

# MECCANO ORRERY

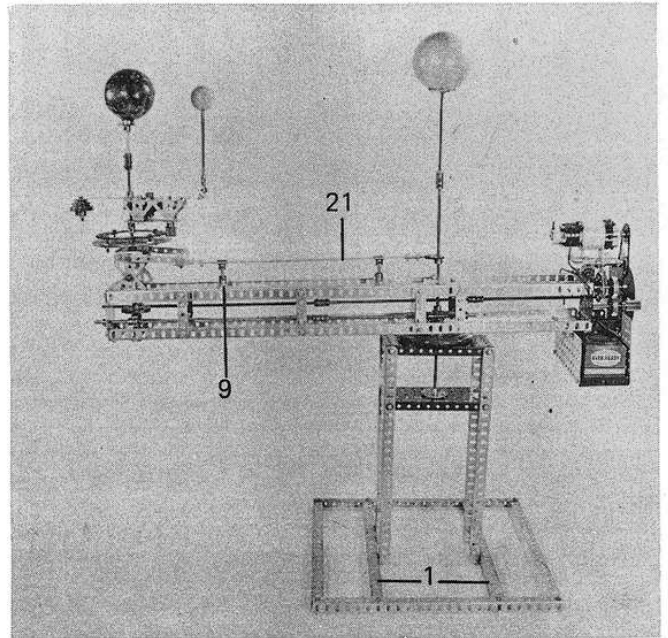
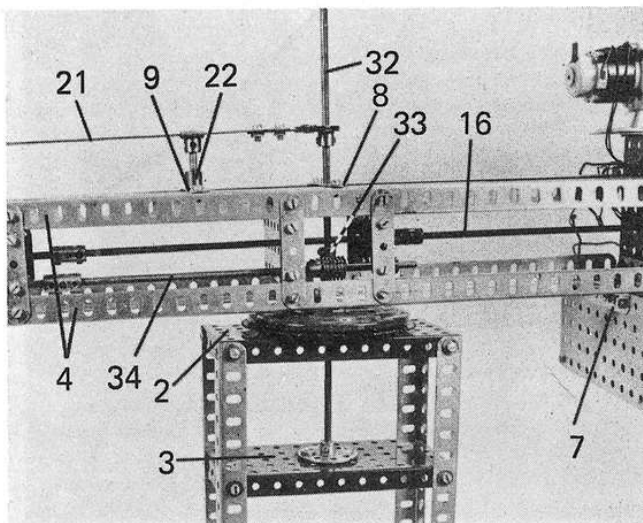
Designed by W. Gomme

Described by "Spanner"

ONE OF THE most significant events in history must surely have been the discovery of the true relationship between the earth, sun and moon.

Today, it seems strange to think that, for many centuries, man believed the earth was flat and that the sun and moon were two light-sources which passed overhead, one during the day and one at night. We know the true situation, but it would have been a terribly difficult task persuading our ancestors not only that the earth was a globe around which the moon revolved, but that it was the earth, with the moon, which revolved around the sun! Imagine trying to explain even further that, as the earth revolved, it tilted on its axis and thus gave the four seasons of the year by moving the two halves of the earth alternately nearer to and further from the sun. Imagine, too, explaining that the moon was not actually a light-source after all, but a spherical planet illuminated by the sun – and it did not change shape every month, really; it was just partly illuminated!

Above, an overall view of the Meccano Orrery designed by William Gomme of Toronto, Canada. Below, a close-up view of the main beam/support tower connection.



