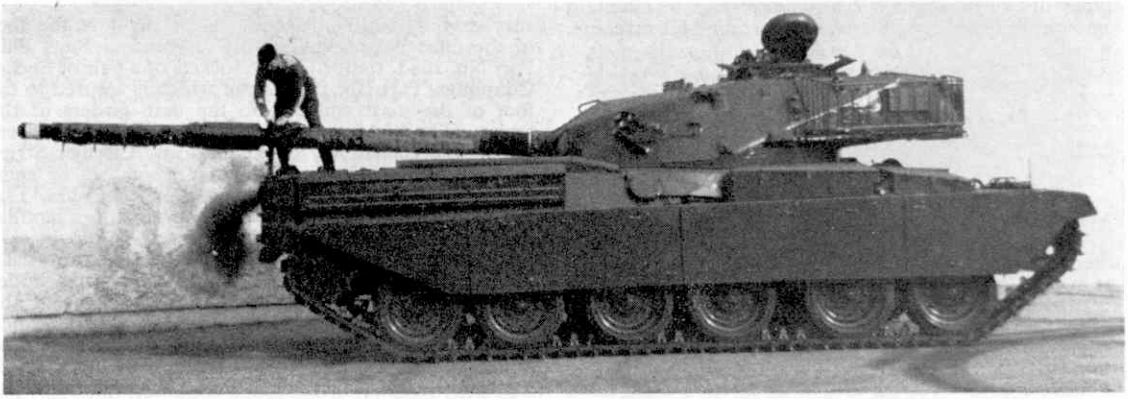
These defects were of course curable, but Johnson was a stubborn man. His relations with the Master General of Ordnance's office became very poor, and he got a little out of touch with the Tank Corps. He was devoted to Fuller, and attempted to serve the latter's ultra-modern theories of mechanised warfare by designing a whole range of cross-country fighting and transport vehicles, and making them, as well as the 'D' tanks, float. We are familiar with amphibious vehicles and Armoured Personnel Carriers and Self Propelled Guns today, but in the early 'twenties they were wildly new, and alas, Fuller and Johnson came to be regarded as cranks. Especially as Johnson stuck to his cable springing, which kept on breaking. The inevitable happened. Opposition to the 'D' grew, General Elles turned against it, and would not have it rated as a service machine. The building contract was cut to 20, and all these were designated "experimental". Meanwhile, General Birch, the Master General of Ordnance, secretly had a much less imaginative tank designed, which nominally was capable of the D's speed and range, and this he contracted with Messrs. Vickers to have built. Then came the showdown. With the Tank Corps getting rid of its obsolete old wartime tanks, and with only 20 'D's', all branded experimental, what was the Army to fight with? It was useless for Johnson to indicate the foundations he was building for a fully mechanised army, way ahead of any other nation's. General Birch pointed out that general mechanisation was not wanted by the General Staff; meanwhile the Vickers tank had a revolving turret and a reliable spring suspension. General Elles approved it, and in slightly modified form it went into production. Very soon, Johnson's experiments were declared redundant, and his department was closed in 1923. All work on the D machines stopped the next year.

Medium D (Third Prototype) on flotation tests at Christchurch.

The Tank Corps had the Vickers Medium from 1921 until World War Two. It was fairly reliable, but it was underpowered, bumpy, fatiguing to the crew, of inferior layout (the petrol tank was beside the main exit) and incapable of being developed. It was soon overtaken by foreign designs, and by World War Two Britain was a back number in armoured vehicle development. Had the 'D', with its many advanced features been supported by Elles and the M.G.O., one feels that its defects would have proved quite curable; and Britain could have possessed an unrivalled range of cross country combat vehicles. Perhaps personal quarrels and ambitions did our nation a great disservice in this respect, in the early 'twenties.

For Fuller's theories of armoured warfare, and Johnson's vision of a full-range of cross-country AFVs, were taken up and elaborated in Germany, and fully vindicated in the early years of World War Two. Had Britain possessed an adequate armoured force, the German Blitzkrieg might have been stopped in early flow, or better still—Britain might have been first to use the Blitzkrieg.

The 'Chieftan' tank. Note the superficial similarities to the Medium 'D'.



MECCANO CONSTRUCTORS GUIDE

Part 5: Rotating Superstructures by Bert Love

BROADLY SPEAKING, rotating superstructures can be placed into one of three categories as follows:

(1) Static balanced structures, such as gun turrets and roundabouts.
(2) Counterweighted structures, such as hammerhead cranes and,
(3) Pivotting structures which swing around a mast, such as tower cranes.

Swing bridges and locomotive turntables fall into the first category which is concerned with rotating structures which are more or less permanently balanced and are therefore fairly simple in design. A large roller path is provided in the form of a ring and a central pivot post is anchored to centralise the rotating structure. In many cases the stability of such turntables is provided purely by gravity from the sheer weight of the revolving mass. A classical case of this is illustrated in the scuttling of the German Grand Fleet in Scapa Flow, after the 1919 Armistice. When the great Battleships and Cruisers were salvaged they were found to be without their heavy guns. When the ships capsized and turned turtle, the gun barbettes simply fell out of their deep circular wells, where they simply rested on roller bearings, and plunged to the bottom of the ocean. Although the fairground roundabout is, generally speaking, a balanced rotating structure, many traditional types did pivot about a central mast and to maintain smooth running, a good fairman, in loading his machine, especially with heavy adults, would see that they were equally distributed round the 'ride'.

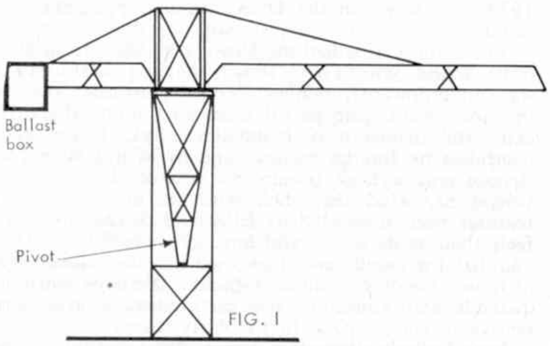
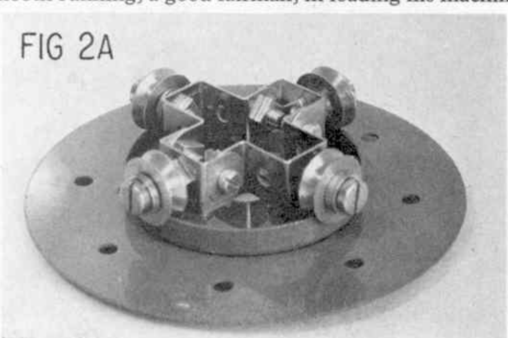


Diagram of a tower crane employing a rotating mast.



A miniature roller bearing used at the foot of a crane mast.

The two diagrams Fig. 1 and Fig 1a (not to scale) illustrate cranes that fall into the second two categories. In the first diagram we see the general outlines of a tower crane which represents those types which make use of a central mast for their rotation of the long boom. The tapered mast which runs down through the tower is pivotted in a fixed bearing, as shown, and this often takes the form of a phosphor bronze pad. It is important to realise that, in such a crane, the entire weight of the rotating structure is carried by the bearing at the foot of the mast and a roller ring situated at the break of the tower is a very light-duty affair which supports only the lateral, or sideways 'lean' of the crane when under load. This system has the advantage of being safe; requires no heavy components; can be made up from light-weight lattice components and absorbs both wind displacement and 'whipping' of the crane boom under awkward load conditions or jarring. The tilting moment from the load (or ballast box) is also transmitted to the foot of the mast so that the tower contributes to the general stability of the crane and must be designed and anchored accordingly.

After considerable wear, the phosphor bronze bearing is replaced by 'jacking up' the mast, the upper roller race being designed to allow its rollers to move vertically, and a new bearing inserted. This type of crane is very easy to build in Meccano, the pivot at the foot of the mast being provided by a Meccano Steel Ball, Part No. 168d, trapped in the sockets of a pair of Socket Couplings, Part No. 171, one of which is secured to the foot of the mast and one to the base girders of the tower. The upper roller race to take the lateral thrust can be made from any of the Meccano Circular Strips or Circular Flange Rings, against which six or eight Flanged wheels are set to roll round on the inside. Fig. 1a represents the heavy type of crane which is a familiar sight in ports and dockyards and is well known as a favourite type of modelling by the advanced enthusiast. This type of crane requires quite a massive roller bearing because of the sheer physical weight of the rotating superstructure plus the very heavy loads which these giants can handle. Even larger and heavier turntables are used by the World's largest Draglines which literally 'sit' on their own roller bearings and drag

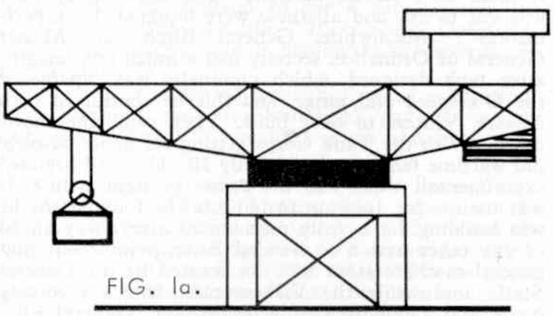
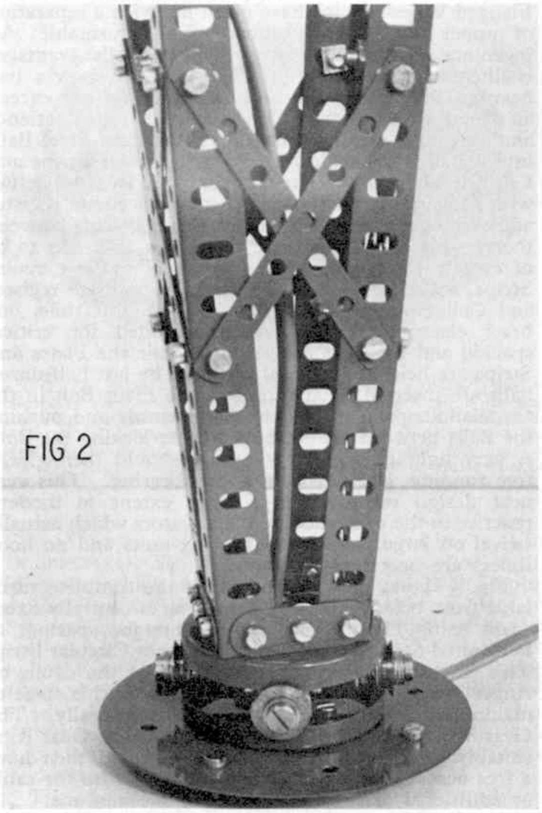


Diagram of a block-setting or hammerhead crane employing a heavy turntable and platform.

them across the face of the earth.

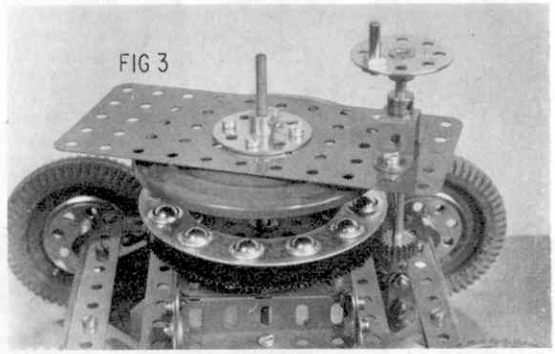
In considering the reproduction of the various turntables found in engineering practice, the Meccano Constructor must use his ingenuity to overcome problems within the limits of the parts at his disposal. Referring back to the tower crane, one problem which does arise is the supply of power to the cab controls when it is necessary to pass a cable up through the crane mast. Obviously a hollow pivot bearing is required and Fig. 2 shows how this can be done. One of the neatest and smallest thrust roller bearings which can be built in Meccano is shown in Fig. 2a which has the excellent advantage of being completely self-centring. The lower part of this bearing is a Wheel Flange, Part No. 137, bolted to a Circular Palte. As both of these parts have a substantial hole in the centre, a generous size of multicore cable can be passed right through the



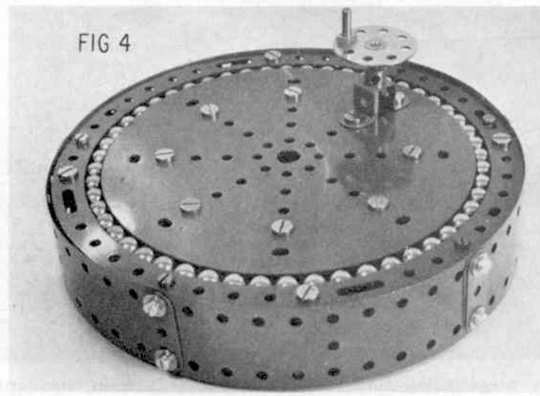
A hollow pedestal-bearing for the foot of a crane mast, through which a power cable is fed.

middle of this neat little roller bearing without impairing its efficiency. The foot of the crane mast is fixed to a second Wheel Flange by Angle Brackets, as shown, and the whole mast can then be rotated by a suitable drive at cab level, or by attaching a 3½ in. Gear Ring, Part No. 180, to the foot of the mast.

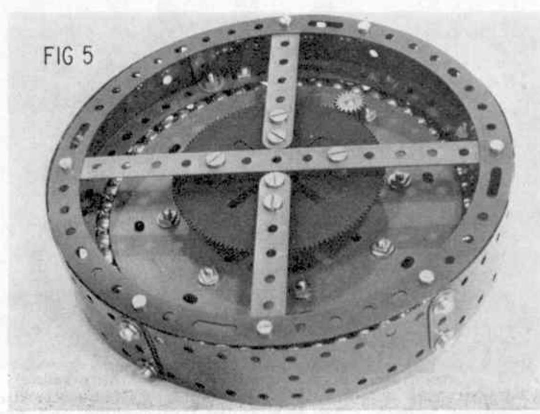
Moving up a little in size, we come to the purpose-made Ball Thrust Bearing, Part No. 168. This is a versatile component as its three parts can be used independently and Fig. 3 shows an exploded view of a built-up Ball Bearing on a model of a mobile crane. Only the top section and actual Ball-race of the bearing are used in this case, the lower flange being replaced by a 3½ in. Gear Wheel. The parts shown in Fig. 3 are separated for clarity but, in action, the top flanged would cover the Balls which, in turn, would ride on the flat surface of the large Gear Wheel. The hand wheel driving the slewing Pinion would be replaced by a mechanism inside the cab of the crane, of course. A Bearing of this nature must have an Axle Rod passing up through



An "exploded" view of a ball bearing for a model mobile crane. All three parts of the bearing are in contact when operating.

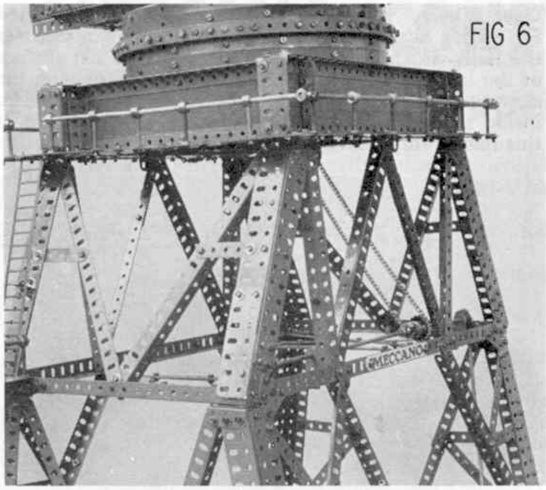


A built-up flush-level multi-ball turntable. Pivot Bolt construction ensures essential concentricity.



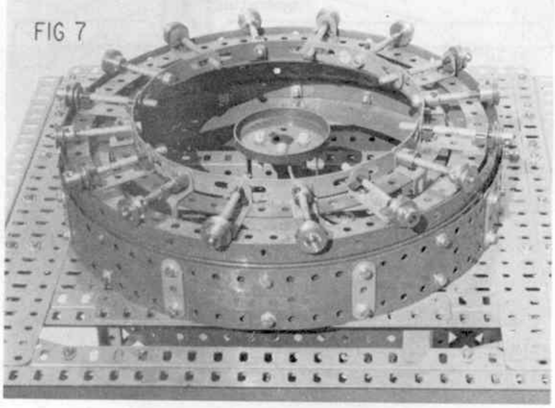
An underside view of the mechanism shown in Fig. 4 illustrating the location of the 3½ in. slewing gear.

FIG 6



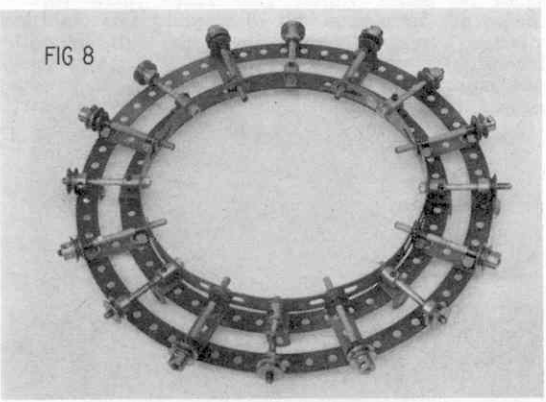
A good example of a tower design to support a heavy crane turntable.

FIG 7



A large heavy-duty roller bearing built from standard Meccano Parts. The centre Wheel Flange is used as a current collector.

FIG 8



A lightweight "hollow" centre spider with alternate "floating" rollers. All rollers are free-running and are located entirely by the centralising action of the large Flanged Rings.

its centre to centralise the whole bearing and a suitable locking device, such as Collars or Bush Wheels, must be added to prevent the bearing from lifting apart under load conditions. This can be quite a serious disadvantage to the model builder who takes his turntable design seriously and he would aim to fit ' hook rollers ' to his model, as is frequently done in full-size prototypes. Hook rollers are often fitted to excavators and similar machines which have a natural tendency to tilt when they are removing stubborn soils and rocks. The purpose of such rollers is to hook underneath the bottom of the turntable ring and to ' pick up ' the turntable bodily if the machine starts to tilt.

Many average-size turntables for models have been published in Meccano Magazine from time to time, utilising the $5\frac{1}{2}$ in. Circular parts as roller rings or flanges but few have employed hook rollers, if any, and many have been out of proportion due to the use of Flanged Wheels which have given too wide a separation of upper and lower portions of the turntable. An ingenious method of overcoming these disadvantages is illustrated in Fig. 4 and Fig. 5 which show a ball bearing, the essential features of which do not exceed an overall depth of $\frac{3}{8}$ in. Construction requires patience and care and the insertion of 52 Meccano Steel Balls into a Ball Race made from $7\frac{1}{2}$ in. Circular Strips and 6 in. Circular Plates. The two Plates are locked together with Pivot Bolts, as shown, to ensure accurate register and each one carries a Collar for critical spacing between the two Plates. Collars *must* be chosen with care to be of exactly the same length. In spacing the Circular Strips, Pivot Bolts are again used for accurate register and Collars are used for spacing, but, this time, one brass electrical Thin Washer is added for critical spacing and the Balls are inserted while the Plates and Strips are held in a vertical plane. The last half dozen balls are inserted by slacking off one Pivot Bolt in the Circular Strips at the top of the assembly and pushing the Balls between the Strips before re-locking the Bolt. A very light greasing (not oiling) should then give a free running, but not sloppy, ball bearing. This very neat design conforms to a large extent to modern practice in the construction of excavators which actually swivel on large, sealed ball bearing units and no hook rollers are necessary of course.

Fig. 5 shows the construction of the complete turntable from below. A $3\frac{1}{2}$ in. Gear ring is centrally fixed, again using Pivot Bolts and Collars for spacing, to Perforated Strips attached to the bottom Circular Strip. This, in turn, is secured to the wall of the drum by Angle Brackets and care must be taken at this stage to maintain the $3\frac{1}{2}$ in. Gear Wheel quite centrally. The Gear Wheel could be replaced with a $3\frac{1}{2}$ in. Gear Ring suitably attached, when the bearing would then have a free access hole right up through its centre for cable or additional drive shafts to upper mechanisms.

As the Meccano turntables get larger, substantial bases are required to support them and Fig. 6 shows an excellent type of structure for this purpose in which heavy-section built-up girders are put to good use in providing a strong platform for the turntable.

A typical basic construction for the larger roller bearing is shown in Fig. 7. Three $9\frac{1}{2}$ in. Flanged Rings are used, two of them forming supports for the drum wall, made of three layers of $5\frac{1}{2}$ in. $\times$ $1\frac{1}{2}$ in. Flexible Plates. These are stood off from the Rings by double washers and overlaid with $1\frac{1}{2}$ in. Perforated Strips. The Wheel flange mounted in the centre of the bearing is stood off by electrical Insulating Bushes to provide an electrical slip ring feed to the revolving superstructure. Fig. 8 shows how simply the ' spider ' is made. The outer ring is made of eight $4\frac{1}{2}$ in. Stepped

FIG 9

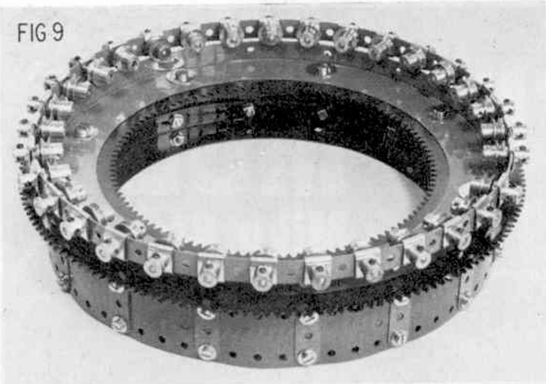
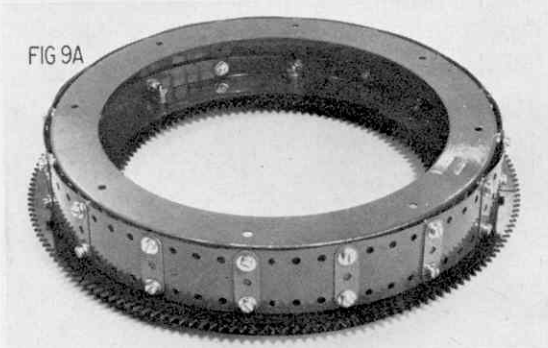


FIG 9A



Above: A roller race carrying 32 ½ in. "rollers" and a complete ring of Large-Toothed Quadrants. No Nuts and Bolts are required for the roller ring. Below: An underside view of the roller race appearing in Fig. 9 showing how the ring of Quadrants is sandwiched between the top pair of Flanged Rings and accurately located by Pivot Bolts spaced with Washers.

Curved Strips bolted at their joins to 1½ in. × ½ in. Double Angle Strips. These in turn are bolted to the inner ring which is a 7½ in. Circular Strip. Each Double Angle Strip carries a 2 in. Axle Rod held in place by Spring Clips to provide spindles for eight of the 16 'rollers'. Interwoven between each pair of fixed rollers is a 'floating' roller mounted in a Rod Socket attached to a Formed Slotted Strip held in Place by a ½ in. Reversed Angle Bracket which simply clips over the Circular Strip, but allows the 1½ in. Axle Rod to move up and down to allow for any unevenness in the rim of the Flanged Ring.

