Papers communicated to the Association.

Approach of Neptune to B.D. + 18° 2056.

By L. J. COMRIE, F.R.A.S.

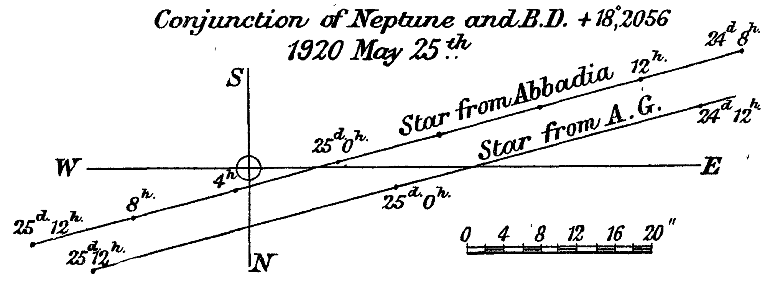
On 1920 May 24 and 25, and also perhaps on the following night, there will be an opportunity of obtaining positions of Neptune by micrometrical measurements from the above 9th magnitude star. The position of the star is a little uncertain. From four observations at Abbadia in 1906 and 1907 the position t years after 1900·0 is

$$\begin{array}{lllllll} \text{R.A.} & 8^h & 44^m & 58^s{\cdot}51 & +\,3^s{\cdot}4001t & -\,0^s{\cdot}00006\,t^2, \\ \delta & +18^\circ & 3' & 46''{\cdot}9 & -\,13''{\cdot}216t & -\,0''{\cdot}0018\,t^2, \end{array}$$

which, with corrections from 1920·0 to date of $+1^s{\cdot}45$ and $-11''{\cdot}1$, gives

$$\text{R.A.}\quad 8^h\ 46^m\ 7^s{\cdot}94 \qquad \delta\ +17^\circ\ 59'\ 10''{\cdot}7.$$

The position reduced from the Astronomischen Gesellschaft (Berlin A) differs considerably from this, even when the systematic corrections of Boss have been applied, being greater by $0^s{\cdot}42$ in R.A. and $3''{\cdot}1$ in Declination. This total displacement of $7''$ suggests a serious error, probably in the A. G. position, which admittedly differs considerably from that in earlier catalogues.



The diagram shows, for these two positions, the path of the star relative to Neptune, which is represented by the small circle of semi-diameter $1''{\cdot}20$ (Barnard). The positions of Neptune are taken from the *Connaissance des Temps*.

On these evenings the sun sets at 8^h (9 P.M. summer time) and Neptune four hours later.

Occultation of Two Stars by Jupiter.

By L. J. COMRIE, F.R.A.S.

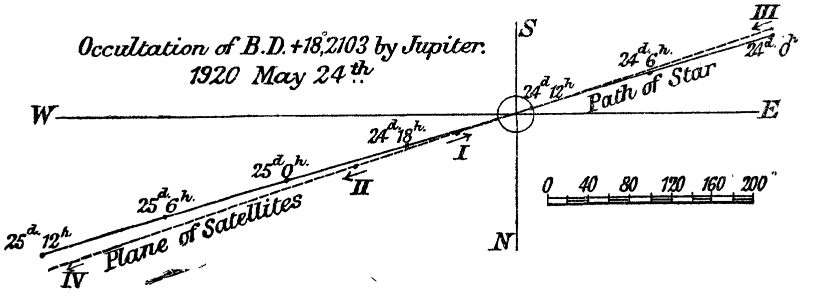
Two occultations of faint stars by Jupiter will occur shortly, one phase of the first being visible here under somewhat unfavourable circumstances. However, the spectacle of a star in the satellite plane should prove of interest. The first star is BD + 18° 2103, of magnitude 8·8, whose position to date has been reduced from Abbadia observations of 1905–6–7. The

Connaissance des Temps ephemeris of Jupiter has been used, leading to the following elements :—

Conjunction in R.A - 1920, May 24^d 12^h 49^m G.M.T.
R.A. of Star and Jupiter - 8^h 58^m $8^s{\cdot}84$
Declination of Star - - 18° 3′ 0″·2 N.
Declination of Jupiter - 18° 3′ 1″·7 N.
Hourly Variations of Jupiter on Great Circles through its centre. } 19″·52 E. / 5″·81 S.
Position angle of Jupiter's North Pole + 18°·18