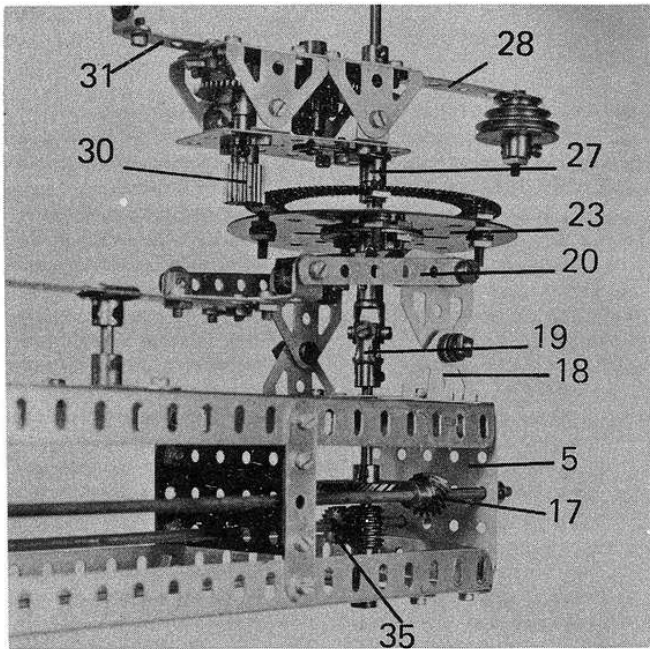
The fact is that anybody in those days would have found the truth almost impossible to grasp. Even today it can be a difficult subject to understand, but the modern world does at least have the benefit of the Orrery, i.e. a model which demonstrates the positions and movements of earth, moon and sun relative to each other.

Featured here is a Meccano Orrery built in slightly modified form from an original design supplied by Mr. William Gomme of Toronto, Canada. It reproduces the major movements of the moon around the earth and both the earth and moon around the sun and also includes the seasonal tilting of the earth. The changing phases of the moon are not directly indicated, however, but the theory is evident from the relative positions of the globes at any given time. We have altered Mr. Gomme's original gearing in one or two places to speed up sequence slightly, but the model as a whole is close to the original specifications.

## CONSTRUCTION

Beginning construction with the support tower, a square base is simply built up from four 12½" Angle Girders bolted together at the corners. Two more 12½" Girders 1 are bolted between two opposite sides of the square, seven holes in from the corners, and to each of these, two vertical 12½" Angle Girders are bolted, 2½" apart. One of these Girders is braced by a 3" Strip secured through the fifth hole of the Girder and the eighth hole of the horizontal Girder. Fixed to the tops of the vertical Girders is a 5½" x 2½" Flanged Plate 2, another similar Plate 3 also being fixed to the Girders seven holes down. A Ball Thrust Race Toothed Disc is bolted to the top centre of the upper Flanged Plate, while an 8-hole Bush Wheel is secured to the top centre of the lower Plate.

Locating on the Toothed Disc – along with a Ball Cage, of course – is the Flanged Disc section of the Ball Thrust Race, this being bolted to the underside of the main beam of the model. The main beam itself, consists of four 24½" Angle Girders 4, the top two of which are joined at the ends by 2½" Angle Girders, as also are the lower two, then the upper and lower 2½" Girders are themselves



A low-level view of the earth/moon support assembly, including the Helical drive transmission system.

connected at one end of the beam by a 2½" x 2½" Flat Plate 5 and, at the other end, by a 3½" x 2½" Flanged Plate 6 projecting two holes upward. Lower Girders 4 are further connected three holes from Plate 6 by another 2½" Angle Girder 7, while upper Girders 4 are further connected by a 2½" Strip 8, bolted through their sixteenth holes, and two more 2½" Strips 9, bolted through their twenty-second and thirty-eighth holes. Four more 2½" Strips are secured in the positions shown, between upper and lower Girders 4 at each side and to each of these is bolted a 2½" x 1½" Flanged Plate which further serves to connect the two sides.

The upper flange of Plate 6 is now extended two additional holes by a 2½" x 2½" Flat Plate 10, while the lower flange is extended a similar two holes by a 2½" x 1½" Flanged Plate. Bolted between the outer edges of these Plates is a second 3½" x 2½" Flanged Plate 11 which together with Plate 6, serves as one of the gearbox support plates.