The choice of ½ in. Fixed Pulleys has three advantages. First of all, they prevent unsightly spacing of the roller rings. The bosses (though completely free to revolve and not secured in any way) give lateral stability to the 'rollers' and prevent any wobble, and, finally, the whole roller bearing is once again completely self-centring with all the advantages of plenty of central space to bring up wiring or other mechanisms to the superstructure. This bearing is very simple to build and works beautifully with a heavy block-setting crane. The more weight on this turntable, the better are its self-centring properties. Slewing is carried out by the simple expedient of a 1 in. Pulley fitted with a Rubber Ring which bears against the lower roller ring from the outside and is driven from a mechanism in the superstructure.

Finally, Figs. 9, 9a, 10 and 10a show a further development of the same roller bearing for the advanced constructor. Fig. 9 shows the 32 rollers employed and the way in which they are mounted. All of them are carried in Slide Pieces, Part No. 50 which does the dual job of holding the 1 in. Axle Rods forming spindles for the rollers and also of securing the lapped ends of the eight 5½ in. Perforated Strips which form the external roller ring. Each pair of 5½ in. Strips are lapped over three holes and locked simply by the jaws of the two Slide Pieces in that vicinity. The first and last 5½ in. Strips are tucked back into their own 'tails', the two final Slide Pieces having been slipped on previously.

Fig. 9a shows how the new Large-Toothed Quadrants are sandwiched between the two top 9½ in. Flanged Rings and located by Pivot Bolts spaced underneath with Collars. The upper 'deck' of the turntable is shown from below in Fig. 10a where it is seen to be perfectly symmetrical and is suitable for either of the last two turntables described. Fig. 10 shows the completed heavy-duty turntable fitted with an outrigger girder frame which carries the new 167c Pinion to mesh with the complete circle of Large Toothed Quadrants. Hook rollers may be mounted on this outrigger to engage below the toothed rack. With the Power Unit mounted as shown, set in the lowest ratio, one further stage of reduction via Bevel Gears, Part Nos. 30a and 30c, a nice scale speed of rotation is achieved with 6 volts which gives adequate power for a heavy crane. The Slide Piece method of construction is quite suitable for a lesser number of rollers or for internal mounting.

FIG 10

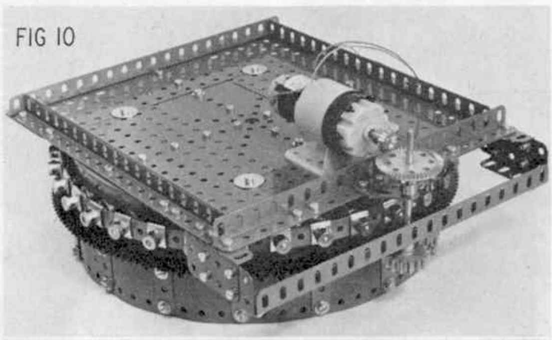
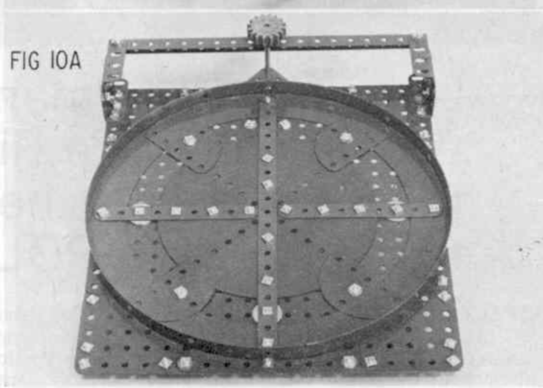


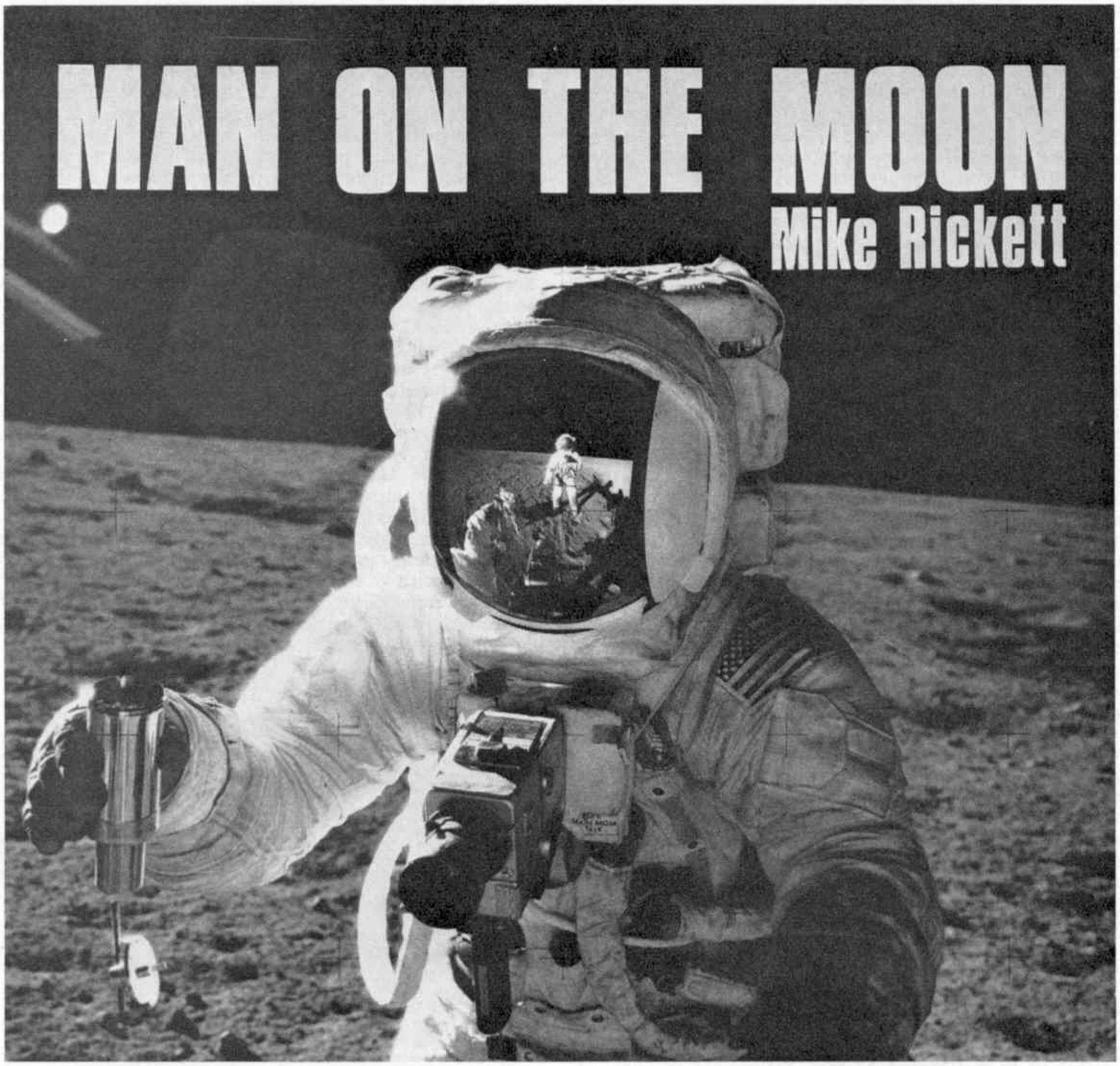
FIG 10A



Above: A heavy-duty crane turntable for the advanced modeller employing the latest Meccano components. Powerful slewing at scale speed is achieved with only six volts fed to the power unit. Below: The upper "deck" of the turntable suitable for either of the large turntables described in the text.

MAN ON THE MOON

Mike Rickett



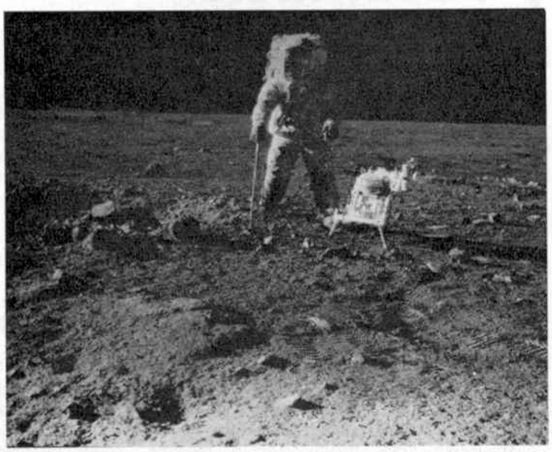
Late last year man at last set foot on the Moon. Mike Rickett describes what they saw, with the aid of photographs taken on the APOLLO 12 mission . . . . .

SPACE UNFORTUNATELY prevented us last month from including some of the most fantastic pictures we have ever seen, of America's Apollo missions to the Moon. We know readers would want to see these and we have therefore devoted an article specially to these remarkable pictures. All six were taken by the Lunar Module crew of the Apollo 12 mission during their period of extra-vehicular activity in the crater in which one of the earlier unmanned Surveyor craft landed in 1968.

Photograph A was taken during the second EVA and shows the Surveyor 111 spacecraft in the right foreground. The crater is part of the Ocean of Storms and the Lunar Module can be seen in the left background on the edge of the crater. Readers may remember that astronauts Charles Conrad—Commander—and Alan Bean—Lunar Module Pilot—descended to the crater shown here, while astronaut Richard F. Gordon Jr.—command module pilot—remained with the Command and Service Modules in lunar orbit.

Last month we discussed the suits worn by crewmen during periods of EVA and the heading photograph shows dramatically the helmet and face shield which reflects the other crewman taking the photograph. In his right hand is a container used for lunar soil and he is wearing on his left wrist a check list to help him follow a pre-planned pattern during the EVA. Photograph B shows a full-length picture of one of the astronauts with lunar hand tools and also shows clearly several footprints made by the two Apollo 12 crewmen during their EVA.

A: This view of Surveyor Cratar was taken by one of the two astronauts on Apollo 12 during their second extravehicular activity on 20 November 1969. This view shows the Surveyor 111 Spacecraft on the side of the crater.

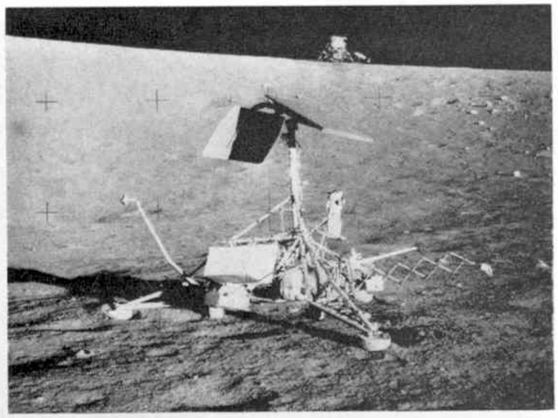


B: One of the Apollo 12 crewmen is photographed with tools and carrier for the Apollo Lunar Hand Tools (ALHT) during extravehicular activity on the surface of the Moon. Several footprints made by the two Apollo 12 crewmen during their EVA are seen in the foreground.

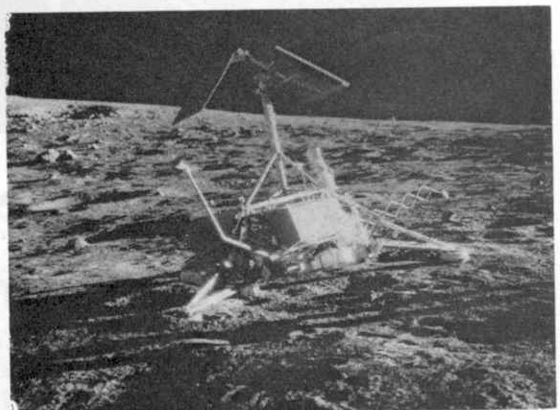
A really good picture of the Lunar Module with Surveyor 111 600 feet away in the foreground is shown in C. Remember, when you look at the picture, that the Surveyor craft is actually inside the crater and that the Lunar Module lies on the edge, just outside.

Photograph D gives a close-up view of the Surveyor 111 craft. Notice the harsh lighting on the Moon. The extreme blackness of the shadows and the blinding brilliance of the sun.

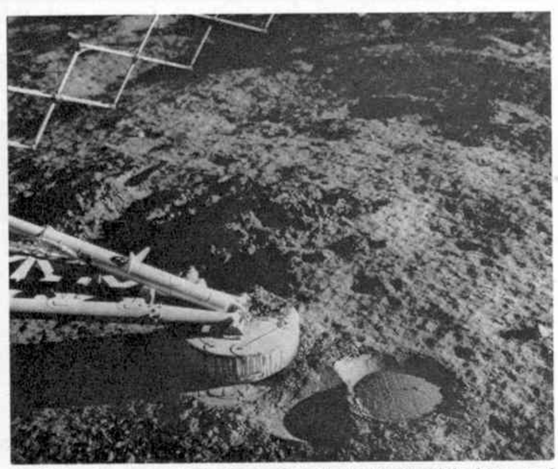
Finally, a close-up shot of one of Surveyor 111's legs, showing the imprint on the lunar soil, left when the craft bounced as it landed.



C: This unusual photograph, taken during the second Apollo 12 extravehicular activity (EVA-2), shows two U.S. spacecraft on the surface of the Moon. The Apollo Surveyor 111 spacecraft is in the foreground.



D: An excellent view of the unmanned Surveyor 111 spacecraft which was photographed dur ing the Apollo 12 second extravehicular activity (EVA-2) on the surface of the Moon. The Apollo 12 Lunar Module, with Astronauts Charles Conrad, Jr., and Alan L. Bean aboard, landed within 600 feet of Surveyor 111 in the Ocean of Storms



E: This close-up shot shows one of Surveyor 111's legs, and the 'bounce' imprint as it landed.

ON TWO WHEELS

This month we take a look at . . . .

A completely automatic moped from Italy

THERE ARE a growing number of people these days who prefer life to be as simple as possible. The less effort needed to achieve anything the better they like it. The sales of automatic washing machines and automatic cars during recent years has increased enormously, and helps to bear out this statement. It follows therefore that every year the number of people who buy automatic mopeds gradually increases, and your Editor for one is completely in favour with this one.

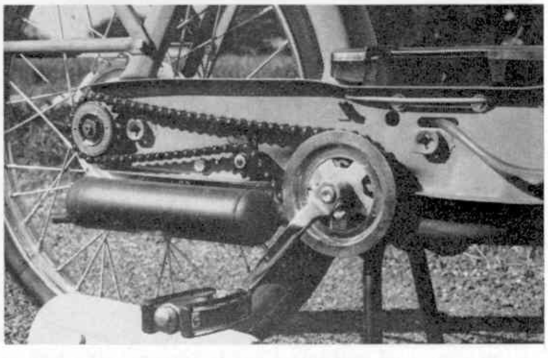
One of the troubles with very small engined mopeds fitted with gears, concerns the sheer lack of power that they have. Every slight gradient means a gearchange, and a longish ride can cause a very large number of gearchanges rapidly making a two wheeled rider doubtful about tackling anything other than a short spin.

The only answer of course is to "go automatic" and the Vespa Caio is a delightful example of "do as little as possible."

There are no gears to change, no clutch to operate, in fact riding this machine is as easy as riding a bicycle. (Even the choke is automatic.)

The Caio is a very simple, sturdy little machine with an engine capacity of 50ccs, very smooth and silent although a little on the uncomfortable side for journeys lasting over half-an-hour or so.

It looks very much like a bicycle, large narrow wheels, a cycle type seat and handlebars. Being automatic there are very little controls, and apart from a decompression lever (to stop the engine) the handlebars could have come straight from a bicycle. The left hand operates the rear brake, decompression lever and horn button, and the right hand the front brake and throttle. To start the machine, the rider simply rides off as per cycle practice, and at five miles per hour or near, the engine automatically engages, and on our test model started immediately. To increase speed involves simply opening the throttle, the single speed variable pitch gearing does the rest. It cruises quite happily at 25 m.p.h. and its top speed is in the region of 30 m.p.h. Lighting is direct from the engine and is simply on or off, just like a cycle in fact, although the lights are far brighter. Into the headlamp is recessed the speedometer and mileage recorder, both easy to read.



With the protective plastic cover removed the "bicycle" elements of the Caio are revealed.

The Engine

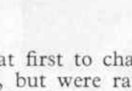
A 50ccs two stroke unit powers the Caio, and it is neatly tucked away underneath the bottom of the frame. Access to it via removable plastic panels is good and the engine itself caused us no trouble whatsoever. It started easily at all times, normally without use of the choke, unless the weather was very cold. Effective silencing makes the Caio extremely quiet even when running hard.

The Gearbox

We were tempted at first to change the title of this section of our report, but were rather lost as to what to rename it! The Caio has no gearbox, instead the gear ratio is changed by a centrifugally operated pair of plates which close as the engine revolutions rise, and force the "Vee" shaped driving belt to be forced outwards, this decreasing its ratio in relation to the rear driving pulley. Got it? What this means in effect is that, as the throttle is opened the machine's speed increases and the gear ratio changes with the result that the engine revolutions remain the same at all speeds. A centrifugal clutch takes care of starting and stopping without stalling the engine.

The Bodywork

Consisting mainly of pressed steel panels mounted on a simple framework, the Caio is a rather simple looking machine, although still attractive and modern in general design. The saddle is adjustable for height and a useful luggage carrier is provided as standard fitting. A small plastic removable tool compartment complete with handbook and tools is located under the rear of this carrier.

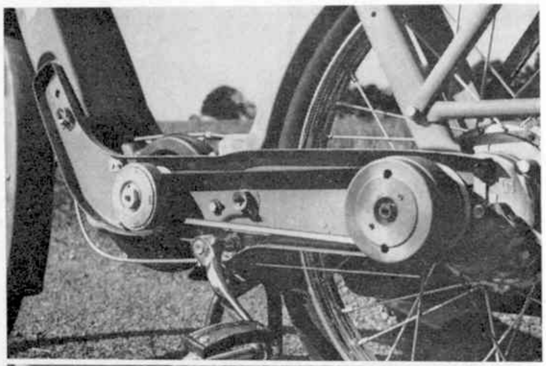


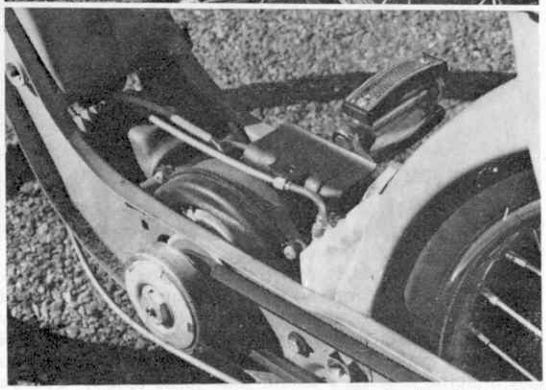
Summary

We found the Caio reliable, quiet and extremely simple to ride. The saddle was a little on the hard side. We felt that as the machine lacks rear suspension the seating should have been far softer by way of compensation. We liked the lighting which was capable of good illumination on dark roads, and the general finish and attention to details, showing that thought and care had gone into its design and construction.

FOR THE TECHNICALLY MINDED

Cubic Capacity:	**49.77 ccs**
Consumption (per gallon):	**180 miles**
Weight:	**85 lb.**
Tyres:	**2 × 19**
Lubrication:	**2% oil through petrol**
Common dimensions:	**Length 54 inches**
	Width 25 inches
	Height 41 inches
Available colours:	**Grey, Blue,**
	Red, Orange

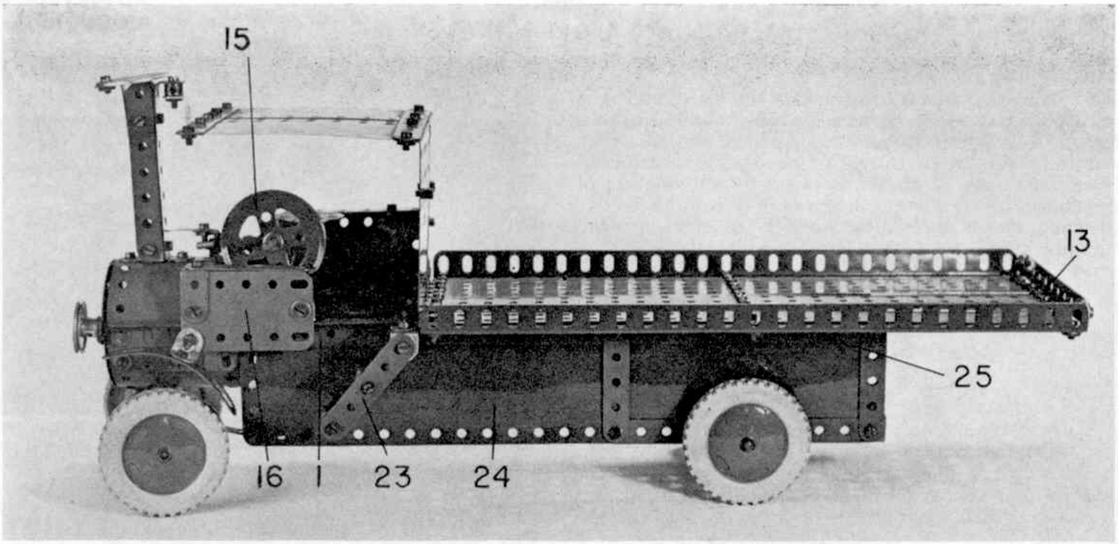




Top: This view, believe it or not, reveals the clutch and gearbox of this unusual machine! Transmission is of course from the engine to the rear wheel via a vee-belt.
Above: The engine unit is tucked neatly away at the centre of the machine.

The small rubber strips fitted onto the mudguard preventing cable from rubbing the paintwork were a touch we appreciated.

For the youngster wanting to get around with the minimum of trouble, and wanting a reliable machine at a reasonable price, the Caio is certainly worthy of serious consideration at approximately £70.

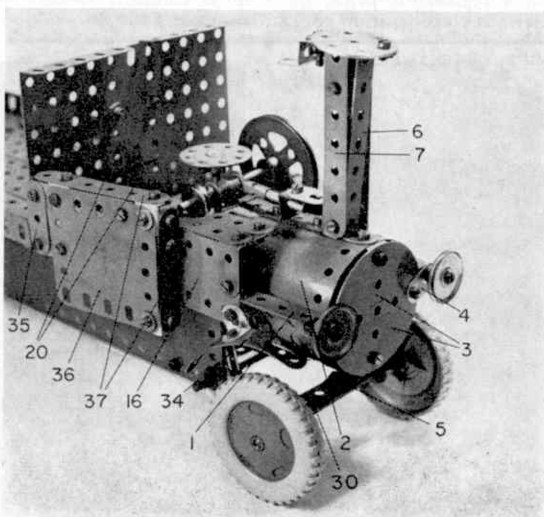


STEAM WAGON

From a No. 6 outfit described by 'Spanner'

THE HEYDAY of the steam wagon was in the first two decades of this century so that, although they were not exactly extinct in the late thirties, those still about had an ancient look about them, even then. You can imagine how they would look to us today! There's no need to imagine too hard, though, because the model featured here is based on a typical Steam Wagon of the period and it will give you a good idea of their highly distinctive appearance—old, but full of character. It is built from a No. 6 Meccano Set.

