MECCANO® Magazine

NOVEMBER 1971

15p

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MAP HOBBY MAGAZINE

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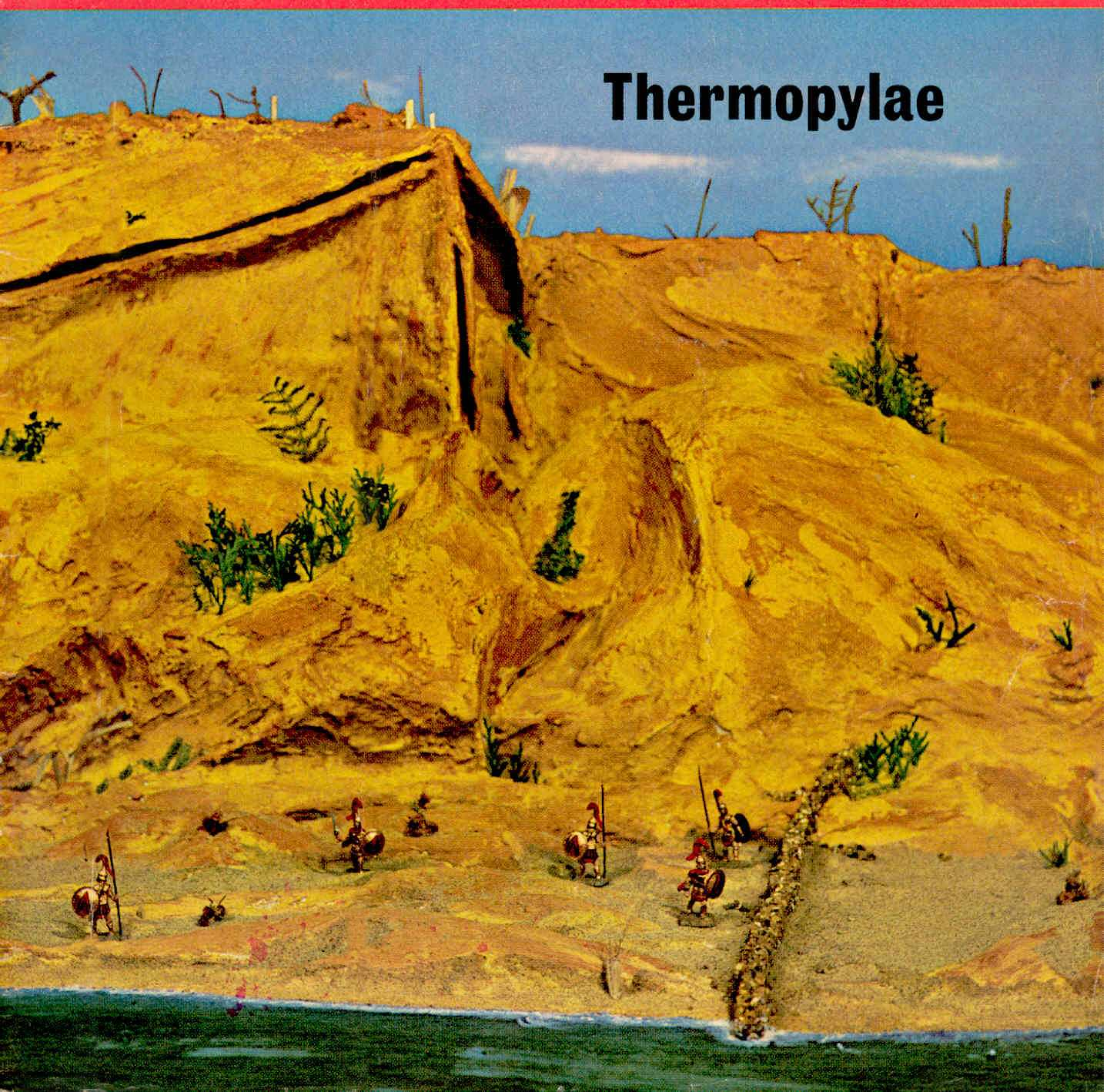

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MECCANO® Magazine

NOVEMBER 1971 VOLUME 56 NUMBER 11

Meccano Magazine, founded 1916

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MAP **HOBBY MAGAZINE**

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FRONT COVER

The Pass of Thermopylae, built by Charles Grant, forms the scene for "intimate" battle-gaming or a set-piece of great historical interest.

NEXT MONTH

Full-size plans for a hovercraft model and articles on snow-sleds, do-it-yourself art, and old-time coaching are some of the features to look forward to in our Christmas issue.

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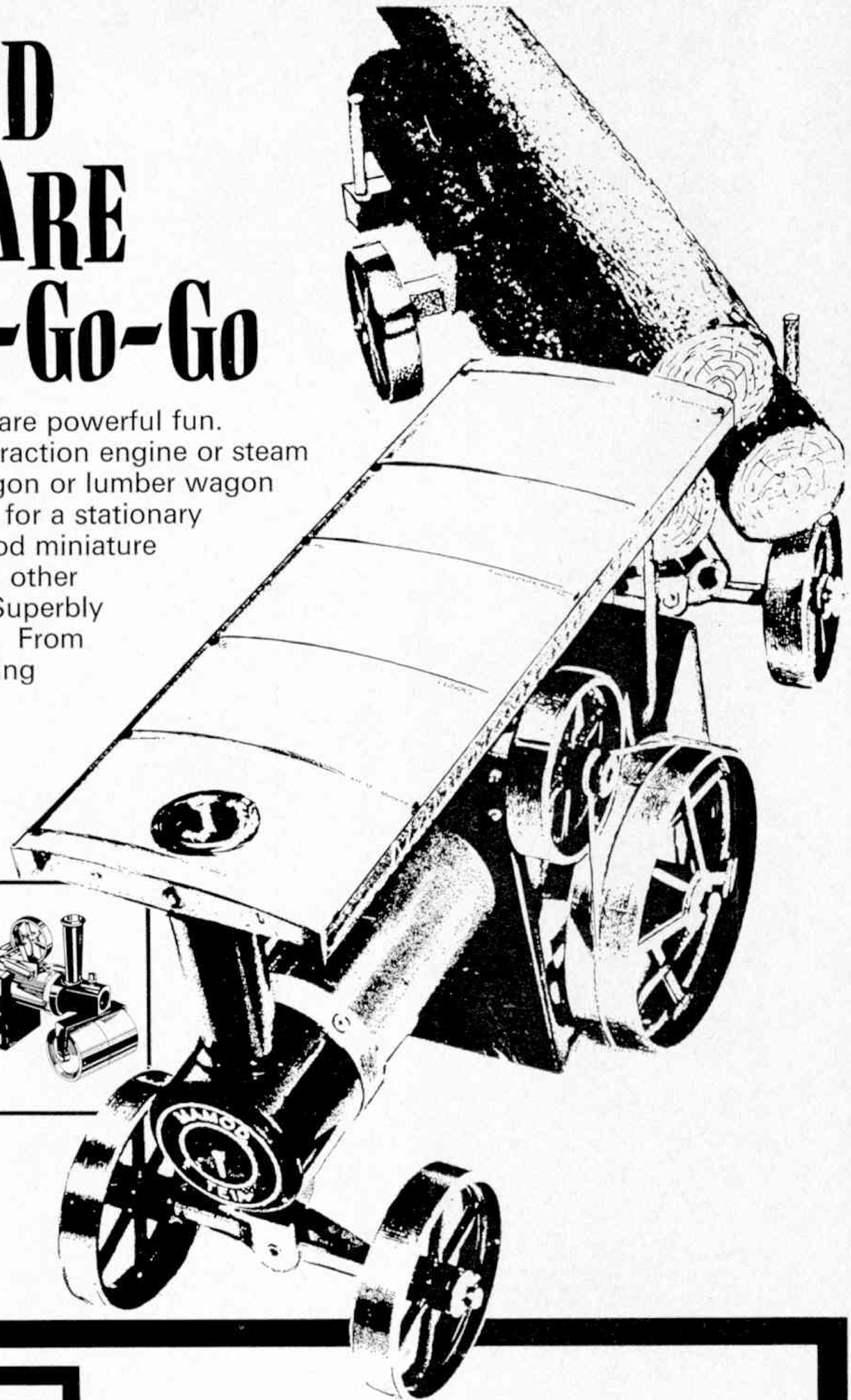

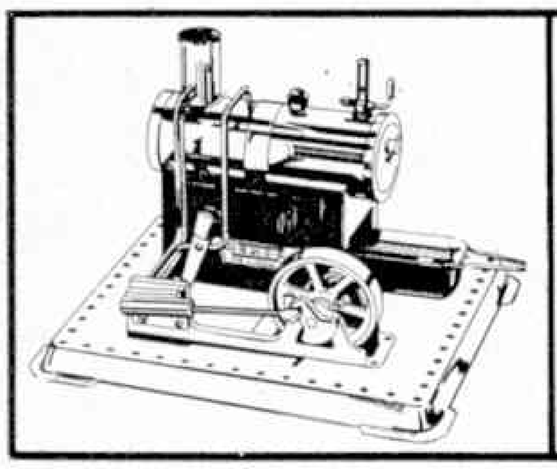

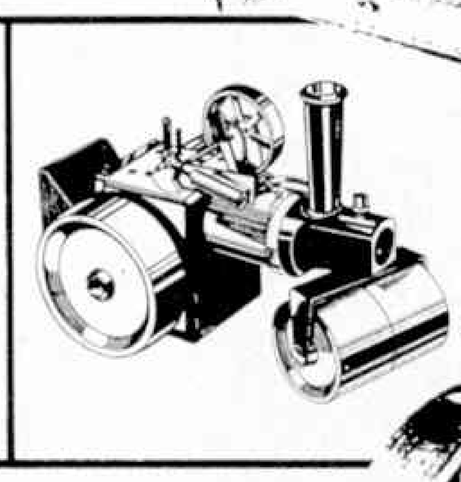

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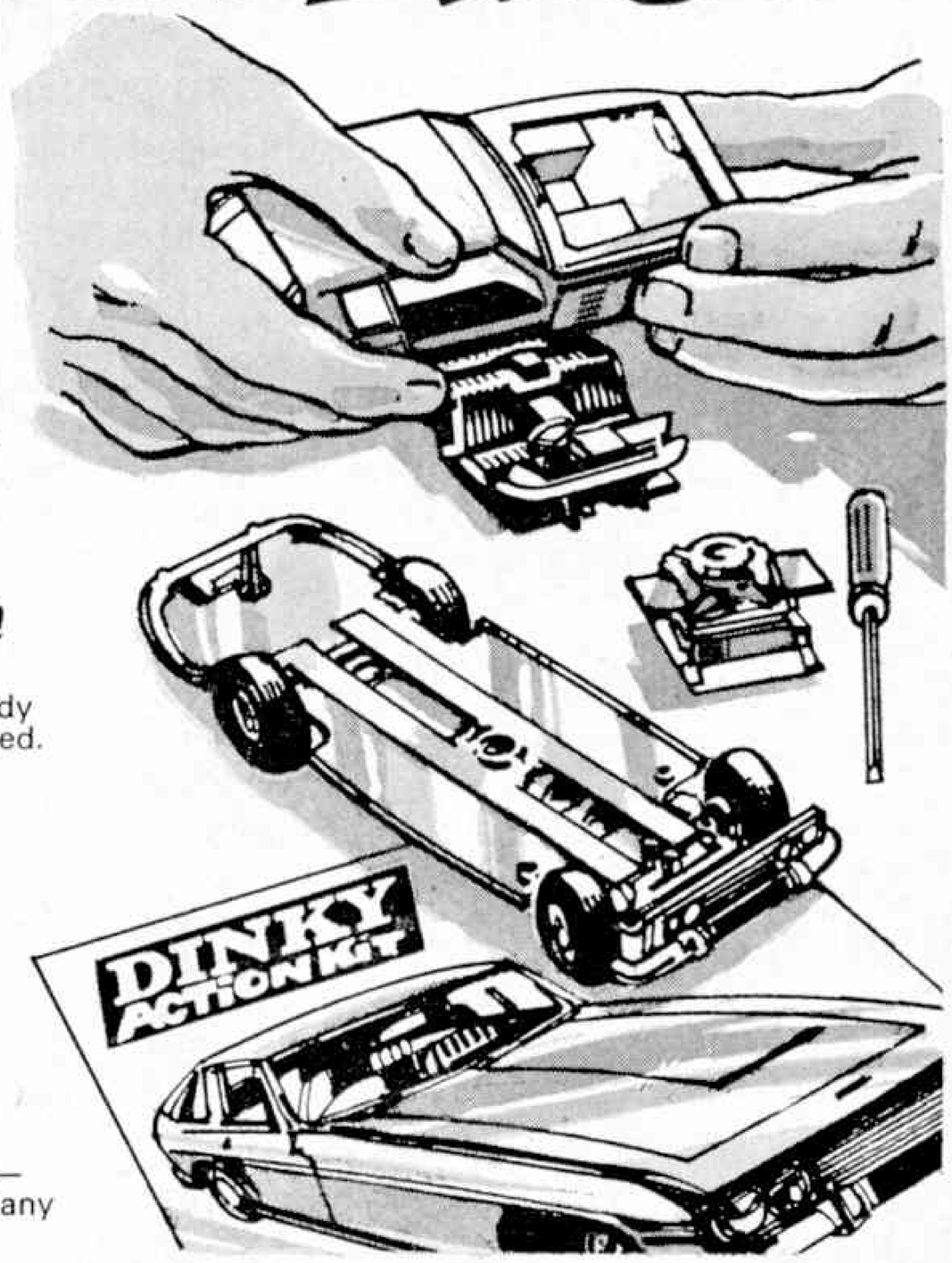

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Have fun building your model over and over again. Endless hours of amusement.

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When you build your model you can modify it to make your model just that much different.

5.

Ready for really tough action!

Made from tough die-cast metal to withstand knocks, **your** model is ready for some great action when assembled.

6.

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Not only can you paint your model any colour but you can design your own livery.

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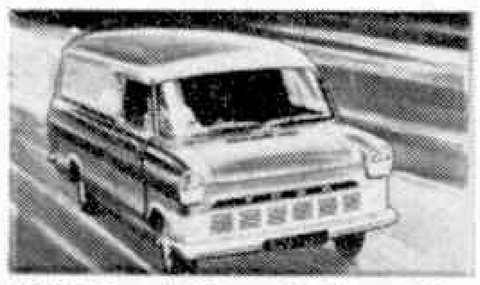

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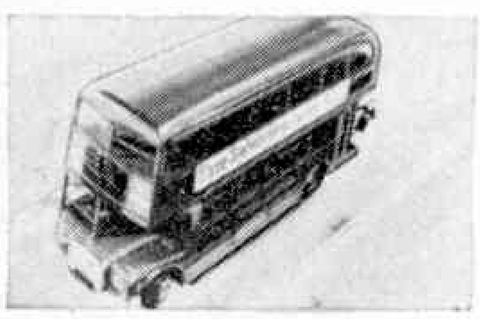

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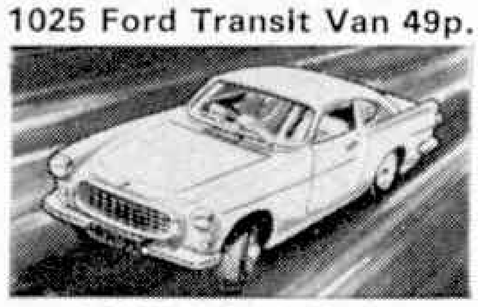

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DINKY ACTION KITS

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Announcing the BiC National Model Making Championship

Regd. Trade Mark

If you have a few used ball pens and a creative mind . . . prove it!

Even when they are the world's finest ballpens, as Bic undoubtedly are, they have to run out of ink sometime! For years a further use has been sought for those empty barrels, destined after gallant service to end their days in sideboard or office desk, side by side with less worthy writing instruments.

And here is the answer!

Because Bic Crystals write first time every time there are far more sold in the U.K. than any other model. In fact, each year a Bic Crystal is sold for every man, woman and child in the Country with a few million more for good luck.

Where do they go to?

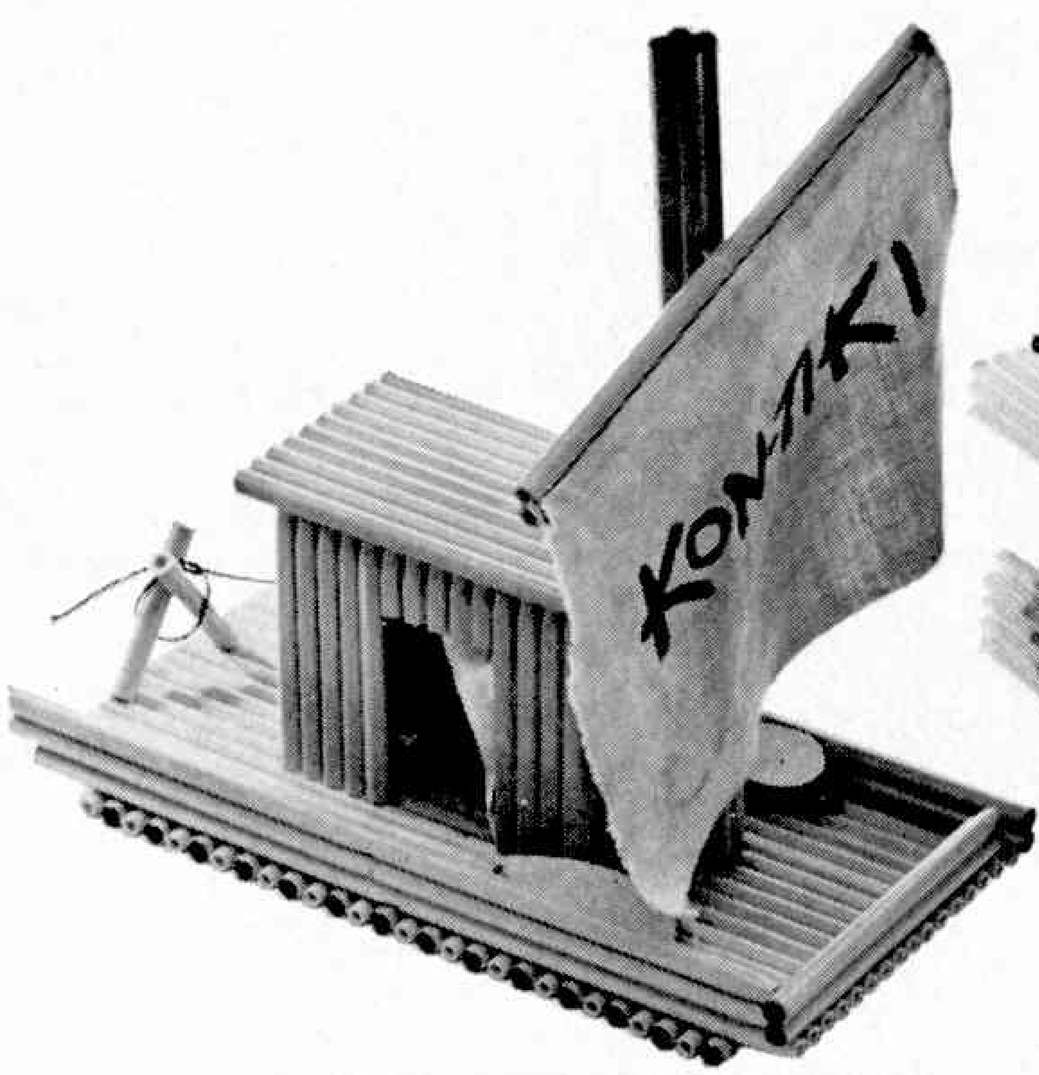
It is human nature to squeeze the last drop of ink from a ballpen or to believe that it may write again after a short rest. This is why you will probably find more than you expect in your own home. In offices and factories you should find them by the hundred.

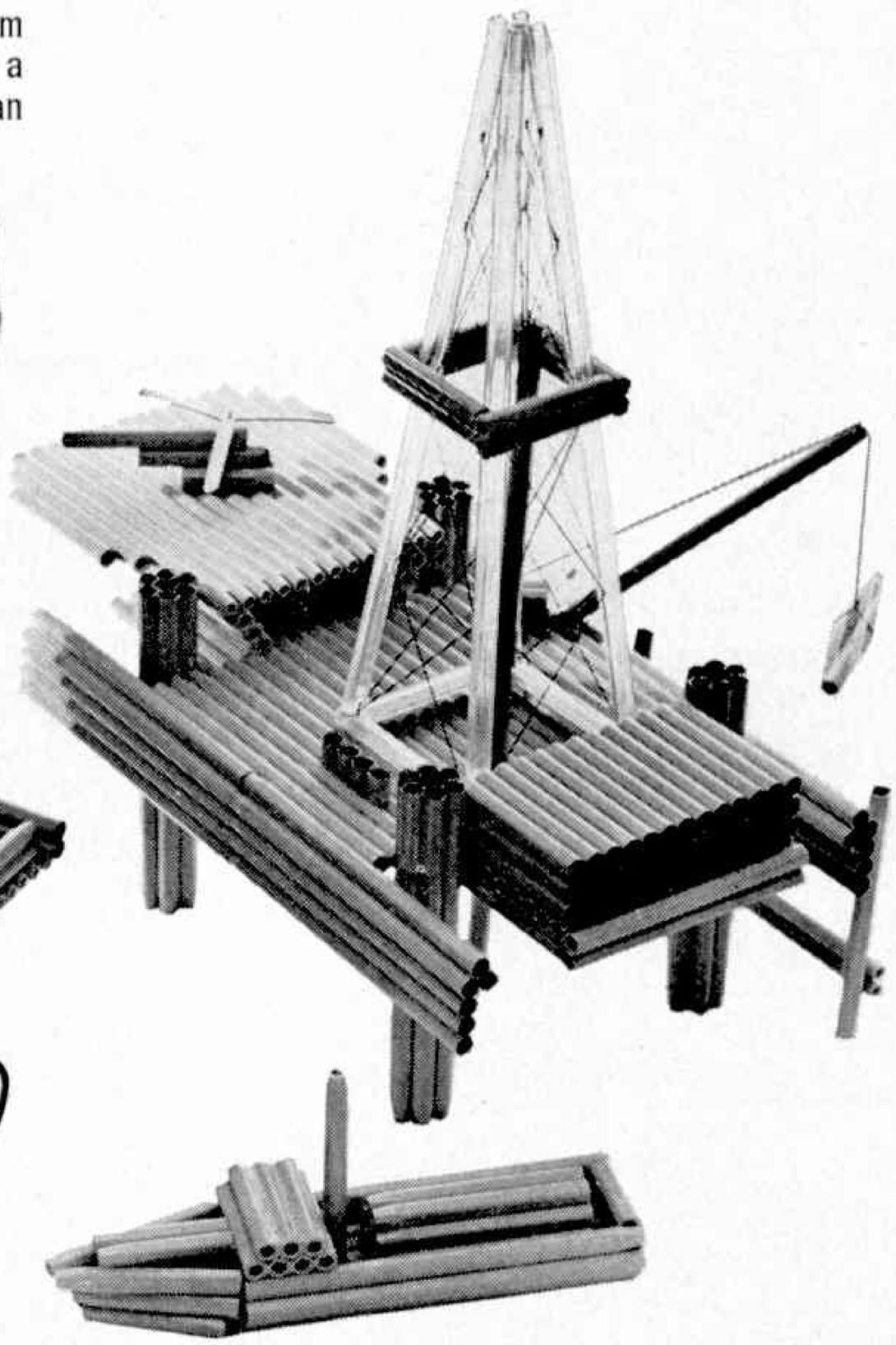
All you have to do . . .

. . . is to start collecting used Bic Crystal medium and fine ballpens now so that you may complete a suitable model and enter the competition.

There will be cash prizes for the best models every three months, both senior and junior and finally the best modeller overall at the end of the year will be awarded a further cash prize of £250 and the handsome Bic championship trophy.

Take your time, read the rules overleaf, then send your model with coupon.





BiC

Regd. Trade Mark

the pen they model on

BIC

Regd. Trade Mark

Model Making Competition

Start collecting your pens now but—
one word of warning—

make sure they are genuine Bic Crystal Medium or Fine Point ballpens carrying the Bic Registered Trade Mark because only these are eligible

RULES

1 The participants of the Bic Model Making Competition will be judged on their originality and technical model-making expertise.

2 The competition will be divided into two parts:
Junior: Participants, either sex, under the age of 16 at time of entry. Within this group no heat or flame technique for moulding may be used, but any other form of adhesion may be utilized.
Senior: Participants, either sex, over 16. Within this group, any form of adhesion is accepted. Heat to bend or shape the pens may be used.

3 Entries for the competition must be accompanied by the official entry form below.

4 Any number of BIC Ballpen barrels may be used. All models must be constructed utilising any part of BIC Crystal Fine (Yellow) and Medium (Transparent) ballpens.

5 BIC Crystal barrels may be cut to shape or size, but each barrel must clearly show the Registered trade name BIC (as imprinted on the barrel). Where models are moulded by heat, there must be at least 10 parts where the BIC Registered trade mark is clearly shown.

6 Accessories other than BIC parts may be used *only* to make the model functional or to infer final design, i.e., wheels, transfers, cotton, string, paper, etc.

PRIZES

7 Prizes will be awarded to competitors who, in the opinion of the panel of judges, produce the most creative, unusual or skilful entry for each quarterly competition.

8 **Quarterly prizes will be awarded as follows:**
Senior section—first prize £25.
second prize £15.
third prize £10.
10 consolation prizes of £5 each.
Junior section—first prize £15.
second prize £10.
third prize £5.
10 consolation prizes of £2 each.

9 Models winning any of the three prizes in either Junior or Senior levels of any of the quarterly competitions will automatically be entered in the BIC National Championship Competition and the individual competitor whose model is selected by the judges to be of greatest merit will receive an additional cash prize of £250 together with the 1971 BIC Model-Making Trophy.

10 **Entrants should send their models to:**
The BIC Model-Making Competition,
c/o Montague House, 23 Woodside Road,
Amersham, Bucks.
Should a model be considered delicate for conventional postage, then a photograph (colour or black and white) may be despatched beforehand. This will be used for preliminary judgement. Entry forms should be clearly attached to each model or photograph entered.

11 No responsibility can be taken for the damage in transportation of any model received. Judges will, however, take into account such unfortunate circumstances and the model will still be eligible for participation within the contest.

12 Should participants require a model returned, then return postage must be included by way of enclosing the appropriate stamps.

RESULTS

13 The 1971 competition will be held during 3-monthly periods and results will be announced during August 1971, November 1971, February 1972.

14 Participants should ensure that their models are despatched to arrive by 1st June (for August judging), 1st September (for November judging) and 1st December (for February judging).

15 Any model received after this date will not be eligible for the relevant Quarter but will qualify for the next Quarter's competition.

16 Any prize winning model will become the property of Biro-Bic Ltd., and may be used in any way they think fit.

17 Employees, relatives or direct associates of Biro-Bic Ltd., Model and Allied Publications Ltd., as well as their advertising agents will not be eligible for this competition.

18 The decision of the Judges is final and no correspondence can be entered into in relation to prizes awarded or decisions made.

I understand and abide by the Rules

Name.....
(BLOCK LETTERS PLEASE)

Address.....

.....

..... Age.....

WHERE DID YOU COLLECT YOUR BIC PENS? .....

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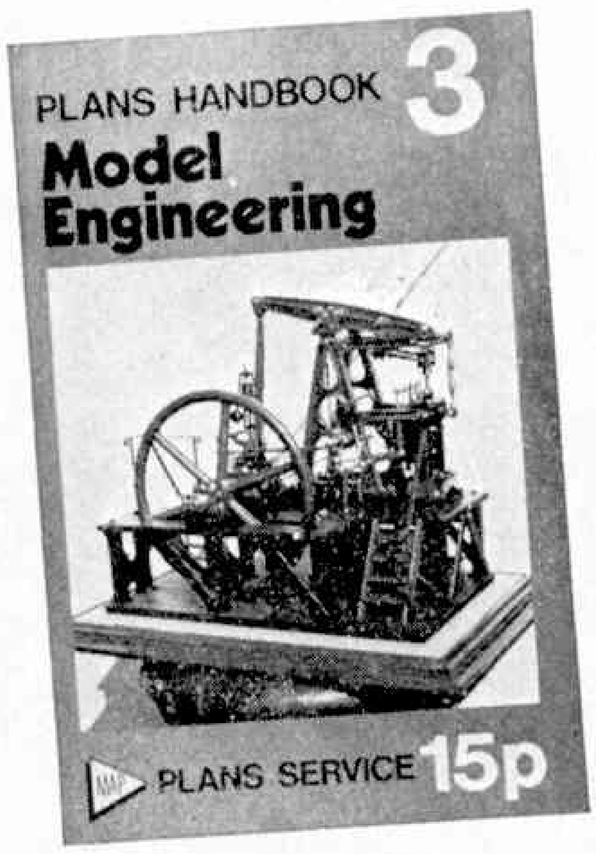
15p each

Aeromodelling

128 pages featuring hundreds of working model aircraft, illustrated almost entirely by photographic reproductions of the actual models, plus span, brief description and graded for ease of construction. Also selected engine list with tabulated data; index to illustrated plans X List of vintage unorthodox novel plans, many other classifications, useful articles, order forms Also good selection of trade advertisements.

Model Boats & Cars

96 pages of plans of scale and semiscale ships, tugs, lifeboats, submarines, paddle steamers, period ships, racing yachts, hovercraft, cabin cruisers, mostly illustrated, fully described, and classed for ease of building. Working model cars and usual vehicles are included and a large range of scale car drawings, racing cars ancient and modern. Index of drawings; useful articles on building; waterline plans; trade advertisements.



Model Engineering

96 pages of working model drawings for steam locomotives, traction engines, steam engines, petrol engines, workshop equipment from LBSC, Westbury, Evans, Maskelyne, Bradley, Hughes. Plus useful model engineering information, screwcutting tables, standard threads, letter and number drills, wire and sheet metal gauges, miscellaneous information.

Radio Control Models

96 pages of radio controlled models are described. There are 128 R/C aircraft all illustrated, including S/C Sports Models and Trainers, Galloping Ghost Models, Competition Aerobatic Models, Multi-Sport and Trainers, Pylon Racers, S/C and M/C Scale Gliders and Soarers. 87 model boats suitable for radio control, plus do-it-yourself R/C systems. Many useful instruction features, like the R/C 'Goof-ups'—an introductory feature for beginners. Fully illustrated current F.A.I. aerobatic schedule.

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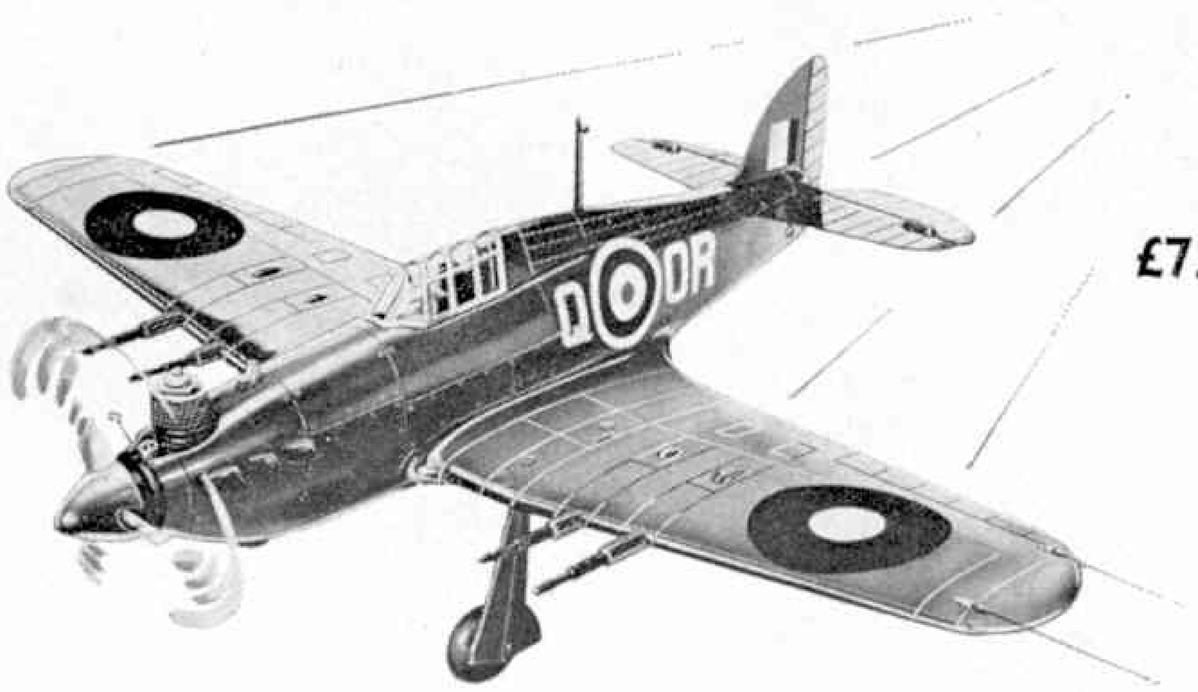
KEILKRAFT HURRICANE



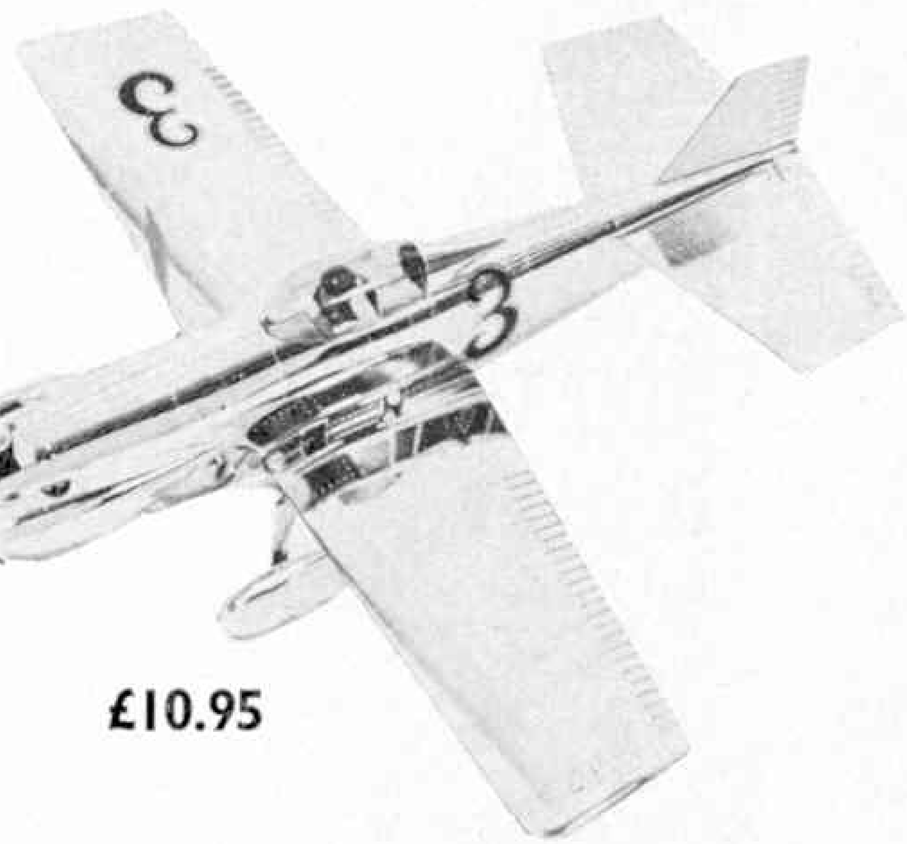
£7.40

YES—this model really flies! Powered by the renowned McCoy .049 Glow motor, fitted with spring starter. The airframe is made from a specially developed tough plastic to withstand hard usage and comes complete with control line handle, control line and glow clip connector—All you need is some fuel (KK Nitrex 15 of course) and a starter battery then prepare yourself for hours of flying fun and excitement. Flying and starting is covered in full in the very complete instruction manual.

Fly your own Control Line Model

TESTORS

Big 22½″ wingspan
21½″ fuselage
Powered by McCoy .049 engine



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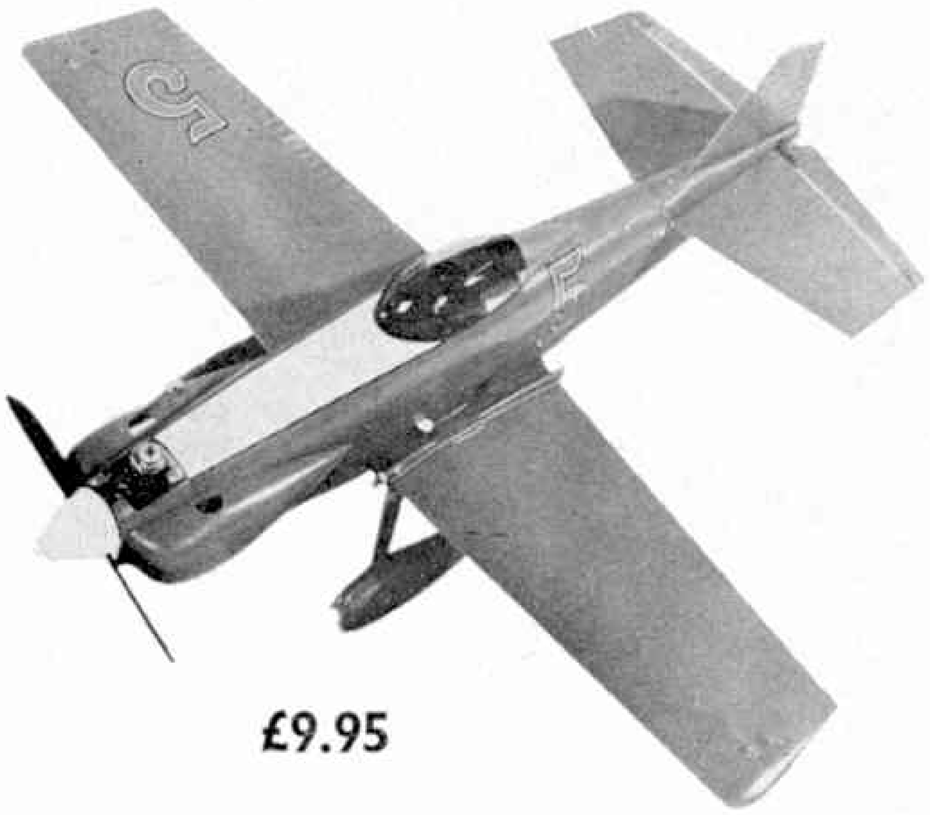
SILVER WIND TRAINER

Completely metalized



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COSMIC WIND TRAINER

Two beautiful ready-to-fly control liners, one in gorgeous red and white trim, the other in an all-over gleaming silver finish.
Almost unbreakable! Rubber band assembly allows parts to separate on impact without breakage.
Stable flight—so stable that even the most inexperienced pilot can learn to fly with these models.
Versatile—controls can be adjusted to make plane an aerobatic trainer.
Unbreakable nylon propeller—cushion-action landing gear with wheel spats.
Engine and Airframe spares for both SILVER WIND and COSMIC WIND TRAINER are always readily available.
A most comprehensive Instruction Manual is included, also control line and handle.

AVAILABLE AT KEILKRAFT AGENTS

Many readers will have read the unhappy news of the financial difficulties of the holding company for Lines Brothers Ltd. Meccano Ltd. has, of course, been a part of the Lines Brothers group since 1964. It may therefore be reassuring to mention that the Meccano products (the construction system and Dinky Toys) are in ever-increasing demand and 1971 sales are considerably ahead of last year's, despite the present very competitive market situation. There is, therefore, every reason for confidence that a secure future is ensured for these popular products.

Internationals

Some 21 nations were represented at the Naviga European Championship for model boats at Ostend in August, and it was really splendid to meet and mix with enthusiasts from so many different countries. In one conversation we had Russian, French, Hungarian, German and Italian modellers, plus ourselves, and the only common language was English. It is surprising how quickly one becomes accustomed to the pauses while one person who has understood rapidly translates for those of his compatriots who haven't; what we liked was the way everyone was prepared to listen and not fight to get his views aired.

Between the time these words are written and when they are read, 23 nations will have competed at the World Championships for radio control aircraft in America. A chartered airliner, heavily subsidised by the Americans, will be taking 252 European competitors, officials, and supporters over to the States, and from experience of similar events in various countries, it is certain that the same open friendliness and tolerance will be shown.

Language and nationality differences make very few difficulties at these international gatherings of modellers, and such meetings must do a great deal to create understanding and mutual respect which is bound to help, even if only in a small way, international relationships.

Bic Competition

The top three entries in the first quarter of the Bic National Model Making Competition have been announced. First prize of £25 goes to David Smith, 26,

ON THE EDITOR'S DESK

of Clifton, Bristol, for his racing bicycle. Second, £15, is A. E. Morris of East Cowes, with a clever ship in a bottle. Third is housewife Mrs A. Newman of Bromley for a simple "working model" (liquid-wise) of a cow. All prizewinning models go forward to the National Championship and a chance of the £250 cash prize plus trophy.