A 6-ratio Gearbox-and-Motor unit, set in the 3:1 ratio, is next secured to the top of Flat Plate 10. A 1" Pulley on the output shaft is linked by a 6" Driving Band to a 1½" Pulley 12 on a 2" Rod journalled in the upper row centre hole of Plates 6 and 11. Also fixed on this Rod, between the Plates, is a 7/16" Pinion which meshes with a 60-teeth Gear Wheel vertically beneath it on another 2" Rod. This Rod also carries a ½" Pinion, which in this case meshes with a 57-teeth Gear 13 off to the side on a further 2" Rod journalled in Plates 6 and 11. A 1" Gear on the same Rod meshes with a second 1" Gear 14 below it on a final 2" Rod, on the outside end of which a ½" x ¾" Pinion 15 is also fixed.

Pinion 15 meshes with a 3½" Gear Wheel on the end of an 8" Rod 16 journalled in Plates 6 and 11. This Rod is extended the full length of the main beam by another 8" Rod and an 11½" Rod, connected by Couplings and mounted in the 2½" x 1½" Flanged Plates joining the sides of the beam and in Flat Plate 5. Mounted on the Rod between this Flat Plate and the nearby Flanged Plate is a ½" Helical Gear 17, which meshes with a 1½" Helical Gear

on a vertical 3½" Rod journalled in two 2½" Strips bolted to upper and lower Girders 4 of the beam. Note that the bolts securing the upper Strip also fix two Trunnions 18 to the Girders, and that a Universal Coupling 19 is secured on the upper end of the 3½" Rod.

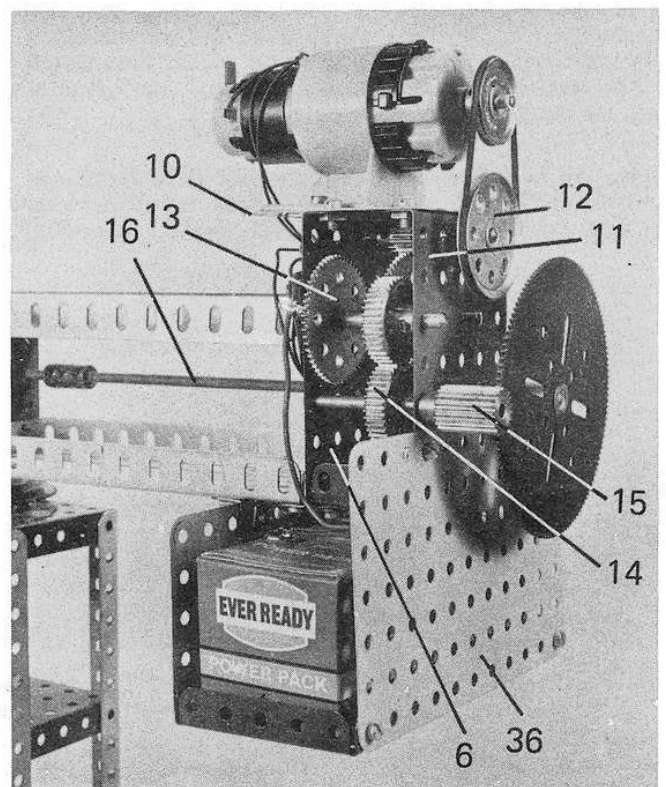
Pivotaly connected to the apexes of the Trunnions by Pivot Bolts, suitably packed with Washers, are two Flat Trunnions which are, in turn, secured by their bases to the flanges of a 2½" x 1½" Flanged Plate. Locked in the base centre holes of these Flat Trunnions and in the corresponding holes of the Plate flanges are two more Pivot Bolts on which two 3" Narrow Strips 20 are carried. The free ends of these Strips are lock-nutted to the lugs of a 2½" x ½" Double Angle Strip, to the back of which a Flat Trunnion, extended by a 12½" Strip 21, is bolted. Strip 21 slides in two Slide Pieces, fixed on 1" Rods which are held in Threaded Bosses 22 bolted to Strips 9 in the main beam. A Single-throw Eccentric is bolted to the end of Strip 21.

**EARTH AND MOON**

The earth/moon support assembly is now built up from a 8-hole Bush Wheel, to which a 4" Circular Plate 23 is bolted. Secured in turn to this Plate by ¾" Bolts is a Gear Ring 24, the Gear Ring being locked by Nuts on the shanks of the Bolts so that it is spaced approximately 5/16" from the Plate.