To get down to construction, the main strengtheners of the model are supplied by two 12½ in. Angle Girders 1, between the forward ends of which a 2½ × ½ in. Double Angle Strip is bolted, at the same time fixing



In this close-up view of the off-side front of the model, the cab roof has been removed to aid description.

the boiler in place. This last is built up from two 5½ × 2½ in. Flexible Plates 2, curved to shape and overlapped three holes at each end, the front consisting of two Semi-circular Plates 3, fixed to the above Double Angle Strip. Note that the Bolts fixing the Semi-Circular Plates in position also hold two Fishplates 4, to which two 1 in. Pulleys with boss are secured by ¾ in. Bolts to serve as headlamps.

The apexes of the Semi-circular Plates are attached to relevant Plate 2 by an Angle Bracket, the securing Bolt in the case of the lower Bracket fixing a ½ in. Reversed Angle Bracket 5 in position, and, in the case of the upper Bracket, fixing a 3½ × ½ in. Double Angle Strip 6 in position. This Double Angle Strip serves as part of the chimney, the remainder of which consists of two 3½ in. Strips 7 attached to another 3½ × ½ in. Double Angle Strip by two Double Brackets. The second Double Angle Strip is bolted to upper Plate 2, the securing Bolt helping to fix a 2½ in. Strip 8 to the Plate in such a position that it projects a distance of two holes past the rear edge of the Plate. The other Bolt fixing the Strip to the Plate also holds in place a Reversed Angle Bracket 9, the free lug of which is extended by a Fishplate, then a 6-hole Wheel Disc is bolted to the upper lug of Double Angle Strip 6 to cover the chimney.

At this stage it is best to complete the bed of the model to give rigidity to the construction so far completed. Bolted between Girders 1 in the positions shown are two 5½ in. Strips 10 the securing Bolts also fixing two 12½ in. Strips 11 between Strips 10. A further seven 12½ in. Strips, together with two 12½ in. Angle Girders 12, are bolted between the Strips to result in a long, flat bed edged by the Angle Girders. Another 5½ in. Strip is bolted between the rear ends of the 12½ in. Strips and Girders, a final 5½ in. Strip 13 being attached by Angle Brackets to the Girders to enclose the end of the bed.

Now secured to the rear end of Strip 8 is a 1½ × ½ in. Double Angle Strip, in the lugs of which a 3½ in. Rod is journalled, held in place by a ½ in. fixed Pulley 14 and a 2 in. Pulley 15, the latter representing the flywheel. Held by a Collar on the Rod, between the lugs of the Double Angle Strip, is a Rod and Strip Connector, in which a $1\frac{1}{2}$ in. Rod is held. This Rod projects through the centre hole of the Reversed Angle Bracket 9.

Attached by Angle Brackets to each Girder 1, as shown, is a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plate 16, to which a 1×1 in. Angle Bracket is bolted. Fixed in turn, to the free lug of this Angle Bracket is a $2\frac{1}{2}$ in. Strip 17, a $1\frac{1}{2}$ in. Strip being bolted, in addition to this, to the right-hand Angle Bracket.

The lower flanges of two $3\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plates 18, separated by a distance of one hole, are next overlayed by a $5\frac{1}{2}$ in. Strip 19, after which they are bolted to Angle Girders 1, immediately in front of forward Strip 10. The space between the Plates is enclosed by two $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates 20, overlapped three holes, while, bolted to Strip 19 are two Flat Trunnions and a $2\frac{1}{2}$ in. Strip 21, this Strip also being bolted to the left-hand Flat Trunnion. The Trunnions act as seats, whereas the Strip will later serve as one of the bearings for the steering column. The cab roof is completed by a $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate and two $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates 22, overlayed by two $5\frac{1}{2}$ in. Strips and bolted to the upper flanges of Plates 18. A $\frac{1}{2}$ in. Reversed Angle Bracket is used to connect the forward edge of the roof to the rear Double Angle Strip of the Chimney, the upper lug of the Bracket being spaced from the lug of the Double Angle Strip by a collar on the shank of the fixing $\frac{1}{2}$ in. Bolt.

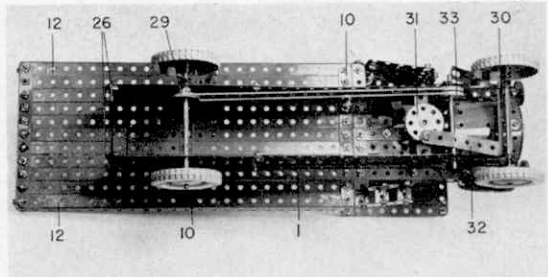
Access to the cab is by a ladder built up from two $2\frac{1}{2}$ in. Strips 23, joined by two Double Brackets and attached to the lower flange of left-hand Plate 18 by an Angle Bracket.

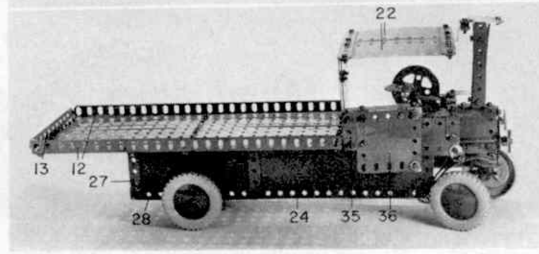
Next, a $12\frac{1}{2} \times 2\frac{1}{2}$ in. Strip Plate 24, overlayed by a $12\frac{1}{2}$ in. Strip 25, is bolted to the vertical flange of each Angle Girder 1 in such a way that it projects a distance of five holes beyond the end of the Girder. Two $2\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strips 26 are used to join the rear ends of the Plates at each side, the securing Bolts also fixing a $2\frac{1}{2}$ in. Strip 27 and a $5\frac{1}{2}$ in. Strip 28 to each Plate. The forward end of each Strip 28 is connected to Strip 25 by another $2\frac{1}{2}$ in. Strip, while, journalled in the centre holes of Strips 28 is a 5 in. Rod carrying a 1 in. fixed Pulley 29 and held in place by Road Wheels.

At the front of the model, a $2\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strip 30 is lock-nutted to the lower lug of the Reversed Angle Bracket 5. Held by Spring Clips in the lugs of this Double Angle Strip is a $4\frac{1}{2}$ in. Rod, on the ends of which two further Road Wheels are fixed. Another $2\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strip is mounted between Strip Plates 24 through their third holes from the front in the lower edge. Journalled in the centre hole in this Double Angle Strip and in the end hole of Strip 21 is a 4 in. Rod held in place by a Collar and an 8-hole Bush Wheel 31. A second similar Bush Wheel is mounted on the upper end of the Rod to serve as a steering wheel, after which a shaped $3\frac{1}{2}$ in. Strip 32 is lock-nutted beween Bush Wheel 31 and the left-hand end hole in Double Angle Strip 30.

Two 1 in. Pulleys without boss 33 are mounted, free, on a $3\frac{1}{2}$ in. Rod held by Spring Clips in the lower front corner holes of Strip Plates 24. A length of Cord is passed round one of the Pulleys 23, is taken up and over Pulley 14, brought down and around the other Pulley 23 then is taken along and around Pulley 29. The Cord is finally pulled taut and the ends tied together to form an "endless belt" which drives the flywheel shaft when the model is pushed along. Two front mudguards are each provided by a Formed Slotted Strip 34 which is attached by an Angle Bracket to one or other Flexible Plate 16.

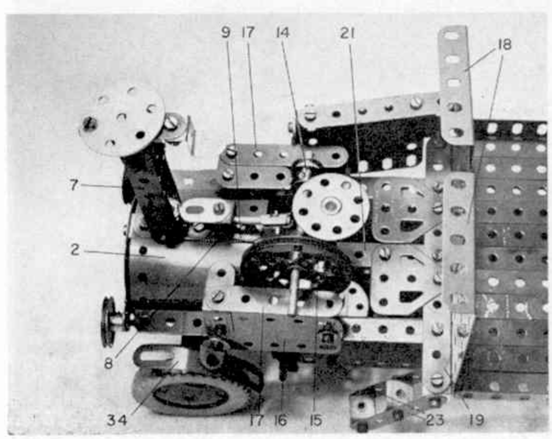
Last of all, two $2\frac{1}{2}$ in. Strips, connected by a $1\frac{1}{2}$ in. Strip 35 are attached by Angle Brackets, to off-side Flanged Plate 18. Bolted to the Strips is a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plate 36, to which, in turn, two further $2\frac{1}{2}$ in. Strips 37 are fixed, also by Angle Brackets, and the model is finished.





PARTS REQUIRED

11—1	1—15	134—37a	3—125
9—2	1—15a	128—37b	2—126a
1—3	4—16	16—38	4—187
1—4	1—18a	1—48	4—188
11—5	1—20a	6—48a	1—190
2—6a	3—22	2—48b	2—191
4—8	2—22a	2—53	2—192
3—10	1—23a	1—53a	1—194
4—11	2—24	4—59	2—197
16—12	1—24c	1—111	1—212
2—12a	4—35	2—111a	2—214
			2—215



An "aerial" view of the cab showing the steering wheel seats, flywheel and imitation valve gear.

THE STORY of SALT

T. HOLLOWAY

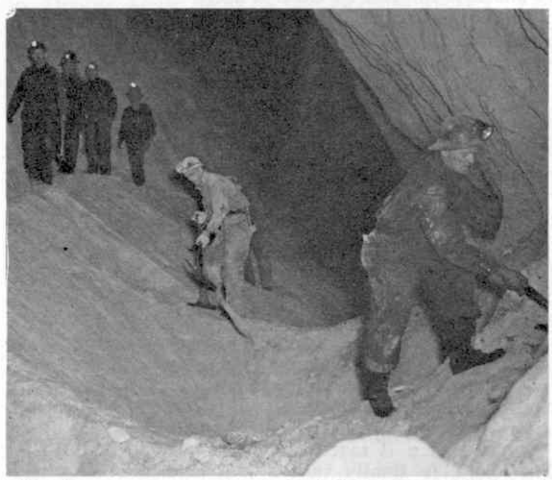
WITHOUT SALT, life on this earth would very soon become extinct. It is our most precious mineral, more precious by far than all the gold and silver in the world. It keeps us in health, it seasons and preserves our food, and is vital to the work of many industries.

If you study the story of man you will find that the first communities were founded in regions where salt was obtainable. Some of the oldest roads in the world were originally the salt tracks, stamped out by the feet of oxen and other beasts of burden, and ground by the wheels of wagons which made up the caravans of the early traders in salt. One of the oldest roads in the world today is the Via Salaria—the Salt Way—along which the Romans carried the salt of Ostia to places far inland. The early salt tracks across the Sahara are still used by salt caravans today. Animals, too, have their salt tracks, leading to the 'salt-licks' without which they could not survive. Primitive man soon learned of these salt-licks and it was there they ambushed the animals they needed for food. The master-plan behind the growth of the Roman Empire was based on the belief that "Who controls salt rules the world." The plan was to conquer the world's salt-producing countries in order to make all other countries submit to Roman rule. In other words—no surrender, no salt ! The word 'salary' comes from the Roman 'salarium' or 'salt money,' with which soldiers were paid. The inefficient soldier was said to be "not worth his salt"—an expression still used today to describe a lazy or incompetent person. In parts of Africa and Tibet, actual cakes of salt have been used in place of money.

Millions of years ago, large areas of sea became land-locked as a result of disturbances of the earth's crust. Over a long period of time these inland seas were gradually evaporated by the sun, leaving only a thick floor of salt. Later disturbances swallowed up most of these salt beds and they vanished underground. Many have been located lying hundreds of feet below the surface and in some cases as much as half a mile thick.

There are four main ways in which our supplies of salt can be obtained. The beds which were not swallowed up and are still at surface level can be worked

The scene after blasting operations at the Malagash mine, Nova Scotia, one of the largest mines in the Commonwealth. Miners are seen clearing a way through a mine passageway blocked by loose rock salt ore. *Photograph: National Film Board.*



This picture was taken hundreds of feet down the Malagash salt mines, Nova Scotia, and shows miners shovelling salt into a tunnel where a scraper will collect it for dumping. *Photograph: National Film Board.*

quite easily. Where the salt lies deep underground it can sometimes be mined in much the same way as coal, and is known as rock salt. In cases where the salt exists as liquid brine, it can be pumped up and the salt recovered by evaporating the water. The fourth method is very ingenious. Instead of going to the trouble and heavy expense of digging into the earth to reach the beds of solid salt, water is poured down easily-drilled bore-holes and allowed to saturate the salt and convert it into liquid brine. The brine is then pumped to the surface and the water driven off by artificial heat, leaving only salt. The largest deposits of rock salt in Britain are found in Cheshire, Worcester, Stafford and Durham. These deposits lie hundreds of feet underground in the form of extensive layers, or beds, 100 ft. thick or more.

Mountain climbing in Canada's salt mine, boating in an underground river about 400 feet below sea level and hiking through long milky white passages and caverns, are among the daily experiences of the workers of the village of Malagash. *Photograph: National Film Board.*

About three centuries ago, a certain John Jackson set out with pick and shovel to try and locate coal for the Lord of the Manor of Marbury, near Northwich, Cheshire. He didn't find coal but he *did* find rock salt, only about 100 ft. down. The news spread and resulted in a ' salt Klondyke.' Mining began furiously at several places without any regard to engineering principles. The pillars of rock salt they left to support the roof were not massive enough for the job. One by one they cracked under pressure, water seeped into the mines and speeded up the deterioration of the remaining pillars of rock salt, and the mines were adandoned. The Meadow Bank mine, at Winsford, Cheshire, operated by Imperial Chemical Industries' Mond Division, is the only working salt mine left in Britain today. The strata include two main beds of rock salt, each about 80 ft. thick, commencing at depths of 260 ft. and 400 ft. respectively.

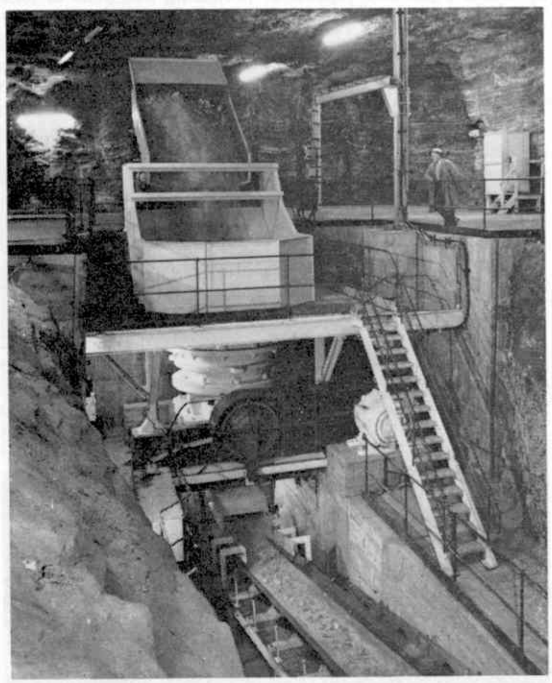
Mining operations are carried out in the lower bed of rock and only the bottom 20-25 ft. of this are worked. The mine consists of six vast inter-connected caverns extending over a total area of more than 130 acres. Overhead there are some 60 ft. of hard rock salt which forms a naturally strong roof, but extra support is given by leaving large pillars of rock salt during mining.

When the mine was first worked in the 19th century, blackpowder, picks and shovels were used to win the

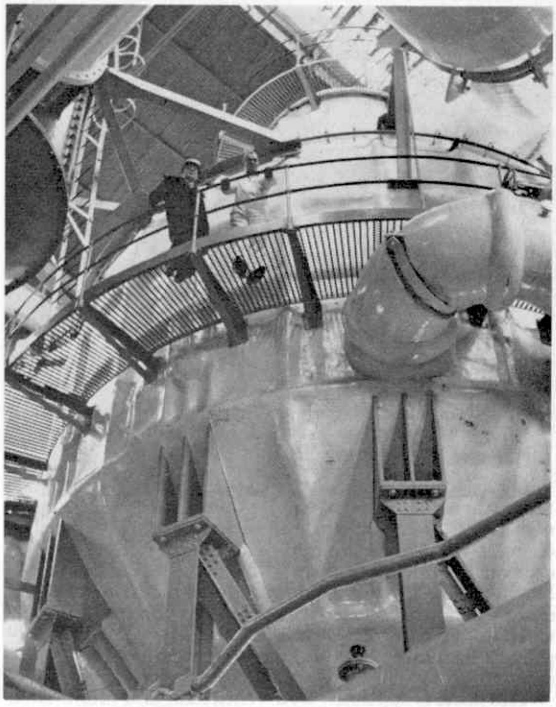
Loading rough rock salt at the working face. About 1,000 tons are blasted at each firing. *Photograph: I.C.I.*

salt, and tallow candles provided light underground. Since then, of course, many improvements have been made both in equipment and techniques. The first big changes were made in 1928 when electric lighting and electrically powered cutting machines were installed. During 1960 a major modernisation scheme trebled the mine's productive capacity, and today almost complete mechanisation is employed all the way from underground working faces to the despatch points on the surface.

The mine is spacious, well-ventilated, and illuminated by fluorescent strip lighting. Air temperature in the mine remains within a few degrees of 55 deg. F. all the



The diesel dumpers tip their loads of rock salt into this giant primary crusher which reduces it to a convenient size before being conveyed to the surface for further crushing. *Photograph: I.C.I.*



In Roman times buckets of brine were emptied into lead pans and boiled over wood fires, driving off water and leaving the salt. What a contrast is this gigantic evaporator heated by steam pipes and capable of producing hundreds of tons of salt in a week. The huge "kettle" dwarfs the two men who operate it. *Photograph: I.C.I.*

Ground rock salt being loaded into consumer's lorry at the Meadow Bank mine. Note the gigantic stock-pile in the background. *Photograph: I.C.I.*

year and the relative humidity ranges between 40 and 75%. About 150 men are employed underground and present production capacity is 1,300,000 tons per annum. There's no need to worry, though, that the mine will soon become exhausted, for it is estimated that there are at least 1,500 *million* tons of salt still remaining for the Winsford miners to cope with !

The visitor to Meadow Bank mine finds himself in what might be the crypt of some great cathedral, with the 20 ft. high ceiling supported by massive pillars of rock salt. Many visitors expect to find themselves in a glaring white chamber and are much surprised when they find that the salt doesn't look like salt at all. It is brown in colour and very much harder than coal. The atmosphere is so dry that vital documents were stored down the mine during the war years.

The first operation in mining rock salt—undercutting—is done by a machine called a short-wall cutter. This machine gives a 10 ft. deep cut at floor level along the face of the salt. After undercutting has been completed, shot-holes are drilled in the working face by a mobile hydraulic rotary drill which can drill a 1¾ inch diameter hole 10 ft. deep in less than a minute. The machine can, from any one position, drill a hole in any direction over an area 21 ft. wide by 25 ft. high.

This 25-ton Foden diesel dumper is carrying salt from the rock face to the primary crushing plant. *Photograph: I.C.I.*

The holes are charged with an explosive by men working from hydraulically operated mobile platforms. The explosive is electrically detonated, and normally about 1,000 tons of rock salt are brought down in one firing. The whole chamber continues to vibrate for several seconds after the blast.

A shuttle service of 25-ton diesel dumpers carry the rock salt to a primary crusher which reduces it to medium-sized pieces for easy handling. It is then belt-conveyed to the foot of the mine-shaft, fed into aluminium skips, each with a capacity of 3¼ tons, then elevated to the surface for final crushing and grading.

The ground rock salt from the Meadow Bank mine has many important uses. It is an essential fertiliser for sugar beet and mangold crops; an important ingredient in animal feedingstuffs; for glazing drainpipes and other clayware; for the preservation of hay; and a fluxing agent in non-ferrous metal refining. But by far the biggest demand is for the purpose of clearing roads of snow and ice. As a result of special treatment, rock salt from Meadow Bank can be stored in the open, even in wet weather, without any form of cover. A ton of rock salt will keep a mile of road open during the bitterest of weather.

NATURE IN THE RAW . . .

James A. Mackay on Stamps

THE UNITED STATES, one of the most highly industrialised countries in the world, is also the home of some of the most interesting fauna and flora. In his epic documentary film, *The Vanishing Prairie*, the late Walt Disney drew the attention of his fellow countrymen to the problems of preserving the natural heritage of America. Fortunately the United States federal and state authorities, backed by youth movements and organisations such as the Audubon Society, have done much to promote a consciousness of the natural history, archaeology and atiquities of the country.

The United States Post Office is co-operating in this campaign by releasing a set of four stamps this month whose basic theme is natural history. Three of the stamps are based on displays in the American Museum of Natural History in New York City which is currently celebrating its centenary. The fourth stamp in the series reproduces a detail from a mural at Yale University's Peabody Museum of Natural History.

The Age of Reptiles stamp is a detail from one of the largest murals in the world—110 feet long, 16 feet high—which Rudolph Zallinger painted for Yale's Peabody Museum in a commission that required four and one half years. Shown on the stamp are six creatures from the Jurassic geologic period, the more prominent being a brontosaurus, left, a stegosaurus, centre, and an allosaurus, right.