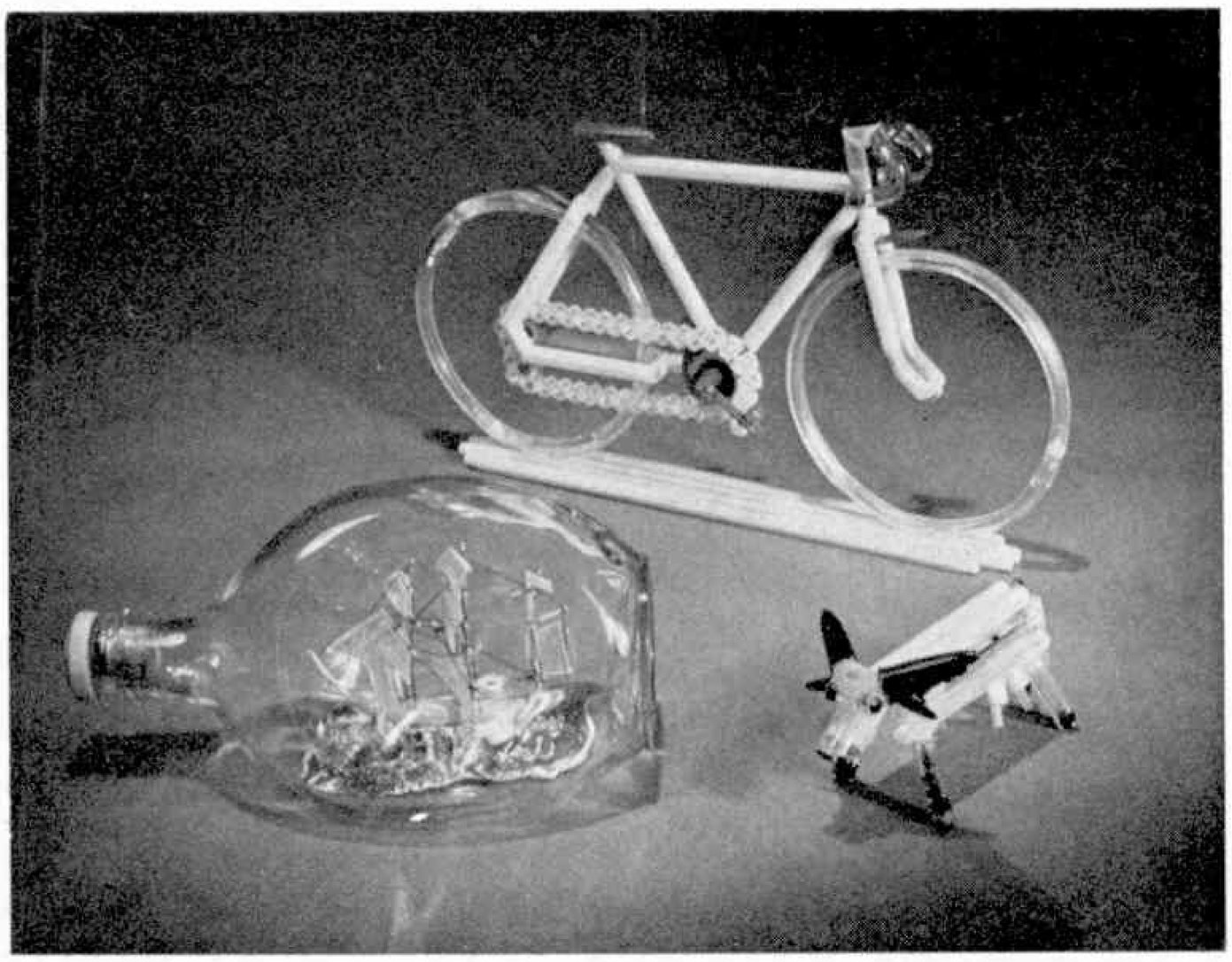
Railway Letter Stamps

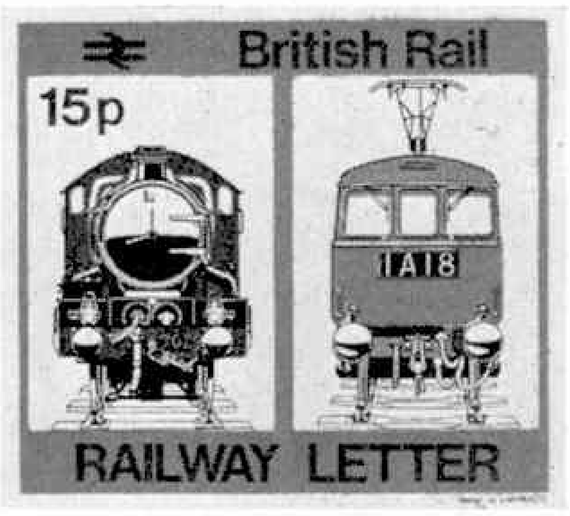
In May 1957 the Talyllyn Railway revived the issuing of Railway Letter Stamps as a receipt for the fee paid for the carrying of a letter under the Railway Letter Act of 1891. Several other union railways have since followed suit, and in August last year British Railways issued stamps for use on letters originating from the Vale of Rheidol Railway in Wales.

This is now being followed up by the issue of a General Railway Letter Stamp. to be introduced with specially stamped covers on October 3rd, in conjunction with the Standard Gauge Steam Trust/British Railways joint Open Day at Tyseley Steam Depot in Birmingham.

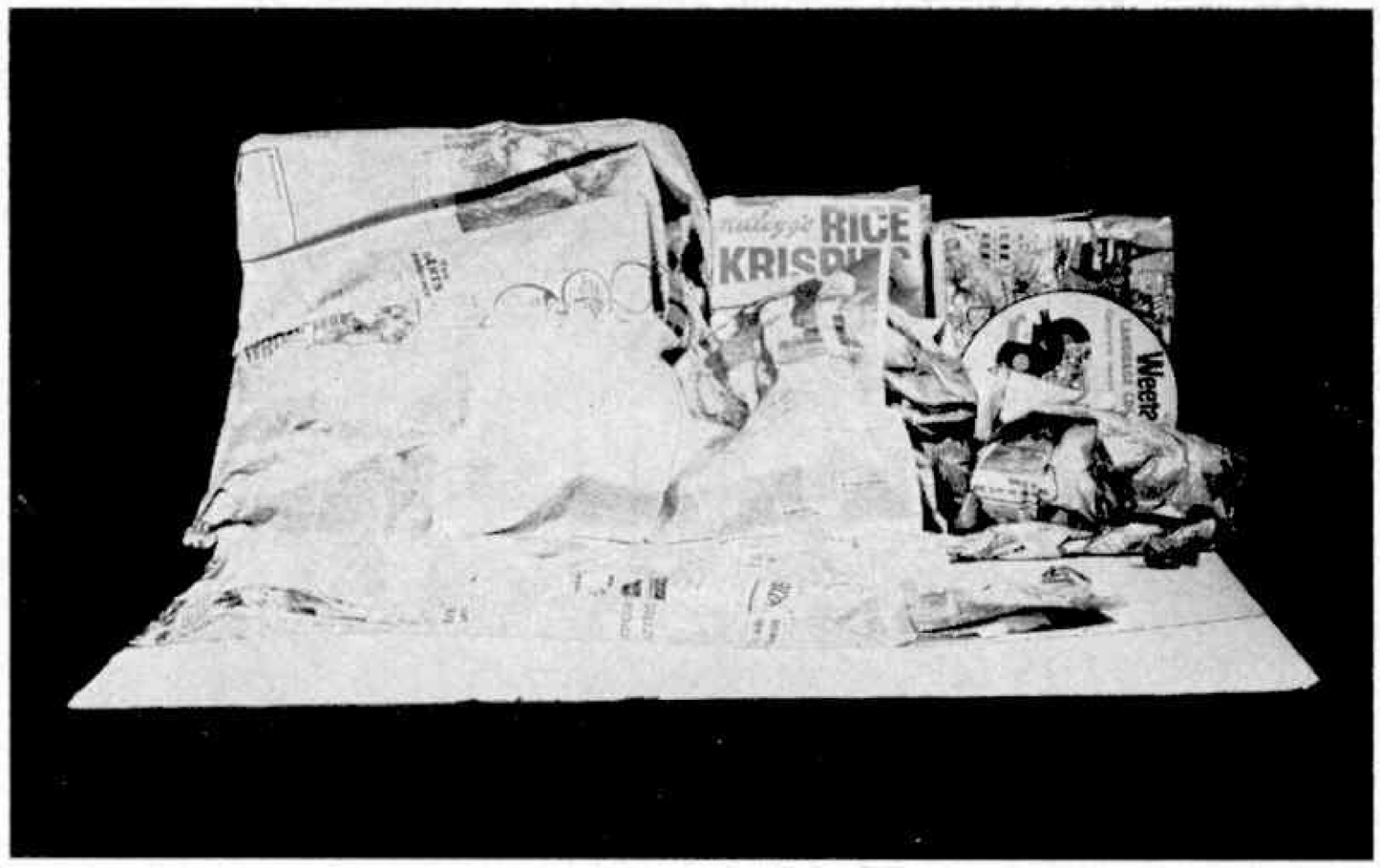
The stamp, shown here actual size, is basically yellow, white, and black, with green, red, and blue on the locomotives. Only one value is being issued, 15p, which is the fee for an Inland letter weighing not more than 2 oz. Its introduction coincides with the 80th year of the Railway Letter Service.

Collectors will be able to service their own covers if they attend the Open Day, but B.R. is offering bulk service facilities to the stamp trade.





Winners in the first quarter of the Bic competition all show simplicity and ingenuity and use very few pens. This should encourage those tempted but doubtful to have a go.



THERM

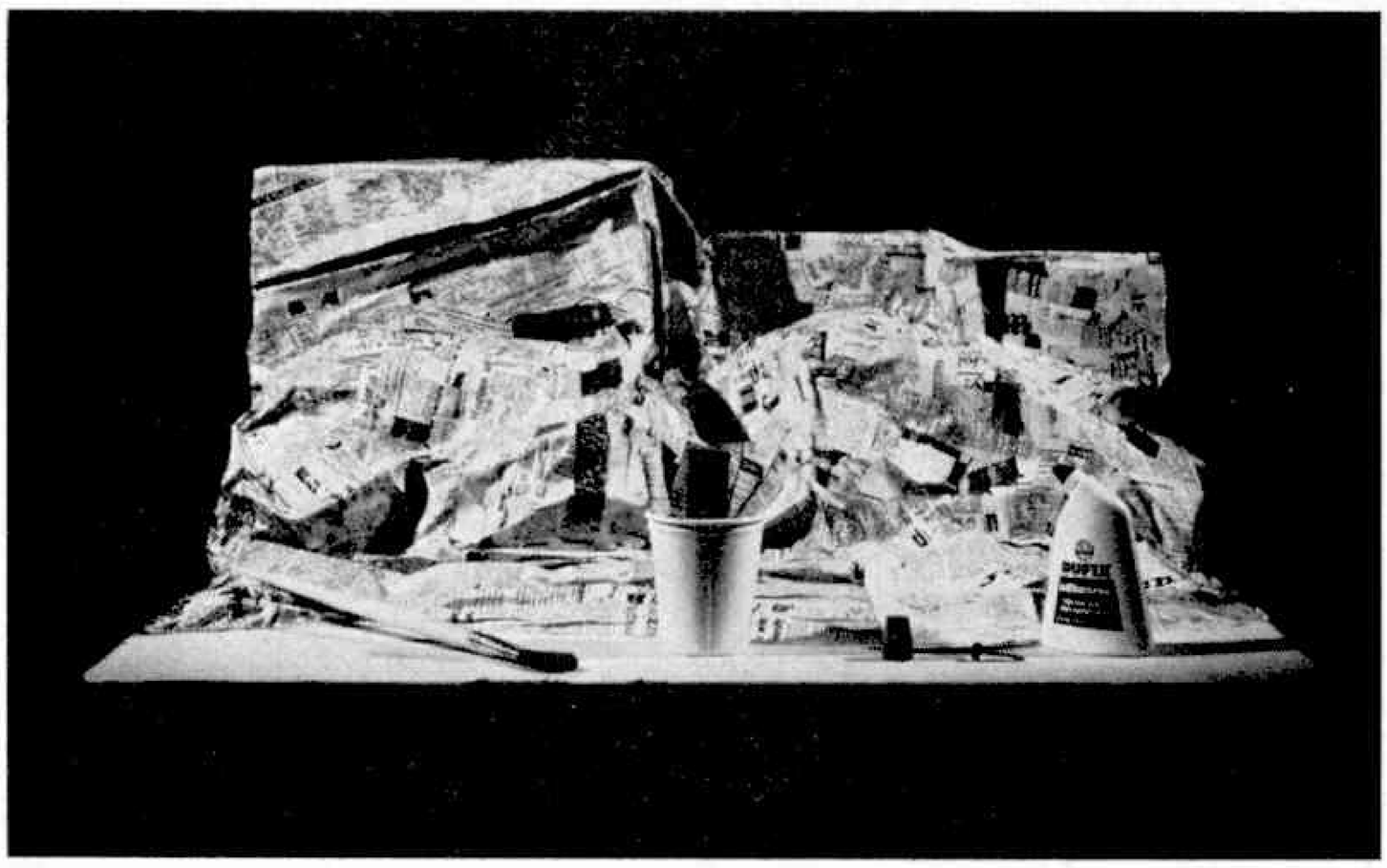
Charles Grant famous pass the virtues of

YEARS ago my scenic efforts for use on the wargame table were the customary baseboards with raised plaster hills, ridges and so on—the whole thing covering a framework of odd blocks of wood, etc.—but this system was abandoned for a variety of reasons, chiefly because the 'pieces' got a bit out of hand in construction, not always turning out just what they were intended to be, and also because the plaster tended to flake off with use and fly all over the place, with the expected domestic wrath to follow. I subsequently opted for the more functional method of using 1 in. thick contour blocks, which were ideal for a situation where a considerable number of games were played, one after the other, with the inevitable quick changes of terrain.

It was apparent, however, when I came to organising a project which, as an 'ancient' wargamer, I had long contemplated—i.e. to re-enact the famous stand of Leonidas and his three hundred Spartans at Thermopylae (480 B.C.), that something was lacking. Of course, I have to say at the outset that this battle is not by any means the most satisfying encounter in the Graeco-Persian Wars (Plataea, for example, gives far more scope for manoeuvre) but it is such a classic that it becomes a 'must', from the purely pictorial viewpoint, if nothing else. In rather a quandary, then, as although tactically the use of contour blocks would adequately simulate the effect of fighting in a narrow pass, the 'look of the thing' would be totally lost and the drama would be missing. Happily, there came to my rescue a most splendid product, one which I found to have all the virtues and none of the vices of the old plaster method.

This was really not one but two media—both produced by I.C.I.—these being Dufix Adhesive and Dulite Supergrip Filler. Using them a most impressive Thermopylae in miniature was constructed.

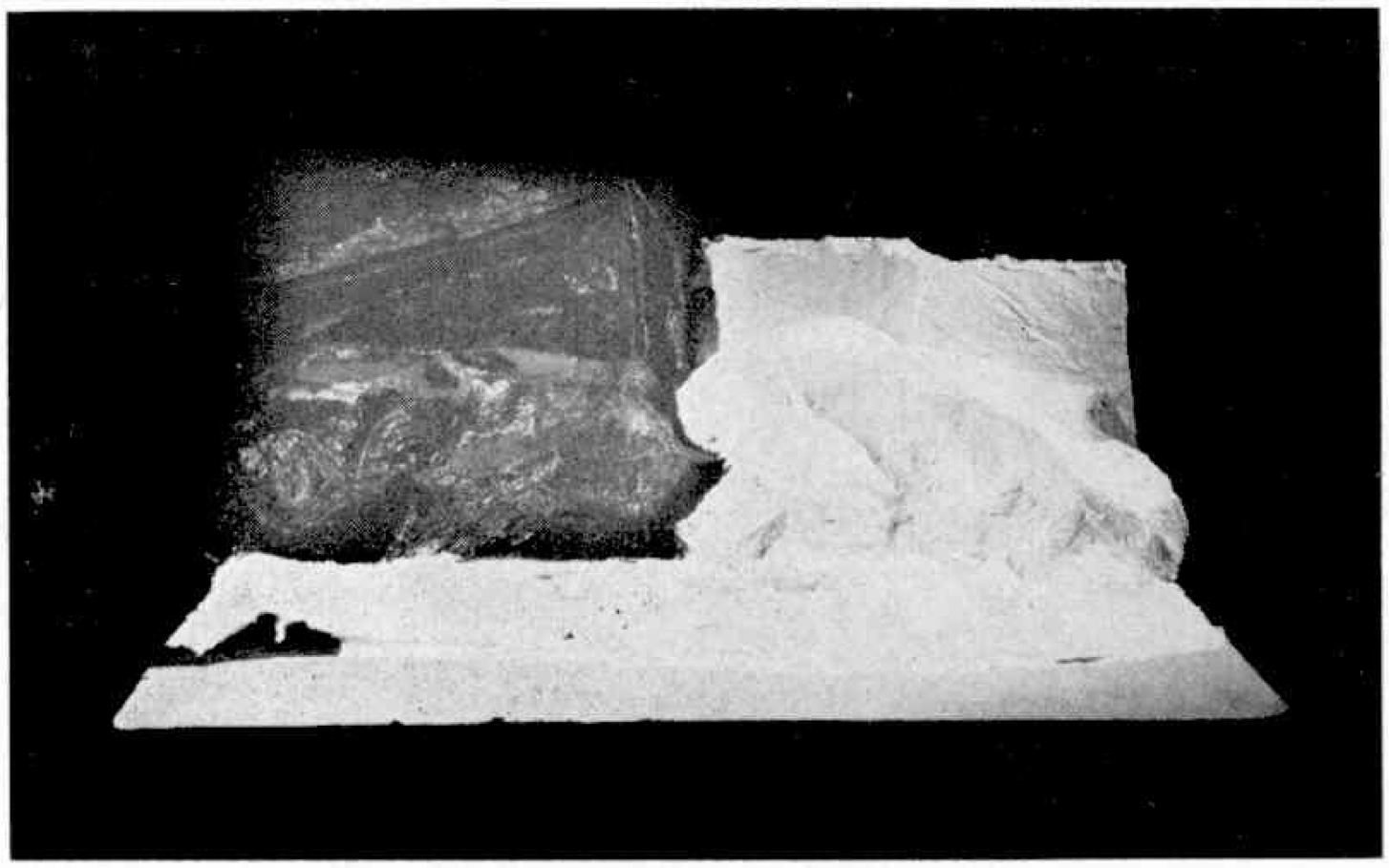
However, before getting down to work with the mixing bowl, a very rewarding bit of research had to be done regarding the actual scene of the action and just what took place. It is the former which concerns us here—the details of the scene of the fighting, in fact. For this, the most exhaustive study by Peter Green in 'The Year of Salamis' was the main source (a splendid book, this) and from this the basic facts emerged in this wise. Between the sea and the cliffs at the point where the fighting took place the level ground was no more than about twenty yards in width—ideal for defence, of course, and the cliffs rose almost sheer and quite unclimbable. Here and there were patches of scrub and similar vegetation. The path by which the Persians ultimately outflanked the stubborn Spartans lay some miles inland and has no part in our present reconstruction.



Now for the actual layout. It seemed that an area about three feet wide (as you look at the photographs) was about right, and the depth of two feet allowed the cliffs to be built up sufficiently spectacularly. The mechanics of construction are not all that difficult. The first step is to create the basic shape of what is desired by using fairly tightly rolled balls of newspaper placed on the base board, plus odd card boxes (no advertisement is intended). It might be found necessary to use smaller balls of paper to fill up crevices—it all gives in-

OPYLAE

reconstructs the and discovers new materials



creased strength, as well. Larger sheets of paper—again ordinary newspaper is perfectly O.K.—are now placed over the shape and stuck to the board at the edges with Dufix. The 'surface' sheets will be found to fall quite naturally into the sort of undulation required. 'Neat' Dufix is now brushed over the surface paper quite generously. When this dries—it does so quite 'clear'—the shape is already satisfactorily stiff. This first coat can itself be coloured in the appropriate hue but this was not necessary in this case as further layers were to be added. The next coat can be pigmented and now the mixture as desired—Dufix plus Dulite Filler—can be applied with a knife—an ordinary one from the kitchen—or a spatula. Failing all else fingers may be used. Already—as in Photograph 2—the shape can be seen quite clearly and it is upon this species of terrain skeleton that we begin to build up the more substantial article.

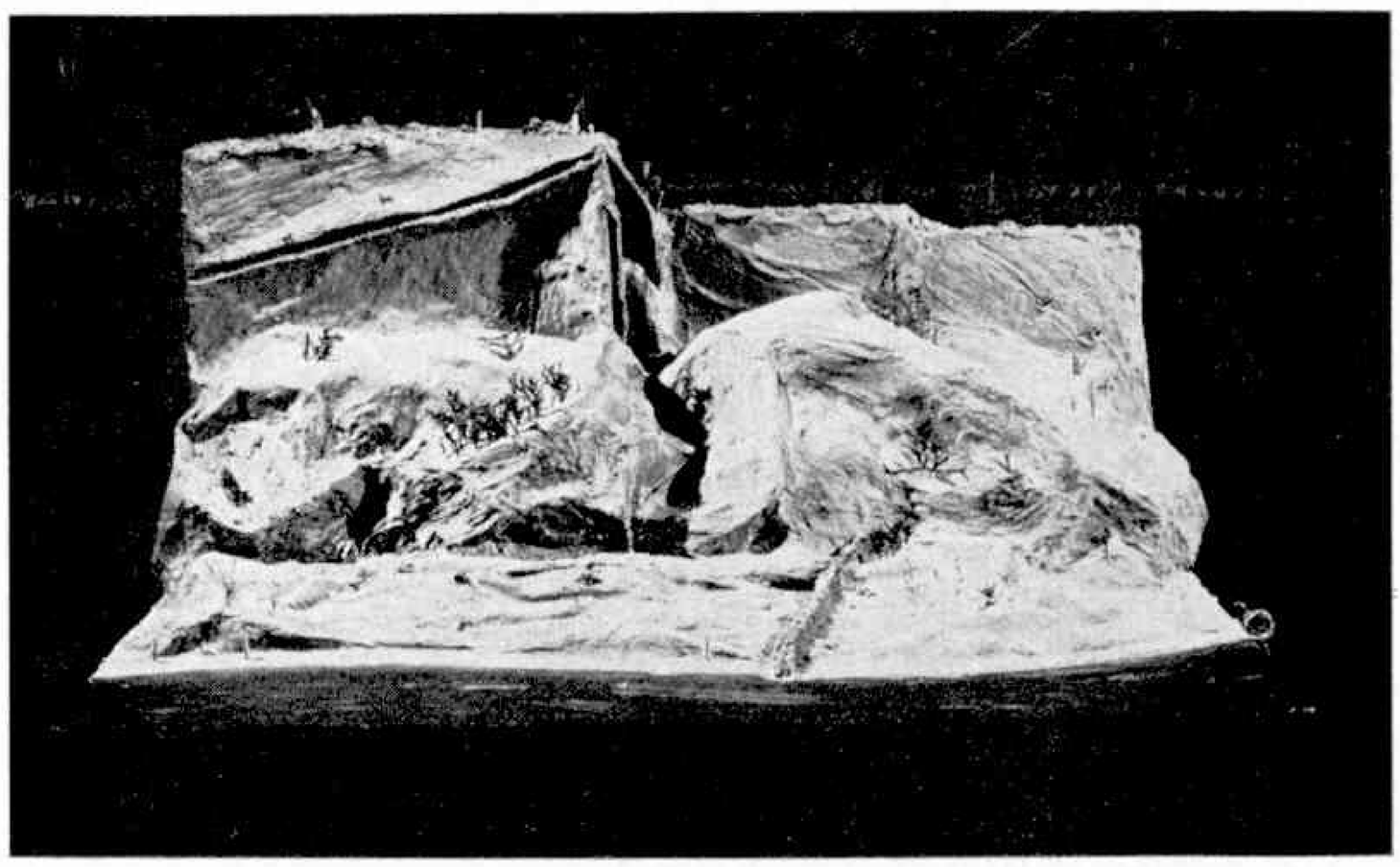
A point which might be made here is that normally the wargamer will require rather more stout terrain pieces than, say, the railway modeller whose aim is simply to make scenic background for his layout. The fact that more often than not the wargamer wants to manoeuvre his troops across his terrain will of course result in their having to be rather stronger. Even so, the Dufix/Dulite combination does not have to be more than an eighth of an inch thick—a quarter of an inch at the most—to take even a substantial weight of miniature soldiery.

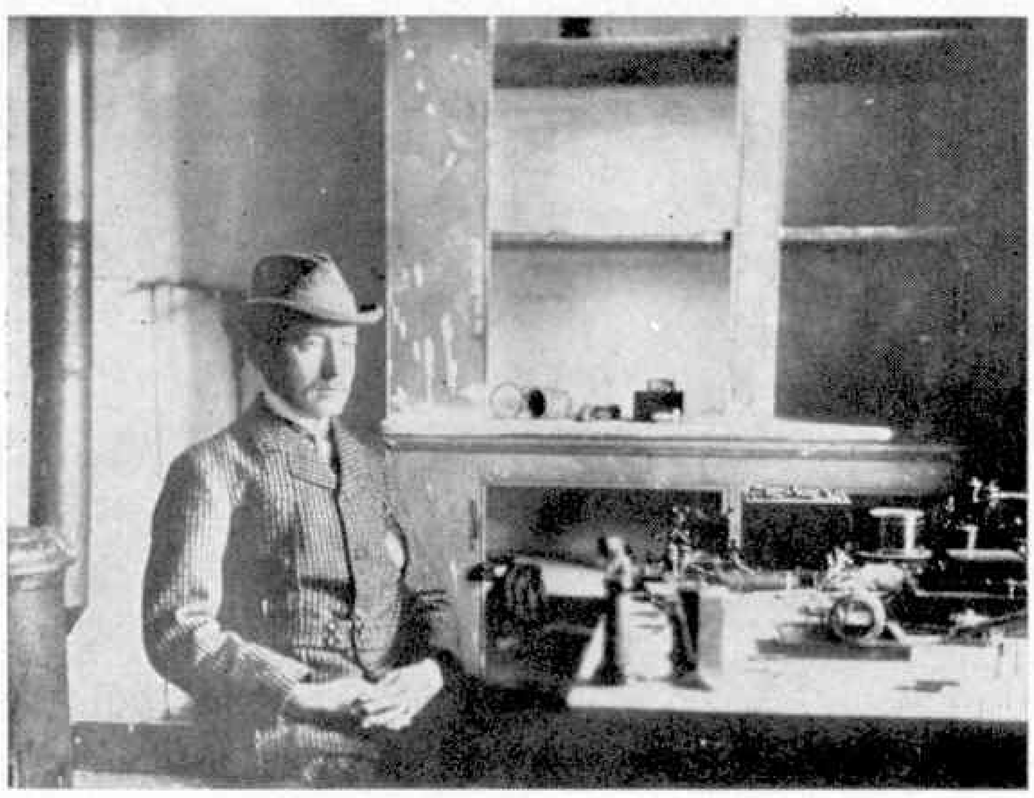
To proceed, then. As the 'build-up' goes on, pigments can be added to the mixture before application, various shades of greens and browns, greys where the rocks emerge from the soil. Dufix indeed can be mixed with all the normal dioramic media, sawdust, cork dust, sand and so on, and any surface texture can be reproduced quite perfectly. With the knife or whatever device he is employing, the modeller can reproduce all sorts of surfaces—from a ploughed field to a modern lawn.

And so, from Photograph 3, wherein the scenic effect is just beginning to come through, we go on to Photograph 4, the complete 'Thermopylae'. In the foreground is the sea—or a small stretch of it—then the narrow area of flat land before the cliffs rise steeply and forbiddingly. Over them at various points patches of scrub and the occasional stunted tree have been added, and in the right foreground is the famous 'low wall' which played such a part in the battle. The whole affair does give a most realistic impression, it can be said without undue immodesty, and one can just imagine the Persian hordes surging up from the right in their attempt to sweep aside the gallant Spartans.

The final point to be made is the fact that these two I.C.I. products are a tremendous boon to the model-maker. A messy sort of worker myself (you should see the table at which I paint my figures!) I found them quite the cleanest modelling substances I have come across. They wash off clothes perfectly easily while still wet.

You should use them for your battle terrain—how about the Pass of Roncevalles or the Heights of Abraham?





WHILE the discovery of radio led to world-wide communication, it was not till July 1969 that two-way work took place with men actually on the Moon (facing Earth), 240,000 miles distant approximately. This was during the 'Apollo' 11 Moon mission. Again, during the 12th, 14th and 15th missions later, both radio and TV pictures of the astronauts proved very successful.

As mentioned in the article: 'World-wide Communication Via Satellites" (M.M. Sept. 1969), various attempts were made to 'reflect' or 'bounce' signals from the Moon. On May 15th, 1959, a speech was successfully transmitted by beaming it towards the Moon from Jodrell Bank Radio Telescope. Using the same technique later, messages were sent from England to Australia. Since its discovery, radio has been gradually perfected after much research and experiment. Many efforts were devoted earlier to its development by either conduction or induction, but these had severe limitations. However, Hertz's method of radiated energy slowly but surely emerged. The many developments that followed are only dealt with briefly.

RADIO DEVELOPMENTS AND SPACE RESEARCH

BY CHARLES A. RIGBY

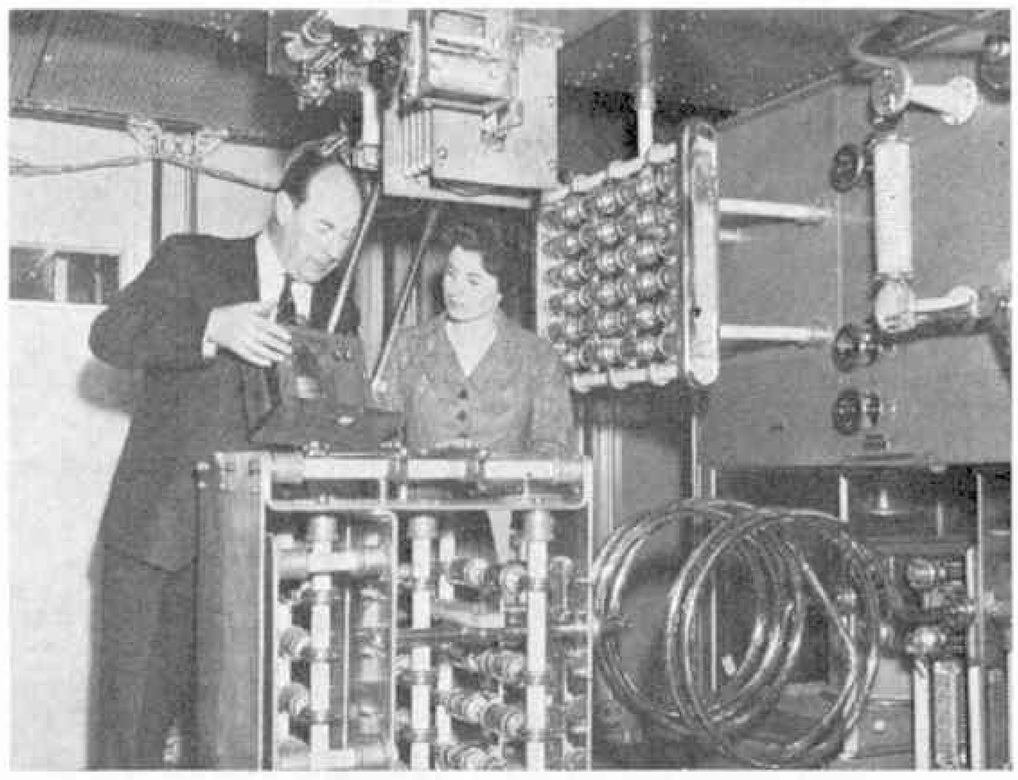
The pioneering work of Guglielmo Marconi both in Italy and other places attracted much attention in various countries. Truly, he was the founder of 'Wireless Telegraphy'. After studying the work of Hertz and how electromagnetic waves are radiated from an oscillator when little 'sparks' appeared in the tiny gap of a metal loop on the other side of a room, he began experimenting. In his efforts to obtain greater range, he made an all-important improvement by adding to the oscillator an aerial and an earth. Adding much greater range, this constituted an important development.

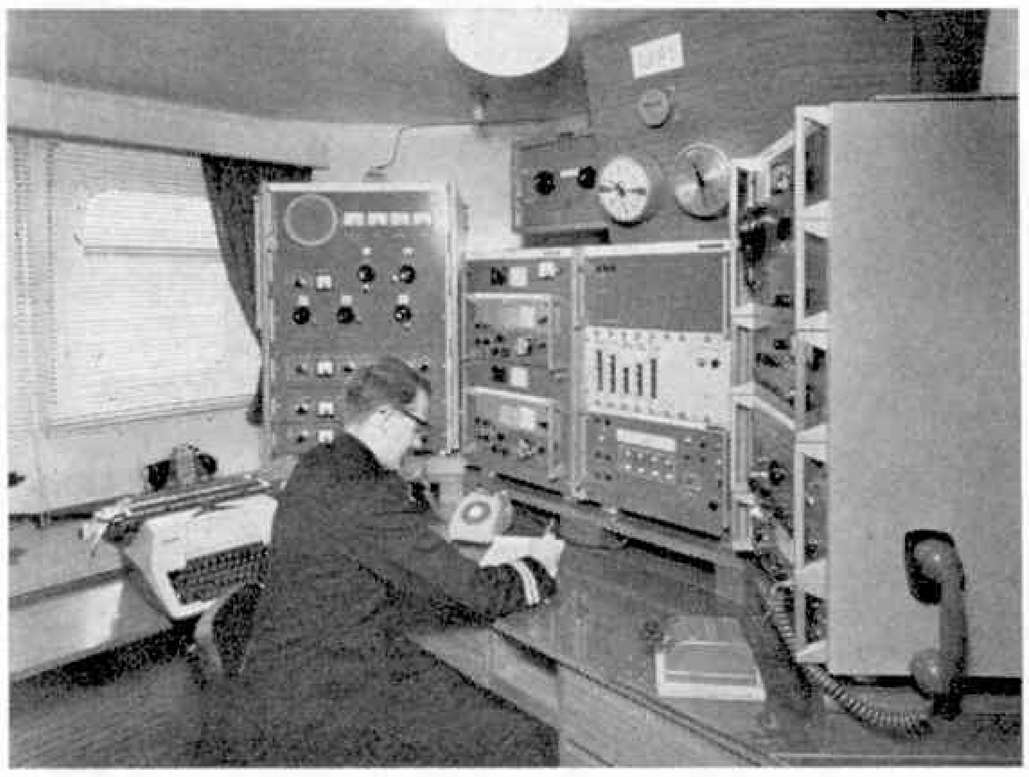
After coming to England in 1896, encouraged by Sir William Preece of the GPO Engineering Department, he attempted more practical experiments. His greatest success, however, was reception of the 'S' Morse signal at the hastily-erected station on Signal Hill, St. John's, Newfoundland, transmitted from Poldhu, Cornwall. The Atlantic had been bridged by wireless telegraphy, an achievement some considered impossible. After this, many ships, including liners, were equipped with wireless telegraphy equipment for communication with other vessels and land stations.

The invention of the telephone by Alexander Graham Bell in 1870 no doubt helped in Marconi's success. Many other helpful inventions have followed, including the microphone, invented by Hughes in 1879. The great need at the receiving end was for some sensitive appliance to convert the enormously rapid oscillations of wireless waves to the frequencies of audible sound. The coherer was at first superseded by the electrolytic

On Dec. 12 1902 Marconi, shown in the top picture with his receiving apparatus, detected in Newfoundland Morse signals emanating from Poldhu in Cornwall. Centre, early broadcast from 2LO. Chimes behind pianist were used for time signals. Bottom, 2LO aerial system on the roof-top above Marconi House, London. *(Photos courtesy Marconi Co. Ltd.*

Right, modern engineer holds the first spark transmitter to incorporate a tuned circuit. He is standing inside the output compartment of a modern 100 kw. HF transmitter. *(Photo Marconi).* **Lower right, part of the radio office on a new ACL container ship,** *Atlantic Causeway,* **which has speech processing units, Lincompex extra talk-power and other refinements as well as normal transmitter and receiver equipment and a whole reserve system** *(Photo, Redifon).*



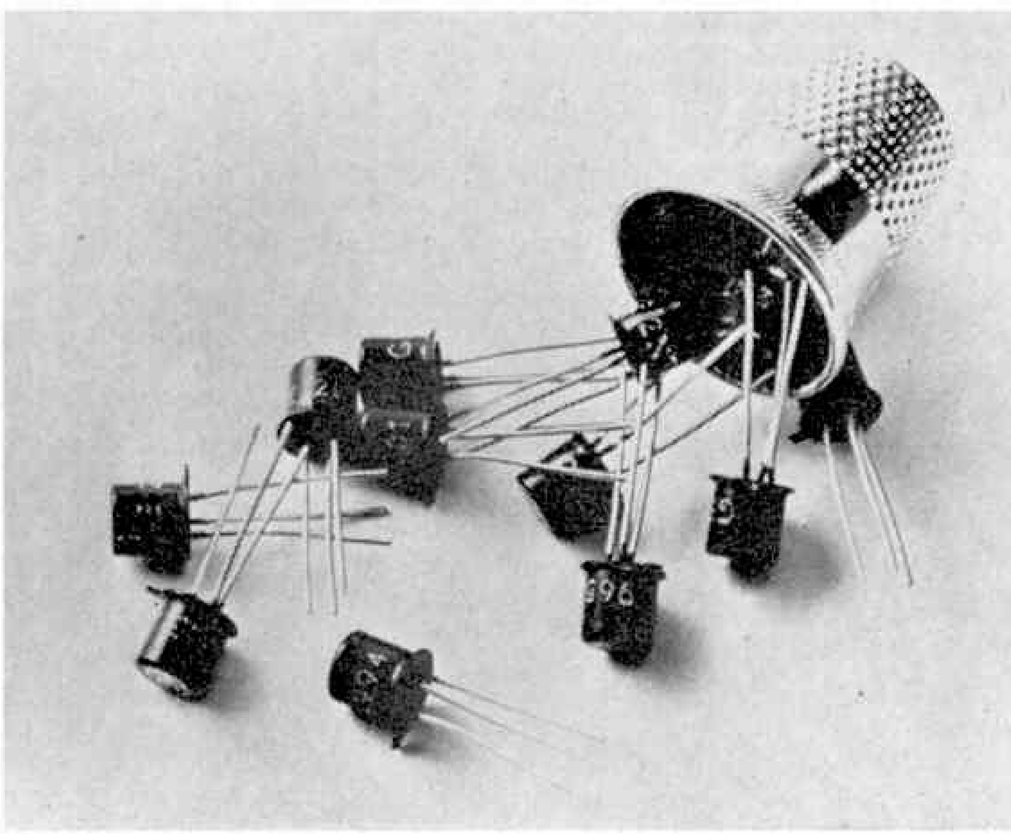


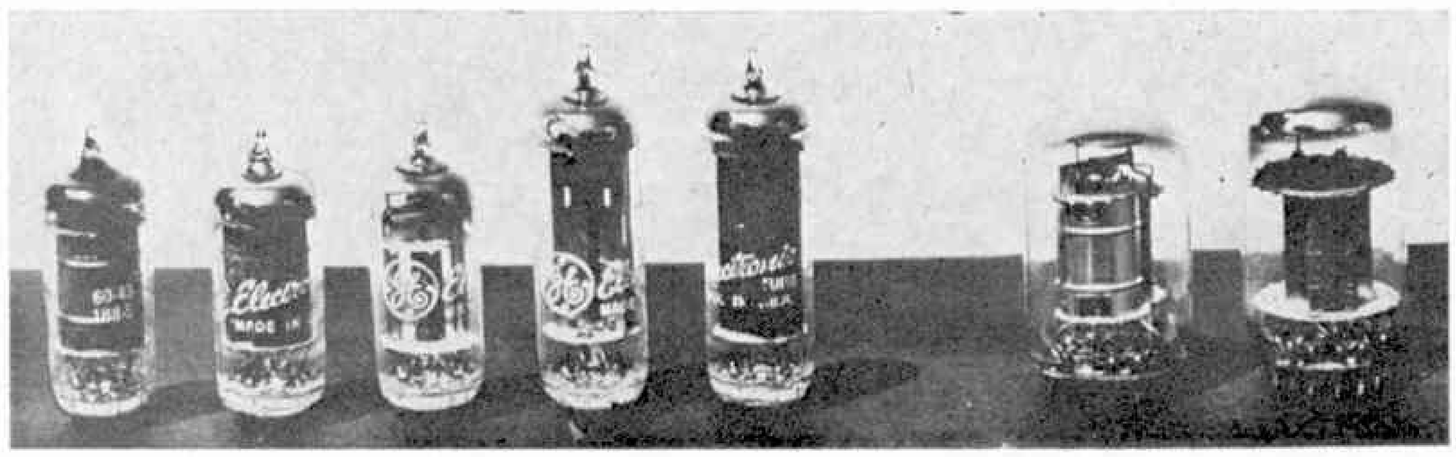
detector, by the magnetic detector, and then by the crystal. Then, Sir Ambrose Fleming invented the first valve, the Fleming 'diode'. Finally, Dr Lee De Forest added the grid, so that it could be used for amplifying or detection. In this form, it was known as the 'thermionic' or electron tube. Many other valve types followed, including the 3-electrode invented by Captain H. J. Round, used during World War I.

Also important was the development of the Alternator. Previously, 'spark' transmitters were used for transmitting signals. In 1904, Professor Fessendon invited an American company to build a high frequency machine to operate at high speeds, and produce a continuous wave transmission. This was undertaken by Dr Alexanderson, who after two years succeeded in building a 2 kW 100,000 cycle machine which was installed at Brant Rock, Mass. In this way, the first broadcast in history took place on Christmas Eve 1906. News about this reached Guglielmo Marconi, and in 1915, he visited Alexanderson in New York. Later, Alexanderson succeeded in building a 200 kW alternator which was installed at New Brunswick.

As many know, the development of Radio Telephony followed, and with the improvement of valve transmitters, modern day broadcasting, the first receivers used being crystal sets. Later, valve receivers came into use, and many improvements in marine and aeronautical equipment were made. In March 1919, a telephony transmitter of 2½ kW input power, with transmissions to Louisberg, was installed at Ballybunion, in Ireland. In the same year, an experimental station at Chelmsford transmitted musical items for entertainment in Britain. The first regular broadcast service began on February 14th 1922 from 2 MT Writtle. Then an experimental service commenced from Marconi House, Strand, this being the original 2 LO, which started operating on May 11th 1922 and was the beginning of the British Broadcasting Company (now a corporation).

Radio as a means of direction-finding came next. In 1905, Marconi first tested a bent or directive aerial, both for reception and transmission. Later this was improved upon by Captain Round who made use of a loop aerial which gives the strongest signal when pointed directly to a transmitter. With two or more stations, and plotting of the directions showing the strongest signals on a map, the distant transmitter is located.





Seven different types of radio valve (right) made in U.S.A., now largely superseded by transistors. Those above are germanium epitaxial mesa transistors incorporating extreme temperature requirements. *(Photos, General Electrical Co., U.S.A.)*

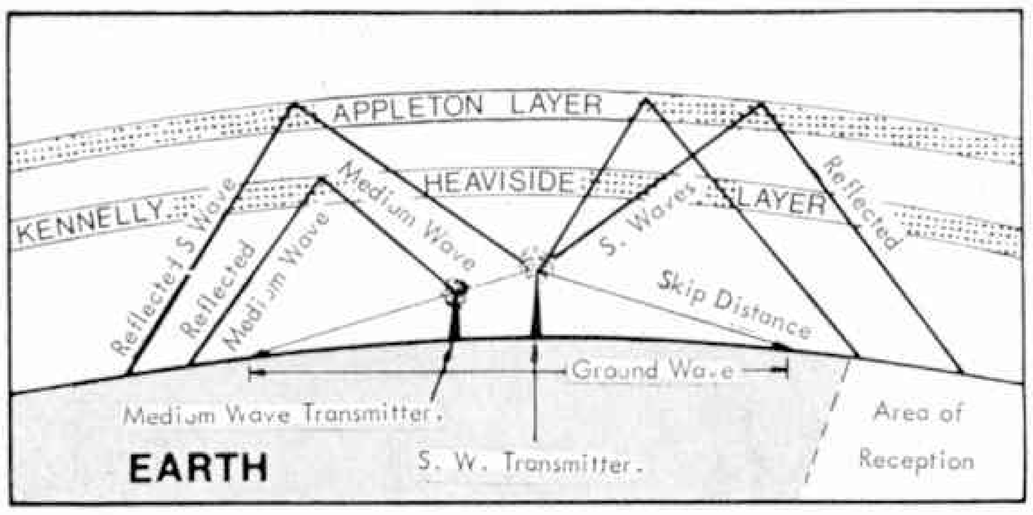


Diagram showing the ionosphere and medium and short wave radio paths.