Tightly fixed on the boss of the Bush Wheel is a 6½" Rod on which a Collar 25 is secured. This Collar acts as the lower stop for the moon assembly which is constructed from two 3" x 1½" Flat Plates 26 connected together by four Trunnions (attached to the upper Plate)

The Orrery is driven by a Motor-with-Gearbox, mounted on top of the main gearbox as shown here. Note that the batteries (two Ever Ready PP1's wired in series) for the motor also serve as the main beam counterweight.



bolted to the lugs of two  $1\frac{1}{2}$ " x  $\frac{1}{2}$ " Double Angle Strips (attached to the lower Plate). Two Cranks 27 are bolted, one to each Plate, their bosses coinciding with the end row centre holes of the Plates and thus serving as bearings for the  $6\frac{1}{2}$ " Rod which passes through them. Note that the Cranks are free on the Rod and note also that the Bolt fixing the upper Crank to Plate 26 also fixes a  $3\frac{1}{2}$ " Strip 28 in position projecting five holes beyond the edge of the Plate. A Cone Pulley is secured to the end of the Strip to serve as a counterweight.

Mounted on the  $6\frac{1}{2}$ " Rod, between Plates 26, is a  $\frac{3}{4}$ " Pinion 29, which meshes with a 50-teeth Gear Wheel on a  $1\frac{1}{2}$ " Rod held in Plates 26. Fixed on the same Rod is a second  $\frac{3}{4}$ " Pinion, this meshing with a second 50-teeth Gear on a 2" Rod journalled in the Plates. Fixed on the lower end of this Rod, beneath the Plates, is a  $\frac{1}{2}$ " x  $\frac{1}{2}$ " Pinion 30 which meshes with the outer teeth of Gear Ring 24.

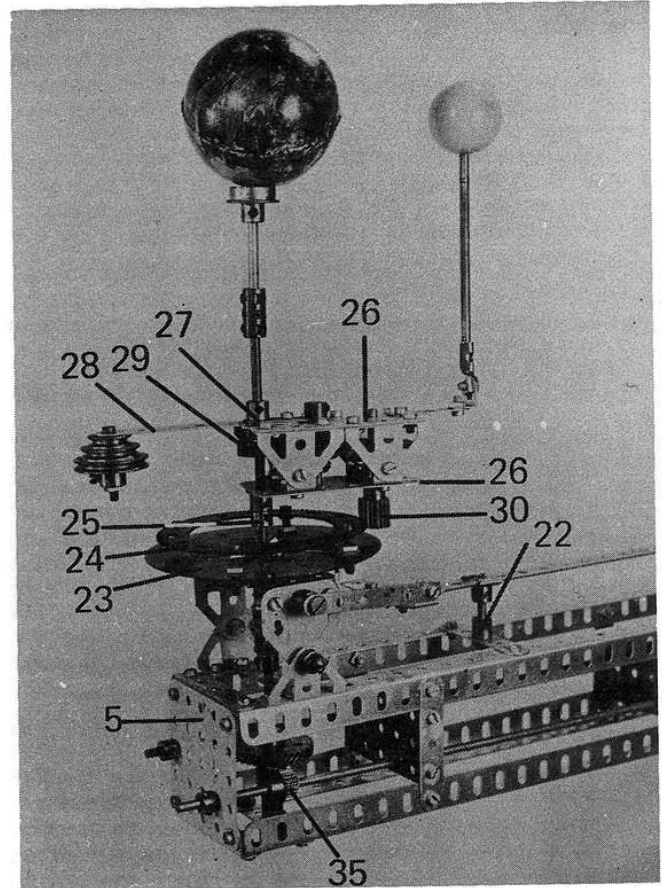
The moon on our model is supplied by a small wooden ball wedged on a 4" Rod, the lower end of which is held in a Rod and Strip Connector attached by an Angle Bracket to a  $1\frac{1}{2}$ " Strip 31 bolted to upper Flat Plate 26. The earth is represented by a somewhat larger rubber ball, suitably painted and wedged on a 3" Rod connected to the  $6\frac{1}{2}$ " Rod of the support assembly by a Coupling. A  $\frac{3}{4}$ " Flanged Wheel on the Rod provides additional support for the ball. The lower end of the  $6\frac{1}{2}$ " Rod is passed through the centre hole in the Flanged Plate carrying Narrow Strips 20 and is tightly fixed in the upper section of Universal Coupling 19.