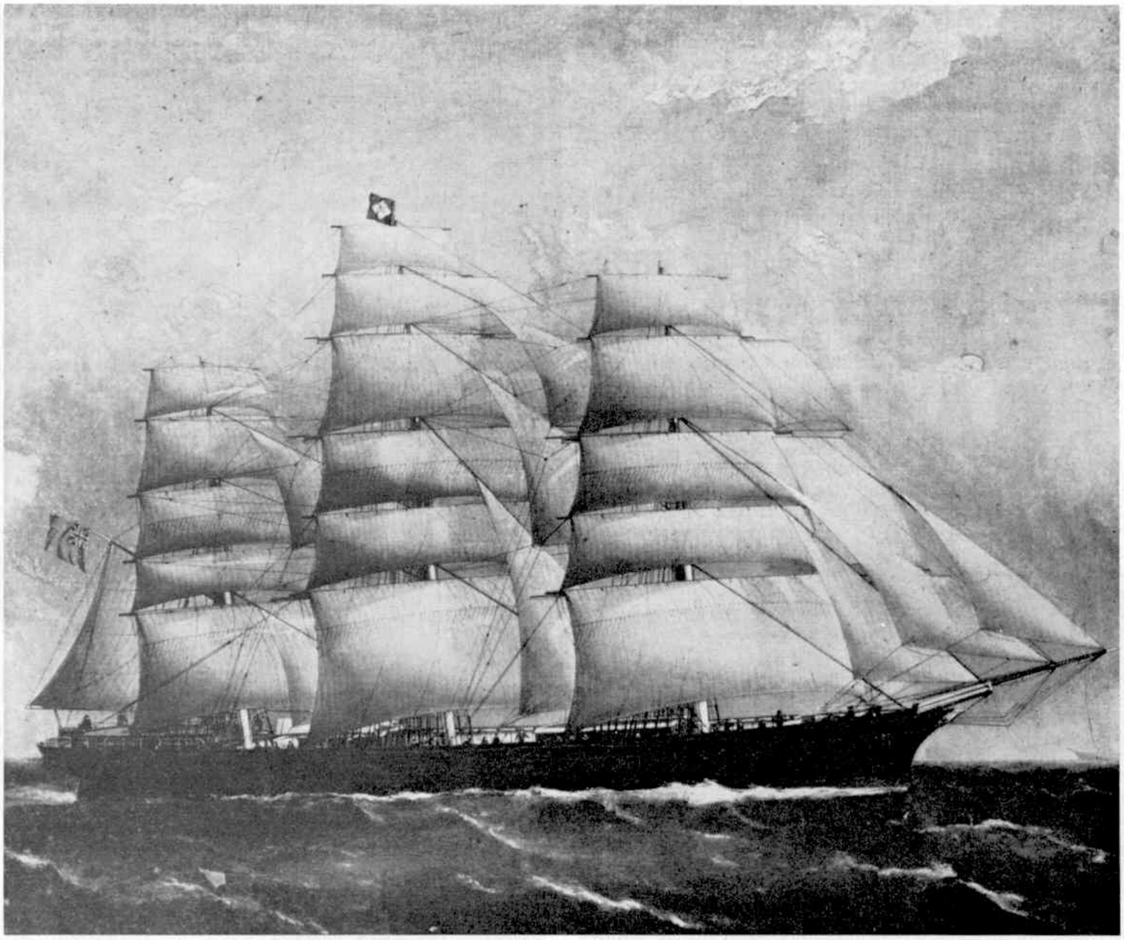
Paul Rabut, of Westport, Connecticut, designed the Haida Ceremonial Canoe stamp, basing it on a display in the American Museum of Natural History. This sea-going canoe, 64½ feet long, was made by hollowing out a spruce tree. The figures in the canoe represent a Tlingit chief and his party on the way to a marriage ceremony.

Dean Ellis, of New York City, patterned his African Elephant Herd stamp design after a display which is also in the American Museum. African elephants are the largest living land mammals, reaching a height of about 12 feet and weighing six tons or more. They travel in small herds, led usually by a female.

Walter Richards, of New Canaan, Connecticut, designed the American Bald Eagle stamp, guided by a model in the American Museum. Eagles are found in most parts of the world, and down through history have been considered the king of birds and a symbol of courage and power. The national bird of the United States is facing extinction.

A nature series with a difference is a set of four which East Germany released in February. The stamps featured a rabbit (10pf), fox (20pf), otter (25pf) and hamster (40pf), in their natural habitat. The appearance of these " nature " stamps is deceptive, as anyone who can read the captions will realise. The stamps, in fact, commemorate the 525th anniversary of the Leipzig Fur Auctions.

Leipzig, second city of the German Democratic Republic and famous for more than 800 years for its International Trade Fairs, is also the centre of the East German fur trade. Several stamps of East Germany have already made reference to this trade. One of the Leipzig Fair stamps of 1949 showed Russian merchants trading pelts at the Autumn Fair of 1650. The stamps marking the Leipzig Autumn Fair of 1958 showed girls modelling a hamster-lined coat and a Karakul lamb coat. A silver fox and a Karakul lamb were featured on a pair of stamps released in 1963 to publicise the International Fur Auctions in Leipzig.



THE CUTTY SARK

described by Edward Crowley

WITH THE WITCH Nannie in hot pursuit, Tam just made it over a running brook (witches can't cross running water) but his horse was somewhat mutilated in the process and left its tail in Nannie's outstretched hand. Burns' strictures on the perils of drink and the cutty sark (or short chemise) may savour of cost benefit analysis but his poem provided the name for one of the world's most famous clipper ships and the figure of Nannie clutching the remains of the unfortunate animal's tail was the figurehead which adorned the underside of the bowsprit.

The *Cutty Sark*, now on permanent display at Greenwich, was a splendid example of the composite-built sailing ship—a tall, beautifully rigged clipper with 32,000 square feet of canvas which enabled her to log 17 knots when 'cracking it on' with a fair breeze.

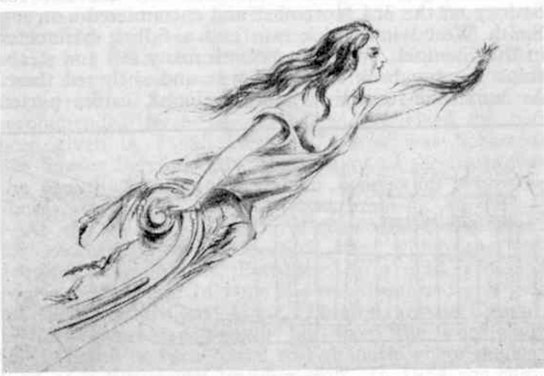
Yet she was, if not an unlucky ship, certainly an unfortunate one in some respects. Built for the China tea trade and designed to work the trade winds and round the Cape of Good Hope, she was rendered obsolescent for her destined calling even before she was launched on November 22nd 1869. The Suez Canal was opened a few days earlier and this event provided the new-fangled steamships with a much shorter route to the Far East, so that by 1877 almost the whole of the China tea trade was carried by steamships.

For her builders, Scott and Linton of Dumbarton, who had previously built nothing bigger than a schooner, her construction spelled financial disaster. On a voyage in 1880, the death of a coloured seaman at the hands of the chief mate, led to the latter's appearance at the Central Criminal Court on a charge of murder and to the suicide of the *Cutty Sark's* master, Captain J. S. Wallace. Nevertheless, the *Cutty Sark* is unique among the great tea clippers in having survived into modern times. She is a relic of an era of great competition for a specialised cargo which led to considerable risks being taken commercially by owners and at sea by tough, hard-driving captains.

In the heyday of the clippers the annual race from China with the first teas of the season was a sporting event for anyone connected with shipping and huge sums were wagered on favourite ships. Apart from the top prices obtained for the cargo, the winning owner stood to collect a small fortune in stake money, while his skipper consolidated his professional reputation for all time. Captain John Willis, a Scottish shipowner with offices in Leadenhall Street and a member of Lloyd's Register Committee, never had any luck with his ships in the race from China and was determined to build a clipper which would outclass even the *Thermopylae* which in 1868 made a record-breaking maiden voyage to Melbourne.

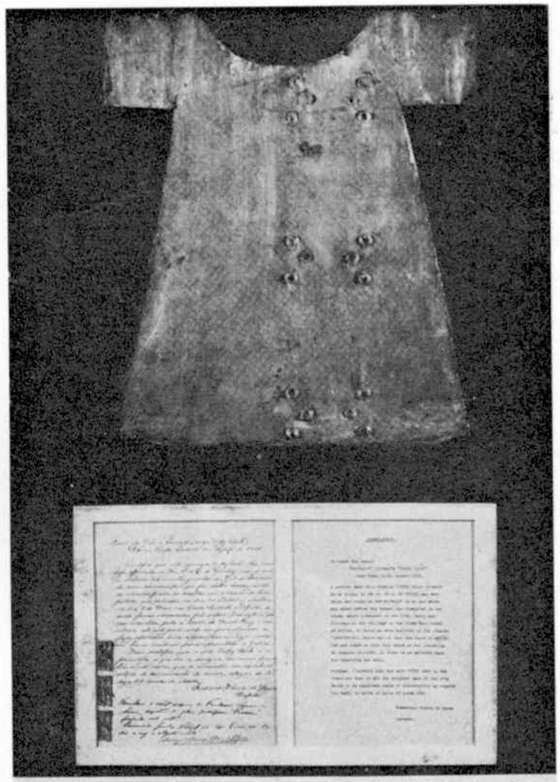
The man Willis chose as his designer was Hercules Linton, son of a Lloyd's Register surveyor and a naval architect and shipbuilder of great ability. Linton had formed a partnership with William Dundas Scott-Moncrief who was a civil engineer and who, amongst other things, invented a mechanically propelled tram-car powered by compressed air. They set up as Scott and Linton, building ships at Dumbarton, and soon established a reputation for turning out fast and beautiful vessels. Willis calculated that the young partnership might be prepared to quote him a favourable price for the chance to show what they could do with a large ship. He was right in this and the agreed price of £16,150 for the *Cutty Sark* (or about £17 per ton) proved to be the undoing of the small firm. They ran out of ready cash before she was completed and called in Denny Brothers to finish her. The partners never recovered from this setback and went into voluntary liquidation in 1870.

Was 'Old White Hat' Willis so pleased with the price he negotiated and the prospect of glory in the City as the owner of a winning tea clipper that he failed to note the significance of the impending opening of the Suez Canal? One thing was certain, he had a good ship for his money. The *Cutty Sark* was surveyed by Lloyd's Register and placed in the 16 A1 class. The survey report noted that she was built with teak decks and with keel, stem and stern post also of teak. Her outside planking was of rock elm and teak and the inside planking was of red pine. As a composite ship she had beams of bulb and angle iron. Her scantlings were heavier than her rival of almost identical size, the *Thermopylae*, and the relative strength of the two ships is often debated. However, the *Cutty Sark* is still with us whereas the *Thermopylae* lies fathoms down off the coast of Portugal.



Original drawing by Hercules Linton for the "Cutty Sark's" figurehead which was carved by Hellyer of Blackwall.

The *Cutty Sark* performed best under a strong breeze and with a real 'driver' as captain. Her maiden voyage to Shanghai was plagued by lack of suitable winds and her captain, George Moodie, was not the one to get the best out of her. Passing the Downs on 15th February 1870 it was not until the 1st

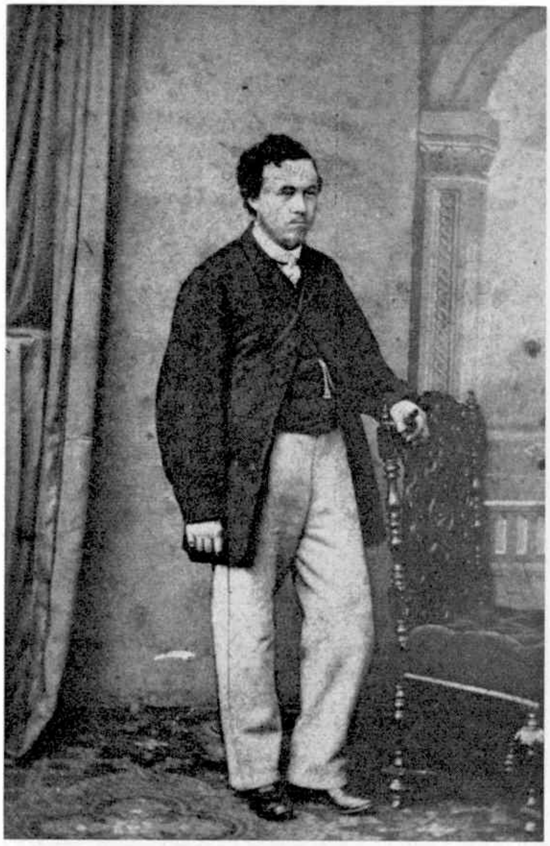


Original masthead decoration in form of a cutty sark, purchased in a London saleroom, together with original certificate in Portuguese signed by Captain then in command.

The original "Cutty Sark" emblem, cut out of sheet metal and used as a wind vane, came to light at an auction in 1960. The certificate is signed and sealed by the Portuguese Consul at Capetown in 1916 and testifies that this was the original emblem rescued from the masthead when the ship was dismasted.

March that Moodie was able to set his sky-sail and royal staysails on picking up the first of the North East trades. After lying becalmed on the line he eventually picked up the South East trades but soon ran into flat calm. Moodie wrote in his log, 'Calm! Calm! Calm! Sea like a mirror.' She reached Shanghai 104 days out on 31st May and after unloading started taking on new teas at £3.10.0 per 50 cubic feet. She was the first tea clipper away from Shanghai in 1870, crossing the Woosung bar on 25th June and entering the Thames on October 13th. It was the best passage from Shanghia made that year and although Captain Moodie and John Willis were disappointed with the actual time of 110 days they were satisfied that they had a vessel which could beat the *Thermopylae* or any other ship in the China trade. From the 18th to the 24th October the *Cutty Sark* underwent the first of many annual surveys by Lloyd's Register and in Green's Upper Dock and East India Docks her yellow metal sheathing was repaired. Samuel Presions, the Lloyd's Register surveyor, recommended retention of class 16 A1.

It was not until 1872 that the *Cutty Sark* was able to match her speed against the *Thermopylae*. The two ships loaded together at Shanghai and sailed from Woosung on the same day, the 18th June. Sailing south down the China coast, round the north coast of Borneo and through the Sunda Strait between Java



Hercules Linton, designer of the "Cutty Sark," was a gifted artist as well as a naval architect and shipbuilder.

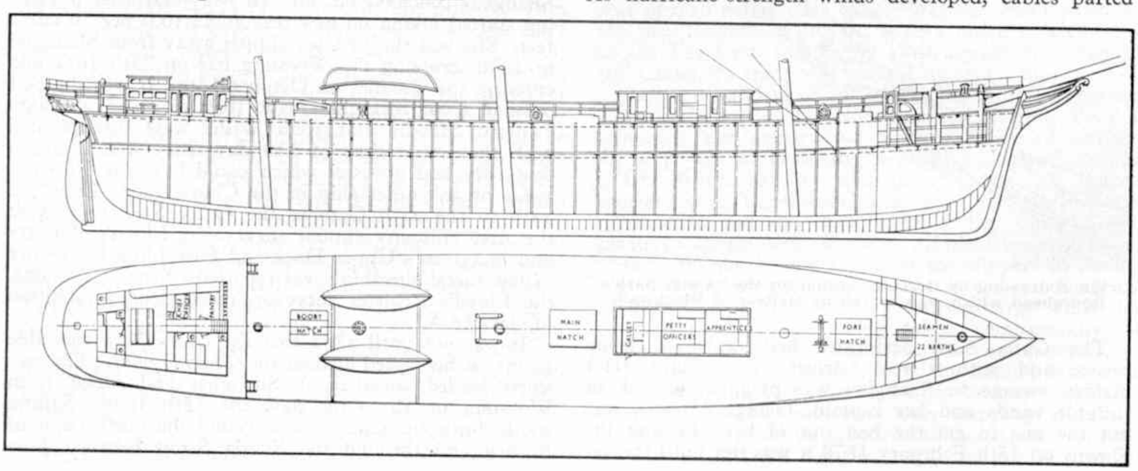
and Sumatra the two ships kept fairly close and the *Cutty Sark* made several sightings of the *Thermopylae*. But once out into the Indian ocean the *Cutty Sark* picked up the strong trade winds and forged ahead.

Copy o original profile and plan drawn by John Rennie, Chief Draughtsman of Scott and Linton.

By 7th August she was off South Africa and 400 miles ahead of the *Thermopylae*. Here her luck deserted her. On the 13th and 14th Moodie encountered a tremendous sea with the wind from the west which developed into a hard gale with howling squalls. On the following day a heavy sea broke under the stern and tore the rudder from the eye bolts. Captain Moodie tried a spar over the stern but was unable to steer the ship with it. The owner's brother, Robert Willis, who was on board pressed Moodie to make for the nearest South African port but Moodie declared for a jury rudder. A spare 70 ft. spar was cut into three parts and fitted. This took a week and while the *Cutty Sark* was hove to, the *Thermopylae* made the most of the prevailing strong winds and passed round the Cape.

Nevertheless the *Cutty Sark* made the Thames by the 18th October in 54 days from the Cape, an extremely good performance with her jury, and this brought her time from Shanghai to 122 days. In the arguments which ensued the captain of the *Thermopylae* insisted he was ahead at the time the *Cutty Sark's* rudder was lost but on being challenged he refused to yield his log book for inspection and it was generally conceded that the *Cutty Sark* would have beaten the *Thermopylae* but for the mishap.

Lloyd's Register carried out a survey of the damage at Green's Lower Dock and South West India Dock between the 29th October and 20th November and the Society's surveyor, Henry T. Tyrrell, noted, 'Repairs: Now done on account of loss of rudder. Placed in dock for examination. Rudder renewed. Main piece with English oak. All new pintles fitted and one brace on stern posts. New iron flange and revolving hoop fitted to rudder head and steering gear refitted and made good. New head rails and timber on port side.' Tyrrell recommended retention of the 16 A1 class. The *Cutty Sark* continued in the China tea trade, though in 1875 her creditable 108 day passage from Shanghai lost some of its lustre alongside the 42 days taken by the steamship *Glenartney* via the Suez Canal. By 1877 the clippers could no longer operate profitably in the once lucrative tea trade. It was in 1877 that the *Cutty Sark* nearly came to grief in the great November gale of that year. She left London for Sydney on the 3rd November and encountered a strong South West wind, thick rain and a falling barometer in the Channel. In company with many sail and steam ships she ran back to the Downs and sheltered there. As hurricane-strength winds developed, cables parted



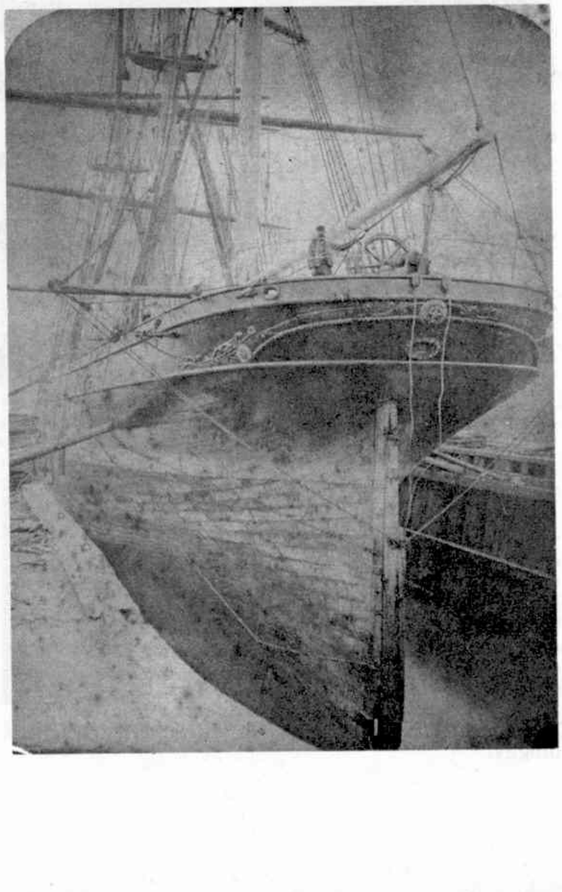
and many of the 60 ships at anchor started drifting. At night, blue lights, flares and rockets were to be seen in every direction and a large steam ship was on the Shingles firing guns and burning distress flares. Five ships went ashore in Pegwell Bay, a large barque sank off Broadstairs and another was stranded on the Goodwins. Margate was full of dismasted coasters. Amid the turmoil the *Cutty Sark's* cable parted too and she fouled a brig on her port bow and then hit another vessel with her starboard side. Tugs eventually took her in tow and got her to East India Dock where Lloyd's Register surveyor J. W. Scullard carried out a damage survey. Extensive repairs were carried out and a diver went down to look below the waterline. 'Sir,' he reported in writing, 'I have examined the Bottom of the ship *Cutty Sark* and all that I could find the matter with her, there was a few sheets of Copper off amidships on the Port Side of the Bilge which I have replaced and now that the ship is alwright.—R. Arnold, Diver.'

The salvage tugs were awarded £3,000 and in the wake of the gale lawsuits were scattered around like autumn leaves. John Willis, owner of the *Cutty Sark*, was sued for damage by the owners of a ship damaged by collision during the gale but the case against him was dismissed through lack of evidence. It is said that, during the gale, the *Cutty Sark's* carpenter found a piece of the name board of a vessel lying on the deck of the *Cutty Sark*, where her bulkwarks had been stove in, and thoughtfully slid the evidence overboard. If he did, it saved Willis a lot of money.

The *Cutty Sark* won her greatest fame as an Australian wool clipper under Captain Richard Woodget in the 1880's. Taking over command in 1885 Woodget took the *Cutty Sark* from East India Docks to Port Jackson in 77 days. On his return trip from Sydney to the Channel he took 67 days, beating his rival the *Thermopylae* by 12 days. The *Cutty Sark* has proved her right to be considered the fastest ship in the wool trade, which in the eighties meant the fastest ship in the world.

In 1895 the twenty-six year old ship docked at London with a record cargo of 5,304 bales of Australian wool putting her two inches below the Plimsoll line and Captain Woodget learned that she was to be sold to J. A. Ferreira & Co., a Portuguese firm. Her last voyage in the wool trade had taken 84 days. After a condition survey at Amos's Dry Dock due to the new ownership and change of name to *Ferreira*, Lloyd's Register surveyor W. Morrison recommended retention of the 13 A1 class she had been given in 1888. Her new master was Sebasteos dos Santos Pereira. One of the signs of the times was the appearance of a letter, in connection with the survey, which was done on a typewriter.

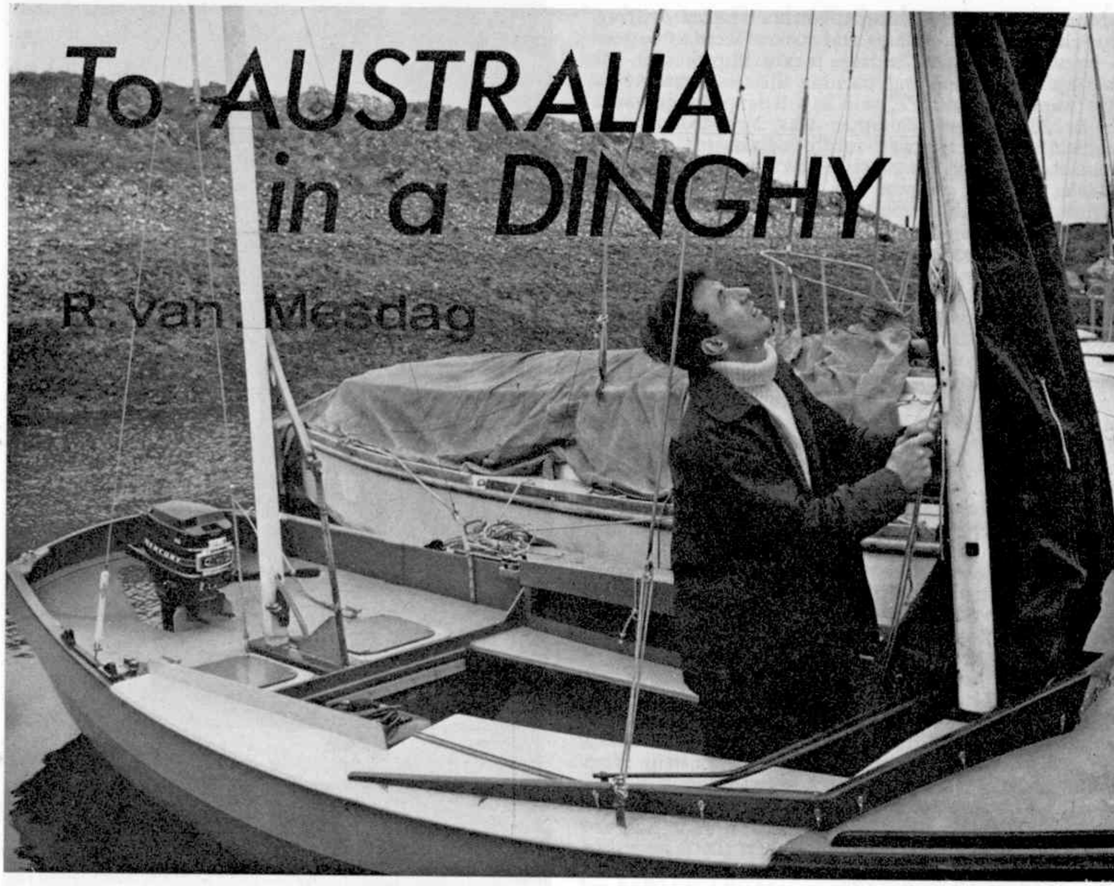
As the *Ferreira*, the *Cutty Sark* sailed the world for another 25 eventful years after which she was acquired by another Portugese firm and renamed *Maria de Amparo*. In 1916 she was dismasted in a gale off the Cape of Good Hope. Finally the late Captain Wilfred Downman bought her from the Portuguese in 1922 and had her towed to Falmouth where she was used as a full-rigged training ship. In 1954 she came to her present resting place at Greenwich. Though she ended her commercial career under the Portuguese flag her crew always referred to her as 'El Pequina Camisola'—the little chemise.