Improved DF equipment is now in general use.

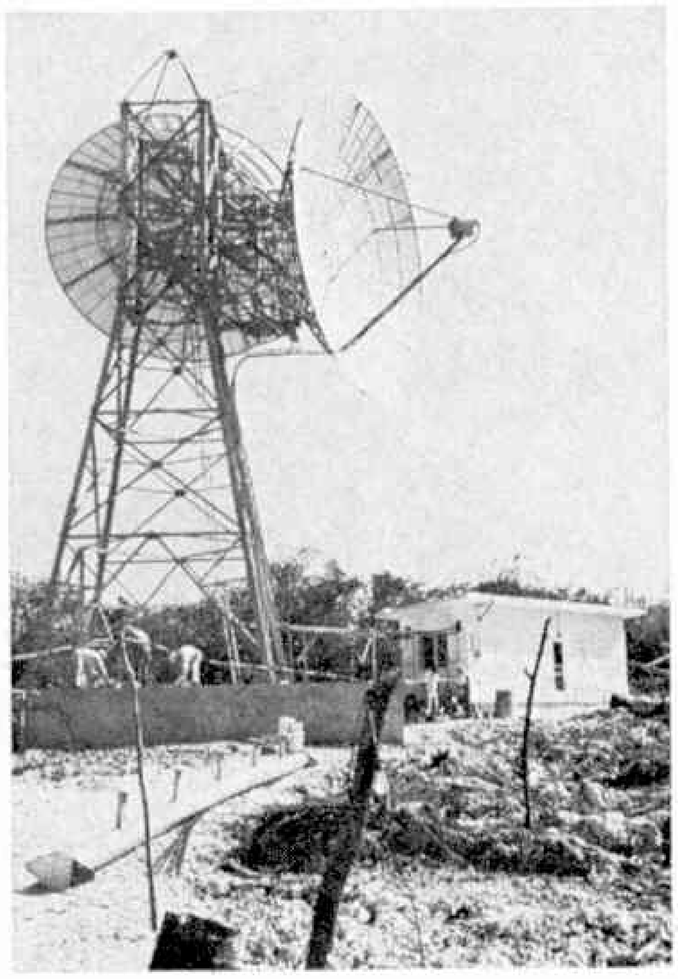
With the beginning of broadcasting and the many licensed amateurs who began experimenting on the short wavelengths, it was then discovered that even greater ranges of reception were possible. This eventually led to the erection of shortwave broadcasting stations in many countries. In 1932, BBC transmissions were radiated for the Empire, and within a few years they had grown considerably. At one time, there were no fewer than 24 different wavelengths, of from 13–49 metres. For good reception results, much depends on solar radiation and ionization of the atmosphere, besides other considerations such as wavelengths in use, paths traversed by the waves, transmissions times etc. Much research was carried out on 'echoes'. On short-waves, another problem is 'fading'.

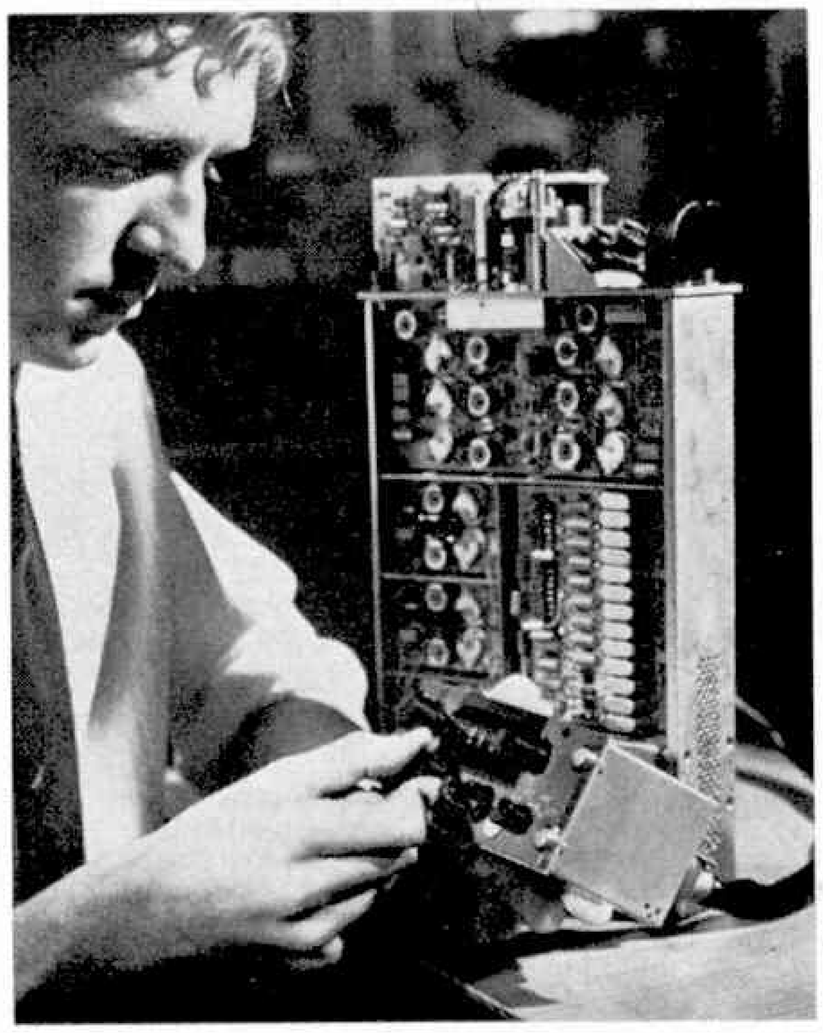
Another important development, in 1956, was the change in modulation from amplitude modulation (AM) to frequency modulation (FM). Up to this time, New York police discovered that with the old system, using AM, 'dead spots' often made communication with other cars impossible, so messages were first transmitted to headquarters, and then relayed to the other car. With FM equipment, communication with other vehicles directly was possible. Again, making use of ultra short-wavelengths, FM has many advantages, and 'High Fidelity' broadcasts became popular in America. First used by police and fire services, mobile radio started a new fashion. The first mobile radio telephone service in Britain was opened in 1960.

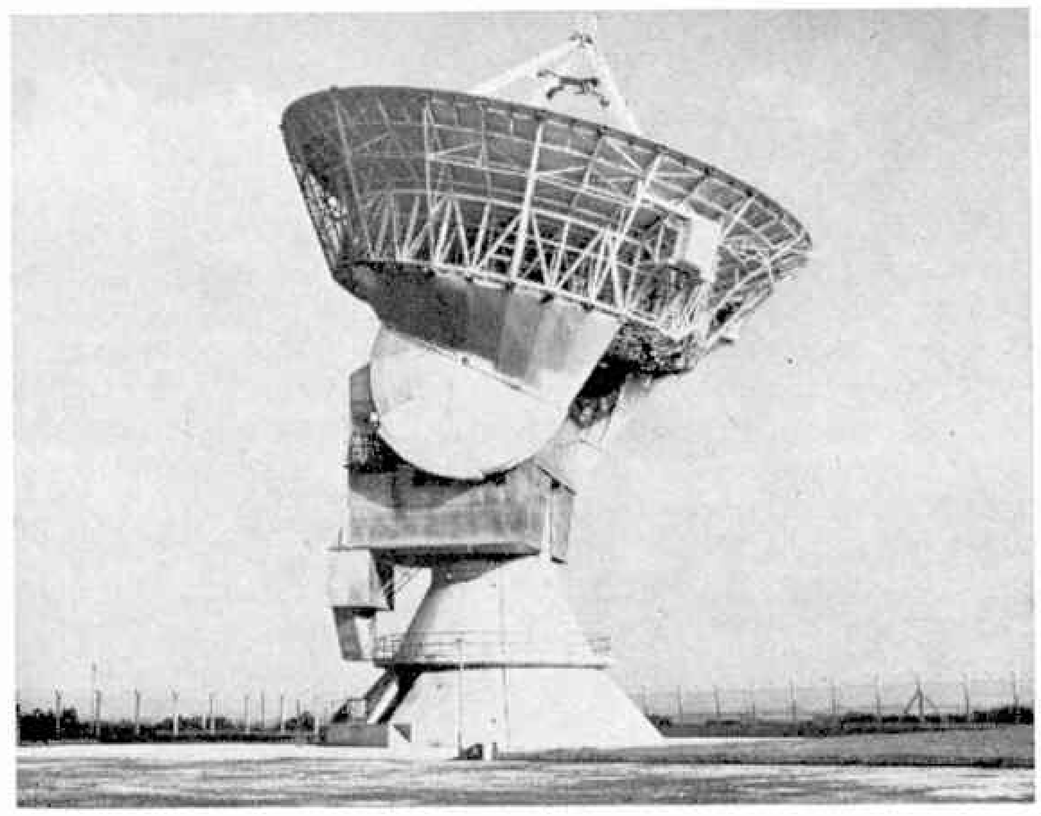
The last few years have seen many revolutionary changes with valves replaced by transistors, and the introduction of 'microminiaturization' in electronics and circuit arrangements with smaller components etc. Broadcasting and mobile radio as well as marine and aeronautical installations have undergone many changes. Electronic tubes and transistors now have their various uses. Regarding radio or electromagnetic waves, these travel at the speed of light, or approximately 186,000 miles or 300,000,000 metres per second. A station's wavelength is the fixed speed at which radio waves travel (in metres per second) divided by the number of waves transmitted.

As mentioned, the ionosphere, which reflects short-wave transmissions, varies in height from 10–200 miles above earth, reception conditions depending on solar radiation. Then there is the lower layer known as the 'troposphere' used for VHF transmissions. As we rise from the earth's surface, gradually the temperature drops to −55°C at a height of 8 miles. Higher still, it remains steady, marking the upper boundary of the troposphere, the height varying according to place. Above the tropics, it may reach a height of 12 miles, but over the poles, it may be as low as 3 miles. The discontinuity surface separating the stratosphere from the troposphere is known as the 'tropopause', varying in height from about 5,500 ft at the equator to 25,000 ft

Below left, 37 Coventry Corporation buses were fitted with mobile radio communications equipment for better traffic control and some protection against vandalism *(Photo GEC-AEI)*. **Centre, a new type of communications system called "Thin Line Tropospheric Scatter" gives freedom from much of the fade and interference on short waves. This installation is on Cayman Brac in the West Indies, relaying to Jamaica & Grand Cayman** *(Marconi)*. **Right, crystal controlled automatic direction-finding equipment for Boeing 737-130 aircraft provides maximum simplicity in taking radio bearings. Receiver in background.** *(Marconi)*.







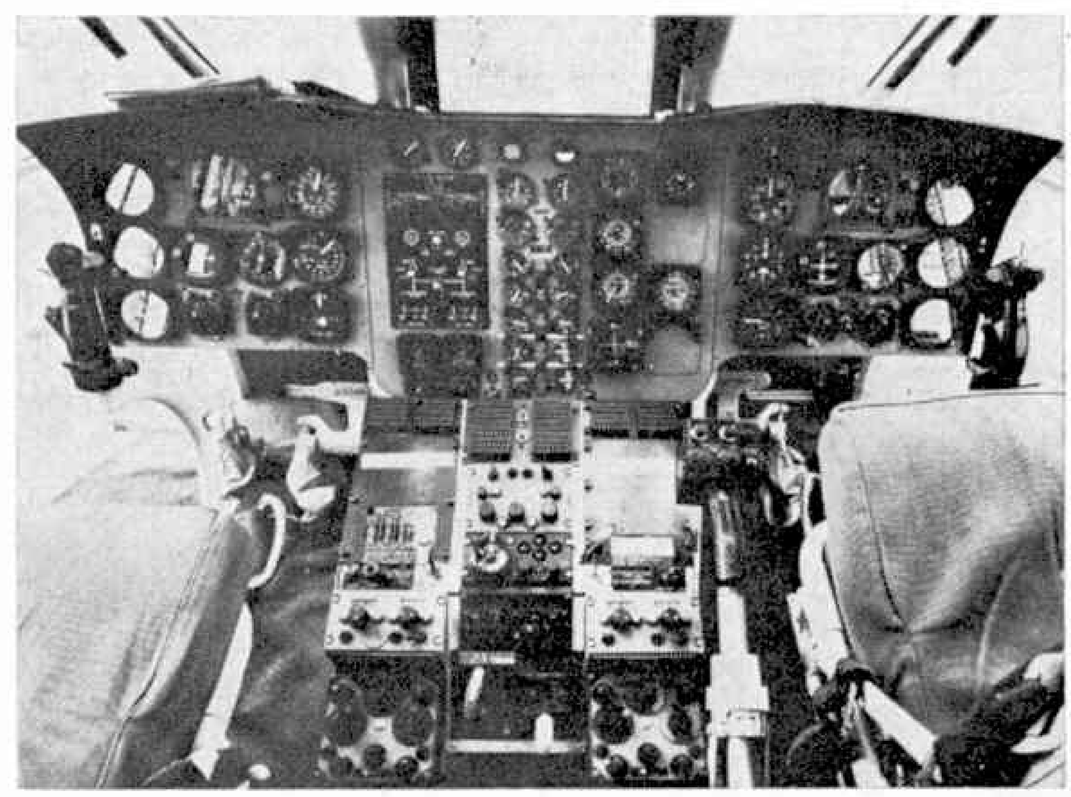
Left, LF/MF/HF communications receiver with all modern requirements—precise tuning, ease of operation, wide frequency range, and reliability *(Photo, Plessey Electronics)*. **Above, 82 ft. diameter dish aerial at the Radio & Space Field Station at Chilbolton, Hants. Main function is to gain knowledge of radio wave behaviour through space as well as Earth's atmosphere.** *(Science Research Council)*

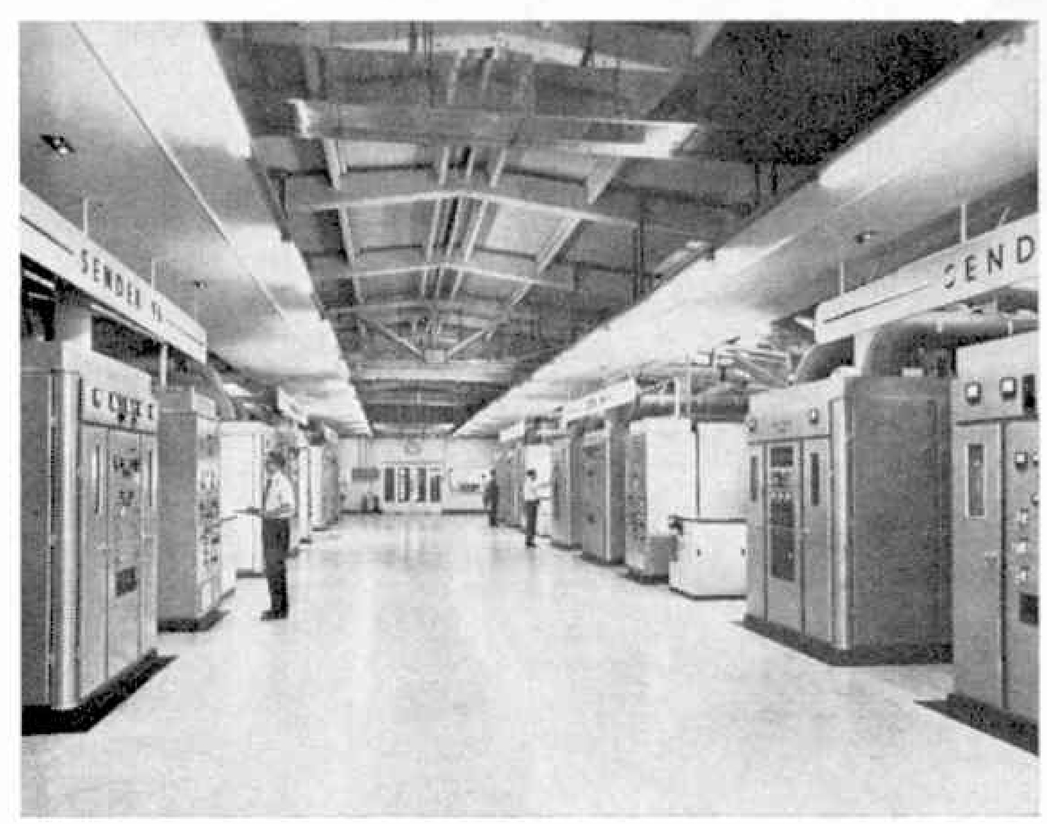
over the poles. Another reflecting layer known as the Van Allen Belt lies at great height above the earth.

Along with its practical uses, special research is also being carried out by three field stations under the direction of the Science Research Council, at Datchet (Ditton Park), nr. Slough, Bucks., Chilbolton, in Hampshire, and Winkfield in Berkshire. Research has been carried out at Slough since 1920, mainly on the propagation of radio waves, with important applications to communications, radio direction finding, and radar. Present work embraces a wide range of studies of atmospheric physics, both experimental and theoretical, in the troposphere in relation to the influence of meteorological conditions in propagation, and in the ionosphere and upper atmosphere in relation to the influence of extra-terrestrial radiations, largely from the Sun. The last mentioned include the exploitation of rocket and satellite techniques.

This station maintains observatories in the Falkland Islands and in Singapore. It also maintains a field station at Winkfield in collaboration with the U.S. (NASA) for tracking satellites and receiving telemetered data from them. The main function of research at Chilbolton is to further knowledge of the way in which radio waves travel, through space and through the earth's atmosphere. The 25-m (82 ft) steerable 'dish' aerial is a reflector of radio waves, being large enough to provide a highly directional instrument, able to distinguish between rays arriving from slightly different directions. Radio astronomy is not the primary object of the work, the main objectives being to investigate the structure of the atmosphere, and of inter-planetary plasma by using radio techniques, and to obtain data on wave-propagation required by planners of satellite and other radio communication systems.

Now that man is venturing into space, reliable long-range radio communications is of vital importance.





Above right, radio navigation aids in a Sikorsky S61N helicopter—three controllers visible in background. Two similar choppers are used to service North Sea drilling rigs. *(Photo B.E.A.)* **Right, "Voice of America" main transmitting hall at Woofferton, Shropshire. Six large short wave transmitters provide 1½ megawatts of HF power, doubled by an advanced technique known as trapezoidal modulation.** *(Marconi)*

WHETHER you are for or against the decision, it seems likely that this country will soon become a member of the Common Market. Once "in", or so the politicians tell us, we can expect to sample, at no extra cost in many cases, the immense variety of commodities produced by the present six member nations. The British motorist, however, judging by the ever-increasing number of continental cars seen on our roads, is already sampling the fruit of European industry, and if the excellent reports we hear are anything to go by, he certainly likes what he tastes!

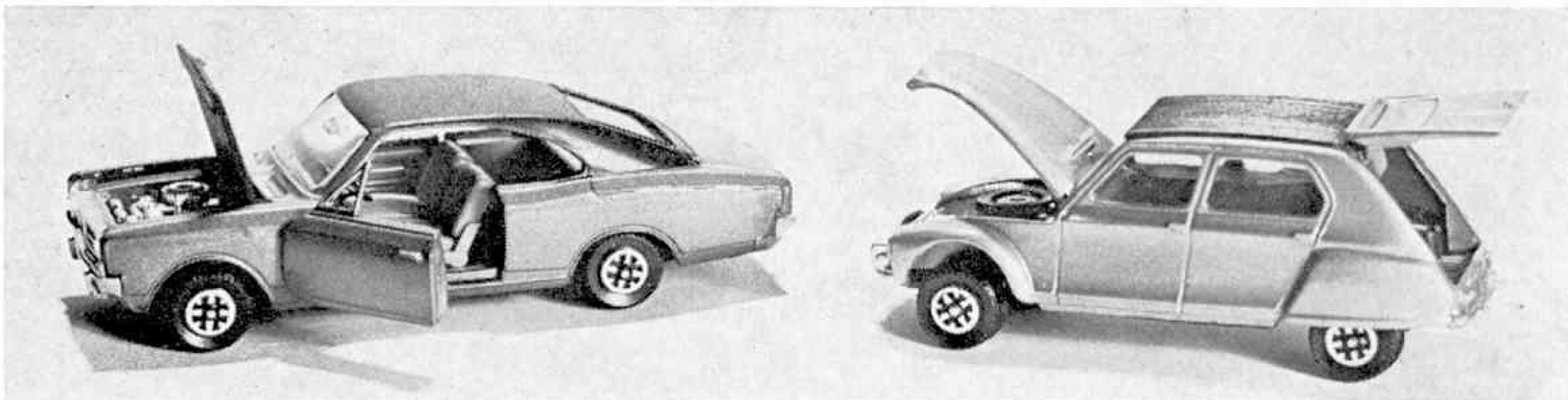
the Citroen Dyane, Sales No. 149.

The Dyane, often referred to as simply a "utility car", was first introduced by the French manufacturers in 1967, and is renowned for its cheap running costs and durability. With an engine capacity of 602 cc and a top speed of 70 mph it has become the ideal all-purpose family car, with enough power to satisfy the young driver and yet not too much to make grandma shake in her slippers!

Dinky Toys have captured all the lines of the original and added some of their own special features to increase the model's realism and

infiltrating the home market for some time with a variety of highly desirable vehicles, especially those of the Opel range, so much so that Meccano Tri-ang have also released this month a Dinky Toy Opel Commodore, Sales No. 179.

The full-size original has an engine capacity of 2,490 cc enabling it to reach a top speed of 110 mph. Fitted with either two or four doors and also available in a coupé bodywork, the elegant Commodore, with its combination of power and beauty, is a challenge to many British automobiles in the same class.



Dinky's two latest releases. Left, the Opel Commodore No. 179 and, right, the Citroen Dyane, No. 149.

EUROPEAN FAVOURITES

Frank Lomax looks at the latest Dinky Toy releases

It is perhaps surprising that the country which so much resisted our path into Europe—France—should be one of the leading exporters of automobiles into this country, but the number of French cars on our roads certainly proves this to be the case. In other words, the typical Englishman might think of the typical Frenchman as a swarthy, frog-eating, snail-chewing onion-seller, dressed in a striped jersey and black beret (no disrespect meant!), but he likes the cars he makes and one of the most popular of all French car makes is, without question, the Citroen. The name of Citroen, in my opinion, typifies France, just as Ferrari typifies Italy.

The popularity of Citroen cars in this country is undisputed, and Meccano Tri-ang, recognising this fact, have chosen as the latest addition to their Dinky Toy range

play-value. The new-design "Speedwheels" are fitted, with all-round suspension, allowing this compact model to streak along at the slightest push. An opening bonnet reveals a detailed engine, complete with spare tyre, while a large rear door opens to illustrate the extensive luggage and seating arrangement, finished tastefully in black. Front and back bumpers, radiator-grille and simulated head and rear lights, round off the model which, with its metallic bronze body finish under a matt-black roof, should prove as popular as the real thing.

German Commodore

The French automobile manufacturers are not the only foreign companies who have managed to capture an avid interest for their products from the British motorist. The Federal Republic of Germany (West Germany) have also been

Dinky's version of the Commodore is, as might be expected, a scaled and accurate reproduction of the original and it also incorporates some interesting action features to add to its play-value.

Fitted, like the Dyane, with new-style "Speedwheels", the sleek body is finished in metallic blue with a sporty matt-black roof. An opening matt-black bonnet reveals an extensive plated engine and the opening doors are furnished with plated quarter-light surrounds. The light-blue moulded interior is fitted with a steering wheel, and plated bumpers and front grille complete an appealing reproduction.

Both models are produced to a scale of 1 : 43 and undoubtedly make attractive additions to the Dinky Toy range.

Collectors' Corner

push the key home, after which the wheel or gear had a surprisingly strong grip on the Axle Rods. However, the addition of tapped bosses on Meccano wheels, shortly before the First World War, made the special Key Clips redundant and they quickly fell out of favour, although they were kept in production for some time for the benefit of owners of the earlier parts. They are now, of course, collectors' pieces, though doubtless there is many an odd box of these early clips buried at the bottom of old storage trunks in some old attics! The other pieces illustrated in the second picture show the type of early Perforated Strips in the "Mechanics Made Easy" Outfits. Tinplate was employed and it was necessary to turn over the edges to obtain any real degree of rigidity in manufacture.

B. N. Love describes some early parts dating back some sixty years

Collectors' Corner

TO paraphrase a well known proverb, "one man's rubbish is often another man's treasure." This is very true of the early pieces which were the forerunners of to-day's Meccano system. Some of the modern Meccano presses at Liverpool run continuously to turn out the small parts like Nuts & Bolts and Spring Clips by the millions. Although not so high speed in production, Frank Hornby nevertheless churned out several million of the smaller parts in his early days of experimenting with his system of "Mechanics Made Easy" in the first decade of the 20th Century. One would think that survival of these early pieces must be assured by sheer weight of numbers and this is true, to a certain extent. However, small things often have little value in their time, especially if they are cheap and are replaced after a comparatively short spell by 'improved' versions. Classic examples of this are the two forms of Meccano Spring Clips which are featured in the heading picture. One might not give these a second glance were it not for the fact that these specimens are something like sixty years old and were essential to construction in the early days. Those illustrated on the left seem much like the Spring Clips manufactured to-day, except that they are made from a thicker gauge of material and have narrow lugs. These were responsible for holding shafts, loose wheels etc., in place, for there were no Collars in the early days of the system. The special Clips shown on the right are a much different kettle of fish and to understand their purpose it is necessary to refer to the second picture.

Here is a further collection of some of the earliest parts in the system and these have survived almost from the beginning of the century when Frank Hornby, creator of Meccano sub-contracted the manufacture of some of the wheel designs to brass-founders; he eventually dispensed with their services because of poor quality and indifferent delivery and began to manufacture all of his own products under one roof in Liverpool. The interesting feature of these early wheels is that they had no bosses to accept Grub Screws. Instead, they were manufactured with a keyway as can be seen. This is where the special Key Clip came into its own. If it was necessary to fix a pulley or gear wheel to a shaft, it was first sited in position and then slid to one side while the special Spring Clip was placed over the Axle Rod with the key tongue in the position to be occupied by the gear etc. By sliding the wheel back into the required position, it would jam the tongue of the key clip against the shaft. Fixing the wheels in this manner required a firm grip and substantial pressure to

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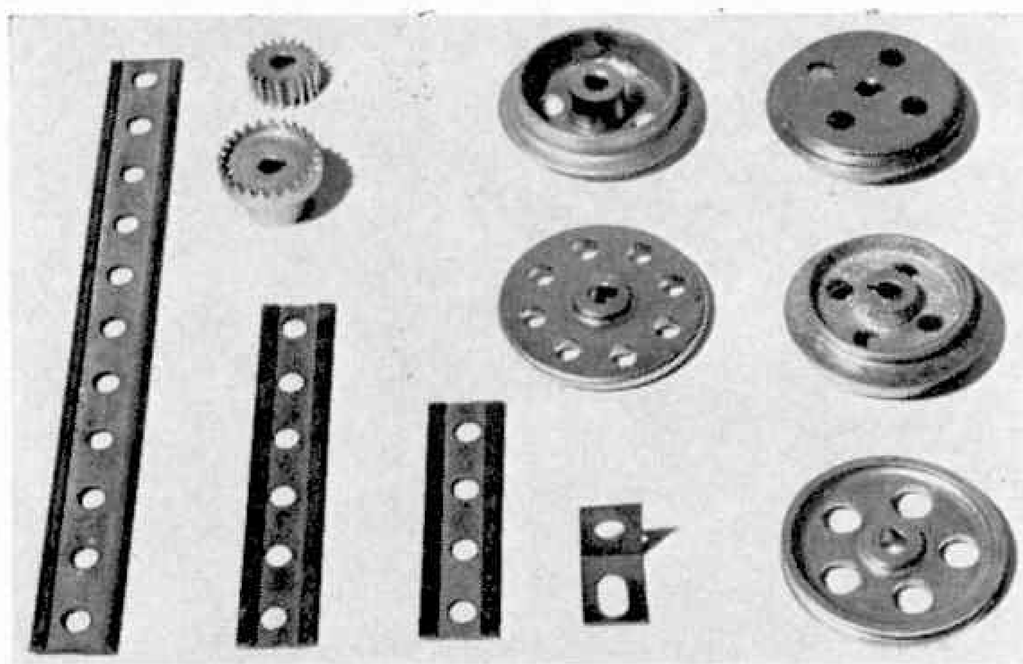


Clips in the top picture are approximately full-size; those on the right were designed to lock wheels to axles. Some of the wheels accommodating these special clips are illustrated in the photo at right.

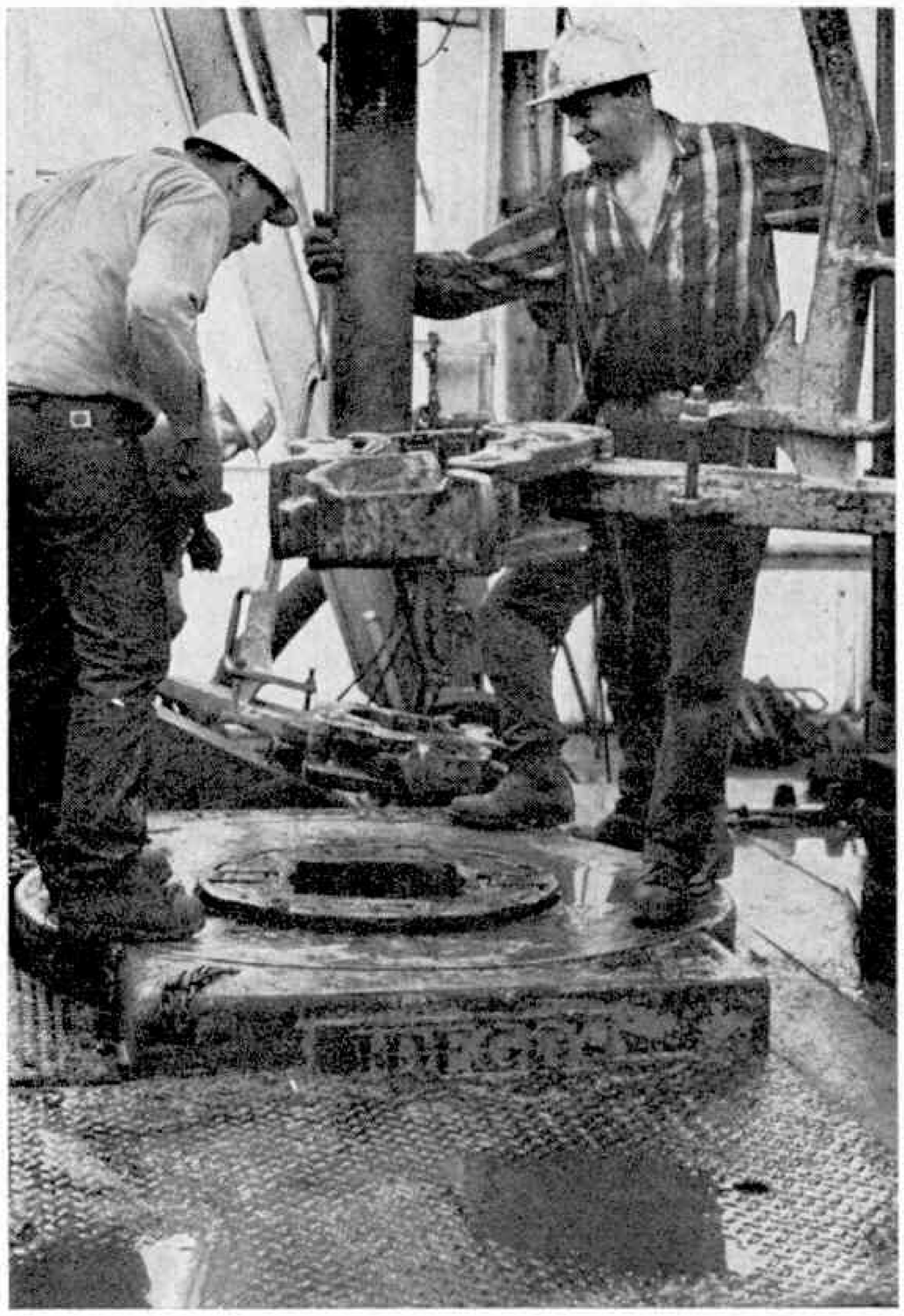
Liquid Black Gold

By Donald S. C. Fraser

MOST of us, if we think about petrol at all, regard it as pretty commonplace. To look at, it is indistinguishable from water—but there the similarity ends. Beyond the fact that it's the stuff needed to run things, airplanes, motor cars, etc. we know little about it. We never get to understand it properly the way we do most of the other products in day to day use. It's just one of those everyday things that we take for granted, regardless of the fact that, next to water, it is the most-used liquid in our daily lives.

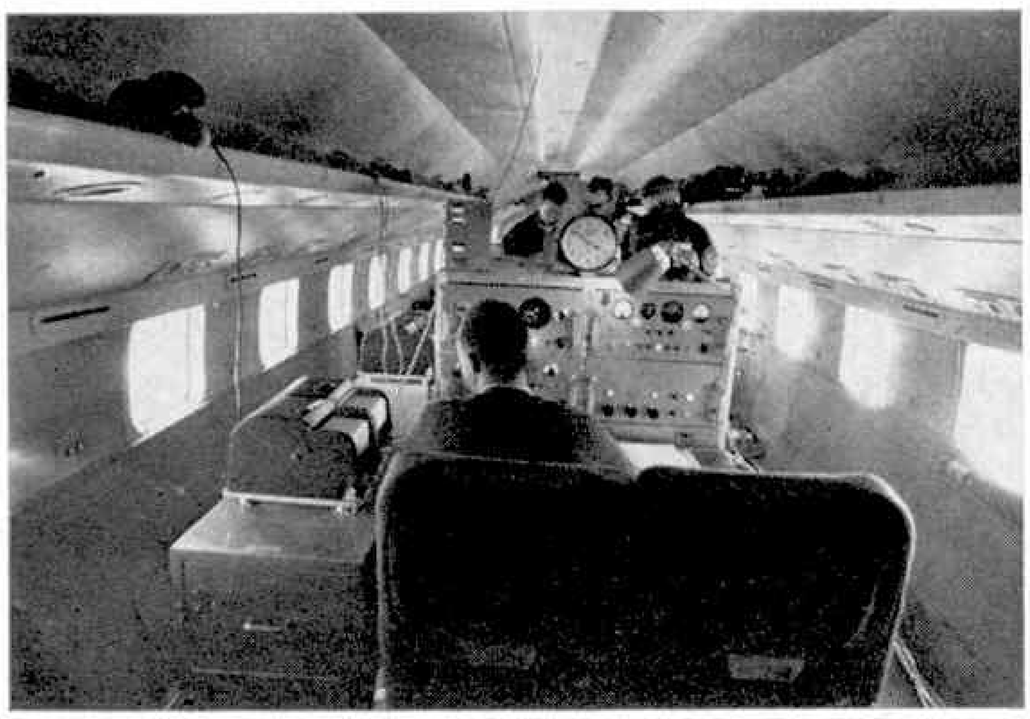
As a matter of fact petroleum is incredibly complex. It is not just one liquid on its own, but many liquids and gases, all drawn together into a kind of rare elixir that brings inanimate objects to life. The petrol that ran the first primitive car, many years ago, was what many people think it still is—a liquid distilled from crude oil, not much more difficult to produce than orange juice or soda pop. Since then, however, petrol has changed in composition and structure much more than the motor car. It is now a highly-tailored mixture of literally hundreds of components, squeezed and cracked from the sticky crude oil by such processes as distillation, polymerisation, catalytic cracking, catalytic reforming and alkylation. A roll call of its components bring forth such exotic names as isobutylene, butane, isopentane, pentylene-1, hexane, benzene, cyclohexane, heptane, isooctane, toluene, nonane, to mention but a few. The actual petrol we now use is composed of these hydrocarbons and thousands more.

Crude oil, from which petrol is made, is black, gooey muck in its natural form. It is found in many peculiar places and, as more and more of this precious liquid is being used daily, a continuous quest takes place for it, by land, sea and air, all the time.



At present, 54 of the world's 123 countries produce petroleum. It comes from gentle farmlands in Holland, from the Sahara Desert, where camels stand in the lee of oil rigs, from the jungles of New Guinea where as much rain as 120 inches has fallen in one month, and where it once took two years to hack and build a road of 30 miles from the oilfield to the harbour. It has been discovered under the sea in many places, from the Arctic's vast silent reaches, and is even extracted from fabulous tar sands in mid-west Canada.

The recovery of crude oil calls for many different techniques in accordance with the geographical formation of the oil well concerned. To most people an oil well is still a structure that looks like an overgrown windmill tower, with petrol gushing out of the top and a group of slap-happy farmers dancing in joy at the bottom. In actual fact, if oil squirts out of a well, something has gone seriously wrong. The pressure that forces oil out of the ground is almost as valuable as the oil itself; it is supplied by gas dissolved in the oil the way the sparkle is dissolved in soda water, by tightly compressed free gas in a 'cap' above the oil, by water pressing up from below, or even by a combination of all three. Nobody wastes an ounce of that pressure if he can help it, for it is the force that drives oil up the well after the



Top, this is what the floor of an oil rig looks like. "Roughnecks"—the name given to the crews—are a happy-go-lucky bunch but it's a hard life.

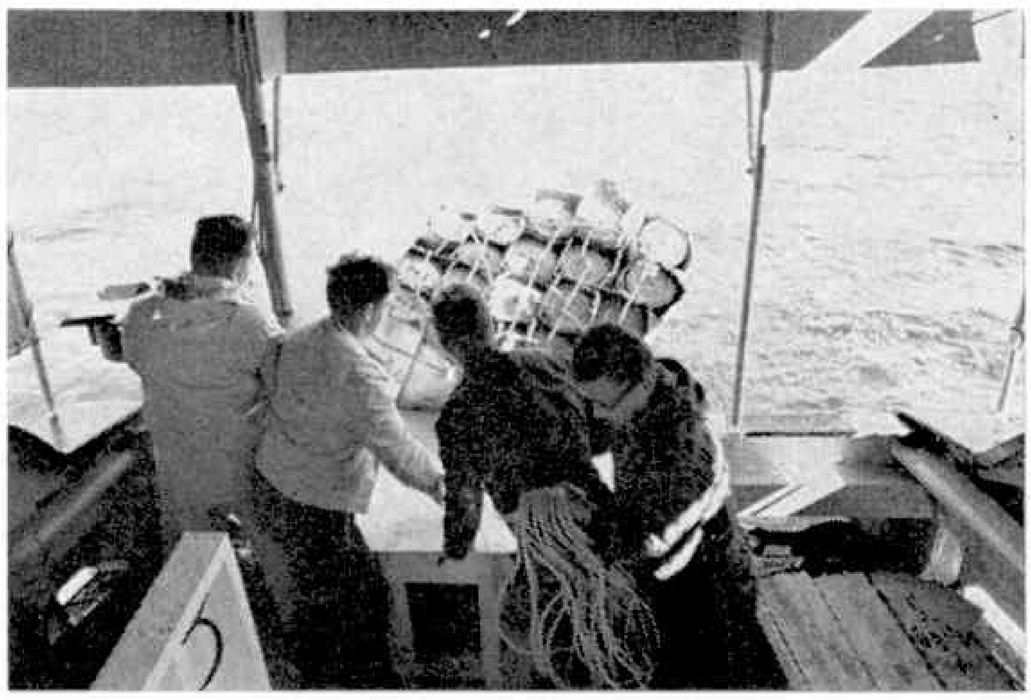
Left, searching for oil in the air sounds somewhat improbable. It is accomplished, however, in a flying geomagnetic laboratory. Possible locations are mapped for future ground-level investigations.

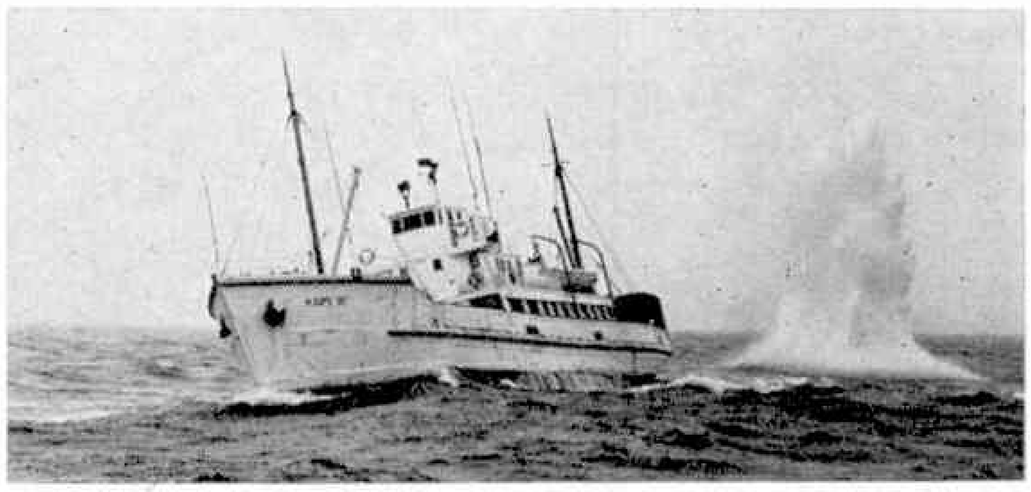
driller has punctured the formation. Naturally, every barrel of oil that leaves the pool reduces the pressure but, in the case of pressure-depleted wells—and also in new wells—new techniques have been devised by reservoir engineers. The methods they have developed include blowing out the oil with natural gas, flushing it out with water, dissolving it with solvents, swelling it with carbon dioxide, making it runny with steam, and setting it on fire in the ground. In the case of the tar sands in mid-west Canada it is mined almost like coal. All of which shows that the recovery of oil is radically different from the gushing oil wells of popular imagination.