The occultation can be observed most easily from the east of U.S.A. just after sunset, although the disappearance might be watched from the northern and western portions of the British Isles. In Dublin the disappearance is at 12^h 0^m with position angle 107°. It will be seen from the following table that Jupiter is rather low for good observing. The times are in G.M.T. :—

Altitude.	Greenwich.	Dublin.	Edinburgh.
	h m	h m	h m
10	11 16	11 45	11 38
5	11 50	12 21	12 16
0	12 30	12 58	12 57



The star passes very close to all four satellites, as will be seen from the diagram, which represents the path of the star relative to Jupiter. The dotted line represents the satellite plane, and the positions of the satellites when closest to the star are indicated, together with their direction of motion at that time. Further detail is given in the table below :—

Satellite.	G.M.T. of Closest Approach.	Least Distance.	Star to.	Motion of Satellite Relative to Jupiter.
	d h	″		
I.	24 15·7	2	South	East.
II.	24 21	5	South	East.
III.	24 0	6	North	West.
IV.	25 11	11	South	West.

The approach of IV. is visible here.

The second star occulted is B.D. + 17° 2028, of magnitude 9.0, the elements being :—

Conjunction in R.A., 1920, June 7^d 16^h 22^m G.M.T.	
R.A. of Star and Jupiter	- 9^h 6^m $36^s{\cdot}84$.
Declination of Star -	- 17° $26'$ $17''{\cdot}5$ N.
Declination of Jupiter	- 17° $26'$ $28''{\cdot}3$ N.
Hourly Variations as above	$23''{\cdot}10$ E., $7''{\cdot}08$ S.

This is visible from North America. Selecting Omaha as a central station the two phases of the occultation occur at 15^h 57^m and 17^h 7^m respectively, with position angles 140° and 255° measured from the north towards the east.

The third and largest satellite, whose diameter according to Barnard is $2''{\cdot}50$ on this date, also occults the star some time between June 7^d $6^h{\cdot}0$ and $6^h{\cdot}1$. This occultation is visible from south-eastern Russia and also possibly from Helwan, Egypt.

From England the star will be seen to the east of Jupiter, between the third and fourth satellites, after sunset on June 7.

Varying Strength of the Earth's Magnetic Field in the Magnetic Storm of 1920 March 22.

By W. J. THORROWGOOD.

During magnetic storms, it often happens that electric currents, strong enough to interfere with the sending of signals, pass over telegraph wires. The currents are intermittent and vary in strength and direction, sometimes rapidly, at other times more slowly. Single needle telegraph instruments' needles are deflected to right and left; the armatures of the Morse instruments are held down for varying periods.

Records of these currents are taken by various telegraph administrations to ascertain the strength and direction of the currents, for reference and for other reasons. A few of the results obtained during the storm on 1920 March 22–23 are given in the following table.

These currents can be accounted for by the variations in the earth's magnetic field changing and cutting the telegraph wire, so that an electromotive force is generated in the wire causing the current to pass, or the magnetic storm may cause a difference of electric potential to be set up on the earth's surface and a current to pass from one place at higher to another at lower potential—the current dividing, and part going through the telegraph wires and part through the earth itself or some other conductor that may be available.

In the first case, of the earth's magnetic field changing and cutting or interlinking with the telegraph wire, the number of C.G.S. lines of magnetic force are given in Column 10 of the Table (page 218). It will be seen that the results are fairly accordant, especially when it is considered that the measurements were made at different times and places.

In the second case, the value of the current calculated varies very considerably, but this is probably due to the impossibility of ascertaining the actual resistance of the earth-path of the current. The calculations have been made on the assumption that the earth resistance between the two terminals of the wire is 1 ohm in every case.

It is difficult to give curves of rise and fall of current illustrating the general effect on circuits, as the strength varies so much and the quickness of the change of rise and fall of reversals varies also. In one case, the current rose from 0 to 74 ma. in 4 minutes, remaining at that value for 6 minutes, and fell to zero in 4 minutes.