Upper right: The restored "Cutty Sark" on display at Greenwich. It has been calculated that there is enough Terylene in the present running rigging to make 50,000 drip-dry shirts. Right: The "Cutty Sark" in dry-dock in 1872 showing her jury rudder and with Henry Henderson, ship's carpenter, at the wheel.

To AUSTRALIA in a DINGHY

R. van Mesdag



Two young men with a taste for adventure are due to arrive in Australia near the end of April after spending a year at sea in a small dinghy . . . . . .

HERE'S GOOD NEWS for all who want to sail on the open sea. You don't require an expensive yacht because even a small dinghy costing £500 will do. But is it as simple as this? Obviously not. However, David Pyle, a 26-year-old youth leader from Emsworth, Hampshire, wants to prove that provided you choose the right dinghy, with ancillary equipment, and provided you plan your trip well in advance, it is definitely possible to cross even an ocean. David should know. For together with his friend, David Derrick, a freelance film sound-recordist from London, he is on his way to Australia in an eighteen foot open dinghy.

Why are they doing it? David Pyle says: " As an Outward Bound Sea School instructor teaching boys the arts of mountaineering, rock climbing and sailing, I believe that sailing is the most invigorating sport any young man can indulge in. It is also character-forming in the extreme. I therefore want to prove to adventurous young people that they can take even a dinghy out to sea, provided they know what they are doing. If one is looking for a challenge, this is it ! "

But on what conditions? It is all a question of preparations," says David. Here are just a few of the most important steps he has had to take after his mind to face this fantastic challenge had been made up.

One of the first things he considered was the choice of dinghy. It should be strong, seaworthy (although this is a vague term for a craft of such small dimensions) and not too expensive. David therefore chose an eighteen foot Drascombe Lugger which he called *Hermes*. She was built by Kelly & Hall in Newton Ferrers, Devon, along the traditional lines of the North Sea Coble, which has proven her seaworthiness for over a hundred years.

Hermes has a 6 ft. 3 in. beam, and her sailplan is that of a yawl, which means that the forward mast is taller than the aft one. Total sail area is 113 square feet, but in heavy weather conditions this can be reduced to as little as 7 square feet. To make sure *Hermes* will remain afloat, even when full of water, her fore and aft decks have been sealed off completely, giving her a built-in buoyancy of 3,000 lb. Watertight hatches have been fitted so that food can be stored inside these spaces. Above and below the side benches more lockers have been made for stowage of food and equipment. As for the choice of paint, a new type of anti-fouling paint was chosen for below the waterline to combat excessive marine growth affecting boats travelling at less than two knots for long periods of time in tropical waters. The topsides are yellow to make the boat conspicuous, and to counteract the strong sun rays. The interior is racing green.

Next, David had to consider which route he and his friend were going to take. As he wants to see something of the world, "This is another reason for my trip," he decided to take the "inland" route. After reaching Le Havre, France, *Hermes* will travel through France, entering the Mediterranean at Marseilles. From there she will go via Italy, and Greece to Turkey. This is where boat and crew will travel overland to Mosul, a town on the Tigris river in Iraq. Down the Tigris and the Persian Gulf, they will call at Kuwait, Bahrain, Sharja in the Trucial States, and on to Gwadar on the Pakistan coast. Here their first real sea crossing will start, as they will head straight for Bombay across the Arabian Sea. Then they will skirt the Indian shore to Ceylon and Trincomalee on the Eastern coast. A second ocean passage, this time of a thousand miles will take them to the Nicobar Islands on the other side of the Bay of Bengal. From there they will travel another 300 miles to Penang in Malaya, and along the coast to Singapore, where the two Davids are hoping to spend Christmas. Their trip will then take them to the Indonesian Islands in the Carimata Straits, Java Sea, Flores Sea and Banda Sea, calling at Java, the lovely island of Bali and Flores on the way. They will then go to Guinea, and along its coast across the Torres Straits to Australia. The last stretch of the voyage will mean sailing down the Great Barrier Reef to arrive at Brisbane within one year after leaving Emsworth whence they departed on April 26 last.

Apart from planning the route, what else is necessary? Well, one of David's obstacles has been to get visas for each of the countries he and his friend will be calling on. They need eight of them altogether, but they can leave England with only two. Arrangements therefore, had to be made to collect the remaining visas on the way, and they needed to ascertain before-hand whether they would be granted, lest entry into a given country is suddenly refused. Buying charts of all the areas was another tremendous task. Where can one obtain them, how accurate are they, and which scale should they be? To find out the answers to these questions David has had to do a lot of telephoning!

While on this subject of writing and ringing, David needed to find firms willing to supply him with equipment at the lowest possible price. Scores of firms were written to, and several have helped. For instance, South Western Marine Factors, who sell Mercury outboard engines, presented *Hermes* with a $7\frac{1}{2}$ h.p. engine at half-price. What is more, they will contact their sales organisations along the route, alerting them of David's impending arrival, and instructing them to service the engine if necessary. S.R. Radio, makers of "Sailor" radios and transmitters have sold David one of their instruments at a reduced price, and have instructed David on how to use it. The two adventurers have been provided with sails, paint, camping equipment and weatherproof clothing at minimum cost.

On their journey the adventurers will consume a fair amount of food. Just some of their supplies are shown above.

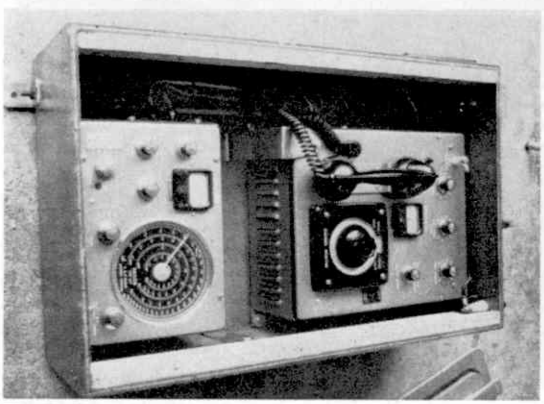
Every piece of equipment must work perfectly and be fully understood, as nothing can be left to chance.

The diminutive size of the *Hermes* is clearly seen whilst moored at Portsmouth.

Despite these generous gestures by several companies, one of David's main worries has been to raise enough money for the trip. To overcome this he has contacted Southern Independent Television and he has arranged to send this company regular film reports from his ports of call. Hodder and Stoughton will be publishing a book after completion of the voyage. Obviously both contracts bring in some of David's much needed cash.

Food, glorious food, featured blatantly on David's list. Anyone spending a day at sea will know how hungry one gets in fresh air all day. Fortunately, David was able to draw on previous experience for he was one of the competitors in last year's single-handed Trans-Atlantic Race for yachts from Plymouth to Newport in the United States. He knew that firms like Heinz, Nestle's and General Foods are specialists in dehydrated foods, and that their home economist departments have recipes for those making long passages. David reckoned he needed 30 gallons of water, and this he has stored in flabby rubber tanks which lie in the bilges of the boat.

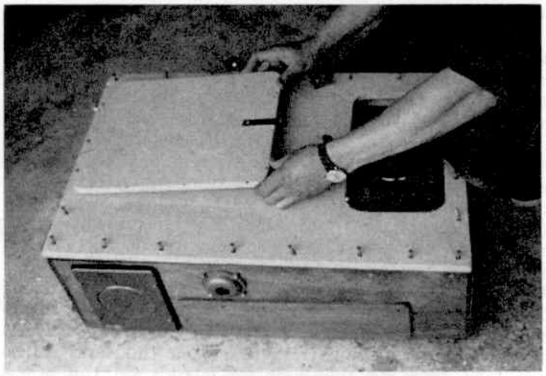
So far, so good. But what happens in a storm ? If, for reasons of extremely strong winds and tumultuous waves sailing is no longer possible, *Hermes'* sea anchor will be cast. This anchor is made of strong canvas, and is rather like a drawn out bucket with a hole at



The Radio Telephone which will be the only link *Hermes* has with the rest of the world.

the bottom. Once all sails are down, and *Hermes* is at the mercy of the winds, her movement downwind can be checked by throwing the sea anchor overboard. It will fill up, and being tied to *Hermes'* bow, it will bring the boat to face the storm head on. She can therefore not be toppled sideways. To keep her dry, a canopy of nylon reinforced pvc can be fitted, which covers the entire boat, while the men inside will be wearing their Sea Chest weatherproof clothing and life jackets. To prevent *Hermes* from capsizing, and to increase her buoyancy in case she does, David has made two 12 feet long buoyancy bags, which like long sausages can be fitted onto the outside of the hull. Should all these precautions fail, and should David's radio distress calls not be picked up or his SOS flares not be spotted, *Hermes* has a four man life raft on board, folded into a parcel. It can be instantly and mechanically blown up, and will contain five gallons of water and food for fourteen days.

Counting up all items so far mentioned, one might well ask, " Where will it all be stored ? " The solution to this problem has needed much careful thought. During the voyage every article has to be readily available, yet it must be out of the way, be kept dry, and be secured to prevent breakage. No wonder the two boys



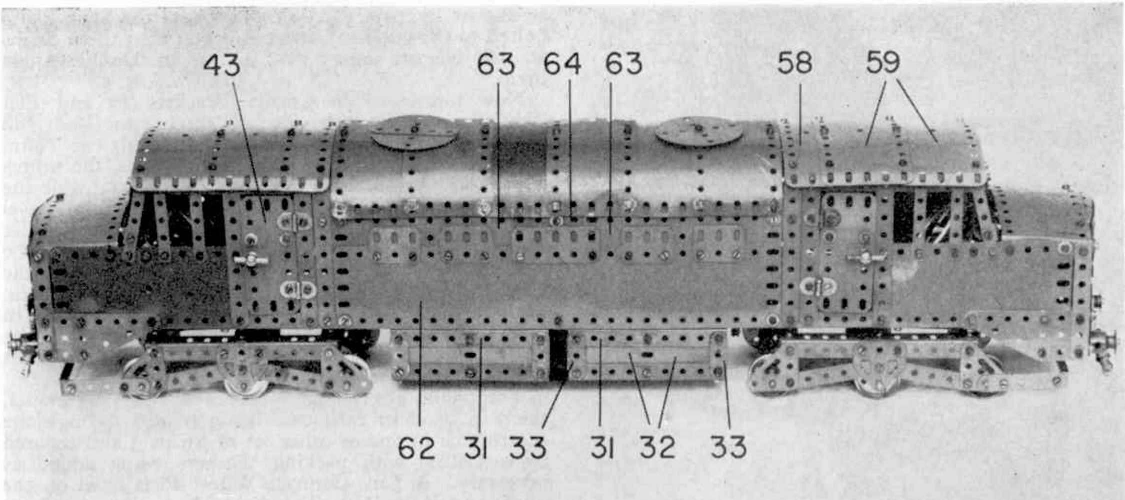
Waterproofing is a must for delicate equipment exposed to the elements. Sea water and sea air are very corrosive.

have made several mock stowings, previous to their departure, discussing at length where every item was going to be stored.

And so to sea. Almost every weekend during the past four months David was out in his boat trying out his sails, his food, and his water, and checking the compass, the radio, and all the many pieces of equipment. He constantly asked himself: " Can this go wrong, could that chafe itself loose, or can water get in here or there ? " He meticulously answered every question by taking such precautions as arranging for spare parts, altering bits of rigging or devising better methods.

Anything else ? Yes ! Two men are required to sail the boat. They must be determined, courageous, skilled in sailing a boat, and willing to work very hard. For there will be plenty to do. There are messages to be sent, there is navigation to be done, and the men must keep themselves, and their boat clean. They must also be ingenious in making repairs, or in wrangling themselves out of difficult situations ashore. They must be friends, and have respect for one another, because they will be together for long periods at a time.

David Pyle and David Derrick fit this bill. They will succeed and we wish them the best of luck.



A CO-CO DIESEL ELECTRIC LOCO

An advanced Meccano Model by Spanner

I AM DELIGHTED to present the advanced Co-Co Diesel Electric Loco featured here. It is a first-class model built to a high degree of accuracy and is fully-operational in both directions' powered by a Meccano 3—12 volt D.C. Motor with 6-speed Gearbox. The "Co-Co" title, by the way, refers to the axle arrangement of the full-size loco, i.e. two bogies, each with three driving axles, although only two of the axles in each bogie are driven in the model.

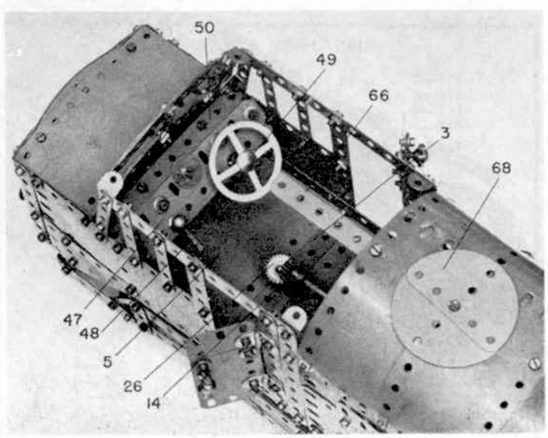
Chassis

Beginning construction with the chassis, two 29½ in. compound angle girders 1 are each built up from a 24½ in. Angle Girder, the ends of which are extended by 3½ in. Angle Girders, then the two compound girders are connected together, one hole from each end, by two 4½ in. Angle Girders 2. Also bolted between the girders in the positions shown are two sets of two 4½ in. Strips 3, placed one on top of the other for strength, seven 4½ × 2½ in. Flat Plates 4 and four 4½ × 2½ in. Flexible Plates 5, these latter Plates being positioned two at each end of the chassis. Note that a space is left between the second and third Flat Plates from each end, the drive chains later passing through these spaces. The larger space is *partially* enclosed by two 2½ × 1½ in. Flexible Plates 6 bolted between the relevant second and third Flat Plates.

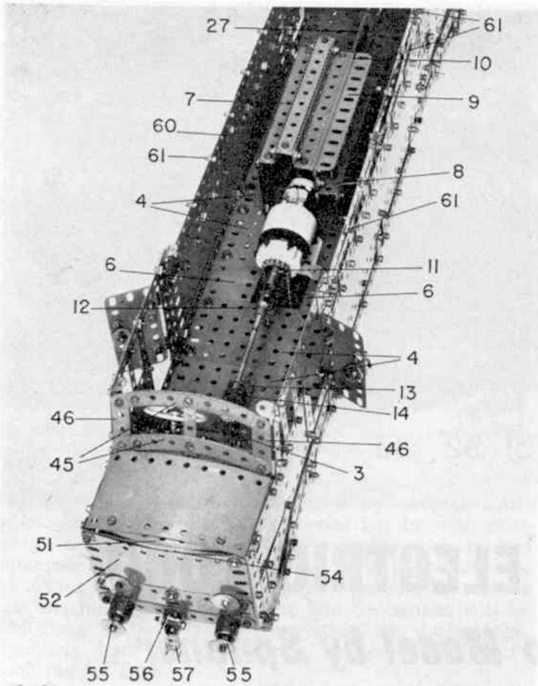
Now bolted to the top of the three centre Flat Plates are a D.C. Motor with 6-ratio Gearbox and two 5½ in. Angle Girders, the latter providing a "bed" for an imitation generator. Fixed to the vertical flange of one of the Girders is a 5½ × 2½ in. Flexible Plate, edged by two 2½ in. Strips. Another 5½ in. Angle Girder is bolted to the upper edge of the Plate then a further 5½ in. Angle Girder 7 is bolted to this Girder.

Fixed to the vertical flange of the second Girder Bolted to Plates 4 is a 5½ × 1½ in. Flexible Plate, this edged by 1½ in. Strips. Bolted to the upper edge of the Plate is another 5½ in. Angle Girder 8, to which yet another 5½ in. Angle Girder is fixed by six ⅜ in. Bolts, the shanks of the Bolts pointing upwards to represent generator fittings. The vertical flange of the last Girder is extended by a 5½ in. Flat Girder, to which a further two 5½ in. Angle Girders 9 and 10 are bolted. One more 5½ in. Angle Girder is bolted to Girder 10, this being attached to Girder 7 by two Double Brackets, to which a 5½ in. Strip is secured. The end of the generator is then enclosed by a 2½ in. Strip and by two 2½ × 1½ in. Flexible Plates, arranged in an inverted "T" with the crosspiece bolted to a 2½ in. Angle Girder fixed to appropriate Flat Plate 4.

Mounted on the output shaft of the motor is a ¾ in. Sprocket Wheel 11, then the shaft is extended, via a Universal Coupling 12, by a 3½ in. Rod mounted in a 1 × 1 in. Angle Bracket 13. This Angle Bracket is



A close-up view of one of the two identical cabs. The controls of course are only imitations and do not operate.

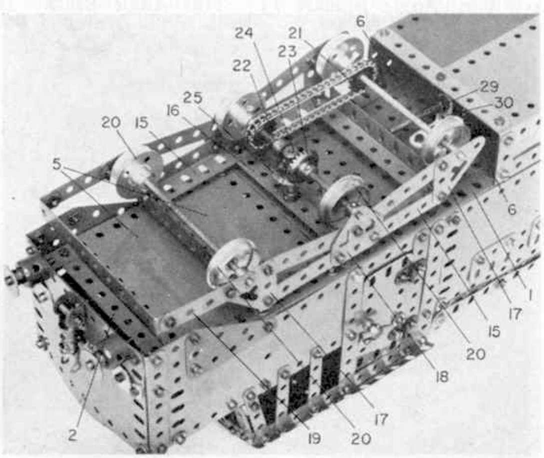


In this view of the model the roof has been removed to show the interior. Note the motor and imitation generator.

fixed to one end Flat Plate 4, but is spaced from it by a Collar on the shank of each securing $\frac{1}{2}$ in. Bolt. A $\frac{1}{2}$ in. Pinion 14 is mounted on the end of the Rod.

Bogies and Drive

Fitted to the model, as to the full-size locomotive, are two swivelling bogies, each of which is similarly built up from two $5\frac{1}{2}$ in. Angle Girders 15 joined together, at the ends, by two $4\frac{1}{2}$ in. Angle Girders and, in the centre, by a $4\frac{1}{2}$ in. Strip 16. Bolted to each Girder 15 are two $1\frac{1}{2}$ in. Corner Brackets 17 and a Flat Trunnion 18, these three items being themselves joined



An underside view of one end of the loco showing construction of the bogie and the transmission to two of its three axles.

as shown by two 3 in. Strips. A $2\frac{1}{2}$ in. Strip 19 is bolted to the outside Corner Bracket, then these Strips at each side are joined by a $4\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strip.

Now journalled in Corner Brackets 17 and Flat Trunnions 18 at each side are three 5 in. Rods, all held in place by Collars and all fitted with two $1\frac{1}{8}$ in. Flanged Wheels 20. In addition, however, the innermost Rod carries a $\frac{3}{4}$ in. Sprocket Wheel 21, while the centre Rod carries a $\frac{3}{4}$ in. Sprocket 22, a $\frac{7}{8}$ in. Bevel Gear 23, a Short Coupling 24 and an extra Collar which keeps the Coupling centralised. Note that the Rod passes through one end transverse bore of the Coupl'ng to leave the longitudinal bore free for a 3 in. Rod mounted loose in the bore and held by Collars in Strip 16. A second $\frac{7}{8}$ in. Bevel Gear 25 mounted on the Rod meshes with Bevel Gear 23, while Sprocket Wheels 21 and 22 are connected by Chain.

The bogies are now mounted in place in the model, the 3 in. Rod in each case being passed through the centre hole in one or other set of Strips 3 and secured by a Collar, with packing Washers being added as necessary. A $\frac{3}{4}$ in. Contrate Wheel 26 is fixed on the upper end of the Rod. This Contrate, in the case of one bogie, meshes with $\frac{1}{2}$ in. Pinion 14, but, in the case of the other bogie, it meshes with a $\frac{1}{2}$ in. Pinion on a 4 in. Rod 27, held by a Collar in two 1×1 in. Angle Brackets fixed to the relevant two end Flat Plates 4, but spaced from the Plates by a Collar on the shank of each securing $\frac{1}{2}$ in. Bolt. Mounted on the inside end of the Rod is a $\frac{3}{4}$ in. Sprocket Wheel which is connected by Chain to another $\frac{3}{4}$ in. Sprocket Wheel 28 on an $11\frac{1}{2}$ in. Rod 29, journalled in two 1×1 in. Angle Brackets 30 bolted direct to the underside of two Flat Plates 4. The Rod is held in place by a Collar and another $\frac{3}{4}$ in. Sprocket Wheel, the latter connected by Chain to Sprocket Wheel 11 on the motor output shaft.