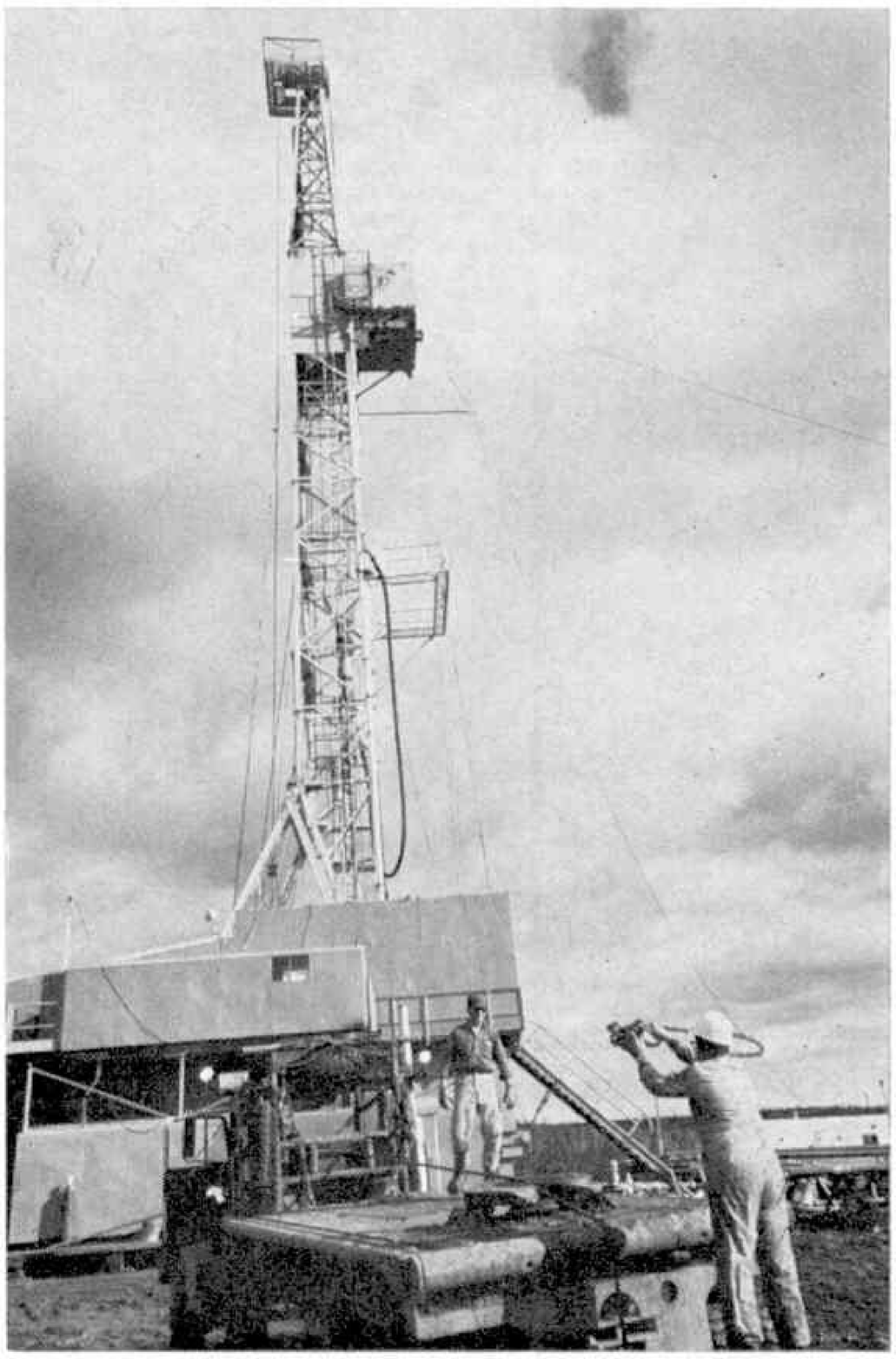
Incidentally, oil fields are not just puddles of oil sealed in underground caverns. They range from formations that look something like beds of coarse sand soaked with oil that clings to every grain, through stones and gravel with oil filling the cracks between, to honeycombed rock with droplets of oil saturating tiny pores. You can't dip a ladle into any of that sort of thing. The oil itself may be nice and thin, runny enough to drain easily out of its sand bed or rock pores, or so thick and gummy that it won't move at all. In shape the oil zone may be a thin layer only a few feet deep extending over thousands of acres, or a nice compact reservoir several hundred feet from top to bottom and extending only a mile or so across. The zone itself may be homogeneous, composed of only one type of rock or sand, or it may be a geological grab-bag of sand, shale, boulders, gravel and porous rock all mixed up together. It may even be an immense bed of oil-saturated sand lying at, or near, the surface.

The two chief methods used in forcing crude oil from a well are called the Water Flood method and the Miscible Flood method. In the former, water flooding the well increases production by forcing water through the underground formation to flush oil out. But it may by-pass some of the oil pockets and leave areas between the producing wells untouched. Miscible Flood, the other technique, is called after the Latin word for mixable. The principle is similar to a garage mechanic's dirty hands; when soap and water won't wash oil and grease from his hands, he dips them in petrol and cleans them in a wink as the oil dissolves in the petrol. Oil is flushed out of a well in the same way, although petrol isn't used to dissolve it. Various oil companies use different formulas of their own, usually a mixture of propane, butane and ethane contained in gas dissolved in the oil. They squirt a layer of the solution on top of the oil, then blow gas in on top of the mixture to force it down through the rock pores, dissolving the oil out of the pores as it goes, and forcing the rest of the oil ahead of it, the way a piston forces water through a pump.

Naturally, the hardest part of the oil industry is finding this precious liquid in the first place. At the moment a world-wide explosion of activity is taking place as explorers have stepped up their exciting quest in the north, south, east and west. The panoramic stage set for this massive far-reaching search stretches from where slender spruce saplings defy the sweeping winds along the Arctic tree line to where hardy fishermen face the chilled heavy waters of the Atlantic; from where warm Pacific seas foam gently against heavily-wooded shores to where white whales cruise in the depths of Hudson Bay. By air, land and sea, the oil seekers are making their geological and geophysical surveys and investigations.

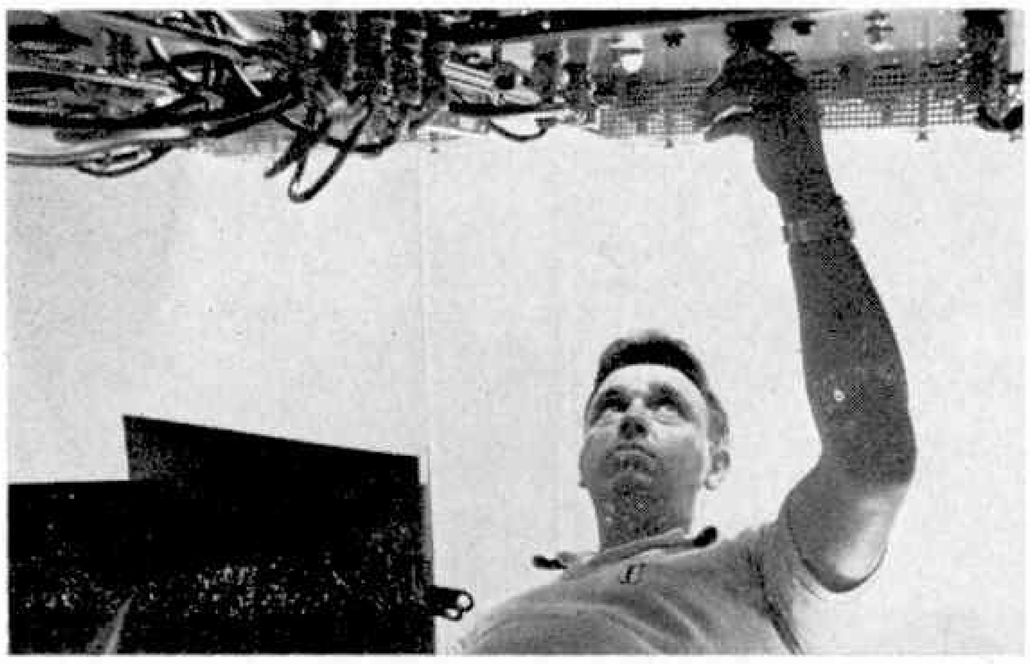




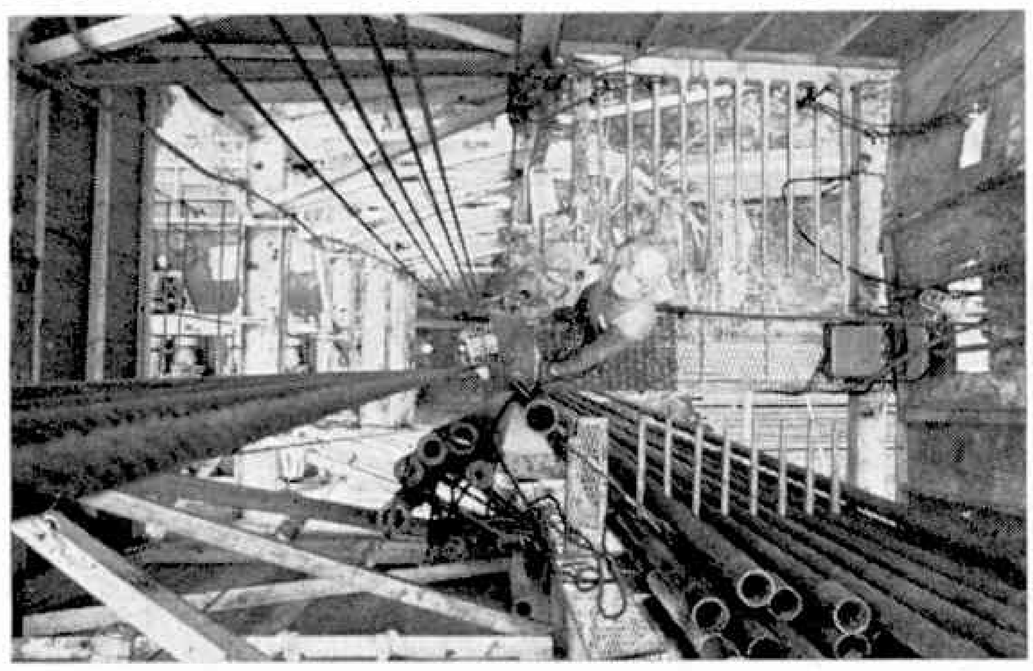


Top, an explosive charge goes over the stern of a seismic vessel engaged in oil exploration and (centre) sends up a plume of water during seismic work at sea in an endeavour to locate possible locations to drill for oil.

Bottom, an oil rig used on land probing for oil during the preliminary search for this precious liquid.



After a seismic explosion at sea—a Decca electronic positioning equipment instrument controls the exact location of detonation. If the shock waves give a positive possibility, a buoy is placed in that position for the drilling ship.



This is a view down an exploratory oil rig. Indications have shown the possible presence of oil but nothing is certain in this game. If they find oil—well and good. If not—a great deal of money has gone down the drain in this particular investigation.

Oil well owners often co-operate with one another in their operations. In Canada's Weyburn field in Saskatchewan, they have consolidated in the operation of that country's largest waterflood project for forcing oil to the surface. Below, alarm panels are being checked in this automated system.

Much of today's exploration is taking place in the north. Future resources of 'buried energy' (especially in the northern sea areas where sailing distances are economically short) could satisfy our hungry markets in Europe where constantly expanding consumption makes fresh sources of supply an imperative need.

The first step in exploring for oil at sea is drilling a hole in the ocean floor. From this they pull up mucky chunks of ancient rock for geologists to investigate. This is the rock that might contain the hidden hints of oil they are looking for. This preliminary search follows a survey of sub-surface formations by seismic detectors. These trace the paths of shock waves, caused by detonating explosive charges, as they pass through the varying densities of rock and hidden deposits. From these repeated signals geologists hope to discover inverted saucers of rock under which pools of oil are gathered and trapped by their flotation properties.

A core-drilling ship is a vessel of many parts. Besides the usual navigational instruments there is much heavy equipment. A 60–70 ft derrick for a start. Then there's a bumper sub, a 10-foot-long steel cylinder which weighs maybe 500 pounds. It is used as a sort of shock absorber to steady the drill pipe from swells under water. By poking a switch on the console in the wheelhouse four huge outboard motor-like units, hinged along the ship's sides at bow and stern, spring out and splash down six feet below the waters. These are harbourmasters, powerful 300-horsepower position-propulsion units, designed to keep a ship from drifting—a nice thing to have when you are trying to drill a hole in 240 feet of ocean. At the same time a 600-pound weight is let down by wire line to the ocean bottom. With this control sending signals to an analog computer, the position of the vessel to the ocean floor is fixed. Then as wind and waves toss the ship around, and the wire line's angle changes with the ship's movement, the computer automatically passes impulses along to the harbourmasters—to counteract wind and swells, one churns a little more speedily, another spins a little more leisurely, the other two stand by for any change in wind and swell direction. In this way, the ship wanders less than three per cent of the depth of water—not enough to shift it off the hole.

The drill bit and pipe pass through what is called the moon pool—a 10-foot-wide hole knocked clear through the ship from deck to hull. The roughnecks, the term used for rotary drilling crews, weight the drilling bit, core barrel and 30-foot lengths of drill pipe with drill collars, clamped on bumper subs for stability under water, and send the whole greasy business through the moon pool to the bottom. The rotary spins, crunching into something 40 fathoms below. Harbourmasters churn, diesel engines throb, guide wires creak, a drill pipe clanks as it spins off the horizontal pipe rack. The whole ship twitches and quivers with a raucous cacophony of sound.

The procedure for locating oil under land surfaces is similar to the above. A geophysical party makes a survey, followed by seismic crews. Then a small hole is drilled in the earth and charged with dynamite. Strings of sensitive microphones (called geophones) are laid across the land and hooked up to a recording truck. The dynamite is exploded, sending shock waves racing into the earth to rebound back through the geophones and into the recording truck where they are recorded on magnetic tape. Later on in a laboratory, the tapes are played back to produce a set of wavy lines which, to a trained scientific interpreter, gives a visual picture of the rock structure thousands of feet below—and maybe a clue to oil.

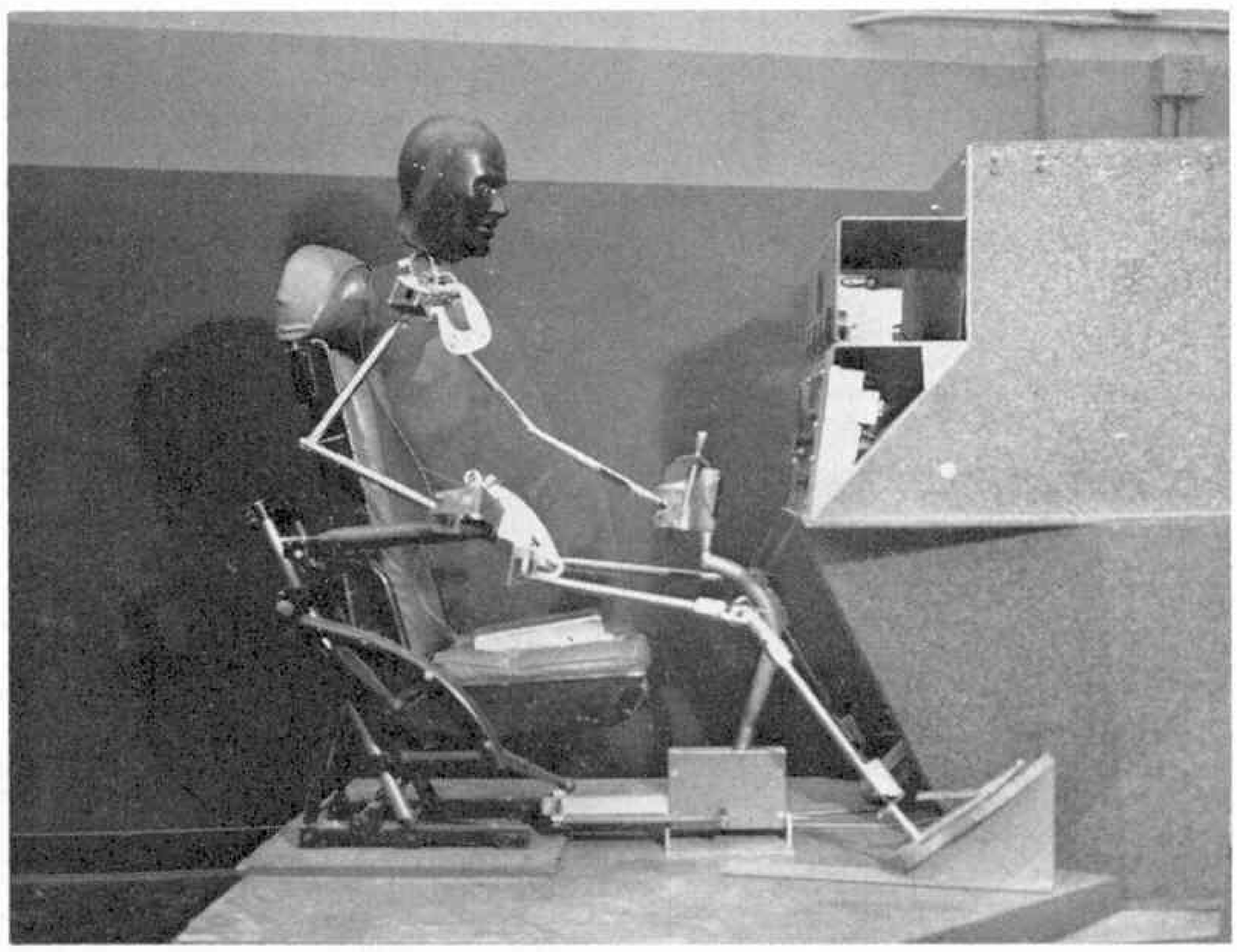
The first port of call for crude oil, after leaving a well-

head, is a refinery. Here it will get the shock of its life for it is turned, not only into petrol, but many other commodities as well. These include waxes, lubricating oils, assorted raw chemicals for use as petrochemicals, asphalt, a clutch of diesel, domestic, industrial and heavy fuel oils, and several other formula products.

Once in the refinery the crude snakes its course, via pipeline, criss-crossing its way through huge steel storage tanks, bulbous towers and giant boiling kettles. Within these science-fiction-like surroundings, the hapless crude oil is cooked and chilled, dewaxed and desalted, slimmed, fattened and rearranged, hypoed with hydrogen, attacked with carbolic acid, sifted for sulphur, plucked for impurities and, in general, harassed until it would not recognise itself.

Other than in the inspection laboratories, few eyes ever actually behold crude oil, or any of its components, in the refinery. To the workers in the central control rooms alongside most of the processing plants, their special interests are reflected in charts, gauges and meters spread across large instrument panels. They can instantly tell you the pressure, temperature, or rate of flow of any given gas or liquid but would be hard put to describe its feel, smell or colour. For crude oil has been tamed by automation. It can be shunted through steel pipes from one confine to another by the twirl of dials. A pressed button or pulled lever will nudge it gracefully through its various calisthenics. Until finally, a control slightly adjusted sends its products slurping into steel tanks, tanker ships, railway tank cars, trucks, cross-country pipelines and sealed containers.

Crude oil, the most sought-after liquid in the world, has been turned into petrol, the 'Black Gold' of the modern age.



"BOEMAN"

The first robot "test pilot"

By M. Lorant

RESEARCH engineers of the Boeing Company and experts of the U.S. Navy have recently developed an entirely novel type robot, named 'BOEMAN'. He is not a mechanical man, as robots used to be, but a mathematical model programmed for computer work.

'Boeman' is actually a collection of computer descriptions of lines and pin-points. By 1973, however, he will be a fully clothed, three-dimensional elastic man-model. It is expected that then he will have 'deformable' skin and his skin will 'ripple' when he flexes his muscles.

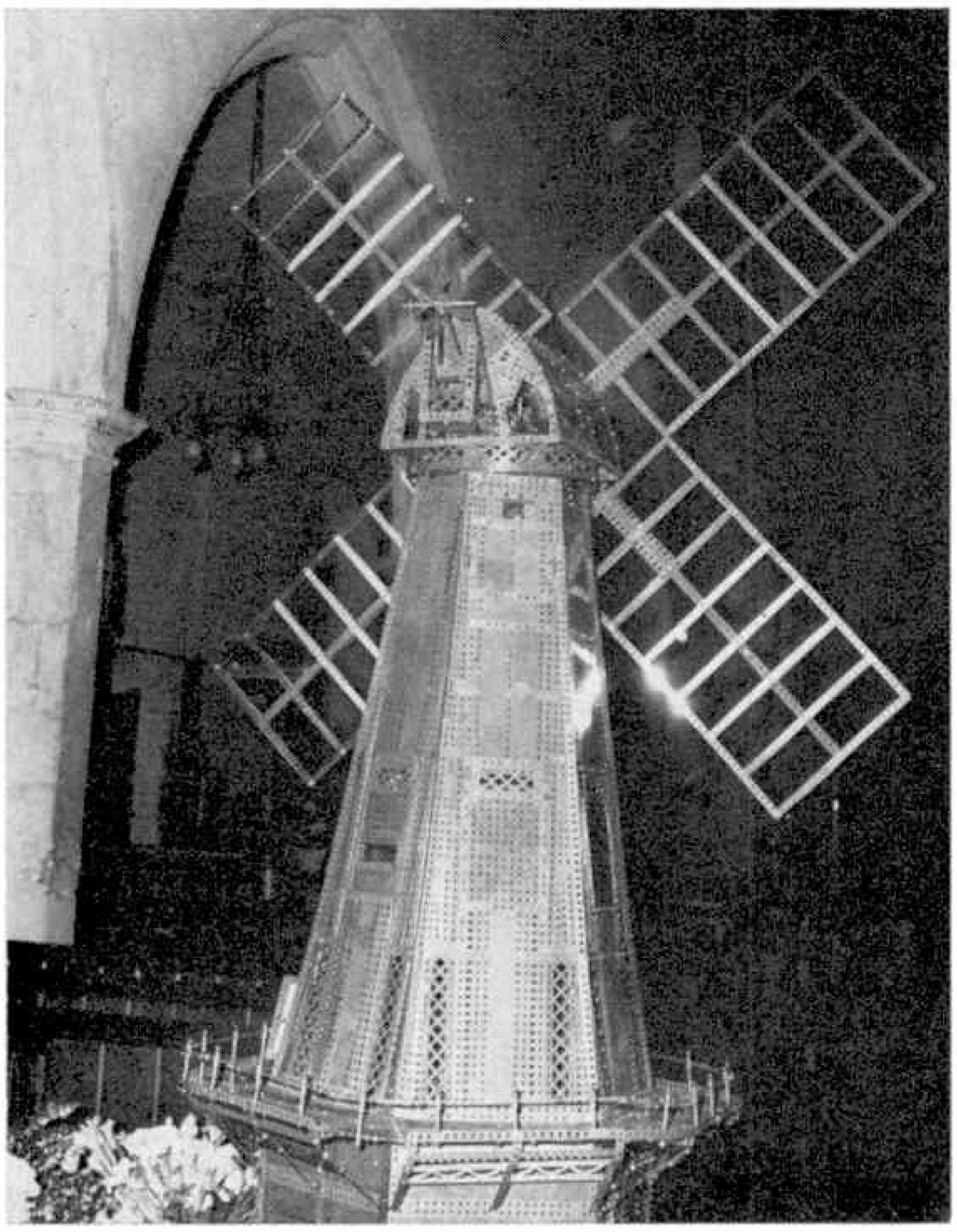
The robot's job will be to see if the drawing-board cockpits of paper airplanes actually will be acceptable to pilots. If an important switch is placed above and behind a pilot's head, for example, 'Boeman' can determine whether a given-sized pilot can reach and operate the switch.

Human anthropometric data is hard to handle because of its massive quantity. Also, it is very difficult to place useful instruments on a human being to measure exact values without interfering with any test. 'Boeman' will have to keep in touch with a complex series of computer instructions to be sure of exactly what sort of aircraft he's flying.

Once fully developed, 'Boeman's' programming will pit human limitations against cockpit geometry, mission requirements, on-the-spot occurrences, visual interferences and physical problems. Tests will include how much work the pilot can be expected to do under certain conditions and, possibly, even how much psychological stress might help or hinder the cockpit situation. Computer programming will allow the robot to 'change size', although this will not be a physical change. The computer simply will interpret 'Boeman's' reactions according to size of the man he's supposed to be at the time. The computer will also change the size of the cockpit around 'Boeman' as the engineers dictate.

To convert the new robot into a flight-test pilot, company engineers and the U.S. Navy will have to dig up new facts on how digits fit together, the movement of joints, how much force a man's arm, hand and leg can produce, and how skin interacts with arm and leg movements. Scientists will aid in developing details on how best to get the robot's backbone connected to the thigh bone, etc.

Currently, 'Boeman' is being engineered for 23 movable joints. While this won't allow the first test pilot to play tennis, for instance, it will definitely allow him to be highly useful in the important field of up-to-date aviation testing procedures.



Among the Model Builders with 'SPANNER'

Left, a rear view of Mr Palmer's windmill showing the correctly-scaled shape of the tower and superstructure.

Land of Giants

When I first heard from Mr. Charles Johnson of North Bay, Ontario, Canada, I thought I was in the middle of a nightmare. I was seeing giant Meccano models before my very eyes! "That's it", I thought. "It's caught up with me at last—I've finally seen too much Meccano!"

Panic was unnecessary, however. I was not having a nightmare and I had not seen too much Meccano, but I most certainly *was* seeing giant Meccano models—or photographs of them—built with enormous Meccano-type parts made by Mr. Johnson to amuse his daughter, Karen.

An interesting story accompanied the photographs. Mr. Johnson explains that, as a boy, he was a fan of Meccano and, like many enthusiasts then, as now, he often had a desire to be able to climb aboard the various creations he produced. At the time, of course, his desires were nothing more than a youngster's fantasies, but as he grew into adulthood, he began to realise that there was nothing to prevent large-scale parts from being produced which could then be built up into large models capable of carrying a passenger. A couple of years ago, therefore, he set to work and finally produced a giant "Meccano Set", scaling up Meccano parts to six times their normal size. For obvious reasons, he says, he calls the Set "Gigano" and a glance at the accompanying photographs of Karen with one or two models will show just why!

Gigano, as presently produced, is not as comprehensive in content as Meccano, but the essential components—Flanged Plate, Strips and Brackets, etc.—are in existence and are more than sufficient to build a good selection of models. The parts are chiefly made from $\frac{3}{8}$ in. thick plywood with any joints glued for strength and the Angle Brackets being further strengthened with metal reinforcers. The 6:1 scale of the parts makes the important $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plate some 2 ft. 9 in. × 1 ft. 3 in. in size, while the common $2\frac{1}{2}$ in. strip measures out to 1 ft. 3 in. with the other parts being sized accordingly. One part which does not follow the scale increase, however, is the Bolt, the reason being that bolt strength depends on cross-sectional area, therefore a scaled increase in size would result in the Gigano Bolt being 36 times stronger than its Meccano counterpart! Obviously, such high strength would be unnecessary and so Mr. Johnson chose a $\frac{3}{4}$ in. diameter Bolt, for appearance, with strength, making the accommodating holes in the other parts $\frac{13}{16}$ in. in diameter to allow ample clearance for the Bolts, The $\frac{1}{2}$ in. Meccano spacing between holes, of course, scales up to 3 in.

Another scale problem lay in the shafting. Meccano Rods scaled up by 6:1 would result in a diameter of over 1 in. whereas Mr. Johnson found that $\frac{1}{2}$ in. diameter Rods were perfectly adequate for his needs. Using $\frac{1}{2}$ in. Rods, he overcame the obvious problem of much larger holes in the Strips and Plates by producing "Bolt Bushes" to be fixed to the Strips, etc. to carry the Rods. These are ordinary Bolts drilled axially to receive the Rods and they obviously have the added advantage of providing good bearing surfaces for the Rods. Three "Fits" are available, Loose-running, Medium-running and Close-running, this approximately reproducing normal engineering practice and allowing different fits to be used to meet different requirements. Close fits for example, would be used for steering mechanisms, while Loose or Medium fits might be used for road axle work.

So far, Mr. Johnson has produced two Gigano Sets, one larger than the other. Among the many models he has built with the smaller Set are a Slide, Sofa and Hand-cart, while one of the most outstanding models built with the larger Set is a magnificent Car, capable of carrying one or two children and fitted with working steering and V-belt hand drive. This model includes a Rod with Keyway to enable the steering wheel to be positively attached to the Double Angle Strip used for the front axle mounting.

Looking at the accompanying photographs of Mr. Johnson's giant Meccano models, can any Meccano modeller honestly deny that he has realised the secret dreams of us all?

All in the Family

I understand that Mr. Johnson's daughter, Karen, has herself become quite efficient in working with Gigano which leads me to think of the very many adult Meccano enthusiasts around the world who have passed their interest in Meccano on to their own children. The number is, of course, so large as to be incalculable, but I would particularly like to mention here Dr. J. de Zeeuw of Leiden, Holland.

Dr. de Zeeuw is an accomplished modeller of many years standing and his Meccano abilities may be judged by the excellent working lathe which we featured in detail in the June and July 1970 issues of the *M.M.* His interest in Meccano has been inherited by his two sons, so

much so that father and sons now regard Dr. de Zeeuw's large parts collection as, collectively, "ours"!

Our photograph shows Dr. de Zeeuw's eldest son, 14 year-old Jan Hilbert, with a Giant Tower Crane he built last winter. Jan tells me that it is based on a real-life original which was working near his school and which he saw every day from his classroom window. Constructed mainly of Angle Girders and Strips of various lengths, the model stands some 10 ft. high and has a total jib length of 13 ft. The roller bearing turntable makes use of two 5½ in. Circular Girders and revolves on eight ½ in. Pulleys. All the movements of the real thing are incorporated in the model, power being supplied by two of the older 20 volt Meccano Motors, one controlling the jib trolley movement and hoisting and the other controlling counterweight movement and slewing. The Motors are carried in a special housing above the driver's cabin, which, incidentally, Jan is holding in the photograph.

A model of the size in question obviously cannot be packed away easily, and so Jan has designed his Crane so that it can be split into four sections: the main tower, the tower top with the motor case and two jib sections. It can be split and re-assembled in four minutes.

A final comment reflects on the size of the de Zeeuw's collection: Jan says that their equipment is sufficient to build a Crane three times the size of the model illustrated—but his room was not big enough to take it!

Above, "Spanner" thought that Meccano had finally gone to his head when he first saw these pictures! Eight year-old Karen Johnson with two models build from a giant-size "Meccano Set" produced by her father. Below, Fourteen year-old Jan Hilbert de Zeeuw of Leiden, Holland with the giant Tower Crane he built last winter.

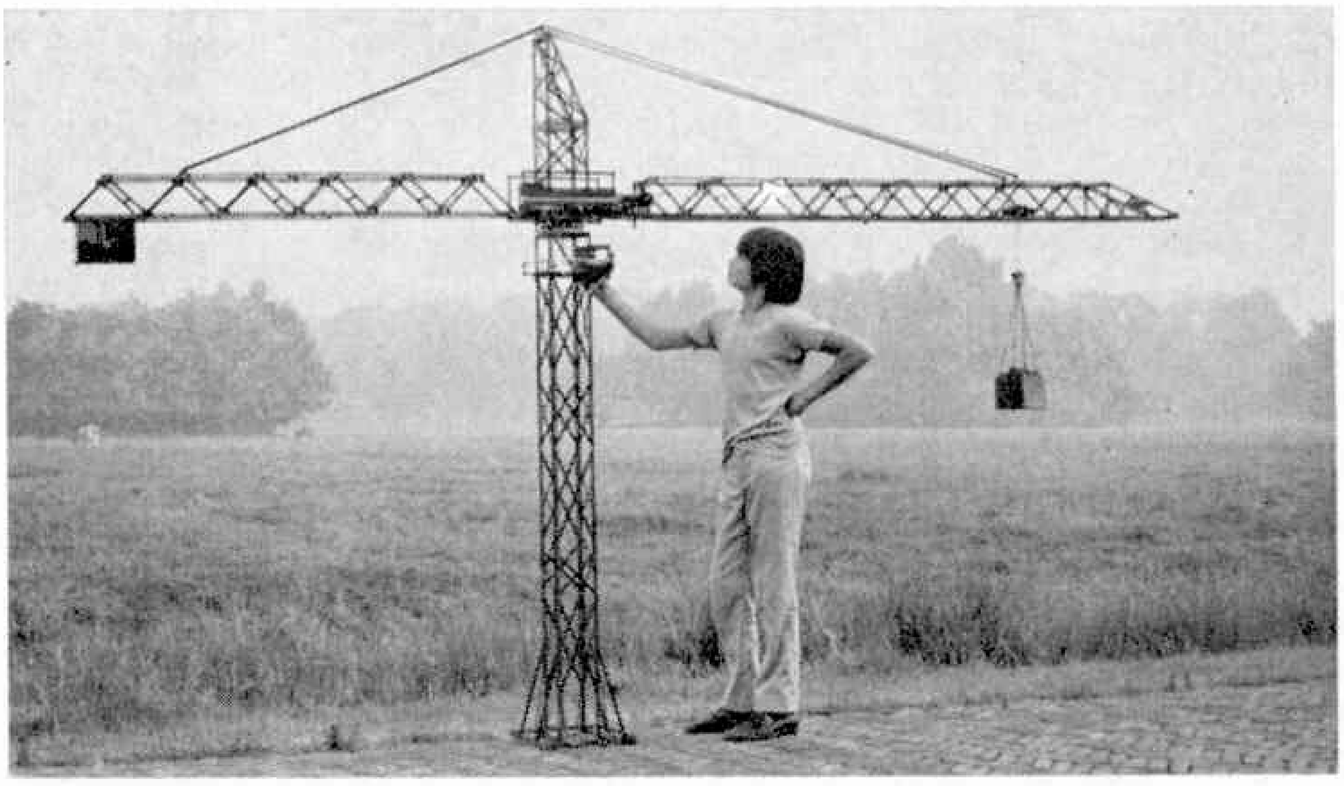
Still with the Giants

The matter of size can be something of a problem and I am sure that Mr. J. W. Palmer, of Meopham Green, Kent, would be among the first to echo this sentiment. He, also, has built a fair number of giants in his time, the latest to emerge from his workshop being the rather splendid Windmill appearing in the photograph on the page opposite. Baced on an actual windmill adjoining Mr. Palmer's house, the model has a maximum height around the 8 ft. mark and a sail diameter in excess of 5 ft. Four distinct movements are included, all of which take their drive from a central shaft, made of 11½ in. Rods joined by Universal Couplings, which runs up from the base to within 1 in. of the canopy. In the base, corn crushers rumble round realistically, while the sails also rotate—"majestically", says Mr. Palmer! The weather vane at the top of the model swirls round and, finally, some complicated machinery in the top of the tower causes the whole superstructure to veer left and right, thus simulating the real windmill's ability to swing round to take full advantage of the wind.

Internally, the model is illuminated by a series of 40 watt lamps and, as Mr. Palmer says, "It works very well indeed and has been much admired. It took about six months to build and swallowed up a very large number of parts, including 1900-odd Nuts and Bolts." The results were worth the time and effort, Mr. Palmer!

Drive Hint

The last word this month comes from another resident of Kent, Master R. Schoolar of Tunbridge Wells. "I am very interested," he writes, "In giving models extra traction, while still retaining a functional differential mechanism. One way of doing this is to put three wheels on the back axle, instead of two, but I have never yet been able to have all three wheels differentially driven. The problem is now solved quite simply by using Mr. James Grady's "Baby Differential" (see December 1970 *M.M.*) and substituting the boss of a Road Wheel or Pulley with Tyre for Collar 2, remembering that the differential *must* be positioned so that the additional wheel is at the centre of the axle. This provides three wheels which may all turn at different speeds, the fact that the speed of the centre wheel is constant having no effect upon the action of the mechanism". Many thanks for the suggestion, Master Schoolar.



Geology on Stamps

By James A. MacKay

AT FIRST glance this may sound like a pretty dull subject, but Geophilately (to give it its proper name) offers plenty of scope to the stamp collector. Geology may be defined as the study of the earth: its history, its composition, and the processes which govern its surface and shape. Each of these broad categories provides numerous philatelic illustrations, and many collectors concentrate on one aspect of geology.

The history of the earth, for example, would trace its development over countless millions of years. From the philatelic viewpoint this branch of geology is best illustrated by stamps depicting fossils. Ammonite fossils, among the commonest found in Europe, have been featured on stamps of Hungary and the Netherlands. A gryphaea (fossilised shellfish) and a petrified fish were featured on some of the 'Pro Patria' stamps issued by Switzerland in 1960 and 1961, demonstrating that Switzerland in prehistoric times was not a land-locked country. Other stamps have featured the fossilised remains of the earth's earliest inhabitants, from giant dinosaurs to tiny trilobites, and including early man himself.

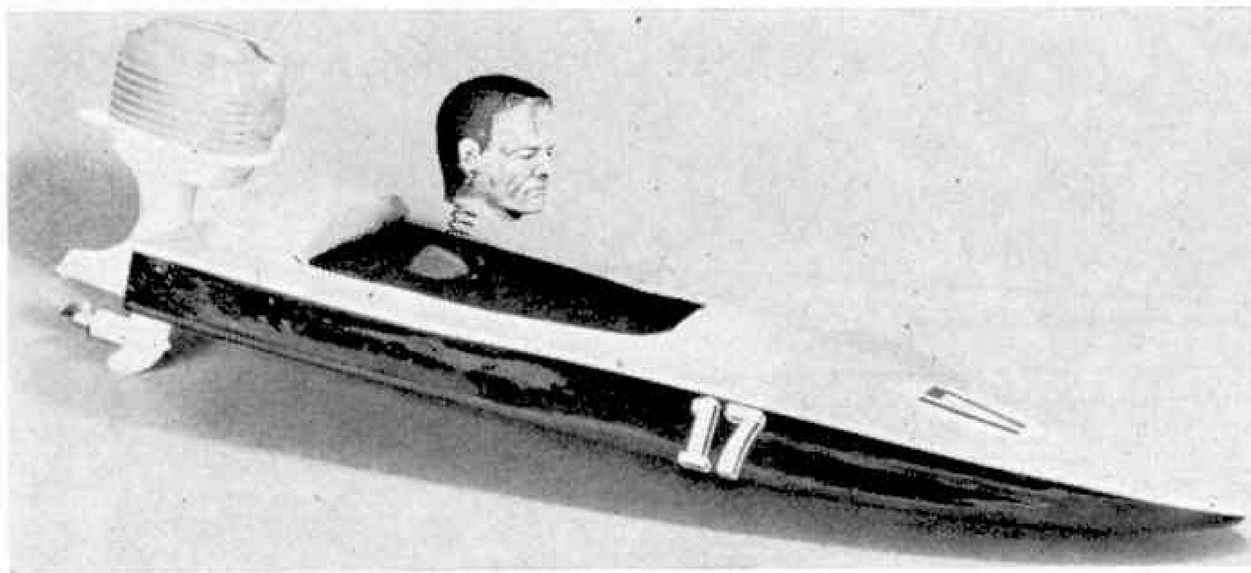
The processes which determine the appearance of the earth are numerous. The most dramatic of these is volcanic activity, and quite a large collection of stamps could be devoted to volcanoes, both extinct and active. From Japan come many stamps featuring the great snow-capped cone of Fujiyama. Another famous volcano is Mount Mayon, shown on several stamps of the Philippine Islands. Nearer home Iceland has issued stamps, from 1935 onwards, depicting Hekla. Following the eruption of this volcano in 1947 Iceland issued a set of stamps showing various views of Hekla with smoke and lava belching from it. Three multi-coloured stamps appeared in 1965 to mark the emergence of Surtsey from the bed of the ocean. The stamps showed this volcanic island in three different stages of its development.

Iceland has also issued several stamps featuring geothermal activity. Eight stamps of 1938 showed the Great Geyser, a famous tourist attraction. On the other side of the world, New Zealand is also subject to volcanic activity. A stamp of 1935 showed a Maori woman cooking in a hot spring while stamps of the 1960 and 1967 issues have featured the Pohutu Geyser. Mount Ruapehu, a still active volcano, has appeared on several stamps since 1898, while Mount Egmont, long extinct, has been shown on stamps from 1935 onwards.

Earthquakes, which help to change the shape of the earth, have been the subject of stamps raising funds on behalf of the victims or for the reconstruction of devastated towns and villages.

By far the largest branch of geophilately is that dealing with the composition of the earth. Mineralogy, the study of the substances of which the earth is composed, accounts for numerous stamps. Britain is among the very few countries, in fact, which has not yet featured minerals on its stamps. Many of the eastern European countries in particular have released long thematic sets featuring the different types of minerals found in these areas. Among the richest mineral regions of the earth is the Ural Mountains and, not surprisingly, Russia has produced more mineral stamps than any other country, featuring emeralds, amethysts, jasper and other semi-precious or precious stones, or industrial minerals such as hematite, felspar, mica and psilomelane. Mineral products shown on stamps range from asbestos (Swaziland) to Bauxite (Surinam). Belgium covers the two extremes of mineralogy with its extensive coal-mining and the diamond processing industry, and both have been the subject of several stamps. Sierra Leone has even issued polygonal stamps simulating diamonds, to publicise the chief export of that country. South Africa issued 2d stamps honouring the Rand gold industry and used gold metallic ink in the printing.

'Granite 71' was the name of a three-week international symposium held in Rhodesia this year under the auspices of the Geological Society of South Africa. Granite is one of the commonest rocks of the earth's crust and consists mainly of quartz, felspar and mica. Granite, however, comprises a wide variety of rock types formed by different processes and at different periods of time. This is demonstrated by the set of four stamps, issued by Rhodesia on August 30th. The 2½c shows a typical sample of porphyritic granite, from the Pomona Quarry north of Salisbury. The 7½c stamp shows a biaxial interference picture produced by a flake of muscovite mica in a petrological microscope. The 15c stamp reproduces a photograph of a thin section of granite as seen in plane polarised light through a petrological microscope. The 25c stamp is a simplified reproduction of the geological map of Rhodesia. The distribution of the granitic rocks that are exposed over half the country is shown, the granites being depicted in red and the related rocks in orange. The major gold belts are shown in green and the black line running from north to south across the centre represents the famous Great Dyke. Younger rock formations are shown in blue.



HEIDI

Full-size drawings for a simple model electric outboard speedboat

HERE'S a nice little boat that can be built from $\frac{1}{16}$ in. and $\frac{1}{8}$ in. balsa wood and uses a small Japanese Gakken outboard motor, available from RipMax (U.K. price 63p).

The first step is to cut out the two halves of the bulkhead H1 and the keel from $\frac{1}{8}$ in. balsa. The two halves are then cemented into position as shown in the plans, making sure they are 90 deg. to the keel. Next, the transom, which is also cut from $\frac{1}{8}$ in. balsa, is glued to the end of the keel. The gunwale shelf is then cut out and positioned on to the keel and bulkhead, after making sure they are flat and aligned properly. After this assembly has dried work can begin on the planking, and for this plenty of pins are needed, to hold the wood in place while the glue dries, as the $\frac{1}{16}$ in. balsa will have to be bent against the grain. Using the straight edge of the balsa plank, cut out a side panel of the same shape but slightly longer than the drawing.