In the Table the columns are numbered 1 to 10 and give (1) and (2) the stations *from* and *to* which the currents were observed, (3) the distance between the stations in miles, (4) the total number of sq. cm. between wire and ground, (5) current observed in milliamp, (6) resistance of circuit in ohms, (7) E.M.F. calculated, (8) total C.G.S. lines necessary to produce E.M.F., (9) number of C.G.S. lines per sq. cm. cutting wire per second, *i.e.*, change of magnetic field in C.G.S. units, (10) current in amperes passing through earth between stations (resistance of earth = 1 ohm). The time of observation was 4.30 p.m. to 5.10 p.m. on March 22nd for all stations, except from Edinburgh to Glasgow ; 1.0 p.m. on the 22nd to 9.0 a.m. on the 23rd ; the maximum current recorded being 150 ma. from Edinburgh to London, 4.0 p.m. on the 22nd to 2.0 a.m. on the 23rd ; the maximum +, being 56 ma., and the maximum —, being 56 ma., recorded at Edinburgh ; and from Edinburgh to London again from 1.0 a.m. to 1.1 a.m. on the 23rd, 45 ma. The maximum — recorded at London being 45 ma., and the maximum +, being 25 ma. In all cases the average height of the curves above the ground has been taken as 32 feet.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Derby -	Carlisle -	190	299×10^8	4·5	4,200	19·	19×10^8	·063	18·9
Derby -	Liverpool -	100	156×10^8	6·5	3,700	25·	25×10^8	·158	24·5
Derby -	Manchester	60	942×10^7	9·0	2,400	22·	22×10^8	·233	21·6
Bradford -	Derby -	88	138×10^8	6·25	3,300	21·	21×10^8	·152	20·625
Sheffield -	Derby -	36	565×10^7	5·5	3.560	19·	19×10^8	·335	19·85
Rotherham	Derby -	42	659×10^7	4·5	3 500	15·	15×10^8	·227	15·75
Derby -	Miller's Dale	31	487×10^7	2·75	3.350	9·	9×10^8	·184	9·212
Derby -	Birmingham	42	659×10^7	2·75	3,600	10·	10×10^8	·151	9·9
Derby -	Gloucester -	96	150×10^8	4·5	3,200	14·	14×10^8	·093	14·4
Derby -	Bristol -	133	208×10^8	4·5	3,650	16·	16×10^8	·077	32·85
Chesterfield	Derby -	24	376×10^7	4·5	3 400	15·	15×10^8	·398	15·3
Edinburgh	Glasgow -	42	659×10^7	74 to 150	1.500	111· to 225·	111×10^6 to 225×10^8	1·68 to 3·4	111·0 to 225·0
Edinburgh	London -	350	549×10^8	56	3,871	216·77	$216{\cdot}77 \times 10^8$	·394	216·0
Edinburgh	London -	350	549×10^8	45	3,871	174·0	$174{\cdot} \times 10^8$	·301	174·0

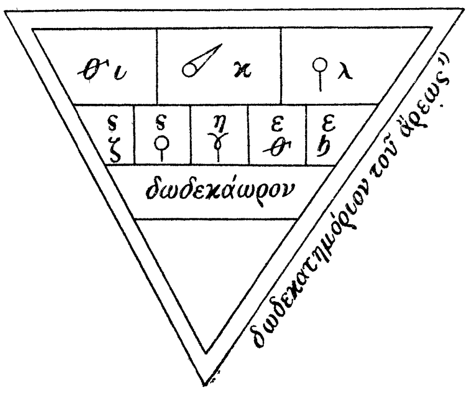
The Origin of the Planetary Symbols.

By A. S. D. and E. W. MAUNDER.

The symbols adopted to represent the "seven planets" known to the ancients are familiar to all of us. They are, to place them in their accepted order:—Saturn, ♄; Jupiter, ♃; Mars, ♂; the Sun, ☉; Venus, ♀; Mercury, ☿; and the Moon, ☽. Capt. Carpenter having recently enquired of us as to whether anything was known of their origin, we looked round for evidence bearing on the subject, and found that there was an opinion current that they dated from the second half of the Middle Ages. If we take the invention of printing as marking a dividing line between those halves, it would follow that the earliest printed books should show these symbols already in use.

In the library of the Royal Observatory, Greenwich, the earliest printed book is the "Introductorium in Astronomiam Albumazaris," printed in Latin at Venice in 1506; Abu-maaschar, the author of the original, having been an Arabian astronomer and astrologer who flourished at Baghdad, in the 9th century. In this book the above planetary symbols are employed in the text in practically the same forms as we use them to-day.