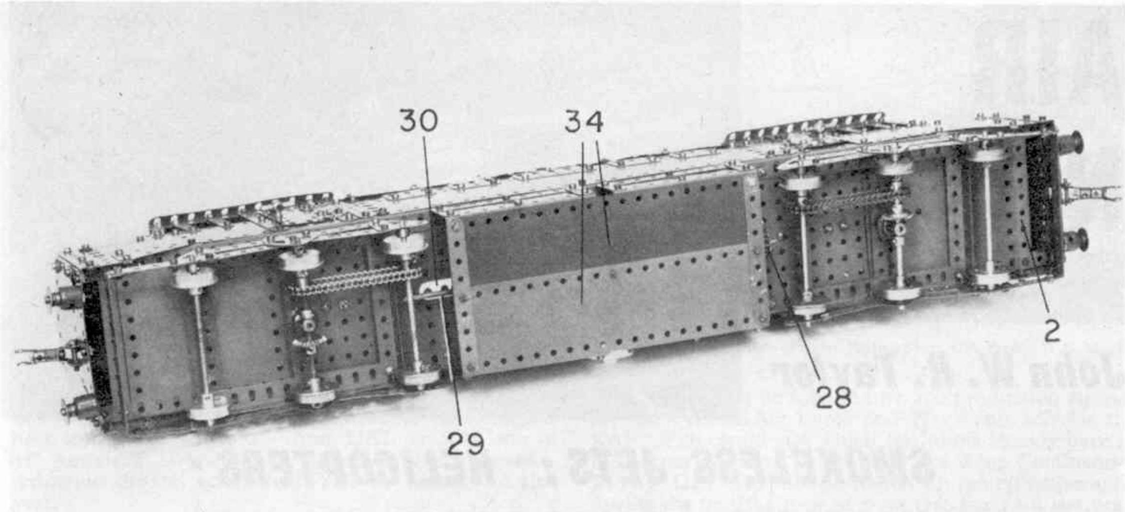
A casing for the exposed section of the drive system is provided by four $4\frac{1}{2}$ in. Angle Girders 31, bolted two to each compound girder 1. Bolted to the vertical flange of each Girder 31 are two $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates 32, overlapped one hole and edged by two $1\frac{1}{2}$ in. Strips 33. Another $4\frac{1}{2}$ in. Angle Girder is fixed to the lower edge of each pair of Flexible Plates, two $9\frac{1}{2} \times 2\frac{1}{2}$ in. Strip Plates 34, edged by two $4\frac{1}{2}$ in. Strips, then being bolted to these Girders at each side.

Cabs and Body

One of the features of a Co-Co Diesel Electric Loco is its identical twin cabs, one at each end which mean that, no matter in which direction the loco is travelling it is always "headed in the right direction!" Twin cabs are, of course, fitted to the Meccano model, both being identical in construction. Bolted to each compound girder 1 in the positions shown are three $4\frac{1}{2}$ in. Strips 35, 36 and 37, plus one $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plate 38, a $2\frac{1}{2} \times 1\frac{1}{2}$ n. Triangular Flexible Plate 39, a $1\frac{1}{2} \times 1\frac{1}{2}$ in. Flat Plate 40 and a $3\frac{1}{2}$ in. Angle Girder 41, the last three items also being connected together. The upper ends of Strips 35, 36 and 37 are connected by a $5\frac{1}{2}$ in. Strip, this Strip also being connected to Plate 38 by three $2\frac{1}{2}$ in. Narrow Strips 42, the forward Narrow Strip being angled slightly to correspond with the windscreen slope.

A door is provided by a $3\frac{1}{2} \times 1\frac{1}{2}$ in. compound flexible plate 43, built up from two $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates, and is attached to Strip 35 by two Hinges. The door catch is a Fishplate held by Nuts on the shank of a Handrail Support mounted in plate 43, with a 1 in. Rod in the head of the support acting as a handle.

At the front of the cab a $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plate



44 is bent to shape and bolted between Plates 37 and Angle Girders 41 at each side, then the windscreen frame is added. This consists of two $4\frac{1}{2}$ in. compound stepped curved strips 45, each built up from two 4 in. Stepped Curved Strips, the compound strips being joined together at the ends by two 2 in. Strip 46 and joined in the centre by a $2\frac{1}{2}$ in. Narrow Strip, the whole unit being fixed to forward Narrow Strips 42 by Angle Brackets. Also attached by Angle Brackets—this time between the centre top edges of Plates 38—is a $4\frac{1}{2}$ in. Flat Girder 47, forming the control panel. Various dials on the panel are supplied by three ordinary Washers and one $\frac{3}{4}$ in. Washer, while hand controls are represented by a 1 in. Rod 48, held in a Handrail Support bolted to the panel, and by a $1\frac{3}{4}$ in. Steering Wheel 49, this being mounted on a $\frac{1}{2}$ in. Bolt held by a Collar in the panel. A $4\frac{1}{2}$ in. Strip 50 is attached to the upper end of Flat Girder 47 by Obtuse Angle Brackets.

Bolted to the forward edge of Flexible Plate 44 is a shaped 4 in. Stepped Curved Strip 51, then the " nose " is completed by three $4\frac{1}{2}$ in. Strips bolted between Girders 41, the securing Bolts also fixing in place one $4\frac{1}{2} \times 2\frac{1}{2}$ in Flexible Plate 52 and a $4\frac{1}{2} \times 1\frac{1}{2}$ in compound flexible plate 53, built up from two $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates. Note that another shaped 4 in. Stepped Curved Strip 54 is sandwiched (not bolted) between the upper $4\frac{1}{2}$ in. Strip and Plate 52.

Two buffers 55 are each provided by a Chimney Adaptor, five ordinary Washers and a $\frac{3}{4}$ in. Washer, all secured to the front of the model by a $1\frac{3}{8}$ in. Bolt. Situated mid-way between the buffers is a coupling produced from a Double Bracket 56, to which a Small Fork Piece is pivotally attached by a $\frac{3}{4}$ in. Bolt. Fixed in the boss of the Fork Piece is a 1 in. Rod, on which a second Small Fork Piece 57 is mounted. Riding lights are represented by two $\frac{3}{4}$ in. Washers, bolted to the cab front as shown, whereas the cab roof consists simply of one $5\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plate 58 and two $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates 59, all bent to shape and attached to the sides by Angle Brackets, the lugs of which are opened out to a slight obtuse angle.

Running between the cabs is the main body section which presents no problems whatsoever. Bolted between Strips 35 at each side is a $13\frac{1}{2}$ in. compound flat girder 60, built up from two $7\frac{1}{2}$ in. Flat Girders, with Strips 35 projecting one hole above the flat girder. Seven Bolts 61 are held by Nuts in the upper row of holes in the girder, the shanks of the Bolts pointing outwards, then the side is enclosed by a $12\frac{1}{2} \times 2\frac{1}{2}$ in. Strip Plate 62, two $5\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates 63 and a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plate 64. Bolted to the Plates in the positions shown are four $1\frac{1}{2}$ in. Flat Girders and a $2\frac{1}{2}$ in. Flat Girder 65, representing ventilator grilles.

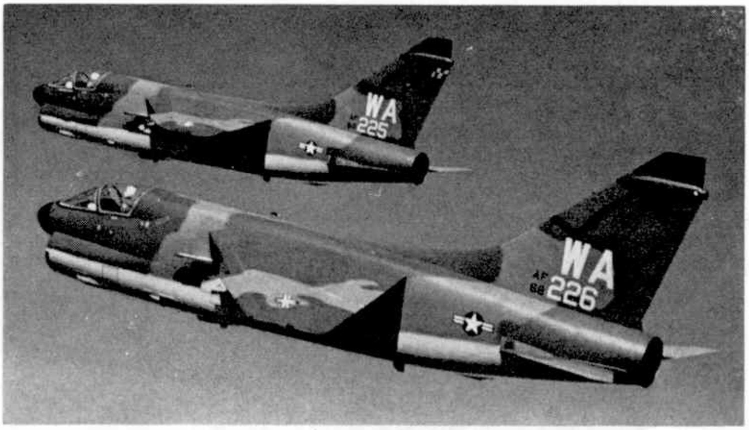
We are now left with only the roof to complete, and the model is finished. First of all, an $18\frac{1}{2}$ in. Angle Girder 66 is bolted between the existing cab rooves, being centrally fixed to the underside of the rooves. Secured to the Girder are six shaped $6\frac{1}{2} \times 2\frac{1}{2}$ in. compound flexible plates 67, each built up from two $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates overlapped five holes. Note that two of the Bolts fixing the compound plates in position also secure two circular discs 68 in place, each disc consisting of two Semi-circular Plates. The ends of the compound plates are finally secured on the shanks of Bolts 61. The realistic lines of the finished model are clearly shown in the upper illustration on page 277.

PARTS REQUIRED

7—2	8—18b	2—111c
24—2a	12—20	4—111d
8—4	2—26	8—1144
8—5	2—29	4—116a
4—6	4—30	4—126a
17—6a	444—37a	8—133
2—7	398—37b	6—136
1—7a	108—38	1—140
13—9	10—38d	4—164
14—9a	2—48c	2—185
8—9b	7—53a	26—188
1—9d	28—59	7—189
4—10	2—63d	18—191
4—11	4—74	11—192
16—12	12—89b	2—196
5—12a	1—94	2—197
8—12c	8—96a	4—214
1—13	1—103	4—221
1—14a	2—103c	4—235
6—15	2—103d	5—235a
2—15b	8—103h	3—235b
2—16a	4—103k	1 D.C. Motor with 6-ratio Gearbox
2—18a	8—111	

AIR NEWS

by John W. R. Taylor



SMOKELESS JETS: HELICOPTERS: HARRIERS: ROLLS-ROYCE ENGINES

USAF Flies Rolls-Royce

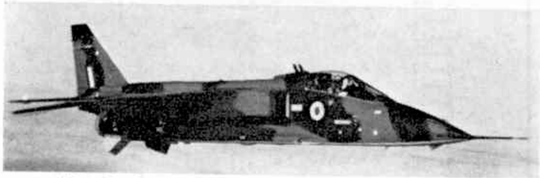
Instructor pilot training on the USAF's new LTV A-7D Corsair II fighter has started at Luke Air Force Base, Arizona. The unit responsible for this latest stage in working up the A-7D for combat service is the 58th Tactical Fighter Wing. It joins the 57th Fighter Weapons Wing Detachment, which has been testing the aircraft for operational use.

Other A-7Ds have been involved in extensive flight and ground testing at Edwards AFB, California; weapons delivery tests at Eglin AFB, Florida, and trials under tropical and arctic winter conditions in the Panama Canal Zone and Alaska respectively. Both the aircraft and their Allison TF 41-A-1 (Rolls-Royce Spey) engines have shown great promise, and the USAF is waiting eagerly to form the first combat squadron of A-7Ds, which will each carry about 15,000 lb. of external weapons, in addition to a built-in multi-barrel cannon.

Baby Helicopter has Four Rotors

Everyone likes the go-anywhere capability of helicopters, but not many people like their high price. The average helicopter costs two or three times as much as a fixed-wing aeroplane with the same number of seats, and usually cruises much more slowly. In exchange for these disadvantages, it offers the ability to take off and land vertically, to hover and to fly very slowly in bad weather or close to the ground in difficult country or among buildings.

For many years, designers have been trying to find ways of reducing the cost of " choppers " and a German company, Aerotechnik Entwicklung und Apparatebau of Frankfurt, believes that it now has the answer.



The single seat prototype Jaguar 5.06 Aircraft.

To test the ideas of its technicians it has built a tiny single-seat prototype, designated WGM 21. This consists of little more than an open-work steel-tube chassis, a seat for the pilot, a tricycle undercarriage, a minimum number of controls and instruments, a 4½-gallon fuel tank and a converted 54 h.p. BMW 700 motor car engine to drive the rotor system. The key to the aircraft's low cost is, surprisingly, the use of no fewer than four main rotors instead of the usual one!

This seems to conflict with all the normal rules for building a low-cost, successful aircraft. These are well summed up in the dictum of the late Bill Stout, designer of the Ford Trimotor of the 'twenties and 'thirties, who always advised engineers to " simplicate and add more lightness." Why, therefore, have Aerotechnik gone for such an apparently-complicated layout ?

As a start, by making the two rotors at opposite ends of each support arm rotate in opposite directions, this eliminates the need for a tail rotor or tail control surfaces. This, in turn, has permitted a simple control system, consisting of a Y-type control column and a pair of foot-pedals. Operation of the pedals causes the rotor support arms to rotate, so " steering " the WGM 21 in the required direction without any need for the usual complex and costly rotor heads.

On the ground, the WGM 21 looks a little cumbersome when ready for flight; but appearances are deceptive. In fact, the rotor support arms can be folded, enabling the complete helicopter to be stored in a ground area of no more than 7 ft. 1¾ in. by 6 ft. 6 in.

Each rotor has a diameter of 8 ft. 6¼ in. and the length or width of the aircraft over the rotor tips when they are turning is 17 ft. 8½ in. The WGM 21 is 5 ft. 8½ in. high, has an empty weight of 540 lb. and can take off at a loaded weight of 740 lb. Maximum speed is 77 m.p.h., rate of climb 1,280 ft. a minute, and range 155 miles at 71 m.p.h., which is pretty good on so little fuel.

The prototype earned its limited certificate of airworthiness back in the summer of 1968, since when its development has continued with very little publicity. If tests continue to go well, we may yet see eventually the low-cost, easy-to-fly helicopter that so many people have dreamed about for so long.

United Bans Smoking

Cigarettes are not the only kind of smoking that has been causing concern in recent years. Smoke from aircraft jet engines contributes less than one per cent. of the total atmosphere pollution in America, but this is still enough for companies like United Air Lines to take very seriously.

Experts calculate that 70 per cent. of the jet smoke in the USA comes from Pratt & Whitney JT8D turbofan engines of the sort fitted to UAL's 75 Boeing 737s and 150 Boeing 727s. As a result, the company has been testing smoke-reducing devices for the past couple of years and has now decided to order from Pratt & Whitney kits of parts that will go a long way towards eliminating smoke from its 665 JT8D engines.

When each JT8D reaches its regular overhaul time, its nine combustion chambers and fuel nozzles will be replaced with parts of new design which ensure improved burning of carbon particles. It sounds simple, but will cost $3 million by the time the programme has been completed in 1972. And UAL is only one of 31 American airlines that agreed to install smoke-reduction devices on their JT8Ds in January of this year.

Harries Hop to Cyprus

No. 1 Squadron of the Royal Air Force, the world's first operational vertical take-off combat unit, flew its Harrier " jump jets " from its home base of Wittering, Northants, to Akrotiri, Cyprus in March. It did so after three Harriers had made a successful proving flight over the route, via France, Malta and Crete.

Following an earlier achievement by a Harrier from Wittering in winning the east-west section of last year's big transatlantic air race, this long-distance flight should silence those critics who claim that VTOL aircraft have such a short range that they are of only limited use. While in Cyprus, 16 squadron pilots, and two from the Harrier conversion team, practised weapon firing and bomb dropping over the special ranges that had been used in the last six months by two of the new Phantom squadrons (Nos. 6 and 54) of Air Support Command.

Jaguar Progress

Statistics released by British Aircraft Corporation give encouraging news of the progress made by the Jaguar strike/trainer programme during 1969. Following the first flight of the prototype Jaguar EO1 in September of the previous year, no fewer than five more prototypes joined the programme last year. These are EO2, the second French-assembled two-seater, AO3 and AO4 French single-seat tactical support versions, the first British single-seat prototype SO6, and the French naval version, MO5. On November 20th, MO5 notched up the 250th hour of prototype flight testing.

Each aircraft is being used for a different section of the test programme. EO1 is proving the soundness of the aerodynamic design and handling, while EO2 concentrates on engine performance and the fuel system. AO3 is proving the French navigation system, radio and electrics, and AO4 the weapon and fuel systems SO6 is flight testing the British navigation and weapon systems and will carry out flight refuelling trials. MO5's trials will include operations from a carrier, performance and deck handling.

The remaining two prototypes, the single-seat SO7 and two-seat BO8, which is intended to replace the RAF's Gnat advanced trainer, are expected to fly in

The new 4-rotored German Helicopter, the Baby W.G.M. 21.

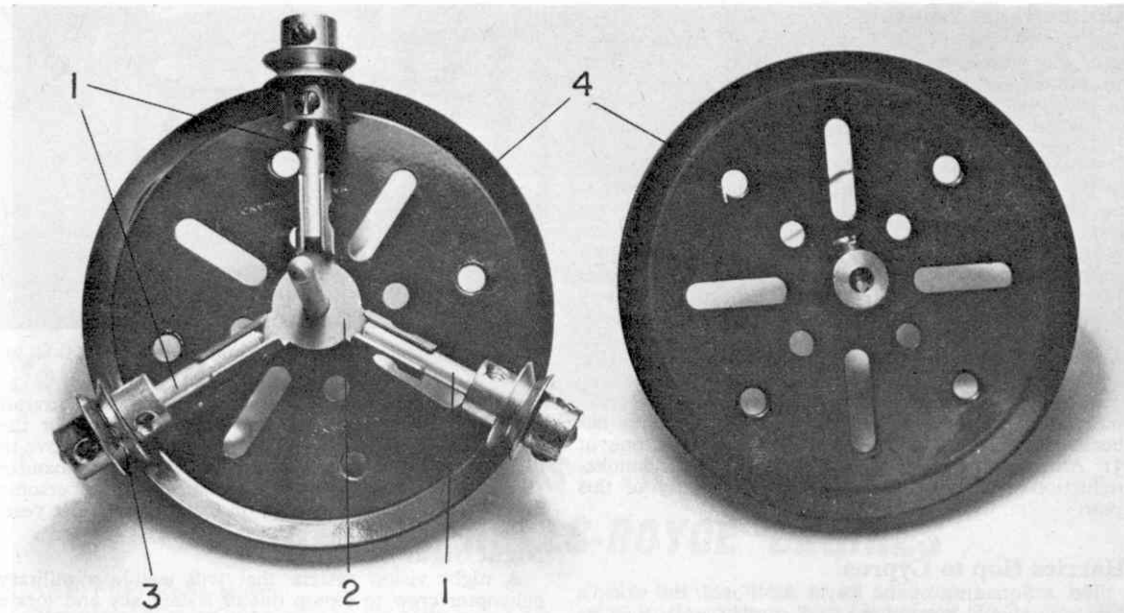
1971. They will be followed by 200 production aircraft for the French Air Force and Navy and 200 for the RAF. The confidence which test pilots already have in the Jaguar is shown by the fact that Wing Commander Jimmy Dell had no hesitation in going supersonic during the first flight of SO6 on October 12th last year.

Night Sight for Choppers

A night vision system that will enable a military helicopter crew to swoop out of a dark sky and locate an enemy illuminated only by starlight has been developed for the US Army by Hughes Aircraft Company. Known as INFANT (for Iroquois Night Fighter and Night Tracker) the system has been installed in a UH-1M Iroquois helicopter and demonstrated successfully during night operations in the California desert. As a result, it is being installed in a number of front-line helicopters and is expected to be used operationally in Vietnam.

INFANT requires only a very small amount of light, and can " see " in what is virtually total darkness to the unaided human eye. It does this by concentrating and intensifying the available light through a series of image intensifier tubes and a low-light-level television system. Two sensors mounted on the nose of the " chopper " each serve a different viewing system. A remote system, using the TV, presents an image to the crew on three cockpit displays. The other, a direct-view system using an image intensifier, transmits an image to the co-pilot-gunner through a fibre-optic cable. If sufficient light is not available for pin-pointing a target, a searchlight can be turned on to illuminate it.

A United States Army Helicopter fitted with the new INFANT night-sight device.



AMONG THE MODEL BUILDERS with 'Spanner'

COMPACT ROLLER RACE

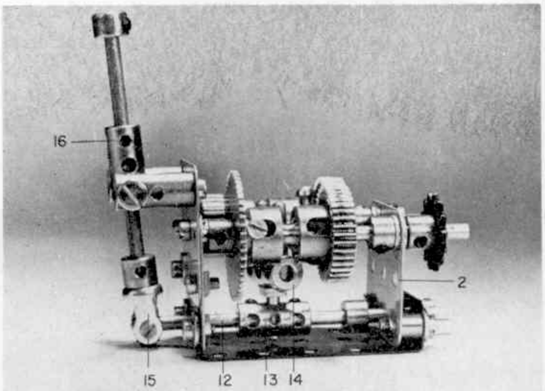
BECAUSE OF THEIR IMPORTANCE in Meccano modelling, Bert Love devotes this month's Chapter of his Meccano Constructor's Guide to crane turntables, roller races and associated mechanisms. Here, in this article—and at the danger of trying your patience too far!—I have a couple more mechanisms in this line I would like to present. The first, a very simple and compact unit, I feature, not because it is an entirely original idea—it isn't—but because this particular version of a known principle is designed by an 11 year-old enthusiast, C. J. Clotworth of Belfast, Northern Ireland. It just shows you don't need to be growing rather long in the tooth as a modeller before you have enough experience to think of useful ideas!

The Roller Race, itself, is amazingly effective in operation, yet it consists of little more than three 1½ in. Rods 1 inserted one into each arm of a 3-way Rod Connector 2, each Rod being fitted with a free-running ½ in. Pulley 3, held in place by Collars. The whole assembly is mounted between two 3 in. Pulleys 4, Pulleys 3 running on the inside lips of these 3 in. Pulleys. A Rod journalled in the bosses of the Pulleys, and running through the centre of the Rod Connector, serves to centralise the roller assembly, but remember that at least one of the Pulleys must be completely free on the Rod otherwise the mechanism will not function. That's all there is to it—well done C.J.C.!

ROLLER RACE 2

Our second roller mechanism is really only an extension of the first, with six rollers instead of the original three. As before, each roller is supplied by a free-running ½ in. Pulley without boss 1, mounted on a 1½ in. Rod 2 held in a 3-way Rod and Strip Connector 3, but, in this case, there is no need for the Pulleys to be held in place by Collars as they will be self-locating. Of course, as there are six rollers, two 3-way Rod and Strip Connectors must be used and these must be placed Rod-side to Rod-side so that the Rods interlock on the same level. The resulting "spider" is mounted between two Wheel Flanges 4, the grooves of Pulleys 1 engaging firmly with the flanged parts of the Wheel Flanges and at the same time keeping the Pulleys in place on the Rods.

Although not shown in the accompanying illustration, Bush Wheels or other suitable parts are bolted to the Wheel Flanges to provide centre bosses so that a centralising Rod may be passed through the Wheel Flanges and Rod and Strip Connectors. Again, remember that at least one of the Wheel Flanges must be left free on this Rod for successful operation.



Left: It may look very simple, but this Roller Race built by 11-year-old G. J. Clotworth of Belfast, is extremely effective in operation. Above: This compact two-speed Gearbox designed by a Lancashire reader, works on the constant mesh principle, as opposed to the mere usual "crash" system.

CONSTANT-MESH GEARBOX

Moving away, now, from roller races, we come to something entirely different: a Two-speed Constant-mesh Gearbox supplied by a Lancashire reader. The joy of this unit is that it does away with the need for a clutch and, because the gears are in constant mesh, completely removes the danger of any gear damage that might result from the "crashing" of the more usual type of gear arrangements.

In operational use the framework for the Gearbox would depend entirely on the parent model, but for the purposes of this article, a mounting is supplied by a 2½ × 1½ in. Flanged Plate, to one flange of which a 2 × 1½ in. compound flat plate 1, built up from two 1½ × 1½ in. Flat Plates, is bolted. Fixed to the other flange of the Flanged Plate, but spaced from it by a Collar on the shank of each ½ in. securing Bolt, is a single 1½ × 1½ in. Flat Plate 2. Journalled in the upper corner holes of this Plate and in the corresponding holes of plate 1 are two 3 in. Rods 3 and 4, Rod 3 being held in place by two Collars and Rod 4 by a ¾ in. Sprocket Wheel 5 and a Collar. Also mounted on Rod 3 are a 1 in. Gear Wheel 6, *fixed in place by a standard 7/32 in. Bolt*, and a Socket Coupling 7, in the outside end of which a ¾ in. Pinion 8 is secured. Note that the Socket Coupling and Pinion must be free to slide on the Rod.