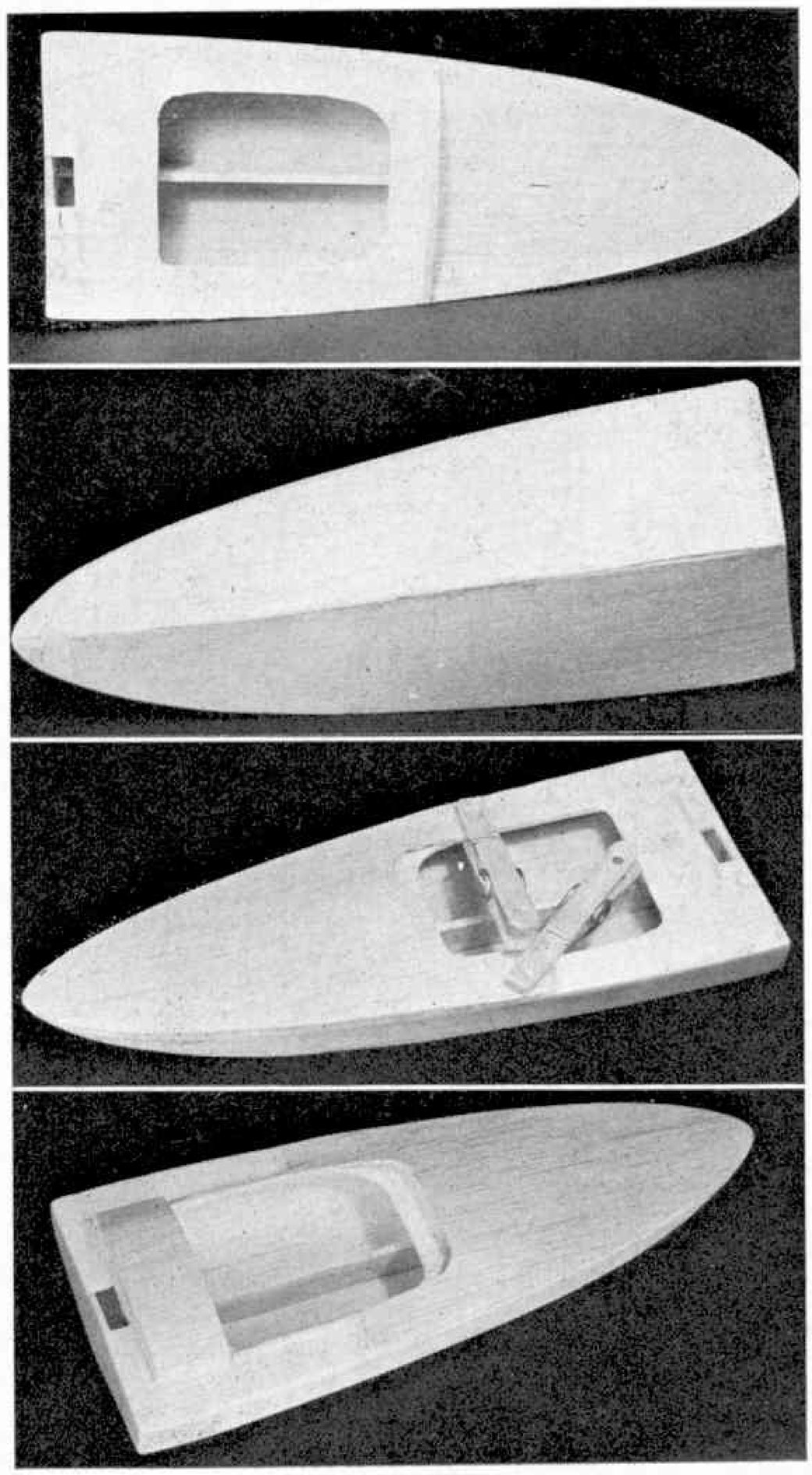
Position the straight edge on the underside of the gunwale shelf and glue the inner surface of the panel to the bulkhead and transom. When glueing these two side panels in position it would be advisable to start at the stern and work your way forwards, glueing and pinning in stages, as balsa cement dries very quickly, and you may find parts fail to stick in places, and sometimes do not show until you start sanding the finished model. This procedure is then repeated for the other panel on the other side. After the glue has thoroughly dried, the protruding edges can be trimmed and sanded to the correct shape.

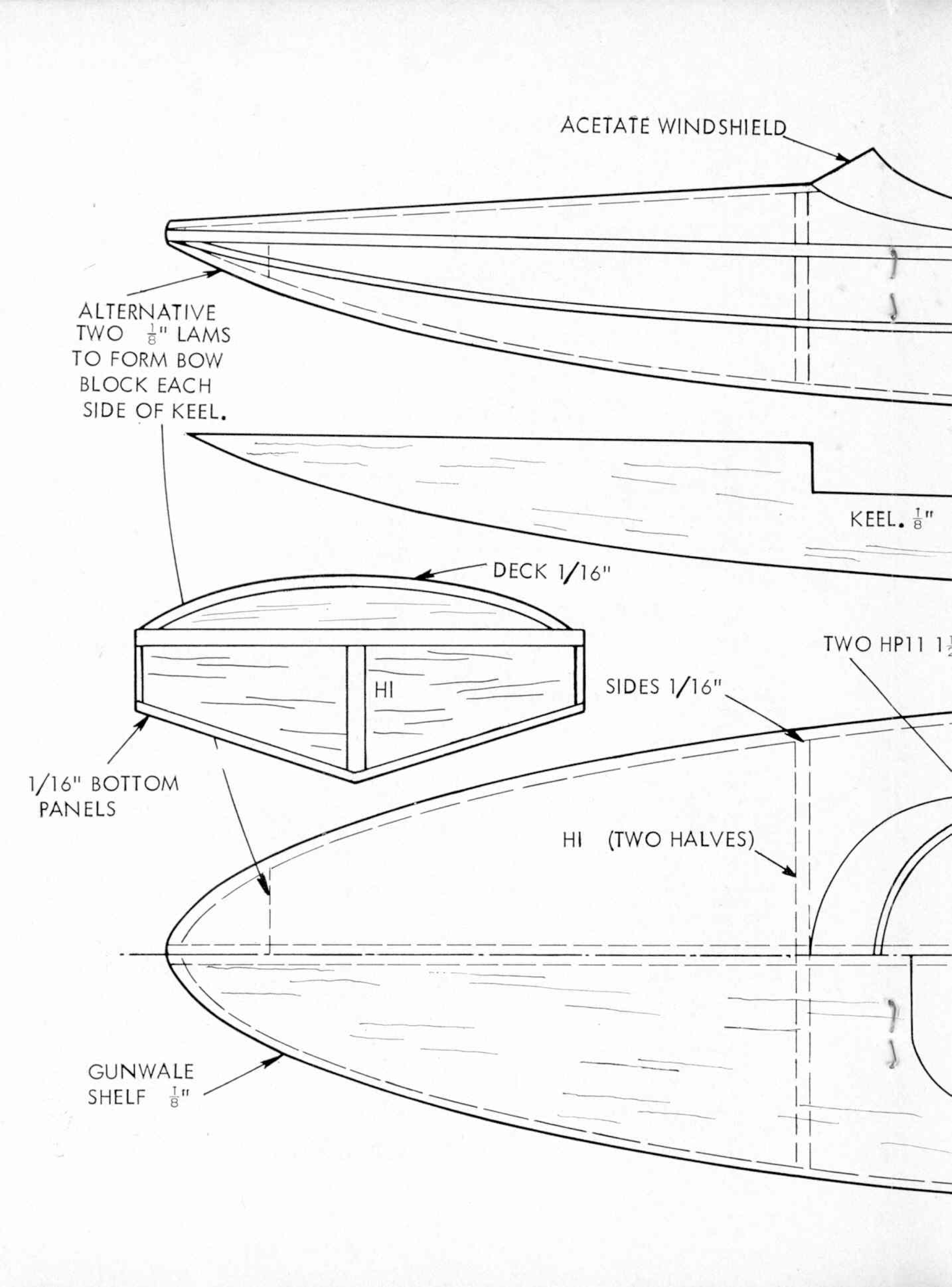
Now work can begin on the bottom of the hull, which is carried out in much the same way as the sides. Cutting the shape of the hull slightly oversize and making sure one side is straight, position the straight edge to cover the centre of the keel and working in stages as before, glue it to the keel and supports. Trim the centre to run along the middle of the keel. This is then repeated on the other side, first trimming the edge to butt neatly up to the first panel, and when the glue has dried the outer edges are trimmed with a sharp knife or razor blade. The bow is formed by two scrap pieces of $\frac{1}{8}$ in. balsa stuck together and stuck either side of the keel.

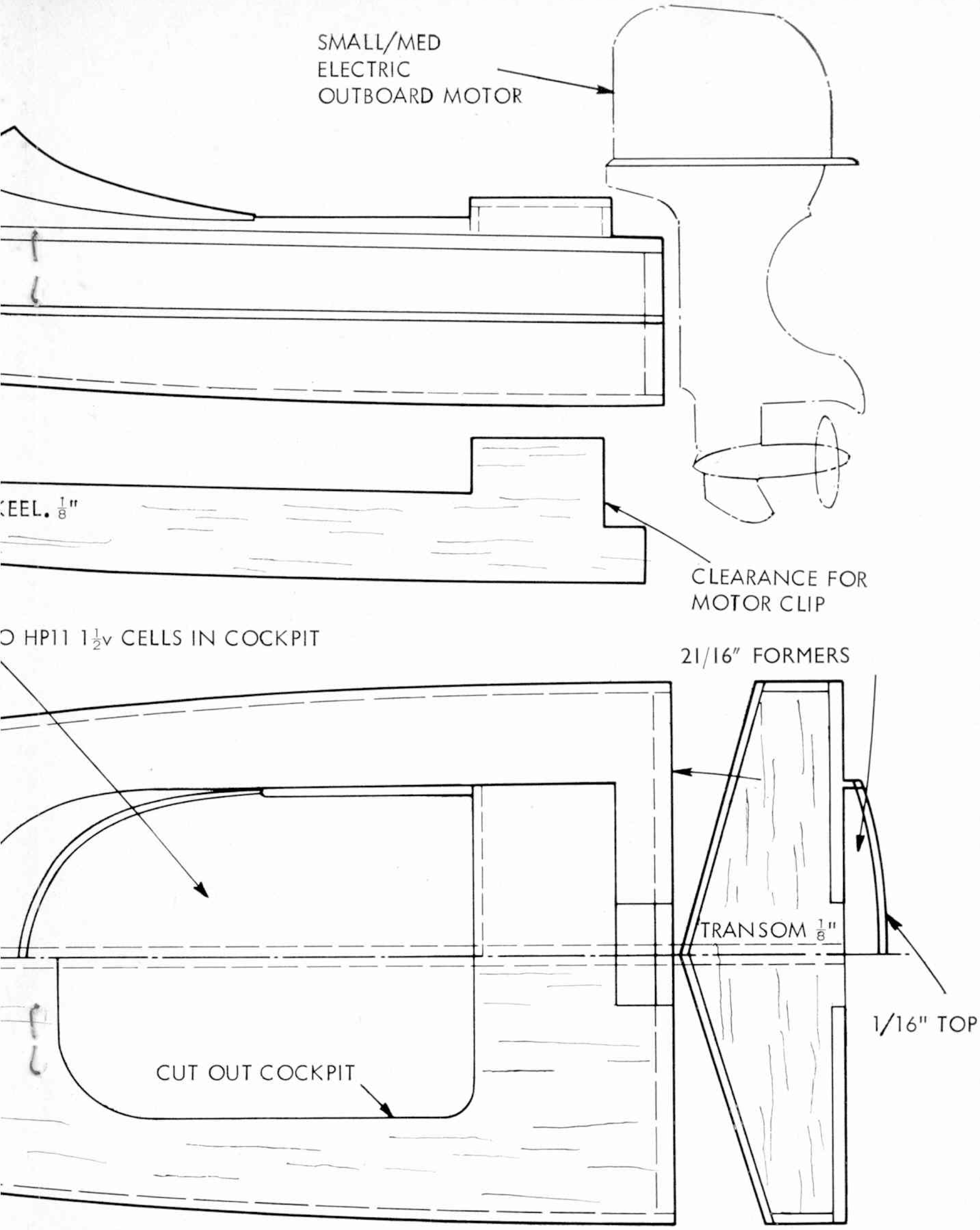
Having completed all this, the top of the bulkhead is cut from $\frac{1}{8}$ in. balsa and glued on the gunwale shelf, in line with the lower half. Now the curved section on top can be tackled by, again, cutting the $\frac{1}{16}$ in. balsa oversize on either side and cementing and pinning in place. It should finish about 3 in. from the stern, and the two ends either side of the cockpit are twisted and pinned and cemented flat on to the gunwale shelf; later they can be blended into the shelf by sanding. The little hump behind the cockpit is optional but is typical of these boats and adds to the appearance.

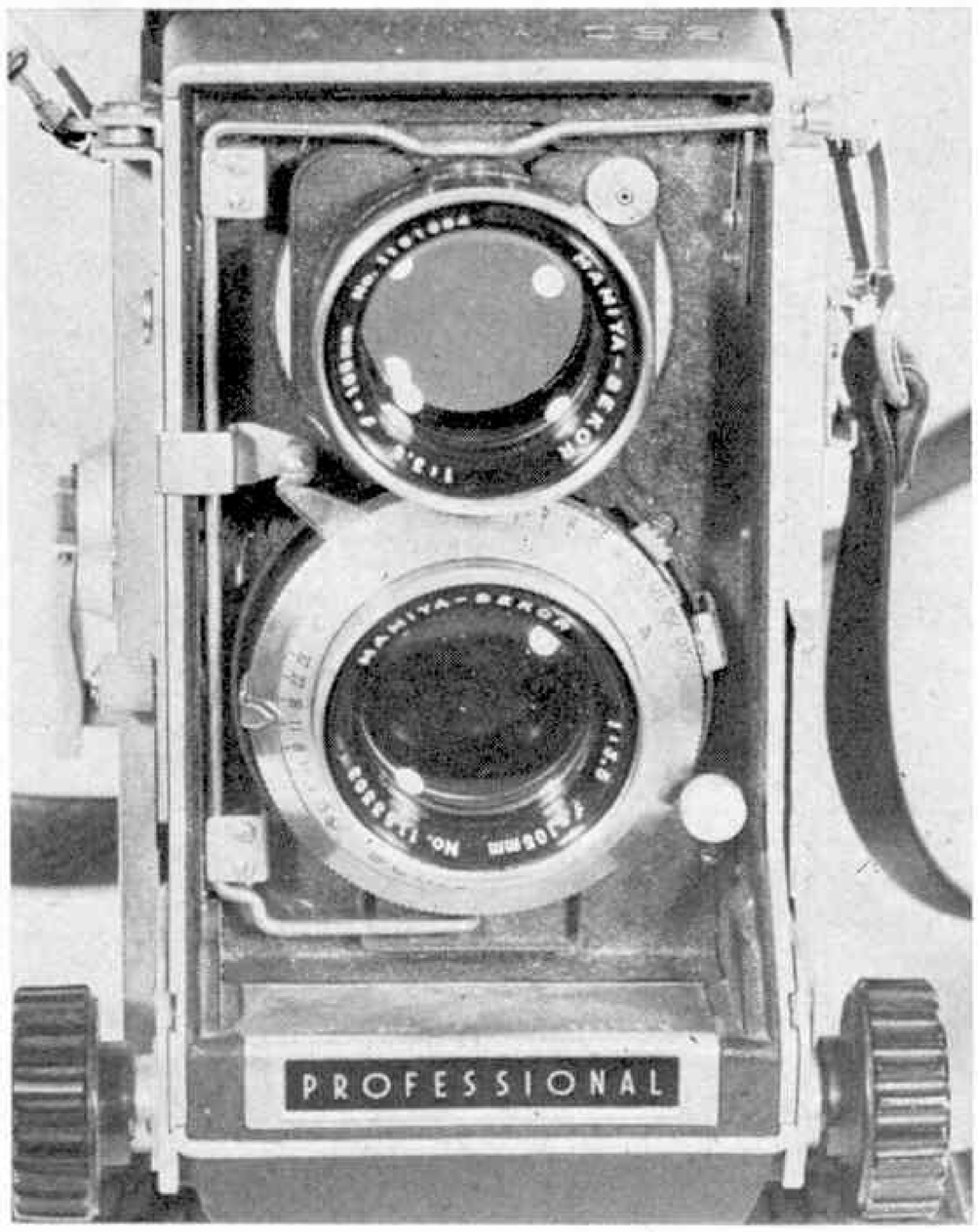
The model can now be sanded smooth and given three or four coats of clear dope or sanding sealer to protect the wood, and after this has dried it can be given a light sand with wet and dry paper, and finally painted.

The character in the boat is the head off one of those refillable sweet containers. To this head was glued a weak spring and then this assembly was glued to the base. Although it has no functional value, it does look rather amusing bobbing backward and forwards, as the boat pitches over ripples.




ACETATE WINDSHIELD
ALTERNATIVE TWO 1/8" LAMS TO FORM BOW BLOCK EACH SIDE OF KEEL.
KEEL. 1/8"
DECK 1/16"
HI
TWO HP11 1
SIDES 1/16"
1/16" BOTTOM PANELS
HI (TWO HALVES)
GUNWALE SHELF 1/8"


SMALL/MED
ELECTRIC
OUTBOARD MOTOR
KEEL. 1/8"
CLEARANCE FOR
MOTOR CLIP
O HP11 1½v CELLS IN COCKPIT
21/16" FORMERS
TRANSOM 1/8"
1/16" TOP
CUT OUT COCKPIT



Photography is Easy

A short series on improving your camera work and getting more fun out of the hobby.

No. 1 **By Peter Wilkes**

FOR over a hundred and fifty years men have sought to fulfil a desire to record for all time the beauties that are part of our everyday life. Pioneers like Thomas Wedgewood, a son of the famous potter, who invented a process whereby painting could be copied onto glass using the energy of solar light, foresaw the time when, by the single movement of a lever or knob, a moment of time would be secured for ever.

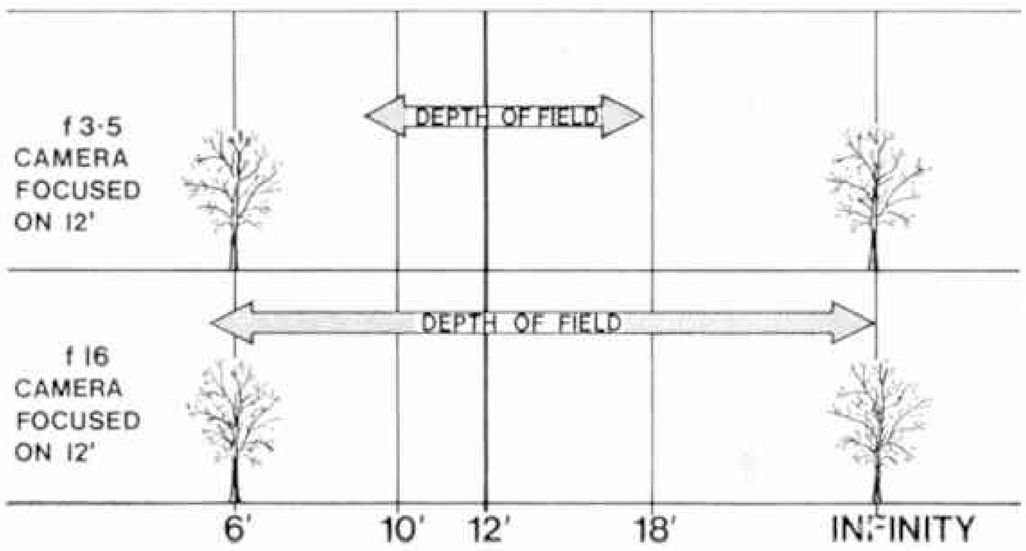
It was from these early experiments that what is today a most familiar of modern objects, the camera, was developed.

To our eyes early cameras were indeed primitive, and if today we could watch our grandfathers preparing for a photographic outing we would admire not only their perseverence, but also their strength.

Not for them the small miniature camera that fits so snugly in a pocket, but a veritable mansion of a camera, made of the finest mahogany with elaborate brass fittings, and with 'film' coated onto glass plates in a portable darkroom that they carried with them.

Yet these early pioneers had two things in common with the camera user of today. The disappointment of failure, and the fact that, basically, their cameras and ours perform the same function in the same way.

FIGURE 1 AREA OF SHARPNESS



If we consider what actually takes place inside the camera we shall see not only the truth of this, but learn two of the essentials of good photography.

At the moment of exposure, whether made by the slightest of movements of the finger on a small knob, or by uncovering the front of the lens and slowly counting away the seconds, as those early pioneers did, the same chain of events is set in motion.

The scene which is in front of the camera lens at that moment of time is projected onto the film at the back of the camera by the light sensitive emulsion being burned by the light reflected from the picture.

When the film is removed from the camera and developed, the parts of the film unaffected by light, representing the dark parts of the scene, are dissolved away leaving clear film, while those which received the most 'burning' from the light parts of the original scene, become opaque.

It is because of this reversal of tones that the developed film is called a 'negative'.

The final reproduction of the scene, the print, is obtained by projecting the negative onto light sensitive paper, during which the tones are again reversed.

The dark parts of the scene which, on the negative, are nearly clear film, let through most light, while those representing the light parts, being opaque on the negative, let through only a small amount of light.

Every camera, therefore, must consist of, basically, a light-tight box with means at the back for the film to be secured, and with a lens to reflect the picture onto the film and a 'shutter', a means of controlling the amount of light entering the box.

So that the print produced by the photographic process is of the highest quality we must operate the camera so that the lens is in focus, otherwise the picture will be blurred, and the right amount of light must be allowed to strike the film, otherwise the picture will be either too dark or too light.

Many cameras, described by some as 'advanced models' and which, despite refinements, still basically are the light-tight box described above, have facilities to ensure correct focus whenever used.

Some are fitted with a rangefinder, whereby either two images of the scene are seen when looking through the viewfinder or the image is split in two. In both cases, when the images are joined as one whole, by moving the lens, the subject is in focus.

Others, called 'reflex cameras' are so designed that the true scene, as seen by the film, is reflected by a mirror into the viewfinder.

However, there are many cameras which have only a manually operated focusing and although it is on the judgement of the operator that good results depend, the task is made easier by a device called a 'Diaphragm'.

Heading, a close-up of a typical shutter unit showing the 'f' stops and shutter speeds. Left, illustrating "depth of field". At a stop of f3.5 only a short area in front and at rear of subject at 12' is in focus while, with a stop of f16, both trees, as well as subject would be sharp in final print.

This consists of a number of metal plates fitted inside the shutter and which, if a lever is moved, either close in so that the opening at the centre gets smaller, or move outwards with the size of the opening increasing.

These plates obviously help to control the amount of light that reaches the film when the shutter opens at the moment of exposure, but they also play a big part in accurate focusing.

The size of the hole or aperture at the centre is expressed by numbers called 'f' stops. These are graded so that each larger aperture lets in twice the amount of light as the one before. It is slightly confusing that the smaller numbers represent a large opening of the diaphragm.

The diaphragm makes the job of focusing a camera easier by its control of the 'depth of field'.

It is almost impossible for anyone, without the use of some measuring aid, to accurately judge distance to the nearest foot and, if a camera would only record sharply the object or person actually at the distance from the camera to which the focusing scale was set, sharp pictures would be nearly impossible with a simple model.

Fortunately, at whatever distance you focus a camera, the zone of focus extends both in front of and behind the subject. It is this zone of focus which is called the 'Depth of Field' and which is controlled by the 'f' numbers.

On most cameras these numbers will read, depending on the lens fitted, 2.8; 3.5; 4; 5.6; 8; 11; 16; 22; 32.

The areas of sharpness increase with an increase in number, i.e. as each small diaphragm opening is chosen, as is shown in the illustration. It can be seen that, with the camera focused at 12 ft and the diaphragm set at f3.5, the area of sharpness is from 9.3 ft to 17.3 ft, but with the camera set at 15 ft and the lens at f16, everything from 5.9 ft to infinity is sharp.

Although it may seem a sensible idea to keep the 'f' stop at 16 and the camera set at 15 ft, and indeed, in summer weather, for normal subjects, this guarantees success, you must take something else into account.

The size of the hole in the diaphragm controls the amount of light entering the camera and hence also helps control the exposure, the second most common source of photographic disappointment.

The part of the camera concerned with exposure is the shutter, which is a device that opens for a very short time to allow the reflected light from the scene to act on the film. The ratio of shutter speeds depends on the type of camera but is always within the range of fractions of a second from one second downwards as follows; 1; 2; 4; 8; 15; 30; 60; 125; 250; 500; and, sometimes, 1/1,000 of a second.

If you are fortunate enough to possess an exposure meter it will when pointed at the subject, indicate the correct exposure, but an adequate guide can be found on the leaflet which comes with the film.

To give an example, the instructions supplied by Messrs. Ilford with their F.P.4 film carries the information that, with the shutter set at 1/100 or 1/125 of a second, and sunshine and blue sky, the required 'f' number is 16. With dull overcast sky the 'f' number should be 11. Dull conditions require f8 and very dull f5.6.

These tables will give excellent results in all the lighting conditions quoted because, remember, the manufacturers rely on your satisfaction for their continued existence.

One of the things that puzzles the beginner is that an exposure meter gives a combination of correct exposures, for example; 1/60 @ f16; 1/125 @ f11; 1/250 @ f8; 1/500 @ f5.6.

(*Continued on page* 557)

A common error in photography without thought—a tree growing out of the subject's head.

Even in poor surroundings photography with forethought changes a snap into a picture.

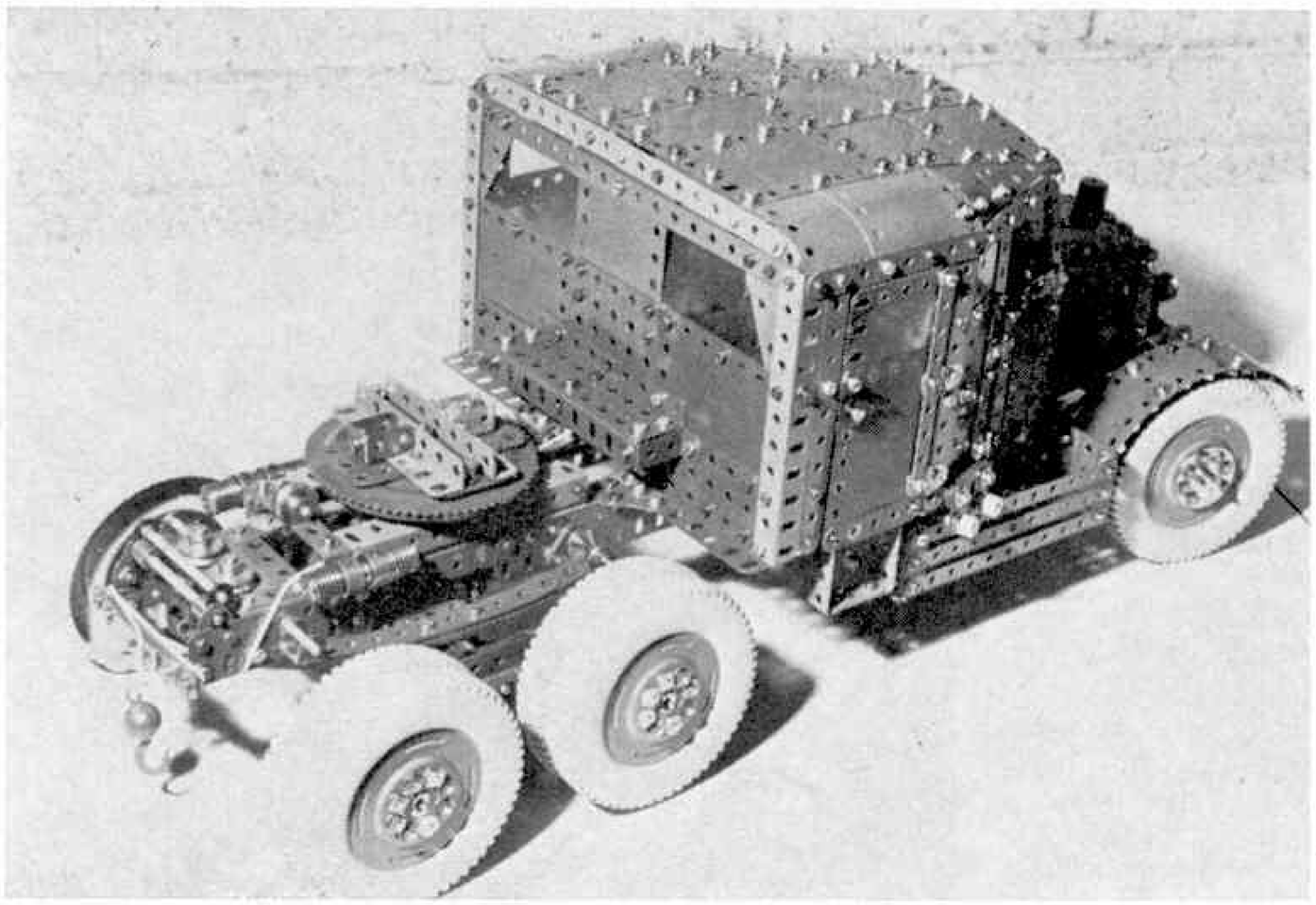


Fig. 1—A Scammell Tank Transporter Tractor Unit of World War II vintage in which the principal mechanisms of the prototype are well reproduced.

HEAVY VEHICLE MODELLING

Some constructional features described and illustrated by Bert Love

HAVING seen what can be done in the way of realistic modelling with the smaller outfits, the junior reader has the challenge of pitting his wits against a limited selection and number of parts. When he is able to move on to the advanced stage or when, as so many youngsters love to do, he pauses to admire the work of experienced constructors, he will be turning his attention to more rugged models, some of which are featured in this article.

A glance at Fig. 1, which illustrates the tractor portion of a famous Scammell Tank Transporter, immediately gives the impression of great strength and power—the essentials of such work horses which carried the Allied tanks of the Second World War across the blazing North African desert and the hilly roads of Italy. This Meccano version of the prototype was originally designed by Phil Bradley, an expert in observing, recording and reproducing heavy-duty vehicle details and mechanisms in Meccano. The model illustrated in this article is a slight modification of Phil's design which was exhibited by Eric Jenkins, its builder, at the March meeting of the Midlands Meccano Guild.

In real life, the basic tractor had to contend with the following requirements. First, it had to be powerful enough to pull its own considerable weight, plus that of a very heavy articulated trailer, carrying thirty tons or more of a fighting tank and its equipment. Secondly it had to be strong enough to stand up to the shocks and stresses imparted to it, both by its load and the almost impossible terrain with

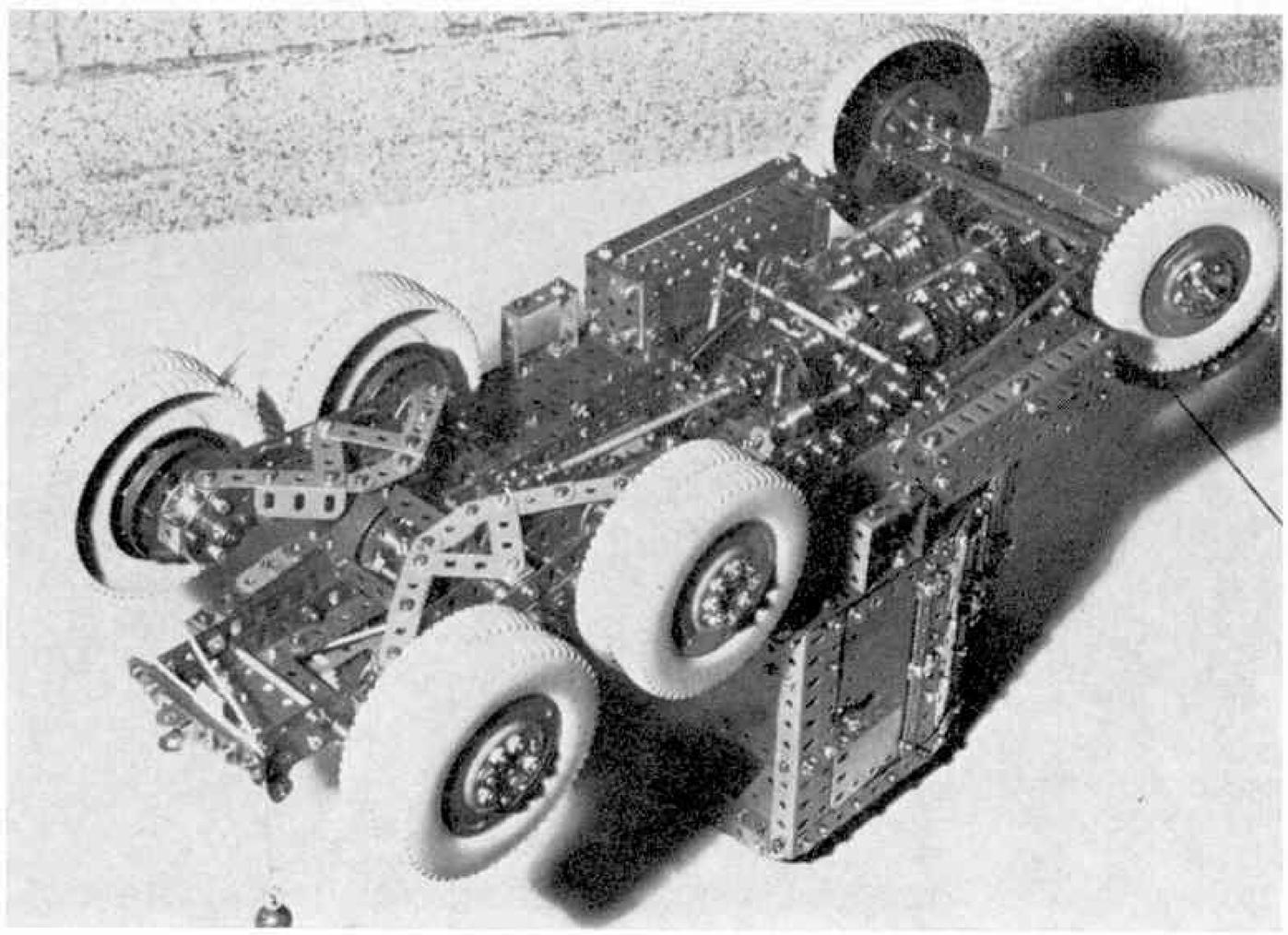


Fig. 2—An underside view of the Scammell Tractor showing the Gearbox, transmission, steering and suspension.

which it was faced on active service. Hence it was fitted with a very powerful engine, a rugged gear-box which could take it up the side of a mountain (by road, of course!) with a full load, and floating rear axle bogies on the tractor fitted with double reduction drives on the eight rear wheels right into the final hubs. Winching gear was also provided, both for hauling on knocked-out or broken down tanks (friend's or foe's) and for general or self-recovery.

All of these basic requirements are skilfully modelled in the Meccano Scammell illustrated in Fig. 1. The dual purpose winch fairleads on the model are clearly shown on the rear of the tractor chassis, two ½ in. Pulleys with boss and a pair of 3 in. Rods providing hawser guides for straight winching to the rear, while a ½ in. loose Pulley just behind the 4 in. Ball Race turntable provides a vertical hawser lead for tank-winching on to the trailer. Semi-elliptical leaf springs are fitted, being anchored at the rear by ½ in. Double Brackets carried on a through Axle Rod, but free to ride on a swinging journal at the front end made from a sandwich of 1 in. Triangular Plates pivoted to the chassis side members and connected to the forward spring Double Bracket by a Long Threaded Pin and Collar.

Further details of the rear axle and bogies can be seen in the view from below illustrated in Fig. 2. The left and right power bogies are quite independent, being pivoted centrally, as shown, from the centre of the rear leaf springs. Axle boxes for each of the four pairs of driven wheels are made from pairs of Bush Wheels attached to 5½ in. Flat Girders and spaced by ½ in. Double Brackets to give adequate strength at several points. A conventional differential drive is fitted to the main back axle from which the half-shafts pass on a first reduction stage via ½ in. Pinions and 57-teeth Gear Wheels, to the final reduction of ½ in. Pinions meshing with 2½ in. Gear Wheels lying inside the back wheels. The 4¼ in. Plastic Road Wheel, Part No. 187b, lends itself very well to this neat and compact construction, allowing the modeller to come close to prototype arrangements.

Note, also from Fig. 2, the unorthodox but efficient gear-box in which the reduction gears from the motor shaft are in constant mesh. They are free to revolve on Keyway Rods, Part No. 230, until such times as they are engaged by compound sliding dogs made from

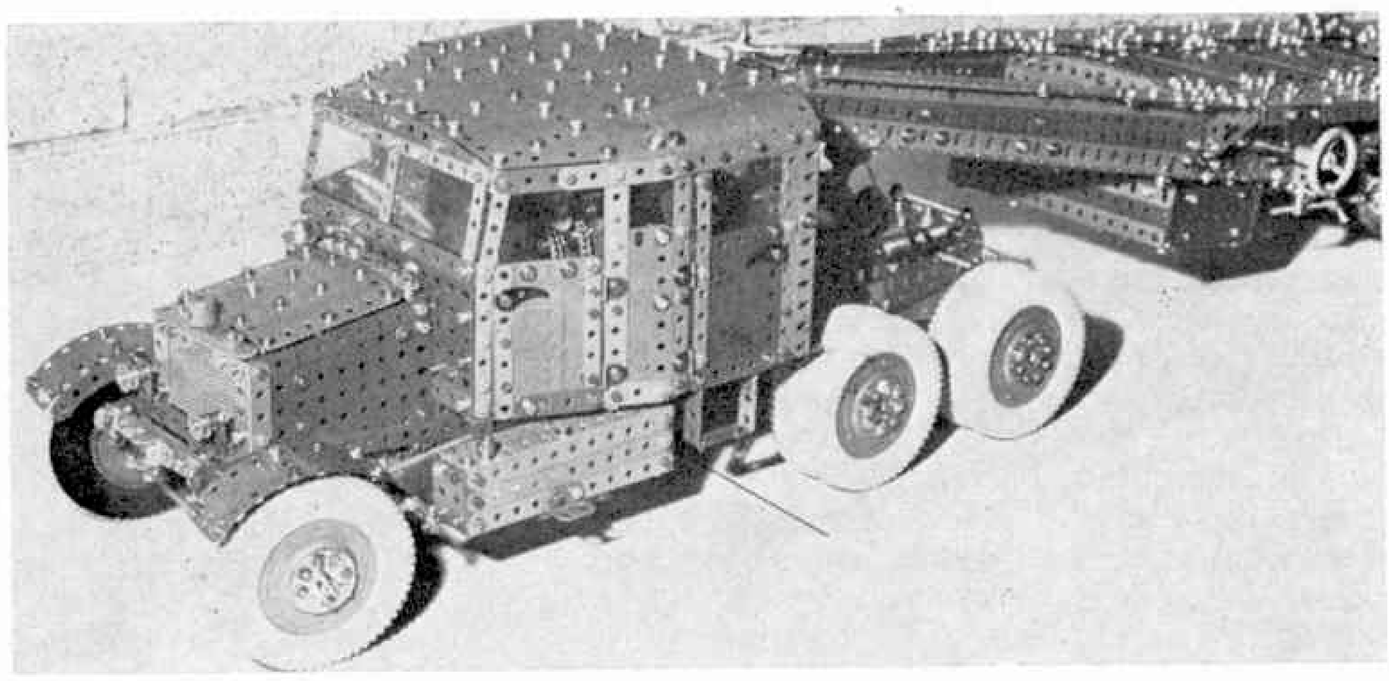
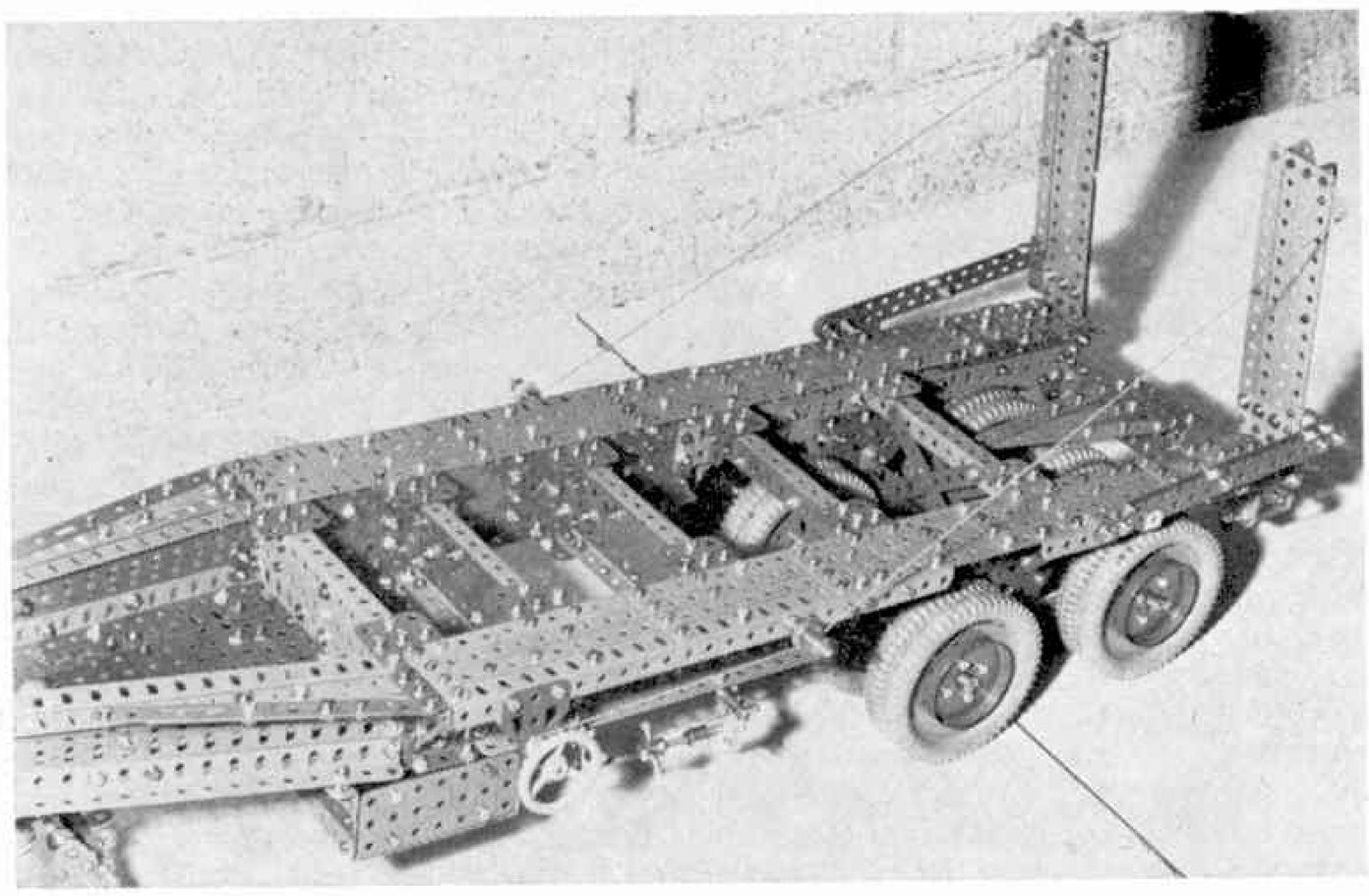
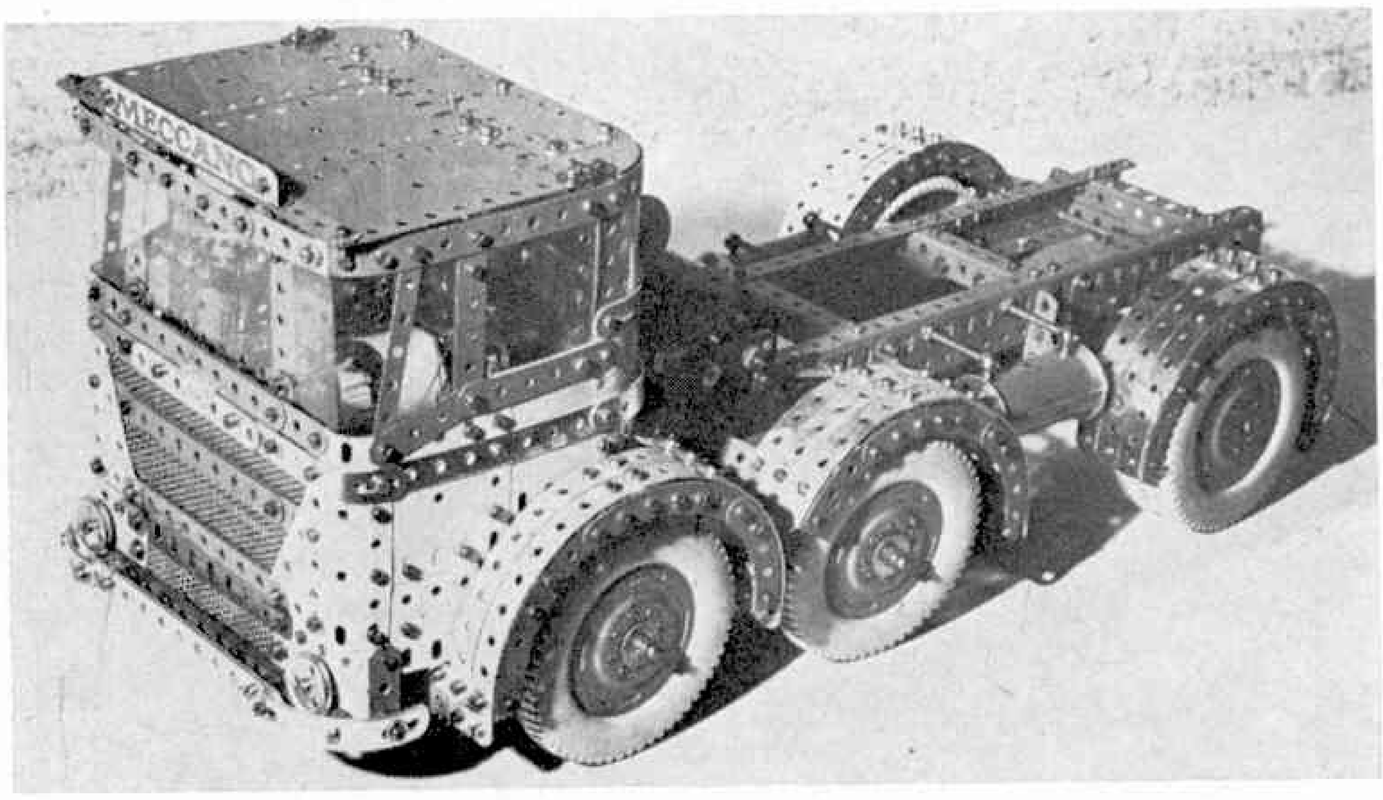


Fig. 3—General view, showing cab details and trailer position. Note the winch pulley and guys on the trailer swan-neck.