Our next step was to ascertain how they were figured in the MSS. of an earlier age. Fortunately we possess a copy of "Sphæra" by Franz Boll (Leipzig: B. G. Teubner. 1903). In this work, Dr. Boll gives the results of his examination of a number of astronomical MSS. discovered in various libraries of the Continent of Europe. One of these, from Vienna, was by Johannes Kamateros, a Byzantine poet of the 12th century, and it contained a little diagram of considerable interest—here reproduced from Boll's work. Boll gives no date for the MS.,



THE KAMATEROS DIAGRAM.

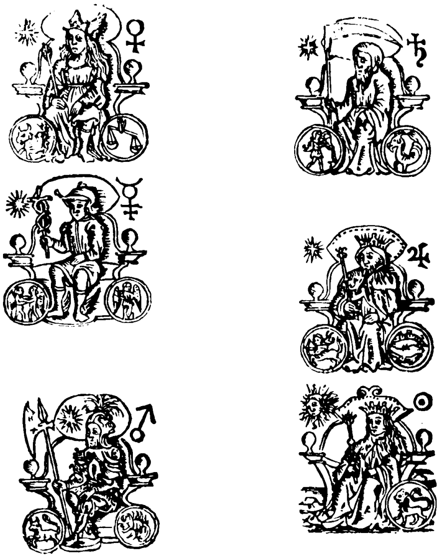
but it was probably not later than the 14th century, and represents a part of an interminable "Compendium of Astrology." The diagram in question, if it is faithful to the original, gives us six out of the seven symbols; that for the Moon alone being absent. If we compare these with those now current, we find there is in general a resemblance between them, but the forms in the Kamateros diagram are simpler. The symbol for Jupiter shows the greatest divergence from the present type, the Kamateros form is evidently the Greek letter *Zeta*, standing for Zeus. The form in Albumazar is that of a Z with a second downstroke parallel to the stem and giving it a close resemblance to the usual script form of our figure 4.

But, for our purpose, the great importance of this diagram was that it led us back to a much earlier planisphere, with which we had been familiar for many years. This is the remarkable fragment which was found on the Aventine at Rome in 1705, and is now in the Louvre, where it is known as the Bianchini Planisphere; it is supposed to date from the second century of ur era.

By the side of the Kamateros diagram there is the inscription "*dōdekatēmorion of Ares*," *i.e.*, Mars. Now, in the astrological scheme, the Ram, the first Sign of the Zodiac, was the "house" of the planet Mars, so that the diagram represents the Sign Aries. The original constellations of the Zodiac were very unequal and irregular, but about six or seven centuries before our era the ecliptic was divided into twelve *equal* portions, the *dōdekatēmoria*. These, through the precession of the equinoxes, have long been divorced from the actual stars. (*See Journal*, Vol. XIV., pp. 244, 245).

The word written across the triangle *dōdekaōron* (for *dōdekaōros*) points to a second duodecimal division of the heavens,—a twelvefold division of the equator,—analogous to the division into the twelve "houses" of modern astrology. But the term *dōdekaōros* is found over and over again in various astrological texts, which are all excerpts from or are based upon a great work by "Teuchros the Babylonian." We know nothing of Teuchros but his name and nationality, but Boll considers that he must have flourished in the first century of our era. In these Teuchros texts, the *dōdekaōros* is a scheme of twelve animals, distinct from the twelve zodiacal figures; each division therefore represents a "double hour," the Babylonian *kasbu*; not the Egyptian hour, which, like that in use to-day, was the twenty-fourth part of a day. The scheme therefore was Chaldæan.

The Bianchini planisphere is much more elaborate than the little Kamateros triangle. The centre is occupied by Draco and the two Bears. Surrounding this is a circle containing the twelve beasts of the *dōdekaōros*, and bearing the same relationship to the twelve Signs of the Zodiac as that indicated in the Teuchros texts. The two next outer rings are each devoted to the twelve Signs of the Zodiac and are thus duplicates one of the other. Then follows a narrow ring of Greek numerals; and, by great good fortune, the division for Aries, the Ram, with its numbers, is complete, so that it can be compared with the Kamateros diagram. These numbers are the same on the Bianchini marble and the Kamateros diagram and are explained in Book I., Chap. XXIII. of the "Tetrabiblos," the great astrological work ascribed to Ptolemy, who allotted the *oria*, the "limits," of the five planets in the Sign Aries as follows:—Jupiter, 6°; Venus, 6°; Mercury, 8°; Mars, 5°; Saturn, 5°, exactly as in the Kamateros diagram, making up a total of 30°. Ptolemy points