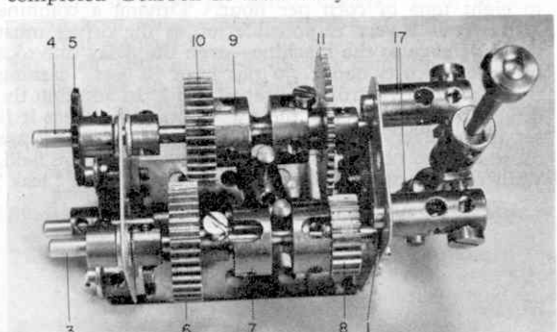
In the case of Rod 4, this also carries a Socket Coupling 9, this one fitted with a 1 in. Gear Wheel 10, both parts being free to slide on the Rod as one unit. Fixed on the Rod—again by a standard 7/32 in. Bolt—is a 50-teeth Gear 11. It will be noticed, by the way, that fixed Gears 6 and 11 are situated towards opposite ends of the Gearbox and mesh with the appropriate sliding Gear. These sliding Gears should never disengage the fixed Gears, therefore their travel should be limited to a distance slightly less than the width of Pinion 8.

Travel limitation in the model illustrated is easily achieved by the gear-change mechanism, built up from a compound 3½ in. rod 12 mounted in the centre holes of the flanges of the Flanged Plate and prevented from sliding too far by two Collars. The compound rod, itself, is made up from a 2 in. Rod and a 1½ in. Rod joined together by a Coupling 13, in the centre transverse bore of which a Threaded Pin is held. The threaded shank of this Pin is tightly screwed into the centre tapped bore of another Coupling 14, in the end smooth bores of which two 1 in. Rods are held. These Rods engage in the waists of Socket Couplings 7 and 9.

Fixed on one end of rod 12 is a Swivel Bearing 15, in the boss of which a 3 in. Rod is held to serve as the gear-change lever. Loose on the Rod is a Coupling 16, in the lower end transverse tapped bores of which two Pivot Bolts are held by Nuts, the Pivot Bolts, themselves, being carried in the end transverse bores of two Threaded Couplings 17 fixed to the upper corners of compound flat plate 1. A Collar is mounted on the upper end of the gear-change lever to act as a knob.

Regarding operation of the Gearbox, as all the gears are in constant mesh, actual gear-change is effected by engaging the slot in the free end of one or the other Socket Coupling with the 7/32 in. Bolt in the boss of the respective fixed Gear on Rod 3 or 4. Thus, when the gear-change lever is pulled back away from the gearbox, the two Socket Couplings are pushed forward away from the lever, engaging Socket Coupling 7 with the Bolt in Gear 6 and, at the same time, moving Socket Coupling 9 away from Gear 11. Socket Coupling 9 and Gear 10, of course, are free to turn on Rod 4 (the output shaft) and can therefore be temporarily discounted as they do not impart any movement to the Rod. However, because Gear 6 is fixed on Rod 3 (the input shaft), its rotary movement when the shaft is turned is transferred through Socket Coupling 7 to Pinion 8. This Pinion meshes with fixed Gear 11 on Rod 4, therefore a ratio of 2 : 1 results.

When the gear-change lever is pushed forward, Socket Coupling 9 engages with the Bolt in the boss of Gear 11, while Socket Coupling 7 disengages with the Bolts in Gear 6. Socket Coupling 7 and Pinion 8, are now free on the Rod and so can, in their turn, be temporarily forgotten. However, fixed Gear 6 meshes with similar Gear 10 and, as the latter Gear is connected by Socket Coupling 9 to fixed Gear 11, drive is transmitted to the output shaft at a ratio of 1 : 1. Neutral occurs where both Socket Couplings are disengaged from their respective fixed Gears. It sounds complicated on paper, but it's easier to follow with the completed Gearbox in front of you!



A top view of the Gearbox showing the layout of the input and output shafts.

PARTS REQUIRED

3—16b	1—27	1—51	1—96a
1—17	2—31	9—59	1—115
1—18a	9—37a	3—63	2—147b
2—18b	11—37b	2—63c	1—165
1—25	10—38	3—74	2—171

RICHARD LEF

HOW A COMBINE HARVESTER WORKS

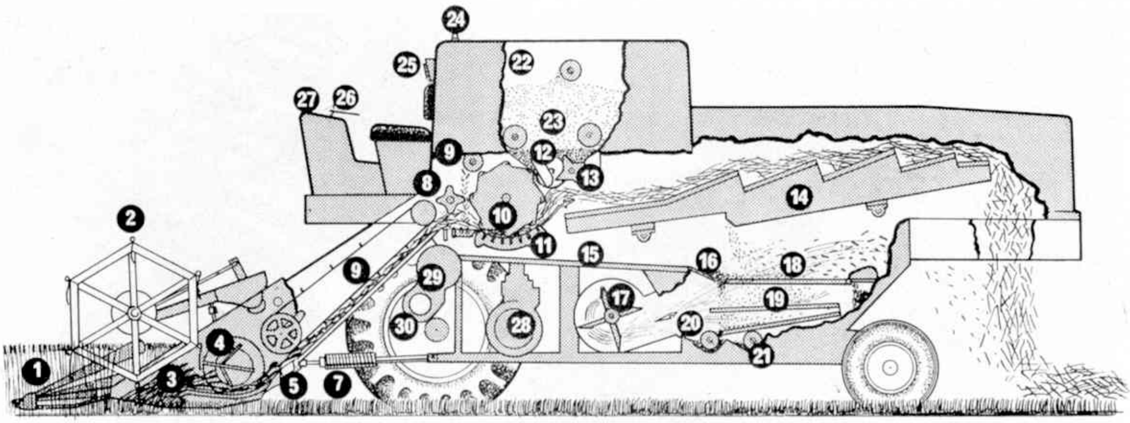
COMBINE HARVESTERS are majestic machines which can be seen hard at work every autumn in the cornfields of the countryside. Sometimes they work in teams to snatch the grain from ' corn prairies ' —like in Canada or on our own Wiltshire Downs— where huge tracts of corn have to be harvested in those few precious days of fine weather whilst the corn is ripe.

The combine harvester has been in use for over fifty years now, and each year brings new models which incorporate additional refinements. Basically, however, the design is much the same in principle to the first inventions. The sketch, which is of a Ransome ' Crusader ' harvester, explains how the machine is able to cut, thresh, sift and store the grain in a continuous ' factory ' operation all at the same time whilst it moves over the ground.

The large modern combines cost from one to five thousand pounds each. The model described will cut and thrash about three or four acres an hour. It is powered by a 100 horse-power engine and extracts up to eight tons of corn per hour. Driving a combine harvester is a very responsible job as the driver must avoid damage to the machine—even the delay due to a breakdown costs about £6 per hour in lost ' earning time,' quite apart from the repair bill ! In addition the driver must understand the machine and see that it is set to get every bit of corn that it can—bad settings cause corn to be wasted and spilled back onto the field. With corn at twenty pounds a ton, just a small ' leak ' will amount to an expensive loss by the end of a working day ! Apart from cereals, combine harvesters will also extract the seeds from crops like beans, or even grasses like ryegrass and timothy which are grown for re-seeding grass fields.

Two combines working as a team. Between them they can harvest twelve tons of grain in an hour—or about six acres of a high yielding crop !

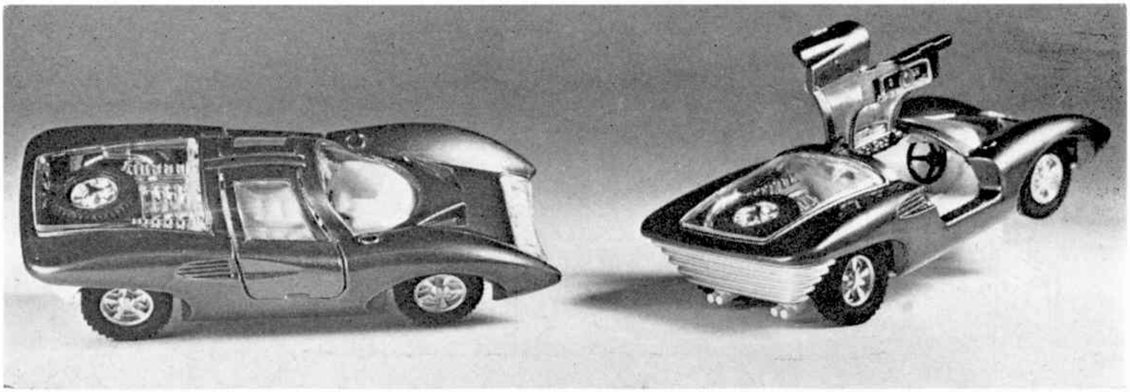
Upper : A giant Massey-Ferguson Combine eats into a healthy crop of wheat. Lower : A Massey-Ferguson 515 machine at work in a rather storm-tangled crop of barley. The driver has to use all his concentration to gather the crop and deal with it cleanly. The windrows of threshed straw lying on the stubble are the evidence of his skill—a good driver leaves the field ' tidy '.



KEY TO DRAWING

1. 'Fingers' run through the crop first of all to tear out any tangles in the way the standing crop is presented to the advancing combine harvester.
2. The pick-up reel 'combs' the crop onto the cutting table so that it falls head-first in an even flow.
3. A sharp knife-bar, reciprocating between small fingers, cuts the corn at stubble height.
4. A rotating auger winds the cut corn from either end of the cutting table to the centre to feed it into the central conveyor tunnel. (See photograph.)
5. A stone trap sorts out any odd stones which have come in with the crop and prevents them from going up into the 'works' where they could cause damage.
6. The feed elevator takes the corn up to be threshed.
7. Springs and hydraulic rams balance the weight of the cutting table to give it a 'floating' action so that it can rise over any obstacle it might meet, such as uneven ground.
8. Primary threshing beater flails round and knocks out the really loose ripe grain.
9. A feed-back auger at this point returns corn for re-threshing which has escaped perfect threshing the first time through.
10. The main threshing drum flails beater bars against the corn at a high speed and rubs all the grain out of the ears in the stalks.
11. The 'concaves' are the concave-shaped grids against which the corn is rubbed by the drum, the loose grain falling immediately straight through the grid.
12. A 'cut-off' plate set close to the drum prevents straw from wrapping around the drum to cause a blockage and seizure.
13. A rear beater revolves to progress the thrashed straw to the straw-walkers. Also a plate here prevents loose grain from being ejected to the rear of the machine.
14. Serrated jog-through 'straw-walkers' convey the straw backwards with a tossing motion. Loose grains still in the straw fall through and are carried back for sifting by the return incline of the walker floors.
15. Grain delivery pan is where all the grain so far secured meets in preparation for sifting. It contains dirt, dust, small stones and many tiny pieces of broken straw and chaff at this stage, as well as weed seeds from weeds which have been harvested along with the crop—thistle seeds, etc.
16. Cascade sieve takes the bulk of fairly clean grain direct to secondary sieves.
17. Fan blows air over the grain as it is seived, thus blowing away light debris which exits through machine rear along with straw falling off the walkers.
18. Top sieve shakes to and fro, allowing grain sized objects to fall through. Oversized trash conveyed to the rear.
19. Lower sieve again cleans the corn falling from higher sieve.
20. An auger revolving in the well scrapes the grain to the side of the machine to be conveyed to the holding tanks aloft via a chain and bucket elevator.
21. Residue from final sieve is fed back via separate conveyor mechanism for re-threshing. It enters the drum to go around again at point (9) as explained.
22. Grain tank—on modern machines the tank capacity may be as much as one ton.
23. Twin augers assist the main delivery auger to discharge the grain via delivery pipe to outside trailer or lorry as required, the lorry driving alongside as the combine proceeds, taking grain off without interrupting harvesting.
24. Flashing light on tank top tells distant lorry-driver when tank is starting to brim. The grain must be taken off before overflow point in order to keep the combine harvester at work for every vital moment !
25. Headlights mounted on the combine enable the machine to work through the night if required. This will depend on whether much dew has fallen with the sunset. Wet corn will not go through the harvester cleanly and results in wet corn which will soon go bad if not artificially dried—an expensive and unwanted extra task.
26. Driver's steering wheel. Many combines have power-assisted steering these days.
27. Instrument panel tells the driver the height of the stubble he is leaving uncut, also rev. counters for engine and drum speed, also oil pressure, fuel gauges, etc.
28. Engine unit, mounted low for stability, usually diesel from 50-100 h.p. which powers the many moving parts of the entire machine.
29. Gear-box allows the driver to select three forward and reverse gears.
30. Disc brakes on the main driving wheels. Steerage is via the rear wheels.

Acknowledgements to Ransome Sims & Jefferies Ltd., for diagram.



DINKY TOY NEWS

"Two in time" by Chris Jelley

LAST MONTH, Meccano Magazine was conspicuous (or so I like to think !) for not containing any news of Dinky Toys and I don't mind admitting I was beginning to think that this issue would suffer the same loss. It's difficult to review new models with no new models to write about, yet the releases scheduled to come off the production lines at Binns Road still had not appeared when the time arrived for the first of this month's models features to go to the printer for setting. Things were getting serious, but, I thought "Don't despair. There's still a few days to final deadline." And my optimism was rewarded. A Ferrari P5 and D.800 Tipper Truck appeared on my desk with plenty of time to spare—and they were well worth waiting for !

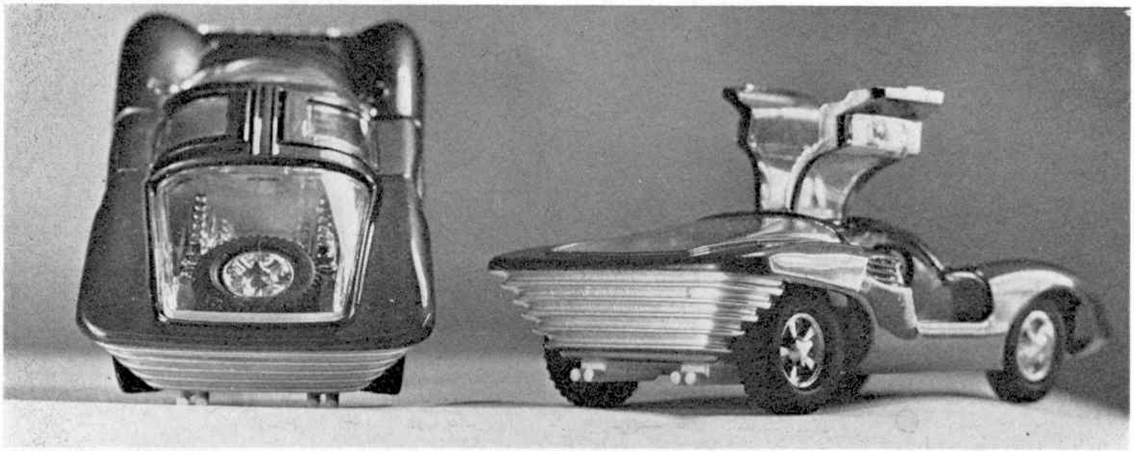
Dealing first with the Ferrari, this really is a model to appeal to sports car collectors. In real life, of course, Ferrari are among the world's top sports car manufacturers, often pioneering completely new designs. In fact, Ferrari have probably done more to influence the technology and shape of the entire sports car field than any other single manufacturer in existence. The industry never knows what to expect from the company as every new vehicle to appear is likely to include a revolutionary feature of some sort. The P5, when it was introduced, was no exception. This came complete with a fluted rear body section and a fully transparent cover to the engine compartment !

Naturally, when a small-scale die-cast model manufacturer sets about producing a miniature version of a real-life car, he does his best to reproduce all the major features of the original. Dinky have long been renowned for their accuracy in modelling and so, as you might expect, the new Dinky Ferrari P5 not only captures all the general lines of the real thing, but also boasts a fully transparent engine cover ! This is non-opening, but it serves its purpose admirably, i.e., it allows an unrestricted view of the model's rear-mounted 12-cylinder "engine," not to mention the spare wheel which is also carried in the engine compartment. At the front of the model, another particularly notable feature is a headlamp assembly which, like that on the full-size P5, comes in the form of one long "glass case" running from wing to wing, while, in the centre of the body, a pair of opening "gull-wing" doors give access to a fully-detailed cockpit complete with window, seats, steering wheel, and even a minute gear-shift lever.

Fitted externally is something which is a "must" for a modern Dinky sports car: Speedwheels—the free-running, low-friction wheels that take a model far and fast. The two rear wheels, by the way, are fitted with extra-wide, "racing-type" tyres which really look good. Marketed under Sales No. 220, the P5 before me is finished in a flamboyant red gloss with yellow interior and silver body fluting. The engine moulding is silver-plated and stands out beautifully against the gleaming red of the body.

Ford "Heavy"

Sleek high-powered sports cars may figure in the secret dreams of most drivers, but a vehicle of much greater importance as far as essential transport goes is the "heavy": the commercial vehicle, without which all industry would be seriously handicapped. Like the private car, the design of the commercial vehicle has altered radically over the years, keeping pace with changing tastes, until, today, the average commercial can look as modern in its own way as any private car likely to honk a horn. Dinky Toys have always had a fair selection of "heavies" in their extensive range



This picture clearly shows the transparent engine cover and fluted rear body section of the new Dinky Toy Ferrari P5, No. 220.

Now they have come bang up to date with the brand new Ford D.800 Tipper Truck, marketed under Sales No. 438.

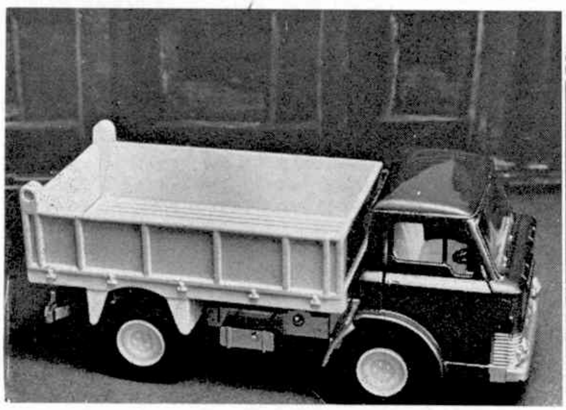
In real life, the D.800 has already won acclaim among fleet operators throughout Britain and the new Dinky stands every chance of doing the same among model collectors. Produced predominantly in die-cast metal for strength, it sports a feature-packed cab and tipping load body, both built on to a detailed chassis equipped with separate chassis members. The cab itself is fitted with wide-opening doors, windows, steering wheel, jewelled headlamps and, of course, full seating, the seats being laid out in the modern single-driver, twin-passenger arrangement.

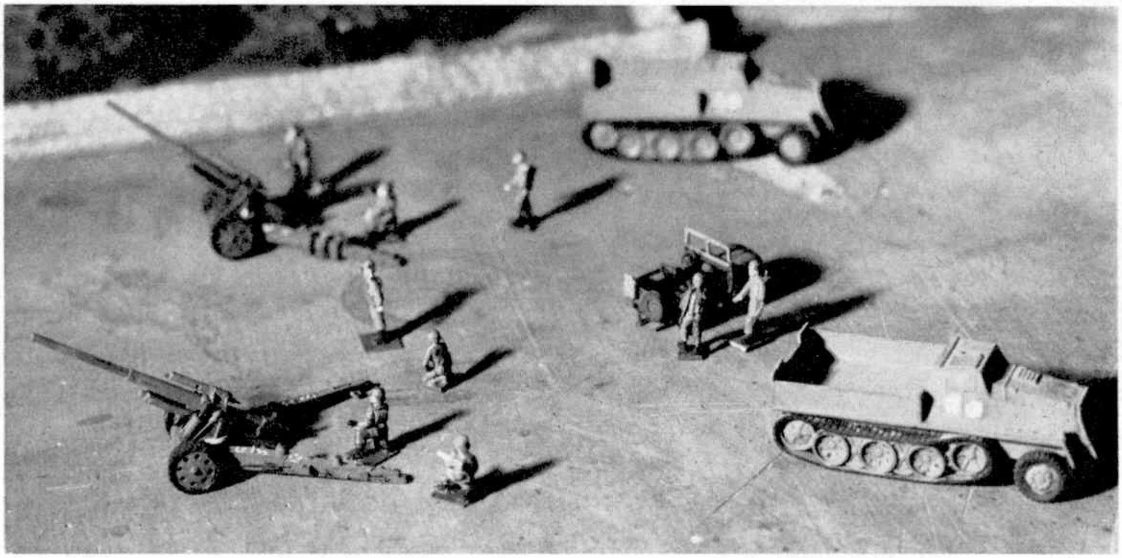
The load body, based on the regular 4-sided design used to carry anything from earth to oil drums, is equipped with an opening tailgate and tips through an angle of no less than 60 degrees to ensure that even the most stubborn load is unshipped. Hand-operated, the tipping angle is controlled by a simulated hydraulic ram running between the chassis and detailed underside of the load body.

True to modern ideas, finish is eye-catchingly bright and colourful, the model before me having a flamboyant red cab, set off by a white interior, and a yellow load body on a silver chassis. Also silver is the radiator-grille which, of course, carries the well-known " Ford " name in large letters across its centre. Black number plates with silver lettering are included at front and rear to add the final touch to a highly realistic model, packed with play-value.

Before signing off, I should like to explain why, when describing the colours of new Dinky Toys for the " M.M.", I make a point of saying " the model before me." When a new model is made, the production schedule calls for it to be finished in a particular colour-scheme, depending on the choice of the designers as well as the enamel available in the paint stores. Consequently, the model is, in nearly every case, produced in the designated colours, but there are occasions when the colours are altered and this can occur at any time from the design stage onwards. As a result, it is possible, although not usual, for the model you buy to be a different colour to the early-production model I receive for review and, for the same reason, the colour of a Dinky Toy may differ from the illustration on the box in which it comes. The boxes are, of course, printed considerably in advance of a new model going into production and, in fact, the manufacturers point out the possibility of a colour difference on the boxes, as you may have noticed. It does not happen often but, as I say, it is a possibility and so I like to make it clear that I refer to my specific review model—not each and every model !

Commercial vehicles are vital to modern industry and the Dinky range recognises the need with the brand new Ford D.800 Tipper Truck, No. 438. The load body of the Dinky D.800 tips to an angle of 60 degrees to ensure that the most stubborn load is unshipped.





'BATTLE' By Charles Grant

PART XXV

MORE ABOUT MORALE

HAVING DISCUSSED at some length the theory of morale it is now incumbent upon us to take a look at the practice thereof.

First, when considering the operation of a Morale Rule, we have to decide upon the size of each individual section or group to which the morale assessment would be applicable (it having already been pointed out how inappropriate it would be to make a single assessment for a complete battalion or regiment). This, obviously, will largely depend on what sort of organisation the wargamer has decided to adopt for his army, and this is especially cogent when the question is one of estimating the effect of a number of casualties on the survivors of some group of men. It is apparent that the loss of one man will have less effect on a unit or section of, say, ten, than it would on one consisting of six individuals. Knowing then that each individual wargamer can, without a great deal of difficulty, adapt a generalised sort of rule to suit his own purposes, I propose then to lay down such a morale rule as is applicable to my own setup, and if that of the reader varies in a major degree, he can easily fiddle about with what I have proposed until he arrives at something more suitable to his own organisation.