Above, Fig. 4—A close-up view of the articulated trailer with tank ramps in the travelling position. Note the rugged construction.

Below, Fig. 5—A short-wheelbase A.E.C. prime mover, designed and built by Phil. Bradley. A fully operational tilt-cab is provided, together with tandem steering and the usual transmission features.



Bush Wheels locked to the ends of Socket Couplings, the Couplings being keyed to their shafts by Keyway Bolts. Bolt shanks, ½ in. or ⅜ in., protrude from the Bush Wheels to engage similar Bolt shanks set in the Gear Wheels. The required gear is engaged by sliding the appropriate Socket Coupling by means of a gear selector rod and lever.

The winching barrel is carried inside the cab and is worm driven from below. The winch can be coupled to the gear-box by a winching hand lever which disengages the transmission clutch at the same time. This can be seen in Fig. 2. The front axle beam is centrally pivoted and comprises a double set of leaf springs to take up forward shocks and to allow a wide margin of rise and fall in negotiating uneven ground. Axle stability is provided by torsion bars made from Axle Rods in Rod and Strip Connectors running back to the chassis side members. Note that the mudguards are supported on the steering arms and hence turn with the steering motion.

The general view of the tractor in Fig. 3 shows further examples of neat modelling in the cab and bonnet details, striking realism of prototype form having been achieved. Driver's and passenger doors hinge authentically and are fitted with working door handles, while Narrow Strips and Transparent Plastic Plates do much to help with neat outlines of the cab framework. Nor does the skill finish here. Fig. 4 shows how the rugged construction principles are carried over into the trailer portion, where Eric Jenkins has produced a first-class working tank trailer complete with heavy-duty compound axle beams in floating journals—again to accommodate wide differences in ground level—stabiliser jacks for on and off-loading, hand winch for loading ramps and swan-neck winch pulleys and guides for tank handling. Rigid cross-bracing with compound girders and similar construction of the trailer sides give all of the rugged appearance of the original transporter.

Fig. 5 shows another thoroughbred from the Bradley stable. This, time, by contrast with the veteran Scammell, a modern A.E.C. short wheelbase prime mover is illustrated. The same careful attention to detail in the cab area is embellished by a little licence in using a small sheet of perforated zinc for radiator grill realism, but this does not detract from the obvious skill in using standard parts for the main features. Incidentally, this cab was modelled in a very careful selection of yellow Plates with silver and green Strips with striking results. The cab top is hinged for easy access to its interior, but Fig. 6 shows that the whole of the cab is capable of being tilted in accordance with current vehicle construction practice. The hinge line can be seen just above the headlamps in the illustrations of Fig. 5. The customary channel girder construction of the chassis is clearly shown and the close-coupled pair of front wheels give the clue to the tandem steering used in this vehicle and reproduced in the model. Note the neatly slung fuel tanks mounted by Screwed Rods and Handrail Supports to the chassis side members.

Of particular interest is the steering column and reduction gearing employed in the model. Two Sleeve Pieces, fitted with Chimney Adaptors, shroud the steering column, simulating the trunk employed in vehicles fitted with power steering. To give something approaching the correct ratio of steering wheel turns for full lock, the double reduction of 3:1 Bevel plus 3 : 1 spur gearing is used at the foot of the steering column to drive the drop arm linked to the steering arm and track rods. The model is fitted with brakes and clutch, operated from the driver's cab, a four-speed gear-box, miniaturised with Pinion gearing, and, by the clever use of an instant disengaging universal joint in the transmission shaft, the entire gear-box, like the cab, can be tilted forward for inspection, adjustment or repair!

In both models so far mentioned, the large Meccano plastic Road Wheels have been employed and they do much to give a proper scale to these heavy-duty vehicles. However, for the purist who prefers rubber tyres on his wheels, Brian Edward's excellent Petrol tanker shown in Fig. 7 will have much appeal. Again, cab details have been excellently moulded and the contour of the mudguards flows smoothly along the model. This model is also fitted with tandem steering, the drop arm from the cab being placed between the two front axles so that a jointed drag link runs fore and aft to the two steering arms. Neat inspection ladders are moulded to the curvature of the main tank while the vehicle's own fuel tank, made from Boiler Ends and a 5½ in. × 2½ in. Flexible Plate, gives it that 'high capacity' look. Nor is the tail end of the vehicle neglected, as Fig. 7a indicates. Number plates are provided by doubling up Flat Trunnions in reverse (a novel way of producing a 1½ in. square plate) and, when fitted with Threaded Bosses to simulate tail, brake and indicator lights, they give the final touch of detail.

Raising the sights to even bigger scale heavy-duty vehicle modelling, Fig. 8 gives a glimpse of what can be done in Meccano even when going up to a wheel size of 6 in. in diameter. The eight coupled wheels shown are not found in the Meccano range of parts and, once again, a little licence is afforded to get the scale right. The illustration shows but a small

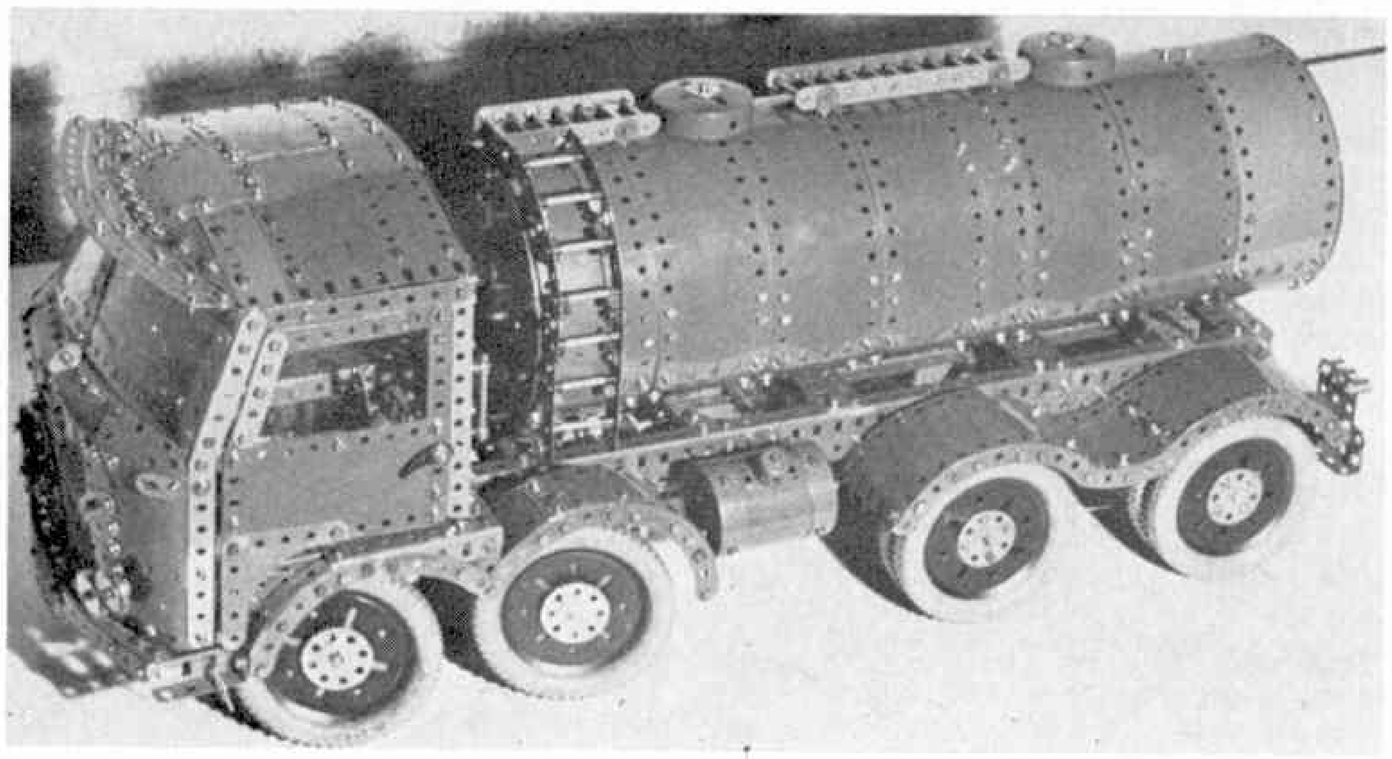


Fig. 7—This Petrol Tanker, designed by Brian Edwards, is fitted with tandem steering, twin differentials, brakes, suspension and four-speed gearbox.

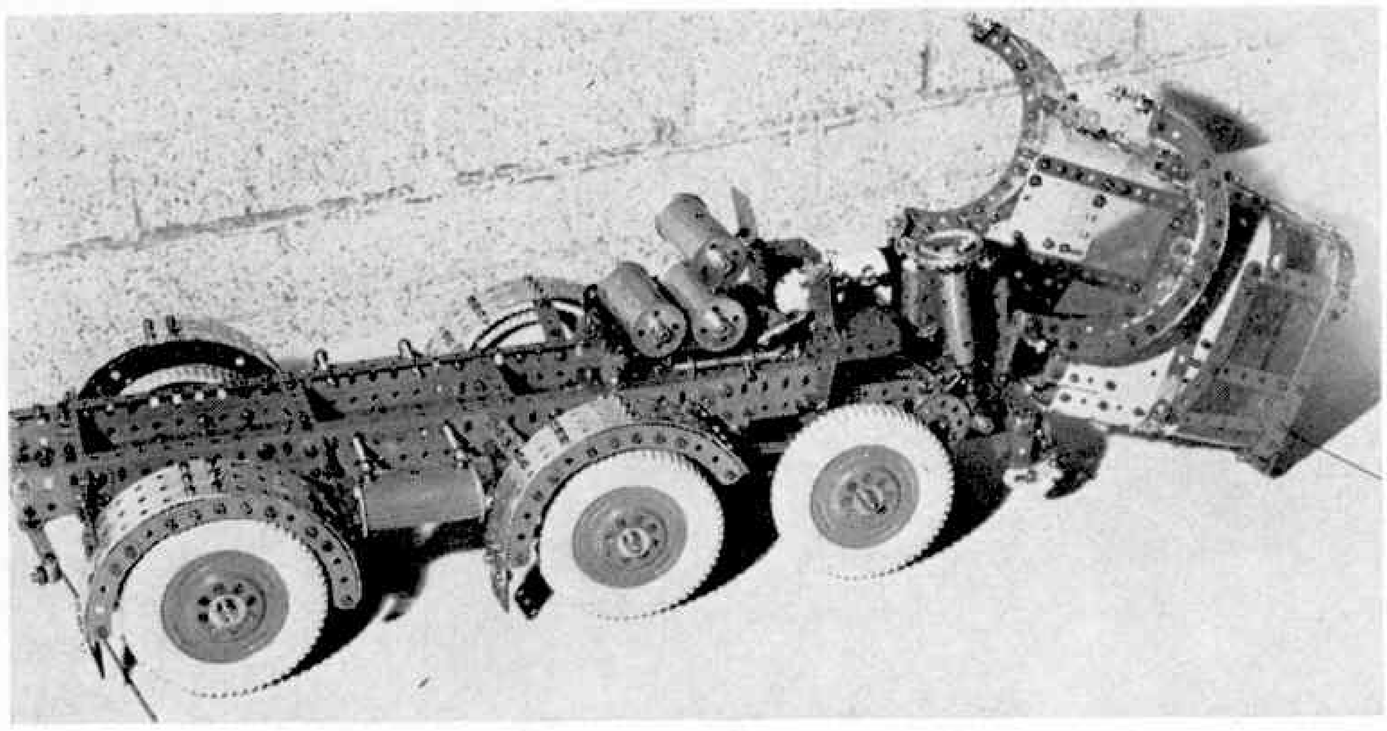


Fig. 6—A rear view of the A.E.C. model, with cab tilted. Note the steering column and auxiliary air and fuel tanks.

fraction of a giant Lorry-mounted Crane, a magnificent large scale model designed by Eric Taylor of Nuneaton. The tyres shown are generally available through motor accessory shops which sell glass ashtrays around which the tyres are mounted. So heavy was the final model that the hollow tyres illustrated had to be fitted with internal wooden discs of substantial proportions, to support the model's weight, previous attempts at stuffing the hollow tyres with rubber hose having proved unsatisfactory for the weight concerned.

This type of vehicle must supply a very stable platform for its crane turntable and hence no springs are fitted at the rear. The wheels, however, must still be able to run over different road surfaces and levels, so swinging bogies are fitted to a beam, halfway between the two differential casings, and the axle tubes themselves, made from double layers and double depths of strips, are pivoted at each end on the swinging bogey arms, but are stabilised to keep the wheels upright by Threaded Rods and yokes running back to the bogey plates at the centre beam. The wheels are built up from Ball Race Flanges and Circular Plates with a 3½ in. Gear Ring mounted inside. This requires a high degree of modelling skill as this Gear Ring, mounted on Bolts, must be absolutely concentric with the half shafts from the differential casings so that a Pinion reduction gearing from the ends of the half shafts can be passed on by idler pinions to the internal teeth of the Gear Ring. Helical Gear differential crown wheels are provided to give 'over the top' drive from the first differential to the second. Thrust bearings made from Chimney Adaptors and miniature ball bearings are used at these points where high torque is required and friction plus smooth Helical drive are important considerations. The built-up universal joint is clearly seen in front of the first differential box, where most of the flexing in the transmission would take place. Bush Wheels, Pivot Bolts, Collars and a 'spider' from a standard Universal Coupling are used for this purpose. Lesser flexing takes place between the two differentials and a simple flexible joint suffices, as shown.

In this article we have tried to give a glimpse, or a taste, of what can be done by the advanced modeller or determined enthusiast who is prepared to break away from traditional leaflet models, take out a sketch pad, dig up some prototype information and then get down to the job. We hope we have succeeded!

Fig. 7a—A neat tail end is one of the attractive modelling features of Brian's Tanker.

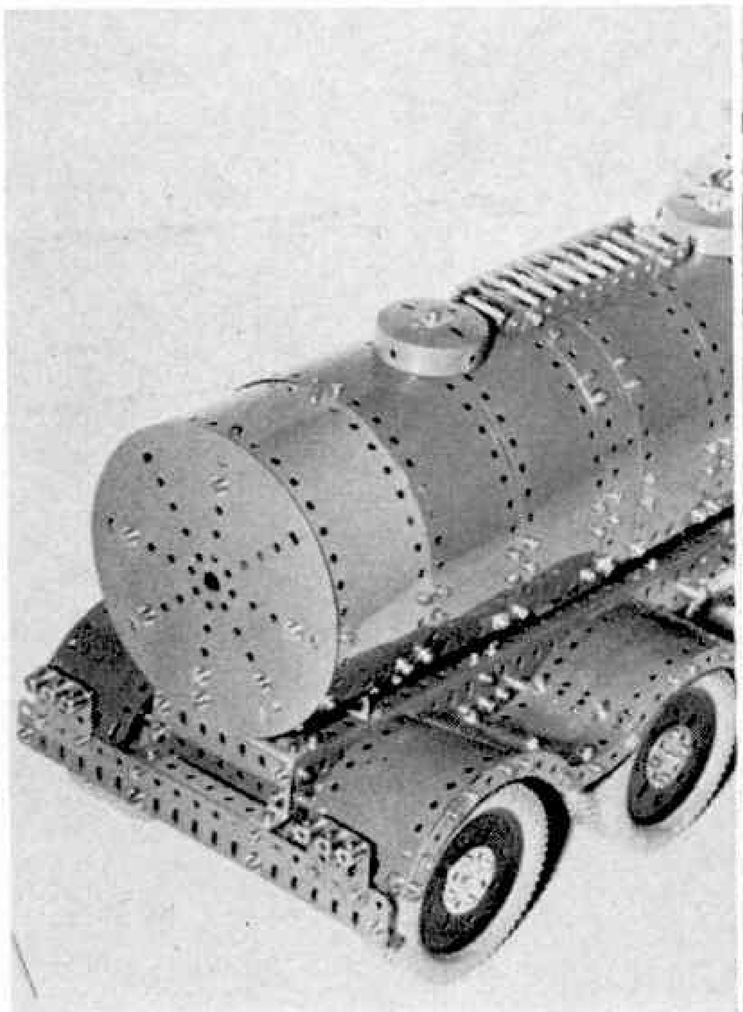
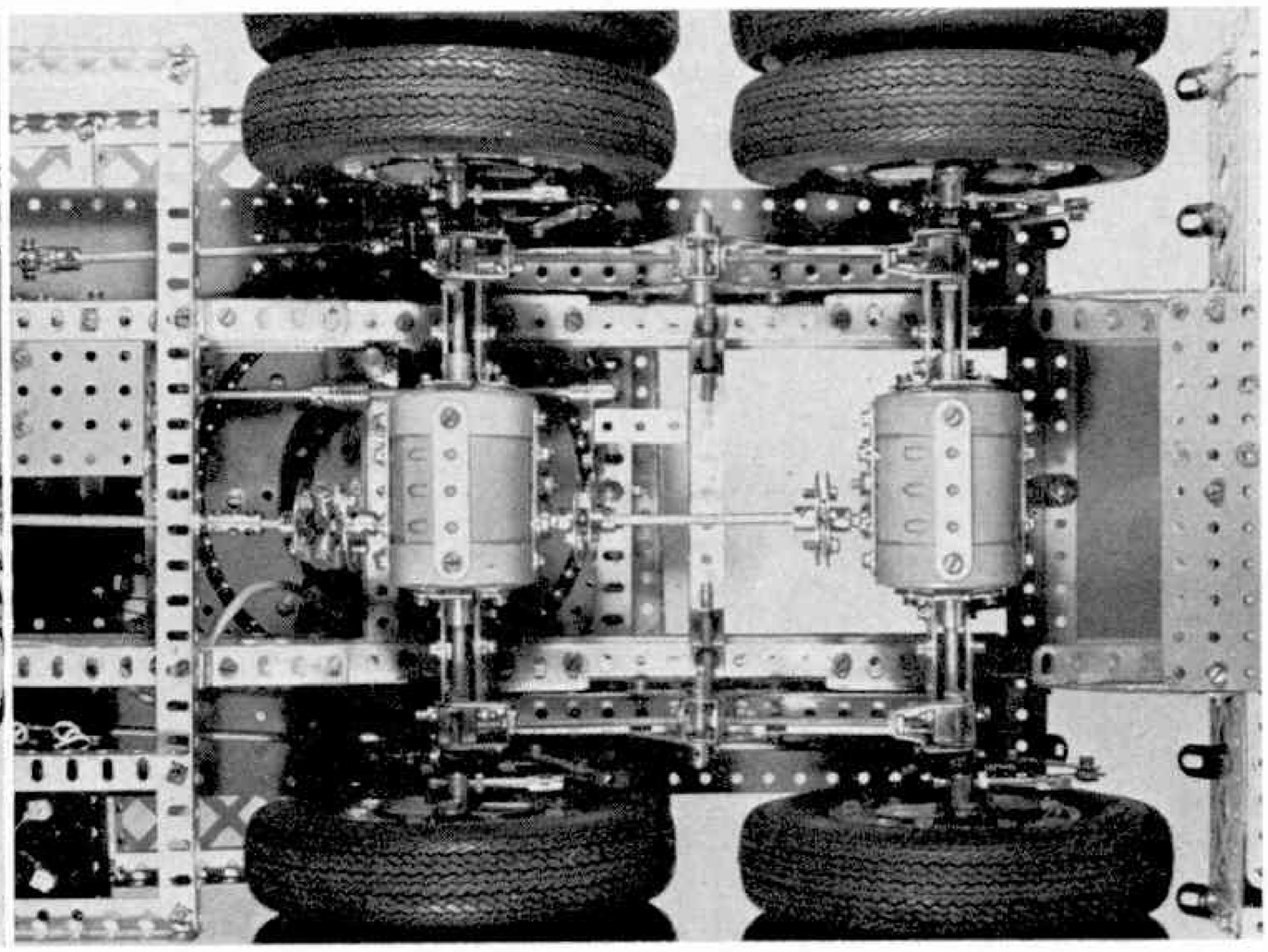
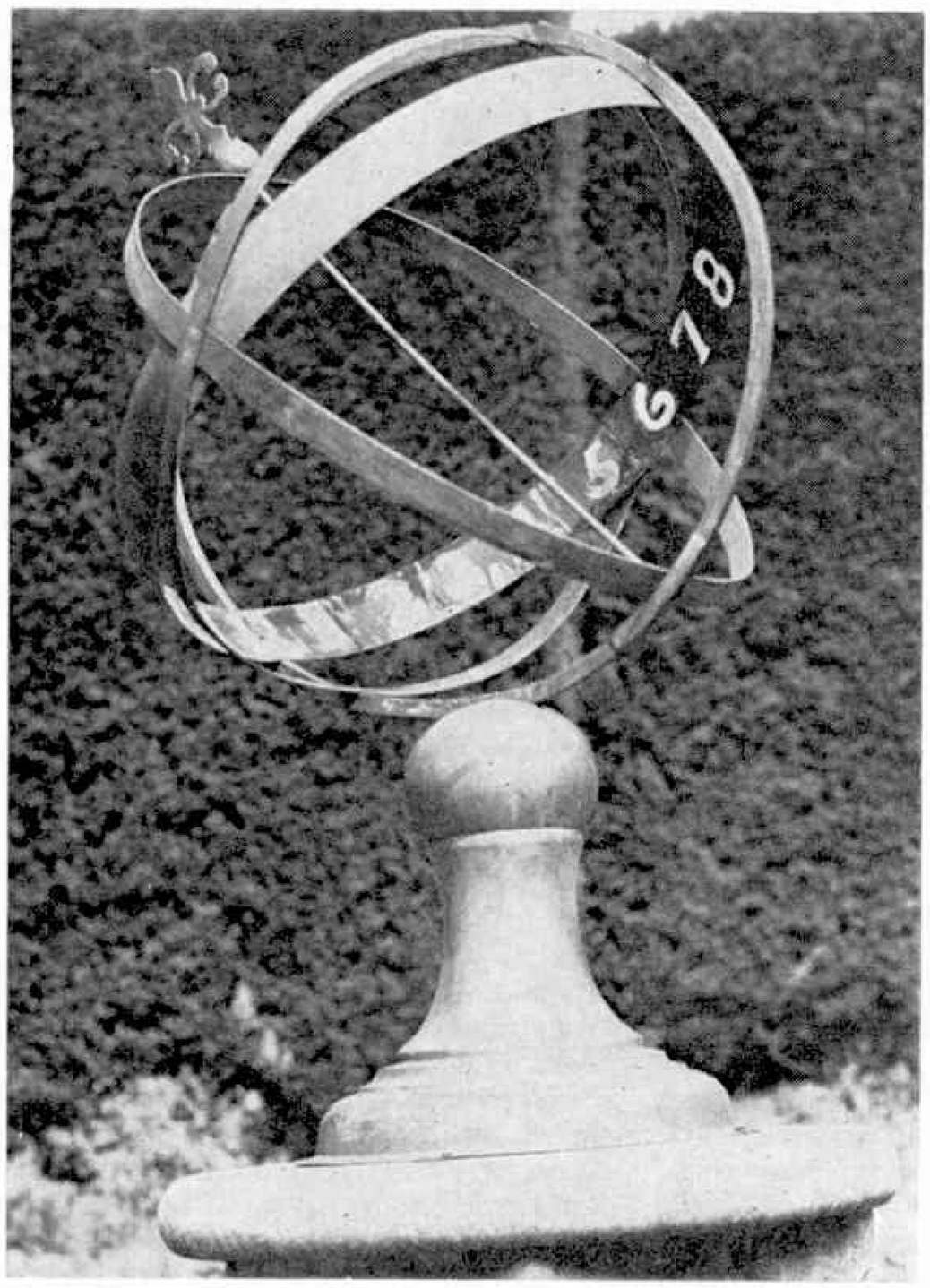


Fig. 8—Really heavy-duty stuff! This picture shows the eight coupled wheels on the rear floating bogey of Eric Taylor's giant Lorry-mounted Crane.





Sundials and Armillaries

By J. E. Manners

Left, an armillary with the time inscribed on the equator ring. Below, the famous dial at Glamis Castle with forty-eight faces. Opposite, top left, the west face of a dial. This only receives the afternoon sun and the time lines run parallel to each other. Top right, a typical sundial of the horizontal type on a decorative stand. Bottom left, the attractive dial at Queens' College, Cambridge made in 1733 tells the time by the sun and also the moon. Bottom right, the sundial at Malmesbury House in the Close at Salisbury tells the time and the date.

EVERYBODY knows what sundials look like, and they can be seen all over the country on buildings, in gardens and in all sorts of places where they add a decorative note.

An armillary does the same job and is usually in the form of a number of circles with an arrow shaped pointer running through the centre.

For reading the time a style or gnomon casts a shadow made by the sun onto an inscribed dial and the time is read off to an accuracy of within about ten minutes. Some sundials are precision instruments called 'Heliochronometers' using a shadow cast by a very fine wire and these can record the time to within about one minute. This was the type used by the French railways to check their clocks up to the beginning of this century. These are comparatively rare but they might be seen occasionally.

People go and look at sundials and then compare the time with that shown on their watches. Even with correctly set up dials the times will hardly ever tally due to a variety of reasons.

Firstly owing to altering the clocks by one hour for summer time a sundial will register one hour out for half the year. A further correction has to be made for the 'Equation of time'. The reason for this is that the earth moves round the sun annually in an ellipse and not a circle and at a speed that is not quite uniform. This produces an error of up to fifteen minutes, fast at one time and slow at another, when compared with the time shown by a watch. The correction to be applied for this is sometimes inscribed on the dial face and it varies with the date.

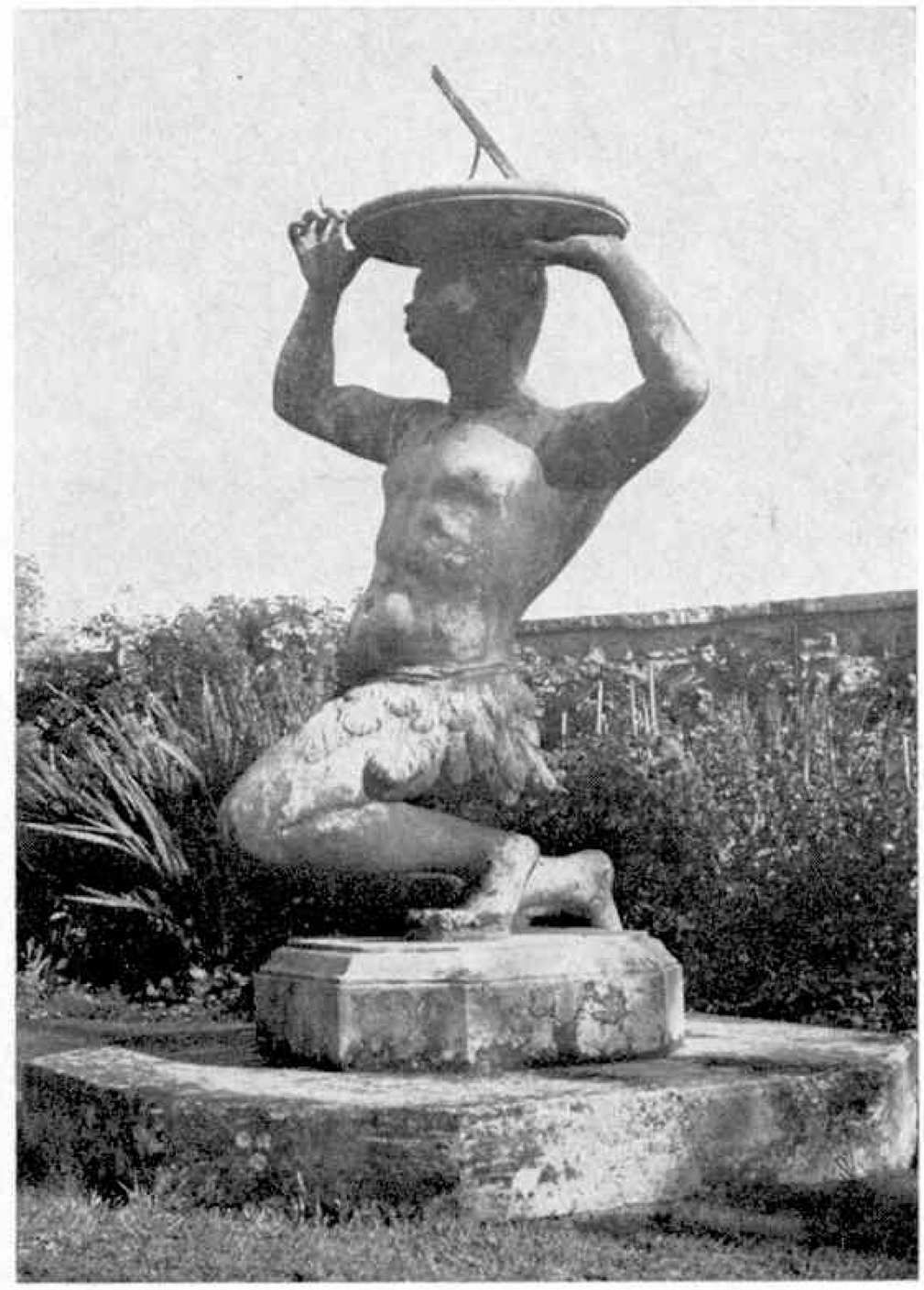
Plastic sundials are now coming on the market and a certain amount of care is necessary in setting them up.

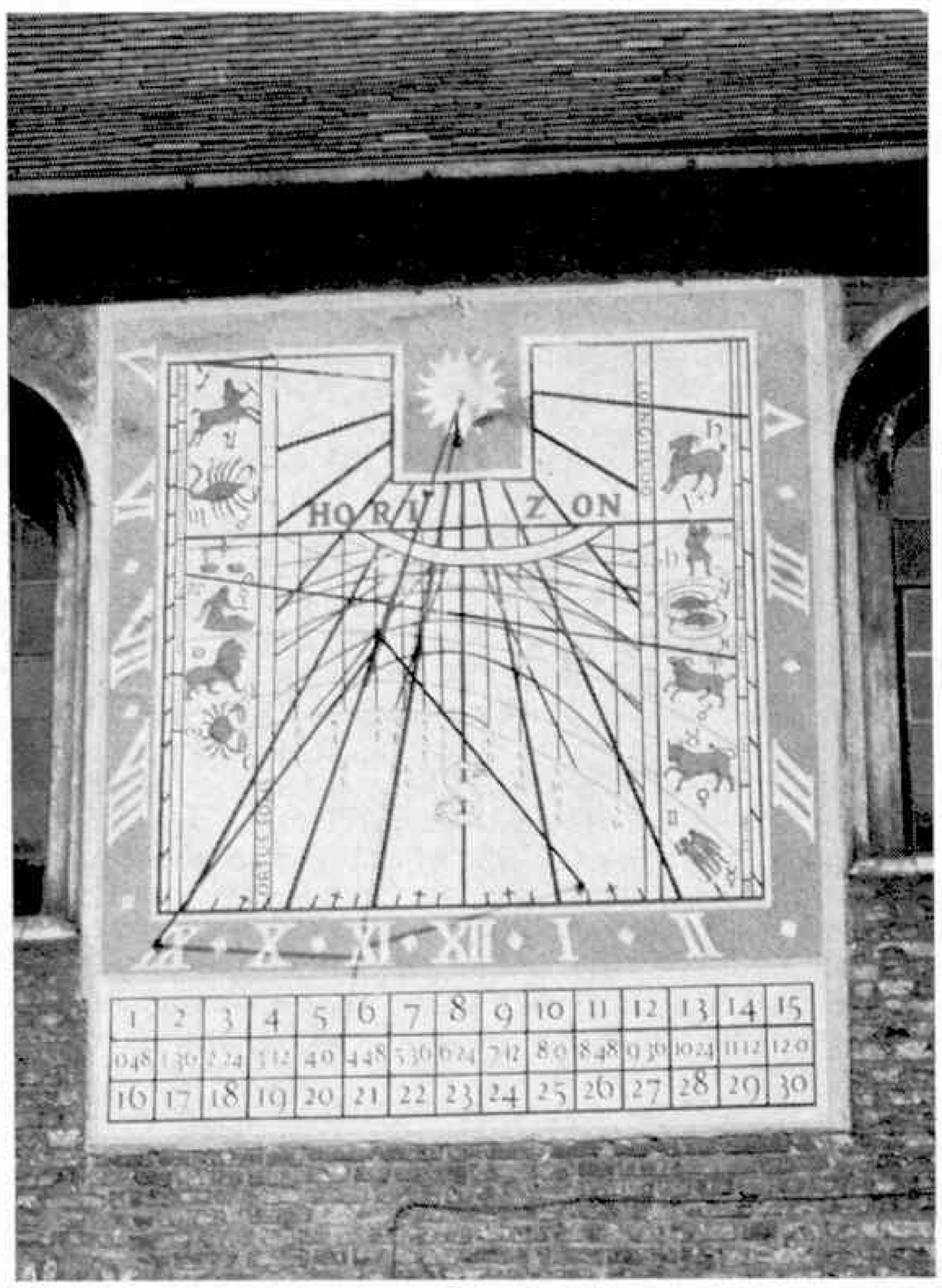
For technical reasons the slope of the gnomon must always be set parallel to the axis round which the earth revolves. This can be achieved by elevating it to the latitude or equally well by pointing it to the pole star.

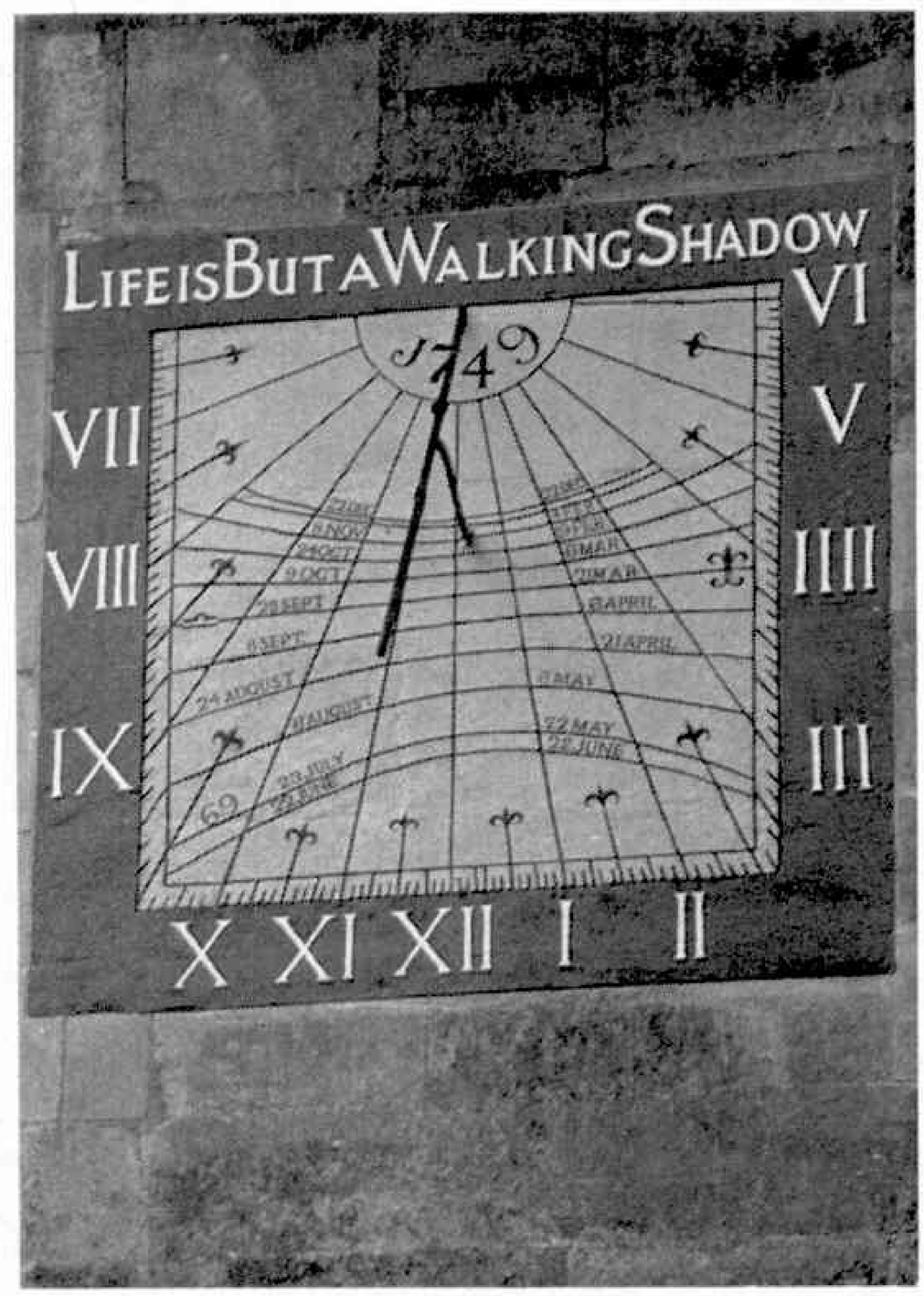
Supposing you bought a sundial in London where the latitude is 51½ degrees and took it to Edinburgh which is in latitude 56 degrees, the gnomon would have to be re-set or it would cast a slightly incorrect shadow. If

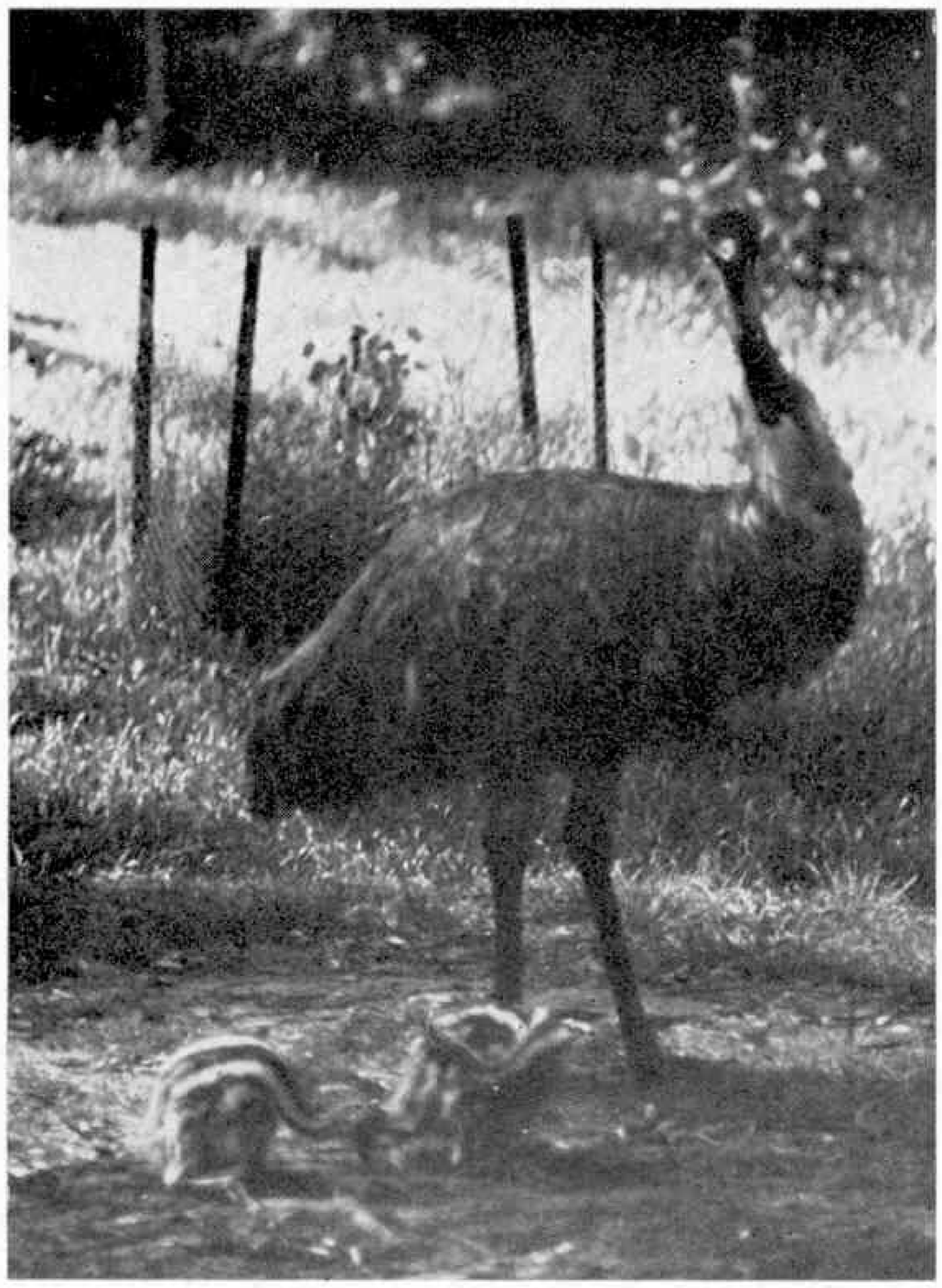
(*continued on page* 557)

Redibo Tu nunquam
IV V VI VII VIII
III
II
VIII
VII
II III IV V VI
Haste Traveller! the Sun is sinking now.
He shall return again; but never thou




HORIZON
XII X XI XII I II
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30


LIFE IS BUT A WALKING SHADOW
VI
VII
V
VIII
IIII
IX
III
X XI XII I II



AUSTRALIA'S LARGEST BIRD

BY FRANK MADIGAN

ONE of the most interesting birds in Australia's tally of about 650 is the 'swift-footed bird of New Holland'. This translation, like its scientific name, means nothing to most of us, for we know it by its Portuguese name—Emu, the largest bird in Australia.