corporum motibus rerum imminentium motus iudicia. Argumentum iu
diciorum visitatus effectus. Fructus rerum consequentium prouidentia. Fi
nis huiusmodi prouidentie vtilitas.
De proprietate ducatus solis
in temperie aerea & nature cō
positione: ac stellarum cum so
lis participatione.
Capitulum tertium.
Nunc a so
le in
cipientes proprie
tates eius nature
temperie & cō
positione stella
rum quoque participatione cum ☉ tractabimus. In qua parte primum eis

alligant sibi hunc
inferiorem naturali motu agitantis consequentur.
De proprietate ducatus lune
in marium accessu & recessu. Ca. 4
Post aeream
solaris
effectus temperie
consequens est lu
naris in aquarum
motus mariumque
alternis accessibus atque recessibus
ducatus vt apud philosophos constat
lumina duo quatuor elemento
rum ordinem ita partiuntur: vt ☉ ignem & aerem: ☽ terram & aquam du

Plate I.—The Planetary Symbols.

From the "Introductorium in Astronomiam Albumazaris," printed at Venice, 1506.

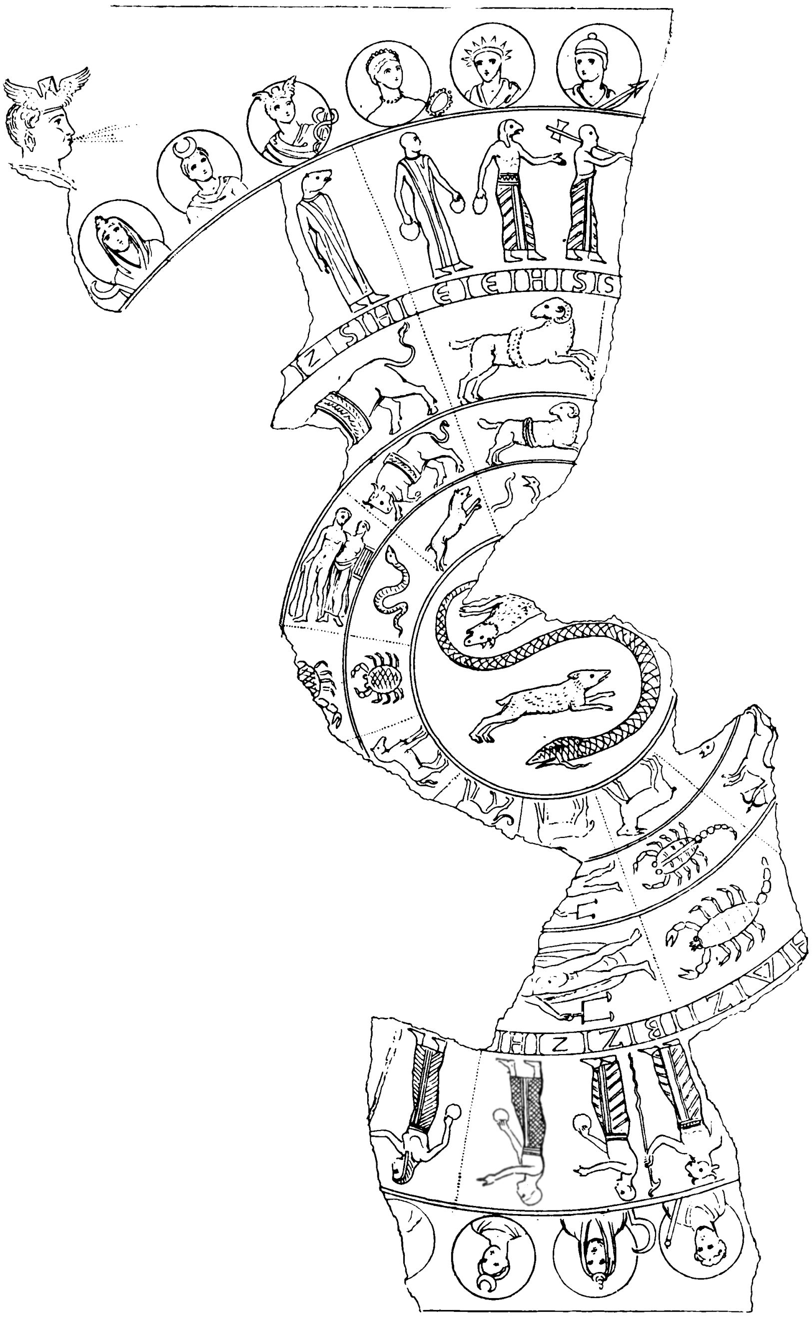


PLATE II.—THE BIANCHINI PLANISPHERE.

out that these numbers are according to the Egyptian scheme, not the Chaldæan. He himself elaborated a third scheme. It will be observed that the numerals are Greek, and we have already pointed out that the *dōdekaōros* is Chaldæan.