Let us take then as an example the motorised infantry battalion whose break-down we have already discussed and with which indeed we have already seen action. It consists, it will be recalled, of three rifle companies and a headquarters company, and it will be convenient to consider, for morale purposes, each of the rifle companies as one unit. They operate independently for most of the time and, as such, each may be considered as an appropriate entity for morale assessment. They have much more individual identity than the Headquarters Company which, as we shall see later, will have to be subdivided in this connection.

Looking back to Part XXIV, let us quickly list again, prior to discussion, the factors which we decided were the principal ones influencing the morale of a unit. They were (1) Control, (2) Cover, (3) Communication, (4) Casualties, and (5) the state of the unit's transport, if this be applicable. These points, considered together with the 'imponderable', the unpredictable factor, which for want of a better term we can call 'luck', will determine the behaviour of wargame troops under fire. Before this, though, we have to say when it becomes necessary to make this assessment. Briefly, it is abundantly clear that troops moving peacefully along a road, with no enemy at hand, are generally in good fettle, morale-wise, and it is only when they are plunged into action that things may start to happen. We shall go a little further and deem, for wargame purposes, that it is only when casualties have been suffered, or when the transport—truck, half-track or whatever—in which the men have been travelling has been destroyed, that such assessment is required. The preamble to the Morale Rule reads accordingly—

"When casualties have been suffered by a section, or when the vehicle in which that section has been travelling has been destroyed, then a Morale Rating must be taken for that section".

Right, so far, so good, and on we go. What we want to do now is to choose a number, a sort of 'constant' which, when considered in conjunction with the various Morale Factors *and* the 'imponderable', will show whether or not the section of troops is in good spirits. After some prestigious calculation to say nothing of an immense amount of trial and error in the past, the magical number has been found to be 10. This means that if, when the dice throw has been made and the relevant Morale Factors added or subtracted, the resulting total is still 10 or more, then the unit is of good morale and can continue to behave as its commander—i.e. the wargamer—would wish. The system works admirably within the framework of the organisation and rules which have been set out in "Battle" and should require only slight modification if the reader's setup is materially different.

Bearing in mind then that we start off with a '10', we shall have a look at the different factors and their effect on the final Morale Rating. The first, as we will remember, was Control, and this simply means the presence or absence of the section leader who may, as we know, be an officer or an N.C.O. If this character is not with the group—his absence usually indicating that he has become a casualty—a deduction of 1 must be made to the total with which the unit commenced. If the leader is still about, 'control' is up to scratch and the deduction need not be made. By being present we mean that he is stationed where he can exercise an effective control, possibly in a central position and certainly within shouting distance of at least one of his men, say 50 yards. This gives us the opportunity of laying down an ancillary rule—

"For a section to be operational, the leader must be within 1½ in. of at least one of the group he commands".

This naturally leads on to the problem of what happens if the leader *does* become a casualty and the solution is a very easy one. The next in seniority would take over—the choice for this individual being up to the wargamer—*but* it would take a little time for the chain of command to be reorganised, so we enact that—

"When a section leader becomes a casualty, two clear moves must elapse before the next in command can take over and during this period the section must remain halted. It may, however, if actually engaged with the enemy, continue in action".

So much for Factor (1)—Control—we can now consider Factor (2)—the question of Cover. It is quite apparent that troops enjoying the protection of some sort of cover will normally feel somewhat more confident than they would were they scattered about the middle of a large, open field. Thus we make allowance for both types of cover—the 'hard' and the 'soft'— and if perchance it happens that some of the section are in 'hard' cover, some in 'soft' and maybe some in the open, we quite simply take a sort of average. If more are under cover than are without—then we consider the lot as being in the first category. If the reverse is the case, then they will have to do without the advantage provided by the cover. One point relating to cover concerns troops who have just been flung out of or who have escaped from a half-track or other vehicle destroyed by enemy fire. As we know, survivors of such an event are placed next to the vehicle (overturned to signify that it has been destroyed), on the side away from the enemy. This cannot, in the first instance, be considered as cover for these chaps. What really happened was that they jumped out from every possible exit, and while this was taking place many of them would be under fire, and in the open, as they scuttled round to the 'safe' side. Now for the details. For troops in soft cover, neither addition nor deduction is made to the Morale Rating. If the troops are in 'hard' cover, *add* 1, and if they are, unluckily, in the open, 1 is *deducted* from the total. This seems fairly straightforward, so we can go on to deal with the 'communication' factor.

This—'communication'—will refer to either personal contact or by means of radio. In the case we are discussing, as the infantry section I use is without radio, it obviously applies to visual or personal contact—or vocal if you like. If then, a section is out of sight of its headquarters, either by reason of terrain irregularities or through poor visibility, and its Morale Rating has to be established, 1 is subtracted to allow for this disadvantage. I would stress that this deduction is made within the framework of the rules applicable to the organisation as already set down, and is merely a basis for any wargamer who decides on something different, and who may, for instance, allocate R/T—possibly a man with a limited range "walkie-talkie" sort of thing—to every infantry section. If such were the case and *he* became a casualty, then the deduction of 1 would have to be made. This radio operator would naturally have to come under the rules for obtaining radio contact with his 'control', presumably the Headquarters Company, and if he failed to do so, then—No contact, and minus one.

On to Factor (4) then—the effect of casualties. Obviously, with different players having possibly varying unit strengths, this will have to be a proportion rather than a specified number of men. The loss of one man, as I have pointed out—probably unnecessarily—will have more effect on a small unit than on a large one. Therefore, if we work on a proportion of the whole, we say that, if one quarter of the rank-and-file strength of a unit has been lost, 1 is deducted from the Morale Rating, and, if a half is gone, then 2 has to be similarly subtracted. For example, in our section of 8 other ranks, if two men become casualties, 1 is deducted, and if 4 have been removed from the table for the same reason, then 2 has to be taken away from the total. In practice it will be found that the loss of fifty-per-cent of a group's effectives will almost always result in the group's being written-off as an effective military entity. If your section numbers 10 rank-and-file, three men would have to fall before the quarter proportion became applicable. In other words, I suggest that the odd ones be ignored—otherwise one's calculations become too involved.

Finally, we have the rather special case—the one involving the destruction of transport—Factor (5). This operates on the move succeeding that in which any troop carrying vehicle has been destroyed by enemy action. When the Morale Rating is taken, a deduction is made—only during this particular move—of 1—to simulate the shock and so on of the vehicle's being hit and the consequent unnerving scramble out to comparative safety.

So much then for the practical details of the various factors influencing morale and behaviour in a group of wargame soldiers. In Part XXVI we shall see how the system operates and shall look at one or two illustrative examples.

GREAT ENGINEERS No. 28

ROBERT FULTON

(1765–1815)

by A. W. Neal

THIS ARTIST TURNED ENGINEER was born in Lancaster, Pennsylvania, U.S.A., his parents being Irish emigres. His father died when Robert who was one of five children, was three years old, ano the family were left in poor circumstances. He received his introduction to education from his mother, later attending a local school and as a scholar he showed little aptitude in general studies but excelled in art. At an early age he readily took over the duties of family bread-winner, and before he left for England he had purchased a home for his family. Indeed, during the whole of his absence in Europe he contributed to the finances of his family.

Fulton was seventeen when he went to Philadelphia to train as a jeweller, but eventually established himself as an artist. Benjamin Franklin (he advanced the single-fluid theory of electricity) advised him to go to England for further training, which he did, arriving in London during 1787. Benjamin West, the American painter, took him into his studio but for some reason Fulton did not settle down and he abandoned art for the pursuit of engineering.

In 1793 he designed a mill for cutting stone which was set to work at Torbay. In the same year he was advocating inclined planes instead of locks for waterways, and also suggested the use of steam for driving ships. Some of his ideas were not new, yet he devoted himself to canal matters, which were then in their heyday, and in particular to a machine for excavating them, but unfortunately things were not going well for him in 1796, a time when his financial position was at its lowest. His luck turned the following year when he sold a part interest in his inclined plane idea.

Fulton was now temporarily flushed with money and crossed the channel to France with the object of developing his schemes for canals there. He secured a French patent for his inclined plane, but France was pre-occupied with weapons of war so the versatile Fulton came up with an idea for a submarine, although this was not new. His long struggle with naval officialdom brought nothing tangible, so he turned to the Dutch but this was also unsuccessful. He developed a rope-making machine and established a Panorama in Paris in 1800. Shortly after the French had second thoughts about submarines, and in that year Fulton completed his *Nautilus*, which had a copper hull and was driven by a hand-turned propeller. It had a snorkel tube and a sail for surface sailing, both capable of folding down when the vessel was submerged. Its first dive lasted eight minutes, and a subsequent one for seventeen minutes. He made a 70 mile voyage with it and attempted to destroy two English brigs. Tests were also successfully completed on another of Fulton's contrivances, the torpedo.

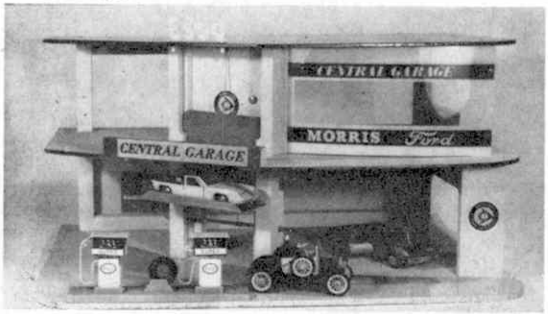
But Fulton was thinking in much wider terms and was anxious to take part in the developments of steam navigation. His first steamer was completed in 1803 and was wrecked in the Seine. Salvaging the machinery he built another which showed great promise during its trials. He returned to England and discussed steam engine problems with James Watt at the same time supervising the construction of a batch of torpedoes for the Admiralty. Some time earlier he had met Robert Livingston, a prominent American, holding a sole licence to operate steamships in the State of New York, and they joined hands to exploit this. Fulton returned to America where he demonstrated his torpedoes, and he was asked by the U.S. Government to undertake canal work. He refused, preferring instead to proceed with steamship design and first vessel was completed in 1907. Then came his 'The Car of Neptune' which was engined by machinery of his own design. By 1815 he had built no less than 17 ships, the last being the 60hp '*Chancellor Livingston*,' named after his partner. Another of his projects was the first ship-of-war, the '*Demologis*,' a twin-hull craft with a paddle wheel between them. She carried thirty guns and two columbiads for firing under water It was during an inspection of the '*Demologus*,' then at anchor in the Hudson, that Fulton caught a cold which turned to pneumonia from which he died.

Fulton was a dedicated man with a keen business turn of mind, and seems to have had little time for anything but his work. He has been called the 'George Stephenson' of the steamboat, yet John Rennie, the engineer, considered him to be " of slender abilities."

HAVE YOU SEEN ?

Model Garage

A natural addition to any collection of Dinky, Corgi or Matchbox models is a garage, and a few days ago we received the sample shown from the manufacturers, Tudor Toy Company. We would mention at this point that this Company produce an extensive range of Forts and Garages, this one being at £2 12s. 6d. the cheapest in the range.



Illustrated above with three of the latest "Dinky" releases, is the smart new garage from Tudor Toys. Its brightly finished paintwork and rugged construction make it excellent value at £2 12s. 6d.

Constructed of hardboard and wood, it is a surprisingly robust unit, strong enough to sit on in fact! The unit is built on a base board measuring 12 in. × 16 in., and consists of a two-storey building with space for upwards of 20 model cars. The top storey is reached by a small lift, operated by a winding handle situated across the lower centre pillars. The top storey has large clear plastic "showroom" windows giving the garage name and the cars it sells.

The lower storey features a large open service department/showroom, and on the forecourt is placed the small "island" containing two nicely detailed petrol pumps and a spare tyre in a rack. (These items are supplied with the garage.)

The forecourt is finished in bright yellow, the main structure in sky-blue and the roof is brilliant red, making this a very attractive unit.

The price, as we stated earlier is £2 12s. 6d. and represents excellent value for money.

Manufacturers: Tudor Toy Company.

German 0-4-0 Diesel Shunter

This little model, built to HO scale by one of

This new loco from Fleischmann is superbly detailed and runs like a watch.

Germany's leading model railway firms, would not look out of place as an industrial shunter on a British layout. It is painted in an attractive green and yellow livery, with black and yellow striped buffer beams. Our picture cannot show you how well this model runs—it will creep along at walking pace with a heavy train with never a falter. Automatic couplings are provided at each end. Overall length is $4\frac{3}{8}$ inches and price 78s. approximately.

Manufacturer: Fleischmann.

Above: The Lockhead Hercules from Airfix. Opposite: Three freight wagons once again from Hornby.

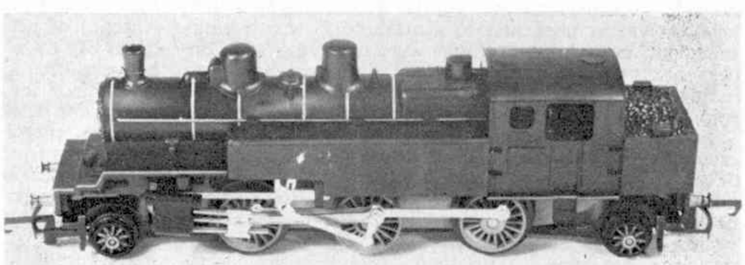
Tri-ang "Continental" 2-6-2 Tank

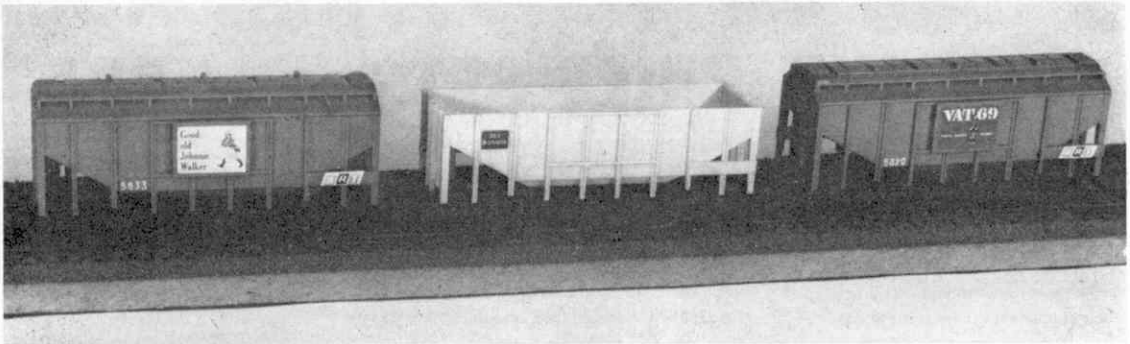
This latest locomotive in Tri-ang's OO range is really a freelance design, but it certainly has an authentic "Continental" look. The body is moulded in dull black plastic, with metallic boiler bands, and the wheels and frames (but not the "motion") are finished in red as in typically European practice.

A useful model, we feel, for those who like to run freelance model railways. Price 73s.

Manufacturers Tri-ang/Hornby.

Shown right is the new Tri-ang Continental locomotive, one of the most attractive around at present, and well up to the Hornby standard.





Lockheed Hercules

As promised in last month's " On the Editors Desk " herewith a brief review of the latest kit from Airfix. Measuring 22 inches from wingtip to wingtip and 16 inches in length overall, this kit is no midget! Despite its large size assembly is quite straightforward and all the parts fit together well. We were impressed with the quality of the clear parts, i.e. cockpit canopy which arrived scratch free and was simple to fit. Interior detailing is excellent and includes full cockpit parts, even pilots! Extras for the kit include a Bloodhound guided missile and a Landrover, plus of course personnel for the above!

Priced at 21s. 6d. we feel that this represents very good value for money, and its sheer size makes it a very interesing model to construct.

Manufacturer: Airfix Ltd.

Freight Wagons from Tri-ang

Illustrated are three interesting Tri-ang freight vehicles. The two end wagons are " Private Owner " Bulk Grain carriers, one *Johnny Walker* and the other *Vat* 69. Both these carry blue livery, and the lettering and insignia are beautifully clear and sharp. These modern long wheelbase wagons have plenty of surface detail, all of which has been well represented in the models. Even the underframes are well detailed, with complete brake gear and solebar details.

The middle vehicle in the picture, and built on the same chassis is the 35 ton hopper wagon, for bulk mineral traffic. This is finished in standard B.R. freight stock grey.

The bulk grain wagons are 10s. 6d. each, and the hopper wagon 8s. 6d.

Manufacturer: Tri-ang/Hornby.

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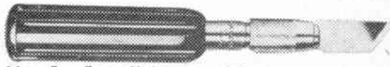

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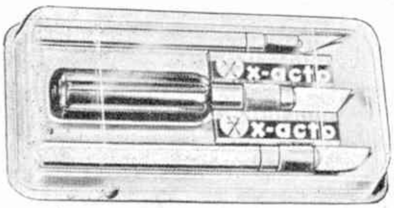

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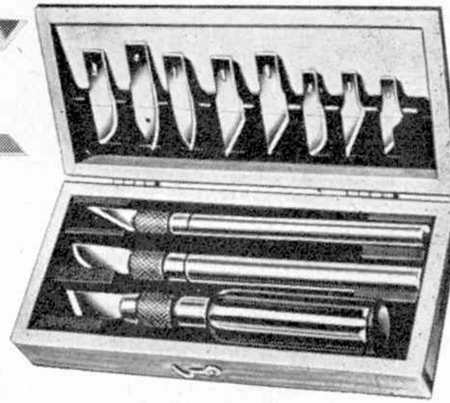

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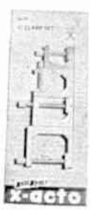

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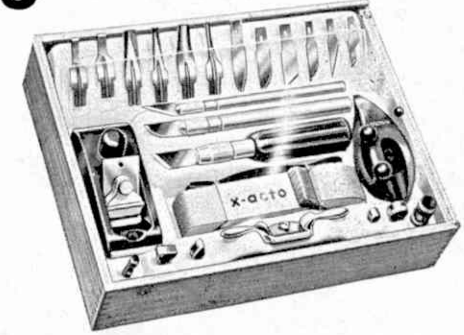

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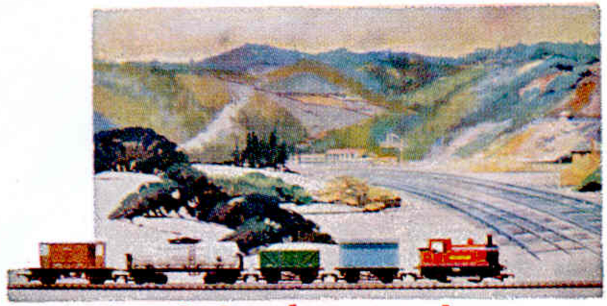

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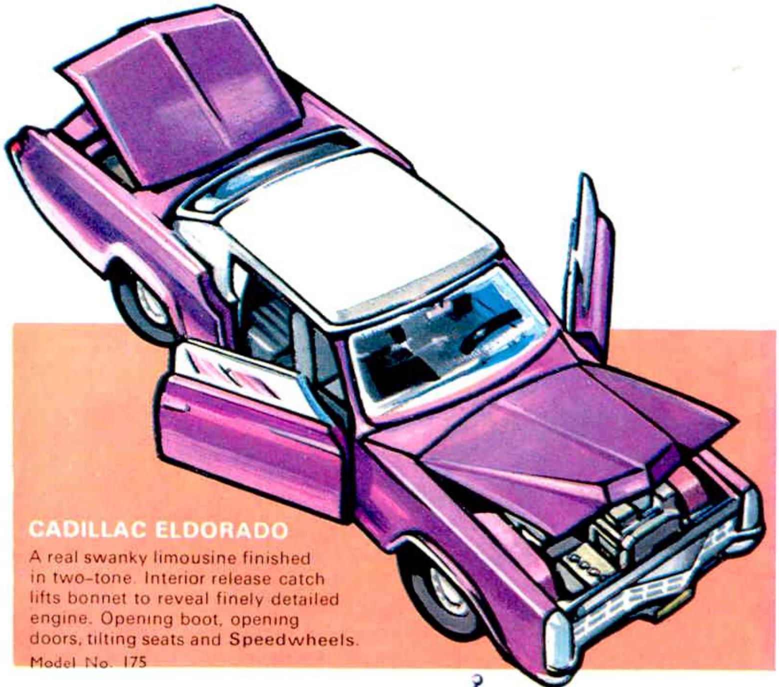

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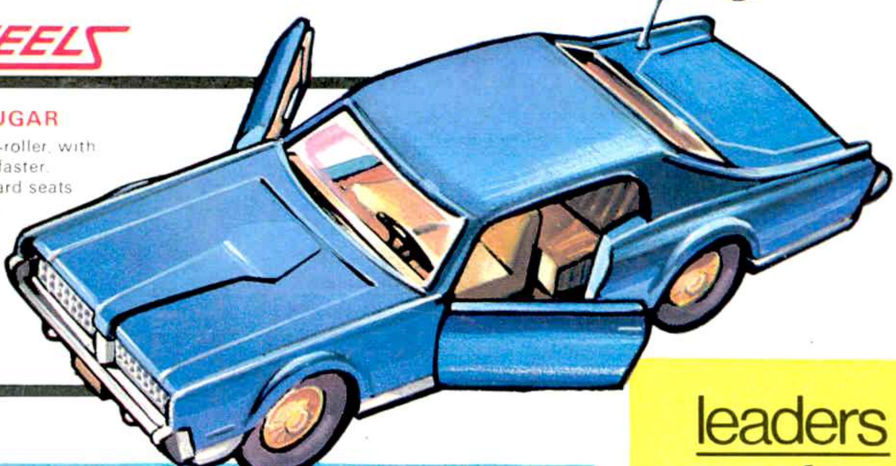

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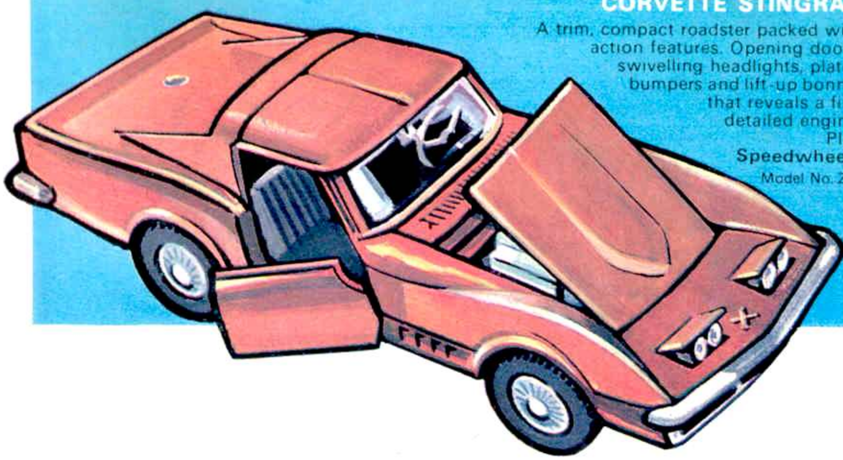

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