The sexes are alike in plumage and size, their colouring being fawn-brown. The flesh about the head and neck has a bluish tinge, whilst the bill and legs are black.

One way of telling the sexes apart is by the noise each makes. The male gives a grumbling, rather guttural sound, whilst the hen makes a deep bass drumbeat.

It isn't any wonder that the male grumbles, for his role in rearing the family is a phenomenon of the bird world. For as soon as the hen has finished laying the eggs in the nest, the cock takes over his long and arduous task. For two months during the time he is incubating the eggs, he neither eats nor drinks. So it is hardly surprising that he loses more than 20 pounds in weight, before the chicks are hatched.

The male alone builds the nest, a platform of grass, trampled on the ground. The mother emu lays 7 to 15 or so large eggs, granular, greenish-black, measuring about 5 × 3 inches, and weighing 20 odd ounces, and then—leaves it all to the father.

Dr J. J. F. Davis of the Commonwealth Scientific and Industrial Research Organisation, while doing research on the ways of the emu, found the father's devotion is rewarded by the chicks following him around for twelve to eighteen months in inland Western Australia, so it is impossible for the father to incubate another clutch until the second year.

The chicks are striped brown and white, and lose these juvenile markings after 4 or 5 months but do not reach adult size for nearly a year.

At a year they look like adults but the chicks still 'squeak', and they lack the deep booming notes of the adult, especially the mating call. During this time the emus team up in monogamous pairs and call to one another explosively with great booming voices.

It is now that the male emu develops 'drumming powers'. Loud booming sounds are produced by the violent expulsion of air from an inflatable sac just beneath the skin where the windpipe is pierced by a narrow slit.

In no living bird has the wing degenerated more than in this flightless giant of Australia, second largest bird in the world. But its natural wariness, its top running speed of about 40 m.p.h., its swimming abilities, and a tough body well protected by masses of feathers, combine to keep it out of harm's way.

The emu stands five feet tall and weighs as much as 120 pounds. Distinctively stupid, endearingly droll, insanely inquisitive, with its broad stubby head, the emu has a long life. At Konigsberg Zoo, Germany, a male emu which arrived in 1897 was still there in 1928, 31 years later.

Its main food is grass, but if hungry it will eat almost anything, including insects, berries, roots, fruits, leaves and even old boots. Being a 'Gipsy Migrant' as the author Alex Chisholm described 'the birds which in the "off" season wanders about in a blithe, leisurely fashion', it will descend on the ripe wheat fields for a tasty snack.

This habit, plus its habit of crashing through paddock fences when running at top speed, makes it a curse to the farmers and grazers. So they declared war on the emu, shooting it and smashing the eggs, wherever found.

When in 1932 the emus in great mobs raided the wheat areas of Northampton, Western Australia, a great outcry came from the farmers for Government aid in the birds' destruction. Persistent pressure led to one of the most fantastic campaigns in Australian Military History.

A group of farmers appealed to the Federal Government to declare war on the emus. Sir George Pearce, the Minister for Defence at that time, agreed, and the war was on.

An attachment of the 7th Heavy Battery, Royal Australian Artillery, under a Major, was sent to Campion. D. L. Serventy and H. M. Whittell, in their 'Handbook of Birds for Western Australia' described the start of the war, thus:

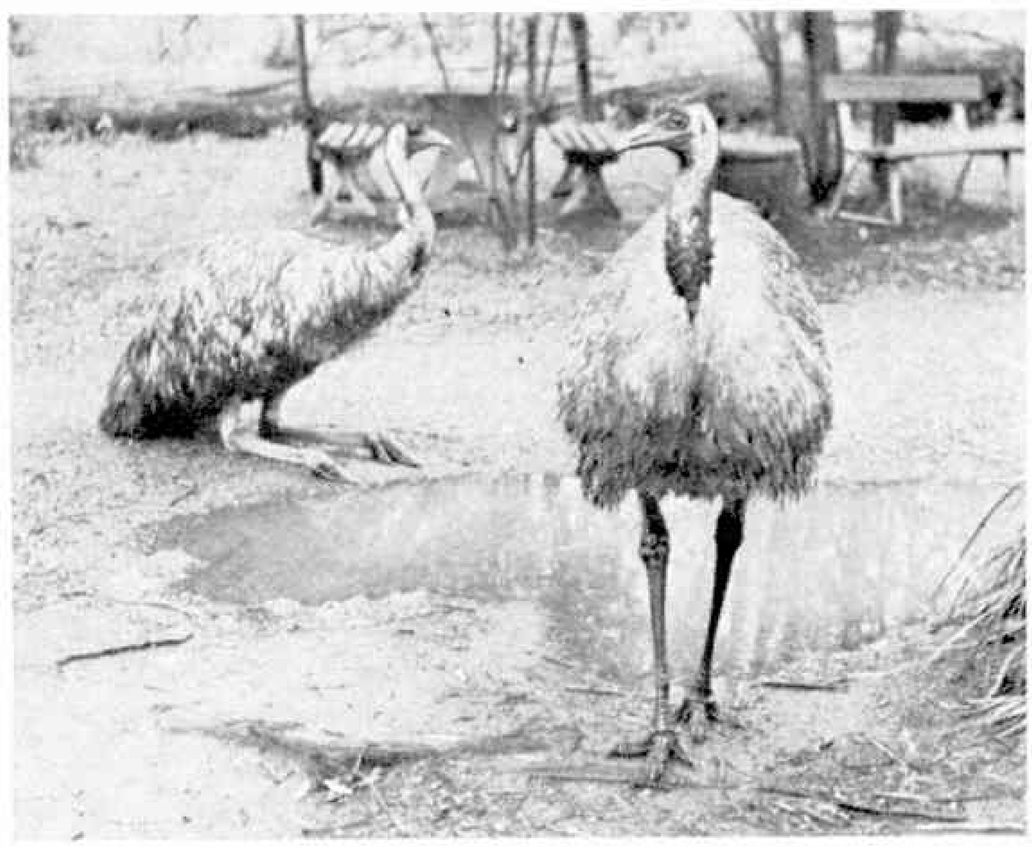
'The offensive began on November 2 at Campion, when an armed party . . . took the field with two Lewis guns and 10,000 rounds of ammunition. About 50 settlers turned out to organise a 20 mile drive of emus to a point . . . where the fire would be concentrated.'

The drive however, was not successful; on the first day only 12 birds out of a mob of 40 were killed.

The second day saw a change of tactics, as open warfare was useless—the enemy had split up into innumerable small parties. An ambush was set up, at a dam where the birds came to drink.

It was dawn on November 4th, when a mob of around 1,000 emus approached such an ambush, the largest mob that had hitherto come within point blank range, 'the Lewis gun opened fire at a few hundred yards and about a dozen birds fell when the gun jammed'.

Opposite, a proud father emu with chicks. Right, a pair of emus having a drink, at Sir Colin Mackenzie Sanctuary, Victoria.



The campaign was finally abandoned, with very little damage done to the emus.

In 1935, however, when the emus came raiding the wheat fields again, the Government put a bounty of one shilling per head for the Northampton emus. Within six months, 57,000 birds were destroyed.

All emus in Western Australia were declared 'vermin', in 1944, with a bonus paid for their destruction. Between the years 1945 and 1960, this bounty was paid on 284,724 birds. The latest figures, those for 1964, showed that bounties were paid on 14,476 emus.

In Queensland, too, the emu has been declared an outlaw because it is alleged to have spread prickly pear. Within two years the Prickly Pear Commission of Queensland caused the destruction of 121,768 emus and 109,345 emu's eggs.

Owing to scientific research, the emu is now known to be a blessing as well as a curse to farmers. For the naturalist A. M. Lea found 2,991 injurious caterpillars in the stomach of one bird.

This factor, and a better knowledge of the ways of this bird, ensure a more tolerant view to its welfare.

The establishment of National Parks means that tourists and Australians will always be able to study this fascinating national bird close up. For most bird-lovers feel, 'that a flock on the move presents one of the finest pictures in Birdland'.

SUNDIALS (*continued from page* 554)

you took it to Cornwall where the sun arrives twenty minutes later than on the Greenwich meridian the dial must be swivelled round or re-inscribed to correct the time, but the gnomon must be left facing due north.

When setting up a conventional dial care must be taken to keep it horizontal. However, a dial on a house or a church needs more care. If the wall faces due south it is comparatively simple but any variation from this direction makes for a harder problem; the difficulties are not insuperable but the dial will not be symmetrical.

If one is put on a wall facing due west it will only receive the afternoon sun and the gnomon which has to point due north will have a dial with parallel time lines instead of a circular dial.

Sometimes in the gnomon there is a small opening called a nodus hole which allows a bead of light to pass through the shadow it casts and light up the date which is indicated on a curved line inscribed on the dial.

An armillary consists of a number of circles usually representing the meridian and the equator whilst others are generally added to stiffen the structure and one might be the ecliptic which represents the course the sun appears to take, being north of the equator in the summer and south in the winter. The time is inscribed on the equator circle.

Armillaries are not nearly so common as ordinary sundials but are more decorative and ornate and are preferred by some.

Sundials can have a number of faces, one of the most famous of this type being at Glamis Castle, near Perth in Scotland, which has no less than forty eight separate faces, and others with a dozen or more are not all that rare.

Another very famous dial is situated in one of the quadrangles at Cambridge in Queen's College. This tells the time and date and in addition the former can be deduced at night from the light of the moon when it is bright enough to cast a shadow.

Sundials did a very useful and necessary job before the advent of reliable pocket watches but now they are hardly ever used for their original purpose and are mostly kept for their ornamental value and to puzzle people over the time they indicate.

PHOTOGRAPHY (*continued from page* 549)

These figures, all of which give the correct exposure for the prevailing lighting conditions, can also be worked out from the tables that accompany the film.

Although each of the above combinations would allow the same amount of light to reach the film, the one chosen would depend on the subject being photographed, and the requirement of depth of field and shutter speed.

If, for example, you were photographing a moving car, it is obvious that as high a shutter speed as possible would be selected to stop the movement of the vehicle. Here the combination of 1/500 @ f5.6 would be chosen.

However, if the view in front of the camera was a static landscape and you wanted everything sharp, i.e. maximum depth of field, the f stop 16 would be selected and the shutter speed, to give correct exposure with that stop, 1/60 second.

For a portrait outdoors a happy medium, enough depth of field to render the figure sharp, and a sufficiently high shutter speed to stop any slight movement of the lips or hair, is needed. The combination of 1/125 @ f11 would fulfil these requirements.

A little forethought as regards focusing and exposure will bring rewards out of all proportion to the amount of effort put in, and will end those previous disappointments. Forethought, however, can do more than give technical perfection. It can improve the pictorial merits of the picture.

It is surprising the number of people who look through a camera viewfinder and yet fail to see the scene. Taking a photograph of a friend they see only that person, failing completely to take in the background, the result—a charming study of an abnormal human who boasts a telegraph pole growing out of the head.

Another source of disappointment is blurred pictures caused, not by wrong focus, but by the operator failing to hold the camera firmly at the moment of exposure. Camera shake, as this disease is called, will cease to be a source of concern if, at all shutter speeds below 1/100 of a second, the camera is steadied by some handy support.

AIR NEWS

BY JOHN W. R. TAYLOR

Beech's Flying Fence

BEECH Aircraft Corporation's RU-21D reconnaissance aircraft, illustrated above, looks as if it tried to take off from a field that was too small and ploughed through a fence on the way. Tiny markings on each side of the rear fuselage show that it belongs to the U.S. Army, but it's no use asking the military what they do with such an odd-looking aeroplane. The RU-21D is one of those types of aircraft which plays an important part in fighting wars, or keeping the peace, nowadays without getting into the news.

The "posts" protruding through its wings and tailplane are aerials; and everyone knows that the new military science of electronic reconnaissance is vitally important. America and Russia both send aircraft and ships, festooned with aerials, as close as possible to the borders and coastlines of "the other side" to pick up every kind of radio and radar signal transmitted by equipment on the ground and in the air. In this way they can keep track of progress being made in electronic guidance systems for aircraft and missiles, and learn what types of radar are being used by the "enemy" defences.

In peacetime it all seems rather like a game. A recent BBC film about RAF Strike Command showed a gunner in a Russian Tu-16 bomber waving to the pilot of a Lightning fighter that had been sent up to ensure that the Soviet aircraft did not trespass into British airspace. But it is a deadly serious business, especially in places like Vietnam where some RU-21Ds are based.

By learning as much as possible about the radars used by North Vietnamese anti-aircraft defences, American forces can reduce the number of aircraft brought down by enemy guns and missiles. By listening for brief radio transmissions below, they can sometimes locate small enemy troop units that have infiltrated into South Vietnam. These are just two of the tasks that come under the heading of electronic reconnaissance.

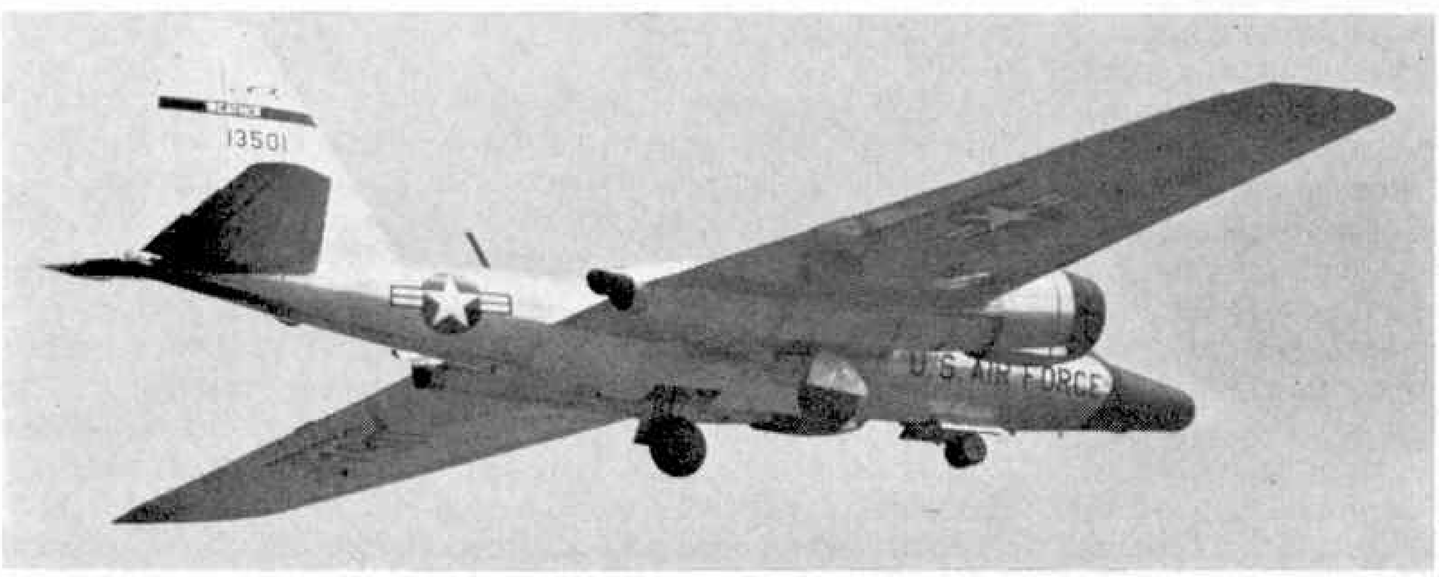
When flights have to be made in front-line areas bristling with enemy fighters and ground defences, speed is essential, allied to the greatest possible cruising height. That is why the RB-57F version of the Canberra, built in America by General Dynamics, is fitted with huge wings which span 122 ft. 5 in. and have an area of 2,000 sq. ft., as well as engines of enormous power.

The RU-21D does not come into this category. It is basically a light transport, powered by two 550 h.p. Canadian-built Pratt & Whitney PT6A-20 turboprops which give it a top speed of around 250 m.p.h. But sometimes it is more important to fly low and slowly, and as quietly as possible. One day the men who pilot the RU-21Ds may be able to tell us just what they did in their "flying fences". My guess is that it will be an exciting story.

Russia's "Starlifter"

While Western air forces have been building up fleets of jet transports, the Red Air Force seems to have been quite content to rely on huge formations of turboprop An-12s, Il-18s and An-22s. Even when Ilyushin's new four-turbofan Il-76 turned up at the Paris Air Show in May, for its first public appearance outside Russia, it carried the civil registration CCCP-86712. Official announcements stated that it can operate from short, rough airstrips and will be used by Aeroflot in Siberia, the north of the Soviet Union and the Far East, where operation of other types of transport is difficult.

This is undoubtedly true. The Il-76 was designed for the basic task of hauling 40 metric tons of freight for a distance of 5,000 km. (3,100 miles) in under six hours, and is fitted with advanced mechanical handling systems for speedy loading and unloading of containerised and other freight. It is fully pressurised, and its 26,455 lb. thrust Soloviev D-30KP engines give it a cruising speed of 528 m.p.h. at over 42,000 ft. With a span of 165 ft.



Heading, the Beech RU-21D reconnaissance "flying fence", an electronic snooper with duties which are highly secret. At least 129 of these aircraft have been delivered to the U.S. Army.

The RB-57F is a development of the British Canberra built by General Dynamics in the U.S.A. Though little is heard of these aircraft, they do a considerable amount of useful work.

Photographed at the Paris Air Show, the Ilyushin Il-76 is an immense machine capable of flying 40 metric tons of freight at speeds in excess of 500 m.p.h. over considerable distances.

8 in. and maximum take-off weight of 346,125 lb., it is in fact a little larger than its nearest Western counterpart, the Lockheed C-141 StarLifter, which has proved to be an extremely useful aircraft.

The StarLifter is, of course, a military transport; but we should not be misled by the "sheep's clothing" of the Il-76 at Paris. It, too, is such a promising aircraft that Russia's military leaders must already be looking forward to the time when dozens of production models take to the air with the red star of the Soviet Air Force instead of the red flag of Aeroflot painted on the tail-fin.

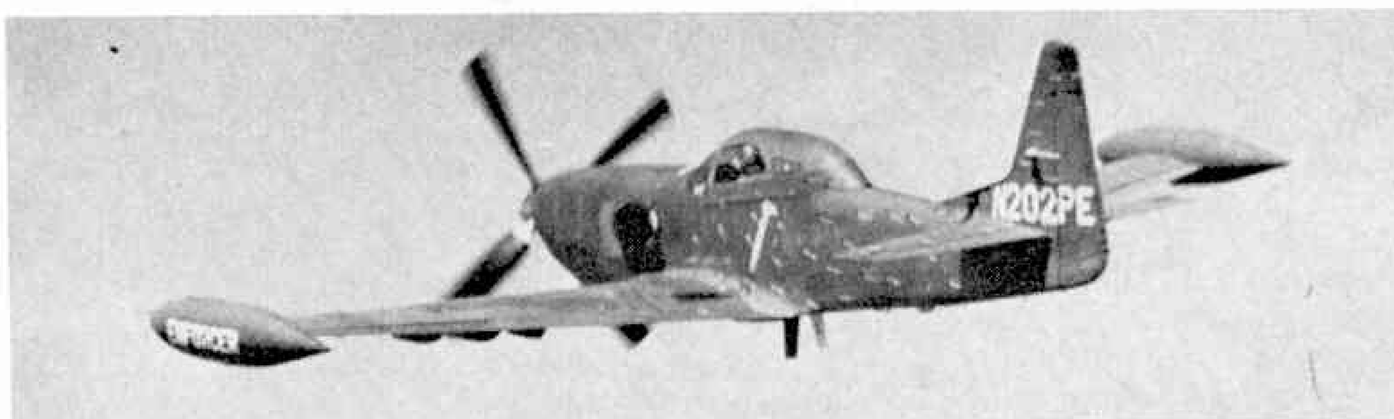
Like all big freighters, the Il-76 is loaded via a ramp that hinges down at the rear of its vast cargo-hold. Slow, short take-off and landing runs are ensured by the double-slotted trailing-edge flaps and full-span leading-edge flaps on its moderately-swept wings. These are features one would expect in any aircraft of this type. Uniquely Russian is the glazed nose, housing the navigator's station, with a large ground-mapping radar in a blister underneath. Equally strange to Western eyes is the main undercarriage arrangement. Each bogie is made up of four pairs of wheels in two rows, under the usual kind of blister fairing on each side of the cabin. But these fairings cover only the retraction mechanism. There are two more under the belly of the aircraft into which the wheels retract.

Even more strange is that the wheels turn through 90 degrees as they retract, so that they stow away vertically but "sideways-on" to the direction of flight instead of pointing fore and aft. All very strange—but quite an aeroplane!

That Piper Looks Familiar. . . .

And so it should! When Piper Aircraft Corporation made the surprise announcement that they had flown a prototype fighter/attack aircraft named the Enforcer on April 29 this year, they did not enlarge on its ancestry. They simply pointed out that it was powered by a Lycoming T55 turboprop engine, which gave it such excellent performance that it would clearly be only a matter of time before air forces ordered it in large quantities for counter-insurgency ground-attack duties in places like south-east Asia.

The prototype Enforcer is illustrated. . . . Despite the absence of the once-familiar under-fuselage air intake, and the presence of a large jet-pipe behind the engine on the port side, no prizes are offered to anyone who recognises it immediately as a Mustang. It is, in fact, a modernised version of that greatest of all American piston-engined fighters of the second World War. With such an airframe, allied to the performance offered by a powerful, lightweight turboprop engine, Piper should have a real winner on their hands.



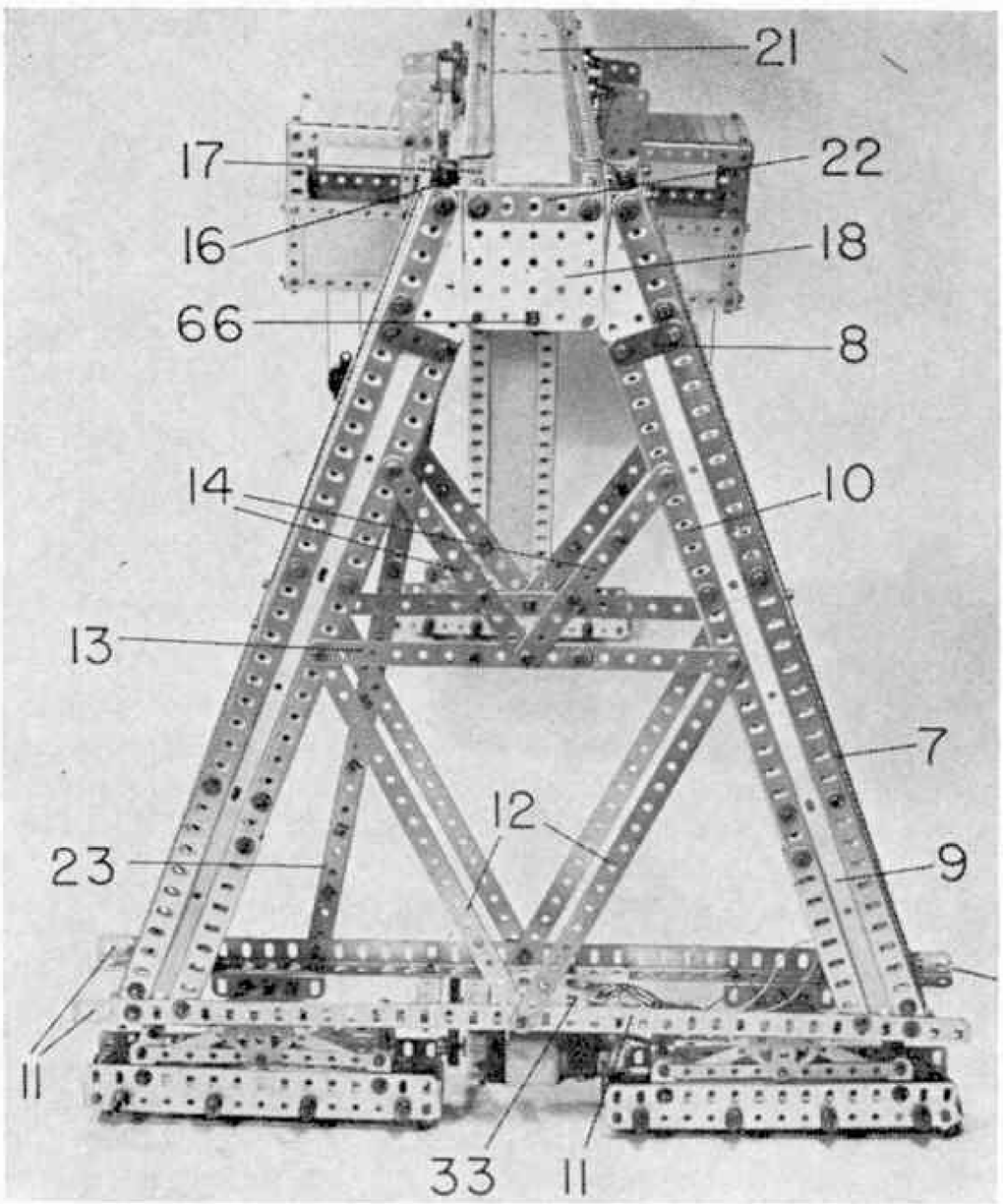
Rebirth of a wartime fighter. The Piper *Enforcer* is a turboprop development of the famous *Mustang*. Incidentally, more *Mustangs* are used in civil air races in the U.S.A. than any other type of plane.

2 Hours to Paris

Since the war, the old piston-engined airliners that once linked London with Paris have been replaced successively by turboprop and jet types. Flying time between the two cities has been cut to much the same time as it takes the average commuter to travel by train between the suburbs and a railway station in London. Unfortunately, by the time the air traveller has added

(*Continued on page* 563)

A BAC-111 in Caledonian/B.U.A. livery; no doubt there will be quite a bit of repainting for all aircraft in this fleet, since at the end of August a change of name to "British Caledonian" was announced.



An end view of the triangular gantry leg showing its strong girder construction with strip cross-bracing.

SHIPYARD CRANE

AN ADVANCED MECCANO MODEL DESCRIBED BY 'SPANNER'

SHIP-BUILDING, as an industry, is something which has played a vital role in the greatness of Britain for many centuries. Our very position as a world-trading nation has been achieved to a large extent by the thousands of ships of every shape and size turned out by the shipyards of this country over the years and it is to be hoped that these shipyards continue with the important work they do.

To the Meccano modeller, however, a shipyard is of interest not so much for its importance to the nation, as for the ship-building equipment to be found in it. The average yard is packed with all sorts of fascinating machinery and it is a typical piece of such equipment that has provided the inspiration for the new Meccano model, featured here. A glance at the photographs will show it to be a Shipyard Gantry Crane, based on one of the giants which are used to lift completed ship superstructures into position. Its design is unique in that the two gantry legs are entirely different in shape, one being a vertical single-column affair while the other is a braced triangular shape. Ground, trolley traverse and load hoist movements are all included to increase the model's authenticity.

Main Superstructure

Dealing first with the single-column gantry leg in the main superstructure, this consists of a large, square box girder, built up from four 18½ in. Angle Girders 1 connected at their lower ends by two 2½ in. Strips 2 and two 2½ in. Angle Girders 3. Three sides of the girder are each enclosed by two 9½ × 2½ in. Strip Plates 4, overlapped one hole, while the fourth side is enclosed by one 9½ × 2½ in. and one 7½ × 2½ in. Strip Plate 5, also overlapped one hole. At the upper end of Plate 5 nearby Girders 1 are connected by a 2½ in. Strip, while each pair of side Girders 1 are connected through their first and fifth holes by two 3½ in. Angle Girders 6, the ends of these Girders projecting two holes inwards.

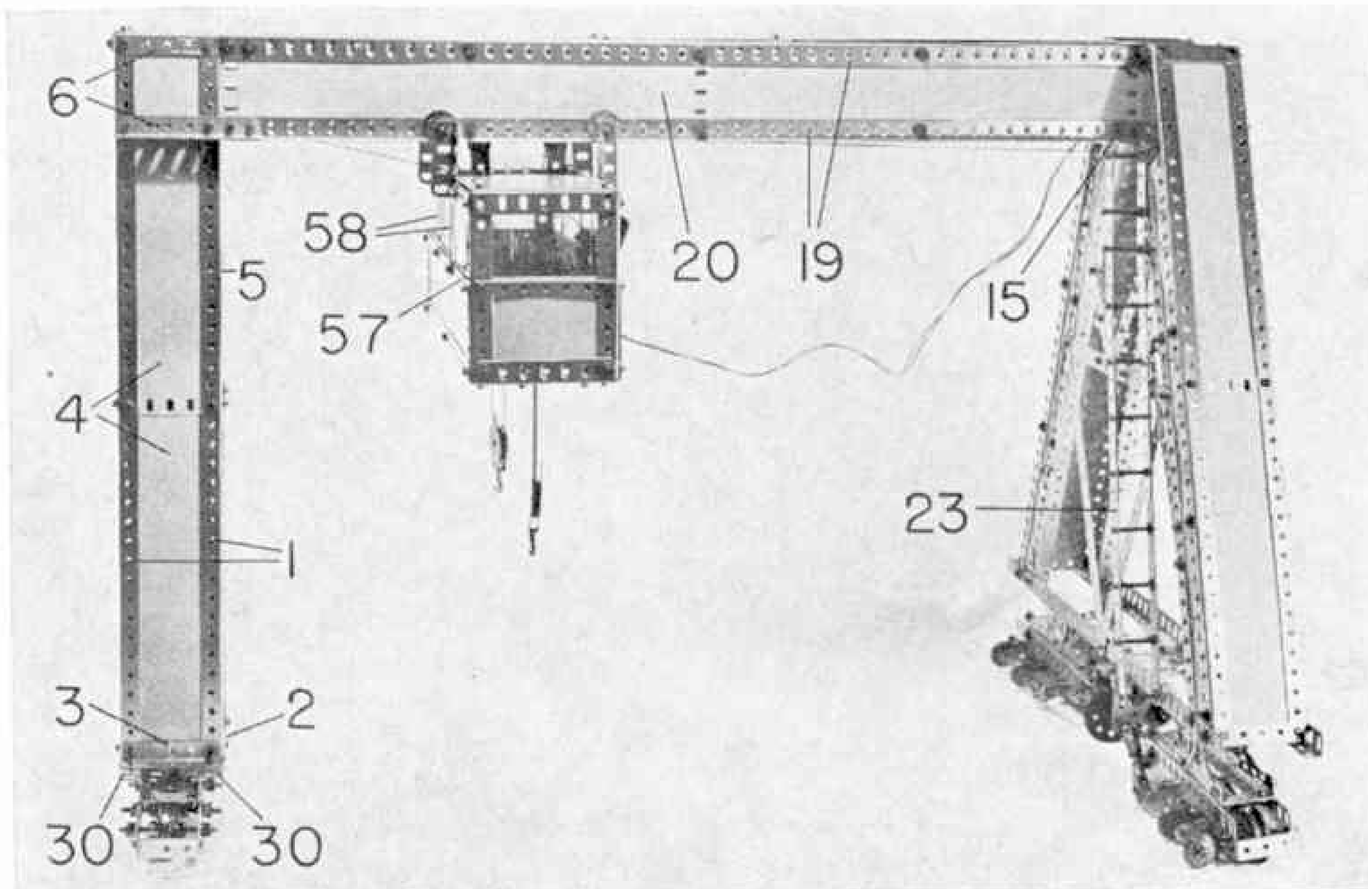
Turning to the other and more complicated gantry leg, two rectangular Girder arrangements are each produced from two 18½ in. Angle Girders 7, connected at top and bottom by a 2½ in. Strip and, along their whole length, by two 9½ × 2½ in. Strip Plates overlapped one hole. Attached to each Girder 7 by a 1½ in. Strip 8, secured through the sixth hole of the Girder, and by three 5½ × ½ in. Flexible Plates 9, is a 15½ in. compound angle girder 10, built up from one 12½ in. and one 4½ in. Girder.

When completed, the two rectangular arrangements are angled inwards, as shown, and are connected together by two 18½ in. Angle Girders 11, bolted to the lower ends of Girders 7 and 10, the ends of Girders 11 projecting two holes beyond Girders 7. Cross-bracing is supplied by a series of Strips and compound strips—two 9½ in. Strips 12 bolted between each Girder 11 and nearby compound girders 7, the upper securing bolts also fixing an 8½ in. compound strip 13 in place, this strip in turn being further attached to Girders 7 by two 5 in. compound strips 14.

Fixed by Angle Brackets to the upper ends of each pair of compound girders 10 is 3½ in. Angle Girder 15, to which a 2½ × 2½ in. Flat Plate 16 is Bolted. The upper corners of this Plate are further connected by Angle Brackets to the upper ends of Girders 7, the securing Bolts also fixing a 3½ in. Angle Girder 17 in position, then another 2½ × 2½ in. Flat Plate 18 is secured to the end of the Plates by Angle Brackets as shown. The lower edge of this Plate is also attached to Plates 16 at each side by a 2½ × ½ in. Double Angle Strip.

The main gantry cross-girder consists simply of four 24½ in. Angle Girders 19 bolted between Girders 6, 15 and 17, the ends of the Girders overlapping the two holes in each case. The sides of the resulting framework are each enclosed by two 12½ × 12½ in. Strip Plates 20, at the same time fixing three 2½ × ½ in. Double Angle Strips in strategic positions between lower Girders 19 for strengthening purposes. The top of

Advanced Meccano modellers may like to build this Shipyard Crane, with working movements powered by two Motors with Gearbox. The Part identified by "5" is on the inside of the gantry leg, out of view in the photograph.



the framework is enclosed by two further 12½ × 2½ in. Strip Plates, connected by a 5½ × 2½ in. Flexible Plate 21, the end securing Bolts also fixing two 2½ in. Angle Girders 22, one between the ends of upper Girders 6 and the other between the ends of Girders 17. Flat Plate 18 is also secured to latter Girder 22.

A gantry access ladder 23, secured to inside Angle Girder 11 and the upper end of compound girder 10, is built up from two 15 in. compound strips connected by eleven 1⅛ in. Bolts and Nuts, the Bolts of course serving as the rungs of the ladder. Each compound strip consists of two 9½ in. Strips overlapped eight holes.

Bogies

Ground movement of the Crane is achieved on three bogies, two on the triangular leg and one on the single-column leg. All three are basically similar in design, except that the two on the triangular leg are motor-powered while the other is free-running. In each case, the frame is supplied by two 7½ in. Flat Girders 23, slotted holes uppermost, joined at each end by a 1½ × ½ in. Double Angle Strip 24. A 5½ in. Angle Girder 25 is bolted to each Flat Girder, the ends of these Angle Girders in turn being joined by further 1½ × ½ in. Double Angle Strips 26, lugs pointing upwards.

Journalled in the circular holes of Flat Girders 23 are four 2½ in. Rods, each carrying a double-flanged wheel 27, built up from a 1⅛ in. Flanged Wheel and an 8-hole Bush Wheel. In the free-running bogey, all the Rods are held in place by Collars, but in each of the driven bogies, a ⅞ in. Bevel Gear 28 is mounted on the inside end of each of the two end Rods. Before fitting the inner Bevel, however, a 2½ × 1 in. Double Angle Strip 29 is bolted to inside Flat Girder 23 in the position shown.

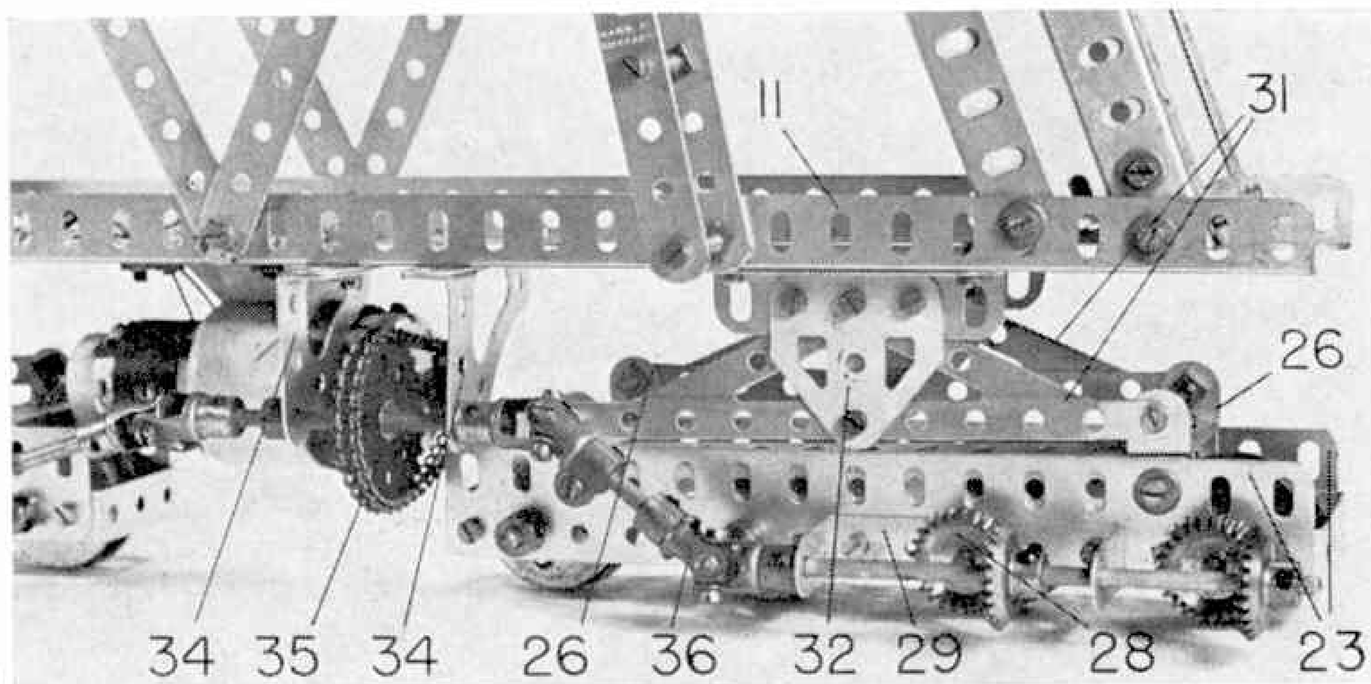
When mounting the single bogey in place under the Crane, two 5½ in. Angle Girders 30 are bolted to the lugs of Double Angle Strips 26 these Girders then being bolted to Girders 3 in the Gantry leg. In the case of each driven bogey, however, two Girder Frames 31 are bolted to the lugs of Double Angle Strips 26, a Flat Trunnion 32, apex downwards, being bolted, in turn, to each of these Frames, then the Frames and Trunnions are tightly fixed to two 2½ in. Angle Girders bolted to Angle Girders 11.

Now bolted across Girders 11, between the two bogies, are a 2½ × 2½ in. Flat Plate 33 and two 3 in. Strips, one hole separating them, one right-hand and one left-hand Flanged Bracket 34 being bolted to these Strips. A 3–12 volt Motor with Gearbox, set in the 12 : 1 ratio, is secured to the underside of the Flat Plate, while journalled in the lowest holes of the Flanged Brackets is a 3 in. Rod, on which a 1½ in. Sprocket Wheel 35 is fixed. This Sprocket is connected by Chain to a ¾ in. Sprocket fixed on the Motor output shaft.