The next circle contained 36 figures, Egyptian in design, representing the genii, either of the 36 decans, of 10° each, *i.e.*, three to each Sign of the Zodiac, or of the 36 decades of the Egyptian year. The uppermost portion of the Kamateros triangle corresponds to this circle, for in its three divisions, reading from left to right, we have in the first division the ideogram for Mars—the shield and spear—and the Greek numeral for 10; in the second, that for the Sun and 20; and in the third, that for Venus and 30. The solar symbol is simplified: the circlet carries only a single ray.

Lastly, and for our purpose, the most important are the figures found in the outermost circle. These are the *prosōpa*: the faces or presentments of the planetary deities; the seven being repeated over and over again. Each *prosōpon* is contained in a neat medallion and three are allotted to each sign of the zodiac. They are arranged in the same order as that given at the beginning of our paper. While the genii of the decans are Egyptian in design, the *prosōpa* are Greek. In the fragment of another planisphere, also given in Boll, the decans as well as the *prosōpa* are Greek in style. The threefold origin of these planispheres reminds us of the remarks of Schiaparelli concerning the names of the days of the week, which he traced to "mathematical astrology, the false science which came to be formed after the time of Alexander the Great, from the strange intermarriage between Chaldean and Egyptian superstitions and the mathematical astronomy of the Greeks." The division of the *nycthēmeron* into twenty-four hours certainly came from Egypt; the order of the planetary spheres which has been described above is probably the result of neo-Pythagoran speculation. ("Astronomy in the Old Testament," p. 137).

From the impression that "Teuchros the Babylonian" made on later astrologers we are inclined to attribute the schemes of planispheres such as this to his inspiration. It is difficult to overestimate the influence that Babylonian astrology made on Western thought at this time: thus Hyginus, the freedman of Augustus Cæsar, in his "Poeticon Astronomicon," in a most matter of fact way writes: "Saturnus Solis stella nomine *Phainōn*," just as in an instance given by R. C. Thompson in his book "Reports of the Magicians and Astrologers," the tablet, No. 176, *rev.*, reports a conjunction of the Moon with Saturn as if it had been with the Sun, adding "Saturn is the star of the Sun."

In the *prosōpa* of the Bianchini planisphere we find the originals of the planetary symbols we use to day. The fragment preserves only nine out of the 36 original medallions which composed its outer ring, but, fortunately, those which remain represent each of the seven planets. And the distinctive marks of the seven are that Saturn bears a sickle; Jupiter, a sceptre; Mars, a spear; the Sun, a circlet with rays; Venus, a necklace—in addition to the necklace that she wears; Mercury, the caduceus, and the Moon, a crescent. All these have left their impress on the symbols which we use as ideograms to-day, except that, in the case of Jupiter, a modified *Zeta* has come down to us—no doubt for the reason that a mere straight rod for a sceptre was hardly distinctive enough.

To turn back to the printed volume of *Albumazar*—that book is illustrated by several small woodcuts of the traditional planetary deities, with their ideograms attached. In another old book, in the Greenwich Observatory Library, an edition of *Hyginus*, printed in 1589, there are somewhat similar, though rougher, woodcuts, which, like those of *Albumazar*, show the planetary deities each holding a distinctive weapon. Thus the Sun and Jupiter carry sceptres; Venus and the Moon, arrows or darts; Mars, a battle-axe or spear; Saturn, a very workmanlike scythe, and Mercury, a caduceus or herald's wand with a pair of serpents twined round it. There has evidently been a traditional influence in the depiction of the planetary deities, Saturn, for instance, still wearing a hood in *Albumazar* and *Hyginus*, as he did on Bianchini's marble, though in the interval his sickle has been enlarged into a scythe. But when we compare the ideograms given in *Albumazar* with the very simple forms in the Kamateros diagram, we notice a significant change —the cross has been added to each, and is quite unmistakeable in the instances of Saturn, Venus, and Mercury; indeed the symbol for Mercury in the woodcuts bears a double cross, though only a single one in the text. If we examine the symbol for Jupiter in *Albumazar*, we see that it is a Zeta *plus* a cross, and the battle-axe for Mars has a cross marked upon it. The ideograms of Kamateros are the cognizances of Bianchini reduced to their very simplest forms; later ages, by this addition of a cross, transformed these into the planetary ideograms that we have to-day.