The sun is also supplied by a rubber ball – larger than the earth-ball and painted yellow – wedged on a  $4\frac{1}{2}$ " Screwed Rod which is connected by a Threaded Coupling to an  $11\frac{1}{2}$ " Rod 32. This Rod is fixed in the boss of the Eccentric bolted to Strip 21 and passes down through the centre holes of Strip 8, the Ball Thrust Race and Flanged Plate 2, being finally fixed in the boss of the 8-hole Bush Wheel bolted to the centre of Flanged Plate 3. Secured on the Rod, above the Ball Thrust Race, is a  $\frac{1}{2}$ " Pinion 33, which meshes with a Worm on a 8" Rod 34 journalled in two of the Flanged Plates joining the sides of the main beam. This Rod is extended, with a Coupling, by an  $11\frac{1}{2}$ " Rod journalled in the remaining Flanged Plates of the beam and in Flat Plate 5. A  $\frac{1}{2}$ " Pinion 35 is fixed on the Rod to mesh with a second Worm mounted on the vertical Rod carrying Universal Coupling 19. This linkage provides drive for the rotary motion of the main beam on its support tower.

## ELECTRICS

This leaves only the electricity source to be provided and the model is finished. In his original model, Mr. Gomme used an external power source which was fed to the motor through a built-up commutator at the top of the support tower. To simplify matters, however, we used a built-in power source in the form of two PP1 batteries carried in a tray slung beneath the main beam of the model. The tray is supplied by a  $5\frac{1}{2}$ " x  $2\frac{1}{2}$ " Flanged Plate, to the side flanges of which one  $5\frac{1}{2}$ " x  $3\frac{1}{2}$ " Flat Plate 36 and one  $5\frac{1}{2}$ " x  $2\frac{1}{2}$ " Flat Plate are bolted. Plate 36 is secured to Flanged Plate 11 in the beam, while the other Plate is secured to a  $2\frac{1}{2}$ " Angle Girder bolted to lower Girders 4 in the beam.

The batteries, with their tray, act as a counterweight for the earth/moon construction at the opposite end of the main beam. Note, therefore, that if the battery-drive system is not used, another suitable counterweight must be provided.



The complete earth/moon assembly set up ready for operation. Note the Cone Pulley which serves as a counterweight for the moon drive gearing.

## PARTS REQUIRED

1 - 1	2 - 18b	141 - 37b	1 - 80b
1 - 3	1 - 20b	40 - 38	6 - 111
2 - 4	1 - 21	2 - 38d	1 - 111d
13 - 5	1 - 22	2 - 48	1 - 123
1 - 6a	2 - 24	1 - 48a	6 - 126
4 - 7	2 - 25	2 - 50	3 - 126a
10 - 8	2 - 26	6 - 51	1 - 130a
4 - 9d	1 - 26a	3 - 52	1 - 140
1 - 12	1 - 26b	1 - 52a	1 - 146a
3 - 13	1 - 26c	2 - 53	2 - 147b
3 - 13a	3 - 27	11 - 59	1 - 168
1 - 15	1 - 27a	2 - 62	2 - 179
2 - 15a	1 - 27b	4 - 63	1 - 180
1 - 16	1 - 27d	1 - 63c	1 - 186a
1 - 16a	2 - 31	1 - 70	1 - 211a
6 - 17	2 - 32	2 - 72	1 - 211b
1 - 18a	164 - 37a	2 - 73	1 - 212
			2 - 235a

1 Motor with Gearbox

2 PP1 Batteries