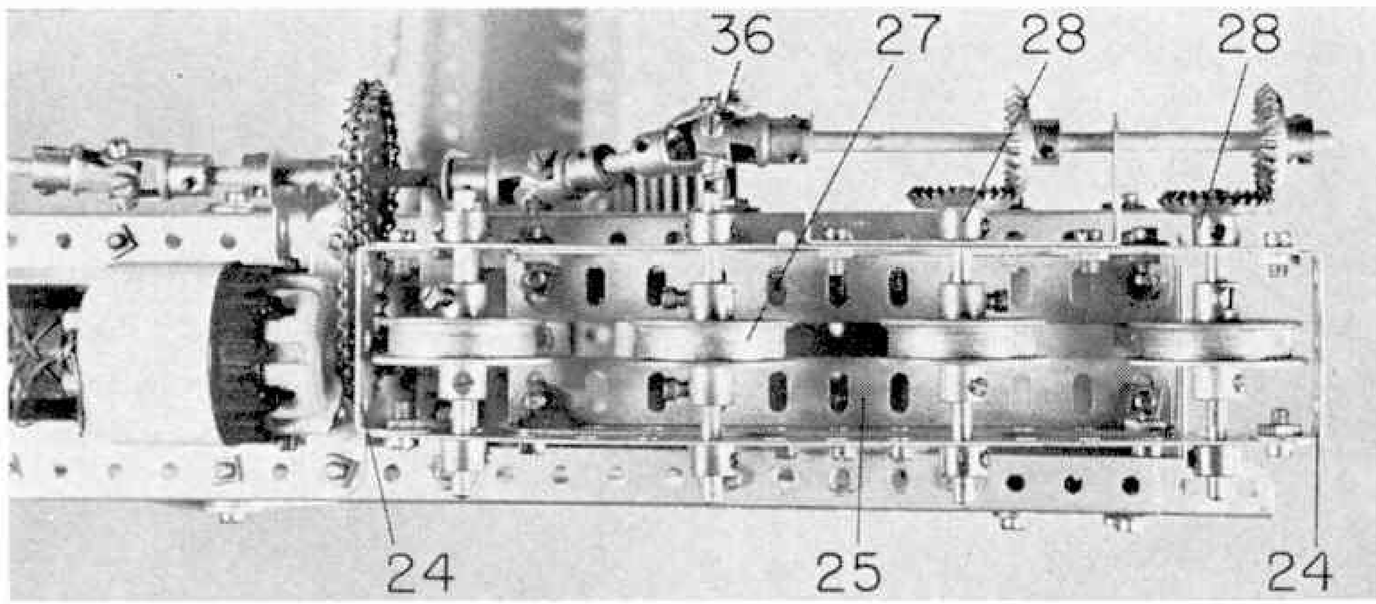
Mounted on each end of the 3 in. Rod is a Universal Coupling, in the other half of which either a 3in. or a 1 in. Rod is held, depending on the end in question. Another Universal Coupling 36 is fixed on the end of the relevant Rod, the other half being fixed on a 4½ in. Rod, journalled in the lugs of nearby Double Angle Strip 29. Mounted on this Rod are two ⅞ in. Bevel Gears which mesh with Bevel Gears 28.

Cab and Winches

In common with most shipyard Cranes, the gantry trolley of the model also serves as the operator's cabin and winch house. Before building the cabin, however, it is best to first complete the hoist equipment, using two 5½ × 3½ in. Flat Plates 37, overlapped five holes, as a baseplate. Secured by 1½ in. Angle Girders to this baseplate, in the positions shown, are two 3 × 2½ in. Flat Plates 38 in which is mounted a 3½ in. Rod, held in place by Collars and carrying a ½ × ½ in. Pinion 39 between the Plates and a 50-teeth Gear Wheel 40 outside the Plates on one end of the Rod. This Gear Wheel meshes with a ¾ in. Pinion



A close-up view showing the drive to one of the powered bogies.



In this underside view of one of the powered bogies, the layout of the flanged wheels is clearly shown.

on the output shaft of another 3–12 volt D.C. Motor with Gearbox (also set in the 12 : 1 ratio) bolted to the baseplate, as shown.

Also journalled in Flat Plates 38, two holes above the 3½ in. Rod, is a sliding layshaft supplied by another 3½ in. Rod, this one carrying a 57-teeth Gear 41, an 8-hole Bush Wheel and a ½ in. Pulley with boss 42, a Collar on one end of the Rod acting as a stop. Movement of the Rod is controlled by a 3½ in. Strip 43, lock-nutted to a 1 × ½ in. Angle Bracket bolted to one Plate 37. A Threaded Pin fixed in the third hole from the top of the Strip locates between Gear Wheel 41 and the Bush Wheel. Movement of the Rod should be limited to ensure that the Gear Wheel remains in constant mesh with Pinion 39.

Another sliding layshaft is journalled in Flat Plates 38, on a line with the first 3½ in. Rod. In this case a 4 in. Rod is used, this carrying two ½ in. Pinions 44 and 45 between the Plates. Movement of the Rod is controlled by a 2½ in. Strip 46, lock-nutted through its centre hole to a Corner Angle Bracket bolted to one of the Plates. The end hole of the Strip locates on a Threaded Pin 47, fixed in the bore of a Collar 47, loose on the Rod, but held in place by two further Collars, one at each side.

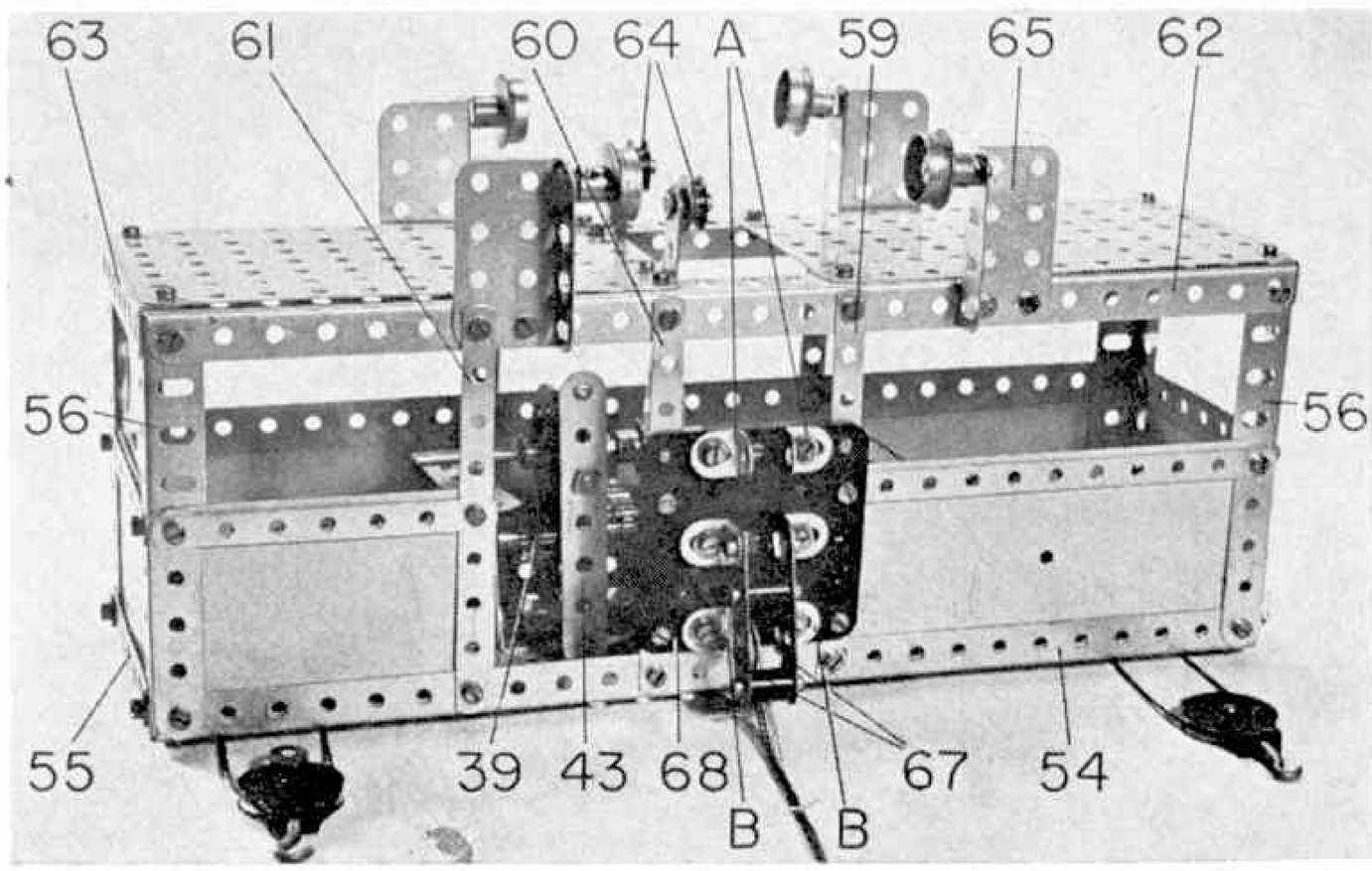
Depending on the position of the Rod, Pinions 44 and 45 mesh with two further Pinions, one on a 4½ in. Rod 48 and the other on a 6½ in. Rod 49. In each case, the Rod is journalled in one Flat Plate 38 and in an Angle Bracket bolted to a 1½ × 1½ in. Flat Plate which is bolted in turn to a 2½ in. Angle Girder 50 fixed to the end of appropriate Plate 37. Note that the Pinion meshing with Pinion 44 is spaced by four Washers from its Flat Plate.

Mounted in the 1½ × 1½ in. Plate and in a Trunnion bolted to a 3 in. Strip 51, secured to Plate 37, is a 3 in. Rod, held in place by a ½ in. Pinion and a Collar. The Pinion meshes with a Worm Gear 52 on Rod 48 or 49, as the case may be. Two 8-hole Bush Wheels 53 are mounted on the 3 in. Rod to serve as one or other of the two hoisting winches. Meccano Cord acts as the winch cable, this being tied to nearby Flat Plate 37 and passed round a Single Pulley Block before being wound round the winch drum.

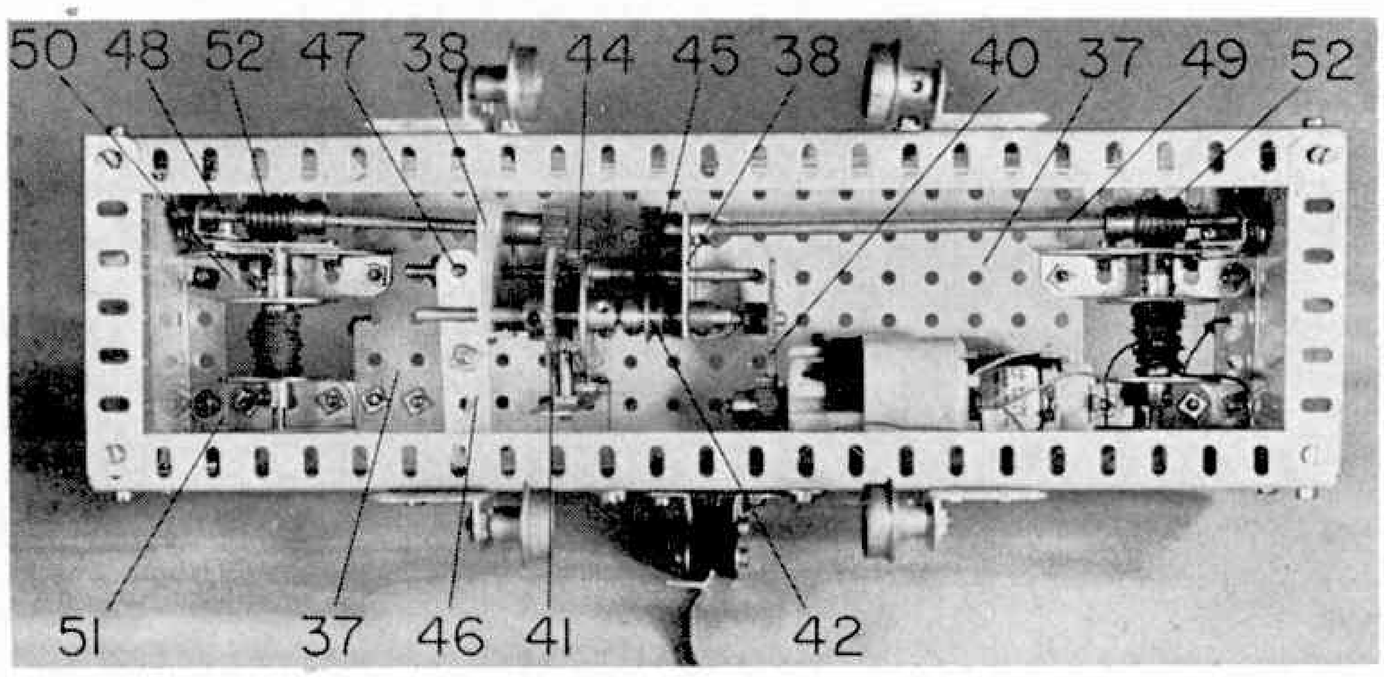
The cabin itself can now be built round the hoisting mechanism, using Flat Plates 37 as the major part of the floor. The Plates are edged by two 12½ in. Angle Girders 54, the ends of which are connected by two 3½ in. Angle Girders 55. Strips 51 and the Angle Girders carrying Plates 50 are also bolted to Girders 55, then corner posts are provided by 4½ in. Angle Girders 56, at the same time fixing the side plates of the cabin in position. One of the long sides is enclosed by a 12½ × 2½ in. Strip Plate, edged along the top by a 12½ in. compound narrow strip 57, built up from three 4½ in. Narrow Strips, and down the sides by two 2½ in. Strips. The securing Bolts also hold three 4½ × 2½ in. Transparent Plastic Plates in position to serve as windows, with window frames being supplied by two 2½ in. Narrow Strips 58, bolted to compound strip 57. The two short sides are each enclosed by a 3½ × 2½ in. Flexible Plate, edged by a 3½ in. Narrow Strip and with a window supplied by a 3½ × 2½ in. Transparent Plastic Plate.

The remaining side is a little more complicated, incorporating the doorway and the winch motor switch. Three 4½ in. Narrow Strips 59, 60 and 61 are fixed to Girder 54 in the positions shown. Bolted between Strip 59 and nearby Angle Girder 56 is a 5½ × 2½ in. Flexible Plate edged along the top by a 5½ in. Narrow Strip, while, bolted between Strip 61 and its Girder 56 is a 3½ × 2½ in. Flexible Plate edged by a 3½ in. Narrow Strip. Both Plates are edged down the outside end by a 2½ in. Strip, but note that no windows are fitted so as to allow access to the winch control levers. The upper ends of Girders 56 are connected by two 12½ in. Angle Girders 62 and two 3½ in. Angle Girders 63, as shown.

The cabin roof is supplied by two 5½ × 3½ in. Flat Plates bolted to Girders 62 and 63 with a space of three holes separating them. Two 1 × ½ in. Angle Brackets are fixed by their short lugs to one of the Plates, a ½ in. Pulley without boss 64 being mounted free on a ⅜ in. Bolt held by Nuts in the end hole in the long lug of each of these Brackets. Four Girder Brackets 65 are then



A general view of the travelling operator's cabin and winch house. Note the built-up switch controlling both motors.



A top view of the operator's cabin with the roof removed to show the winches.

bolted, two to each Angle Girder 62, a ¾ in. Flanged Wheel being mounted on a Pivot Bolt fixed to each of these. The completed cabin is of course slung beneath the main cross-member of the Gantry, the flanged Wheels running on the spare flanges of lower Girders 19. The traverse drive system is provided by a length of cord which is tied to the Strip at the upper end of Plate 5, taken over first Pulley 64, then brought down and passed a *full* turn around Pulley 42. From there, it is taken up and over second Pulley 64 to be finally tied to a Tension Spring fixed by bolt 66 to the Double Angle Strip joining Plates 16 and 18.

Switch and Wiring

Start/Stop control for both the Motors used in the model is from a single built-up switch bolted to Narrow Strips 59 and 60 in the cabin. Two 2 in. Strips 67, connected by two Insulating Spacers, are lock-nutted to two Angle Brackets bolted to a 2½ × 2½ in. Insulating Flat Plate 68. Four more Angle Brackets in two pairs (A and B), are also bolted to the Plate to serve as switch contacts, one pair above the first Brackets and the other pair below them.

On the reverse side of the Plate, one Bracket in pair A is wired to the diagonally opposite Bracket in pair B, the other Brackets in each pair also being wired together. The cabin Motor leads are connected to the Brackets in pair A while the bogey Motor leads are connected to the central Brackets carrying Strips 67. The leads from the power source are finally connected to the Brackets in pair B. Note, however, that both the power source and bogey Motor leads are neatly grouped together, using cord or sticky tape, to form a neat, four-strand cable which trails behind the cabin as it moves on the gantry. This "trailing cable" system is by no means unusual in full-size cranes.

AIR NEWS (*Continued from page* 559)

The Pucara, an efficient-looking design from Argentina for counter-insurgency and similar operations.

on the time spent in getting from city centre to airport at one end, through Customs, on to the aircraft and then repeated the process in reverse at his destination, he might just as well have flown by one of the old Hannibal biplanes of the 'thirties.

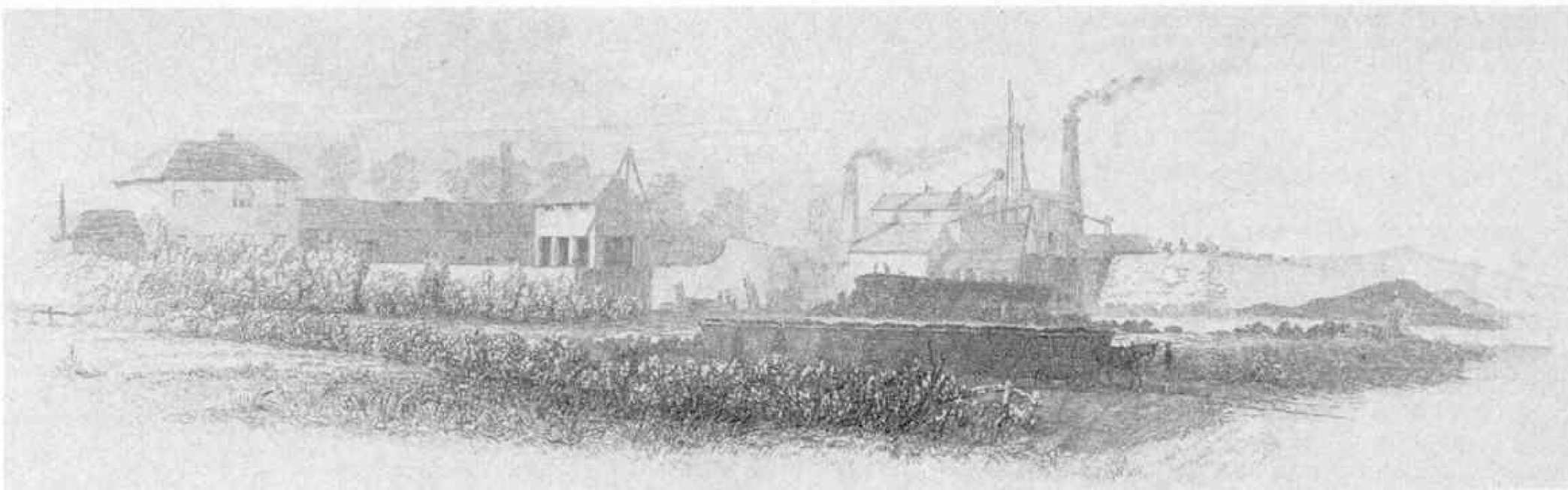
All that should change when British Caledonian—Britain's new "second force" airline set up to provide competition for BEA and BOAC—open a service between Gatwick Airport, London, and Le Bourget Airport, Paris, on November 1 this year. Using BAC One-Eleven jets, British Caledonian claim that they will be able to provide the fastest available link between the two city centres, with a total journey time of just over 2½ hours.

The situation of the two airports provides the key Gatwick has its own railway station and provides a fast connection with Victoria Station in London. Le Bourget is congestion-free and provides prompt boarding or disembarkation through the terminal, which is only 30 minutes by autoroute from the centre of the French capital.

Argentinian Coin

The last picture on this page shows a very different kind of attack aircraft, this time from the Argentine. Designed by Vice Commodore Hector Eduardo Ruiz and known as the IA 58 Pucará, it is a twin-turboprop two-seater intended for counter-insurgency (COIN) operations. The main requirements for such work are agility and the ability to carry a heavy load of assorted ground-attack weapons, rather than high speed. Thus, the Pucará has a top speed of only 308 m.p.h. but can take off in under 500 yards, fly 2,235 miles with full fuel, and carry bombs, rockets and napalm tanks under its fuselage and wings, as well as two 20 mm cannon and four machine-guns in its fuselage.

The second prototype Pucará (AX-02, illustrated) has 1,022 h.p. Turboméca Astazou turboprops instead of the 904 h.p. AiResearch TPE 331s fitted to the first machine to fly. This should ensure increased performance, and the Argentine Air Force is expected to announce soon an order for 80 production Pucarás.



Tracks that Remain from the Passage of the Hoof

By Richard Lee

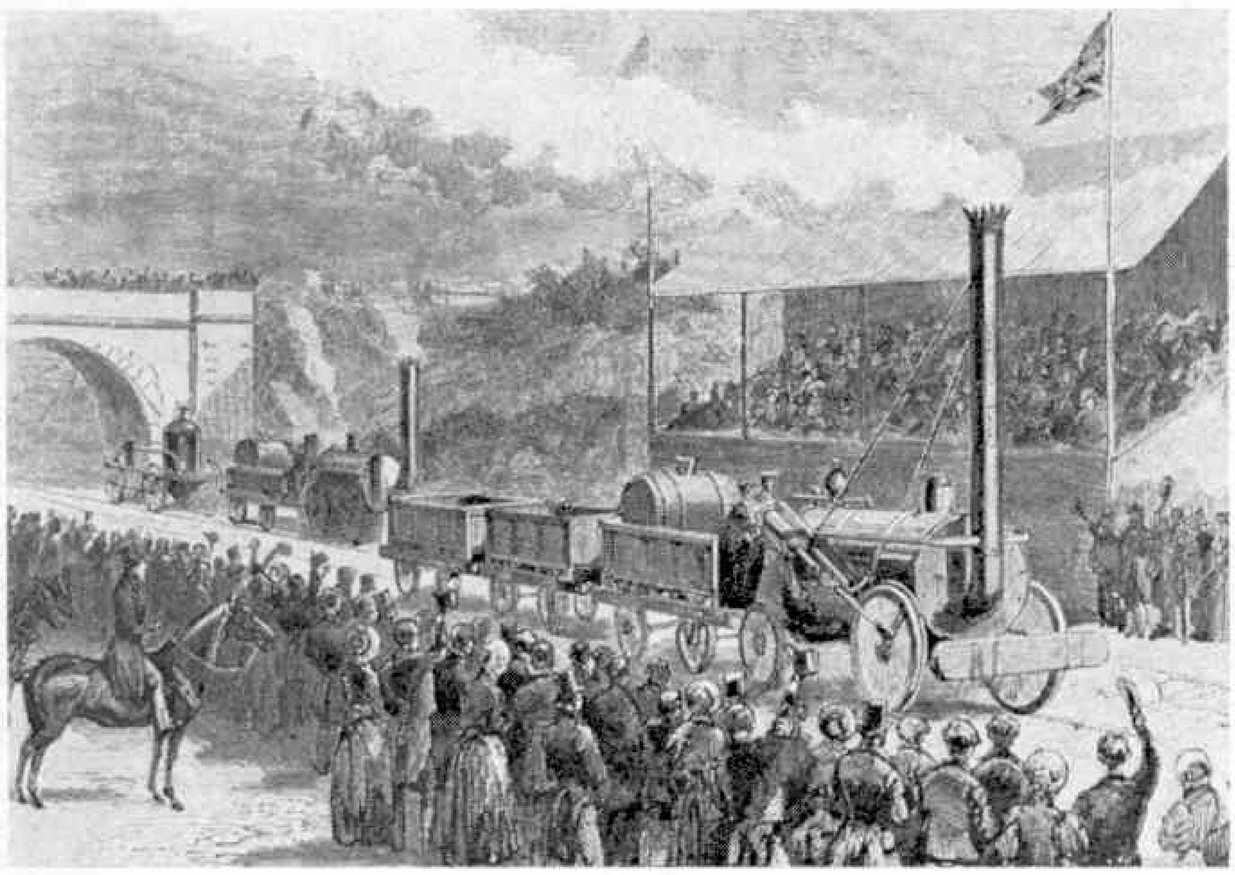
WHICH came first—the steam locomotive or the iron railroad? Ten people out of twelve to whom I put this question plumped for the locomotive—assuming that steam engines were first developed to run on roads and were later modified on account of their weight to run on rails. They were wrong, and the two who guessed correctly did not know the strange history of the horse-powered rail-roads which played a fundamental part in the development of railways as we know them today. For this history has not often been written about.

Between the 17th and 19th centuries virtually all motive power for the inland transportation of goods was by the literal use of horse-power (a phrase now to be lost to the motor world through the advent of the metric system, perhaps the last vestigial motorway relic of horse and hoof?) The road engineers and inventors of those times were continually confounded by the consequences of the one simple and obvious fact—that horses walked on legs, whilst wagons rolled on wheels! Road surfaces were always bad, on this account, from one point of view or another. Rough, soft or loosely surfaced roads were ideal for the horses, for the hooves could cut in and grip, permitting the animals to draw their loads with confidence. But these 'soft' roads deteriorated rapidly and ruts and hummocks in them soon caused damage to the axles of carriages and vibrated and damaged merchandise like eggs and glassware—and caused travel sickness amongst stage coach passengers who rode with the 7d. letter mail!

The streets of London may never have been paved with gold, but Oxford Street was paved with wood in 1840 to provide, it was hoped, a hard wearing surface and a smooth ride. The experiment was not only expensive, it was only partially successful, for hard smooth roads were slippery and fraught with risk should an expensive horse slip down after a shower of rain. A broken-kneed horse was a tragedy in those days similar to a cracked engine block today. Hard surfaces which favoured wheels provided the worst grip for horses' shoes.

In about 1650 an ingenious idea compromised the opposite qualities demanded by hoof and wheel. It was the anonymous invention of laying rails in the roads. In the Northumberland and Durham coal mining areas, where horses plied daily taking one-ton cartloads of coal to the docks, the neat solution of rail-cum-roads was adopted with the specific idea of providing a hard surface for the wagon wheels, now equipped with flanged rims, while the horses could pull on the gravel and shingle laid between the tracks. The very economy of this simple arrangement delighted the innovators of it, for it was found that a horse could now pull, not one, but ten tons of coal at a time in this fashion. This was particularly evident where the rails were laid with care to follow the contours of the ground to avoid steep rises. By this means one horse could do the work of ten. The formula by which the coal wagons alone ran on rails had solved the seemingly incompatible demands to suit the special requirements of both hoof and wheel simultaneously.

In the beginning the rails were made of wood and tied with wooden cross-sleepers similar to recent modern railway tracks. Wear on the rails soon produced the idea of an overlaid renewable wooden rail, which gave way to the improvement achieved by shoeing the wooden rails with an iron 'tyre' about half an inch thick. By 1770, to give longer wearing life, cast iron rails had come into vogue which were improved upon, through faults from brittleness, by malleable rolled steel rails which were in general use by the year 1820. By this time hundreds of miles of permanent way had been laid down—and the locomotive wasn't even thought of! But thousands of horses plied up and down these rail-roads daily with their now-standard ten-ton loads to and from docksides and



Heading, a wagon-way at St. Helens, Auckland.
Left, the Rainhill Bridge Trials, 1829, with the *Rocket* coming in first.

mines. London, however, was rather 'behind the times', for in 1840 the nearest approach to a rail-road in the capital city was a mere flagged trackway between the West India Docks and the City, its route running along what is now Commercial Road.

The existence of such a quantity of permanent way and the invention in 1804 by Trevithick at Merthyr Tydfil of a steam engine which *might* have commercial possibilities of independent progress along rail-road lines, spurred inventors on the quest of realising their dreams of an 'Iron Horse' that could conquer the countryside. Two ideas were in conflict at that time. One theory doubted the practicability of a mobile power unit worked by steam but saw the future of the steam engine best as a stationary power unit which drew its loads along rails by cable, hauling loads across country by some system of passing goods from one engine to another in a chain operation. The opposing faction worked at reducing weight to get the steam engine fully mounted on wheels with independent mobility.

The rivalry thus inspired led, in 1829, to a Competition of Inventions which was held on a piece of permanent way running between Liverpool and Manchester. History records that the competition was won, from a number of entries, by the now famous 'Rocket' constructed by Robert Stevenson, the son of a rail-road engineer. A contemporary account records the event thus:

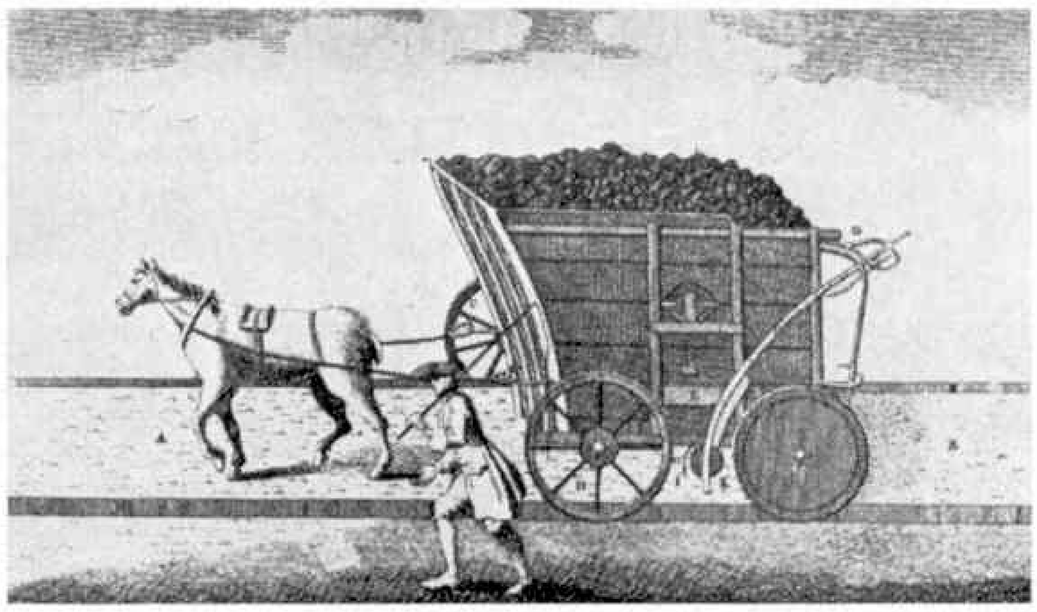
> "In the first trial this engine attained the astonishing speed of twenty-nine miles an hour; and when, unhappily, at the ceremony of the opening of the railway, the accident occurred which deprived the country of Mr Huskisson, his wounded body was conveyed, by the same engine, a distance of about fifteen miles in twenty-five minutes, being at the rate of thirty-six miles an hour."

Thus it is a fair bet that the unlucky Mr Huskisson was the first victim, in 1829, of a fatal vehicle accident, having the doubtful honour of meeting his doom at the agency of the most famous vehicle of all time, a replica of which is still to be seen in the British Science Museum. With casualty figures being what they are today, Mr Huskisson was clearly a pioneer of what has become a national way of death!

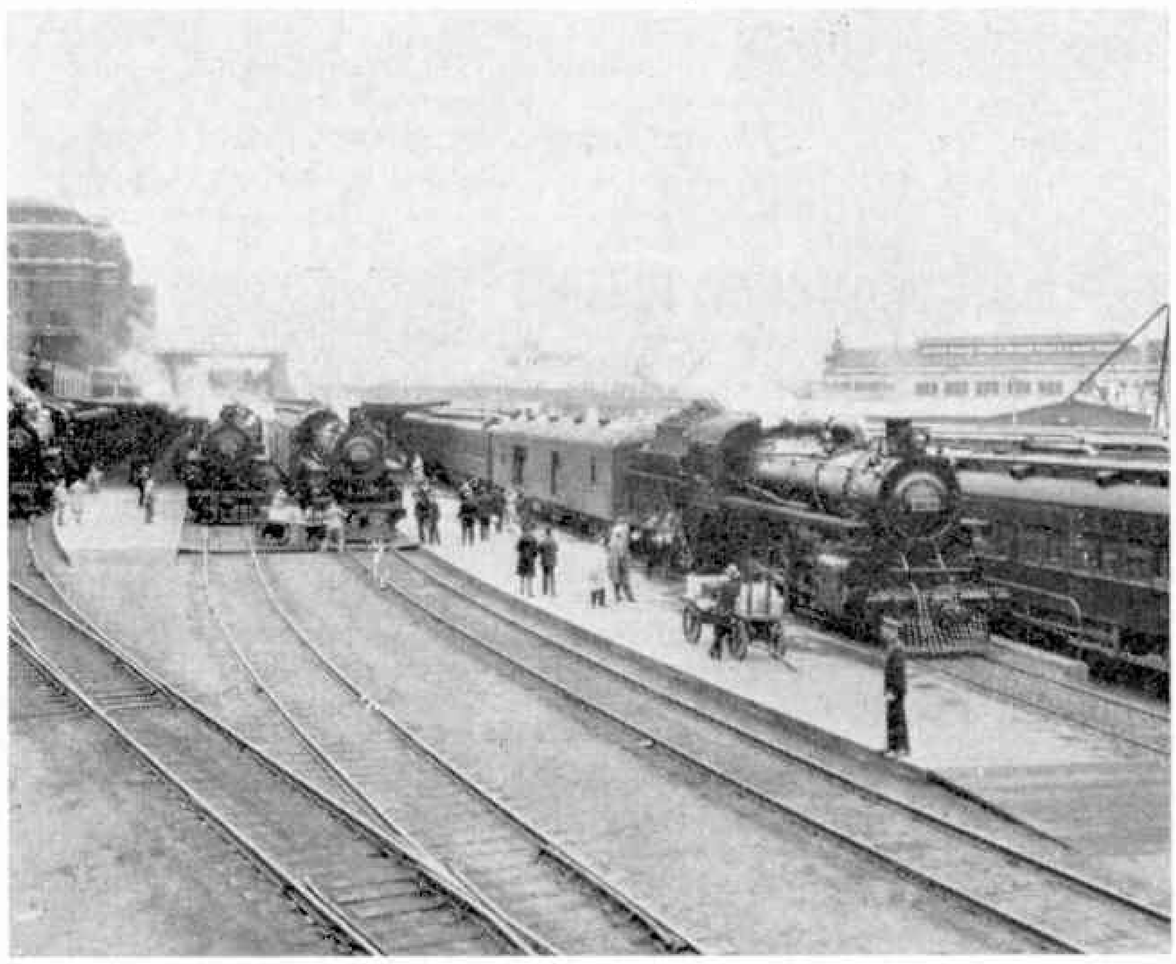
Inventions followed apace from this time on. Nearly every inventor in the land producing a belching brainchild of his own. Cumbersome (and often uncontrollable) monsters emerged lurching and hissing from all corners of the country. Accidents accompanied the trial journeys of these metal Behemoths with such frequency that a law was rushed through Parliament which required the progress of any 'horse-less carriage' to be preceded by a man bearing a red flag aloft! Considering that the stopping distance of the 'Rocket' had been no less than *fifteen miles*, this enactment was not in any way as ludicrous as it might seem today.

While all this was going on, carters and draymen plodded along the rail-road tracks, urging their steaming Shires towards the end of their days of toil. Often they paused to bellow curses at the madcap and hare-brained inventors intrepidly riding their perspiring holocausts of steel which belched and thundered and caused the horses to whinny and rear up in fright. The heavy locomotives shook the ground as they roared by, snorting sparks and live coals which fired nearby thatched roofs and growing crops, stackyards and stables.

The yeomen wagoners hurled oaths at the mechanical invaders of their rail-road, and prophesised an early end to the World as the ungainly steam trains acquired operating efficiency during those years of the synthesis from sweating horse-flesh to steaming muscles of steel. I don't suppose that many of them realised then, as indeed few people do today, that it was nothing



more nor less than the hoof of the humble horse (and its need to walk *between* the tracks) which sired that necessity—the mother of invention—which was giving birth to become the majestic locomotive railway systems of the World.



Top, a Newcastle chaldron of 1764. Above, progress in track-laying—the first passenger train arrives in Vancouver from Montreal, May 23 1887, after the completion of the trans-Canada link. Below, a modern Napier Deltic diesel locomotive—a far cry from the single horses which started tracks!

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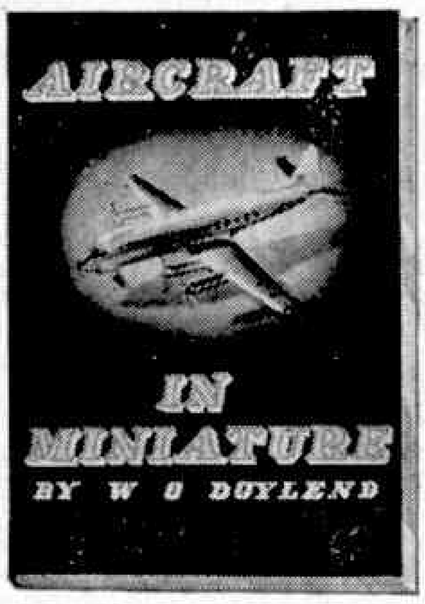

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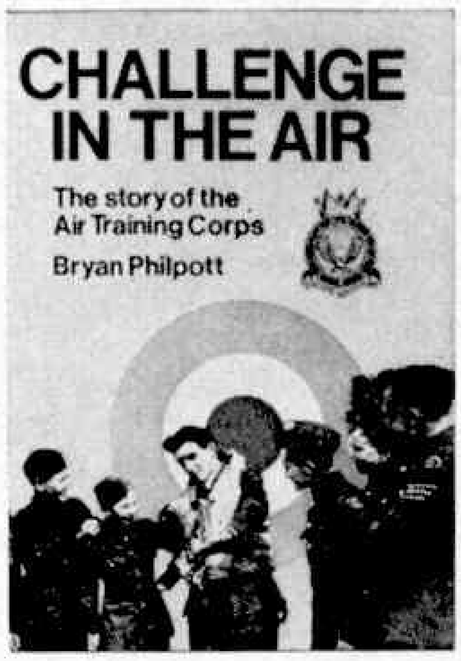

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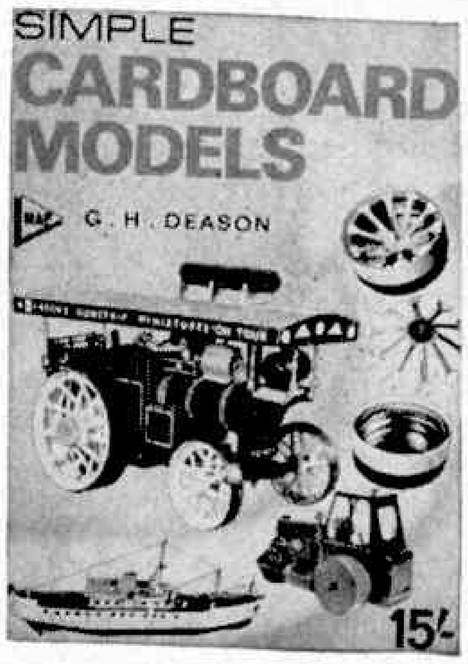

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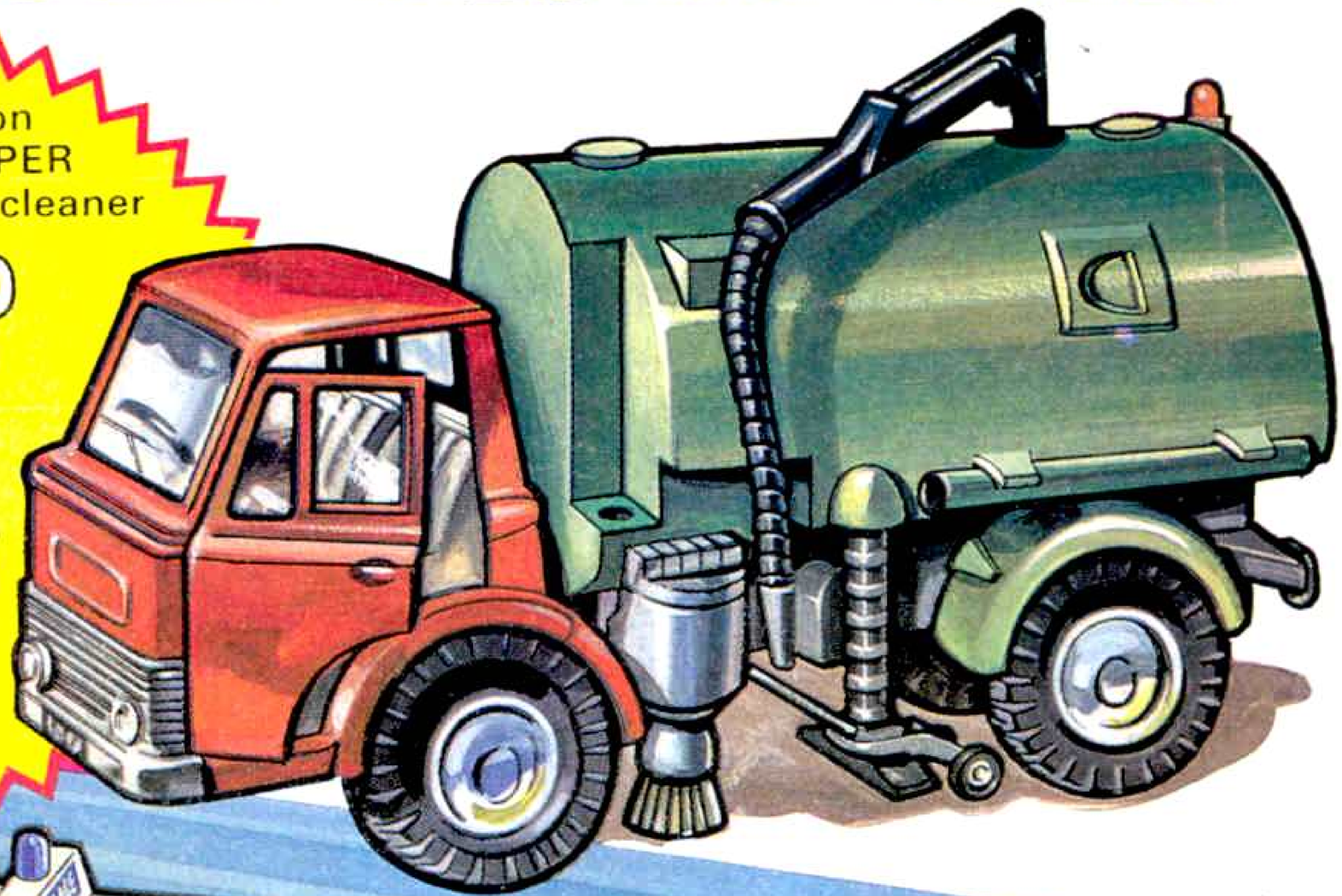

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