No doubt those ideograms were much older than Kamateros; indeed, Boll says that Kamateros understood so little the diagram which he gives that it is clear he did not make it, but copied it; probably it dates back to the time of Rhetorius of the 4th century A.D.—whom Kamateros quotes—or even to that of Ptolemy himself.

But though it is not likely that the planetary ideograms themselves go back further than this, the cognizances of the gods from which they are derived have a much longer history, as Babylonian monuments testify. The spear of Mars is seen on boundary stones of 1000 B.C. as the symbol of Marduk, the supreme god of the Babylonian pantheon, who in virtue of his rank took to himself the significant attributes of lesser gods. In the well-known bas-relief of his fight with the dragon he carries the sickle and the sceptre in the same form as the planets Saturn and Jupiter carry them on the Bianchini fragment. The necklace of Venus is likewise figured on a white agate seal as carried by a goddess, probably Ishtar; and in the Deluge story, the goddess Sirtu refers to the lapis stones that she wore round her neck as her remembrancer. The rod with the twined serpents, such as Mercury carries, figures on a libation vase offered by Gudea, the priest-king of Lagash, earlier than 2000 B.C. But

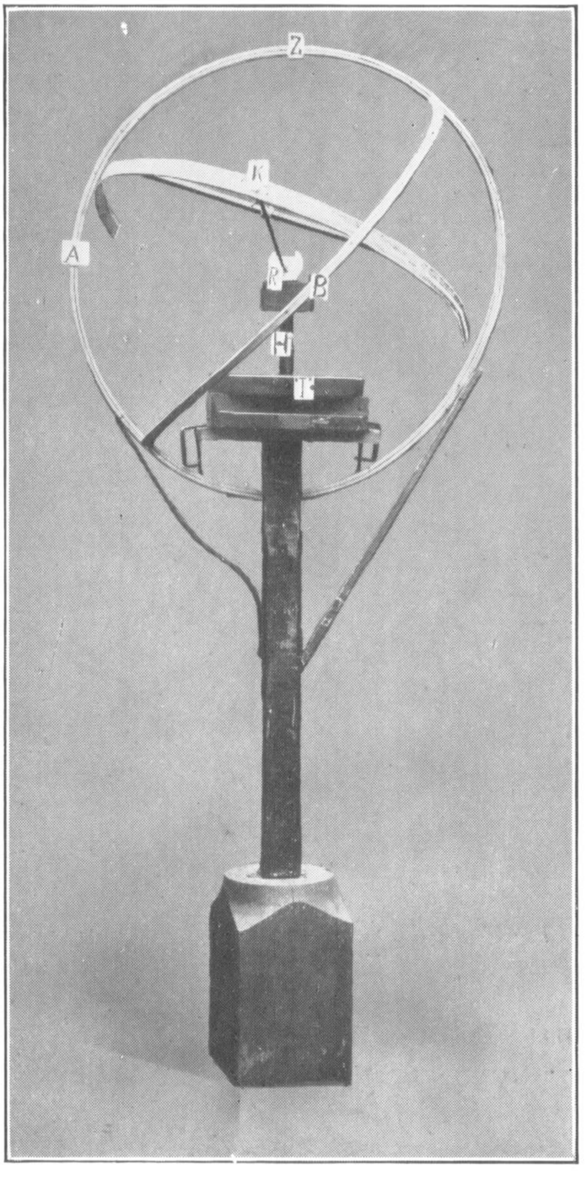


PLATE III—A METEOROSCOPE.

in all these early instances the symbols in question are mythological, not astrological, nor must we expect to find that they bear any reference to the planetary bodies.

An Apparatus for the Observation of Meteor Paths.

By the Rev. M. DAVIDSON, B.A., M.SC., F.R.A.S.

Every observer of meteors knows that it is often very difficult to record accurately the beginning and end of a path, especially with swift meteors. While it is important for the determination of a real path to give these with a fair degree of precision, this is not so necessary for finding the radiant, provided any portion of the flight is carefully recorded. In many cases it is not easy to fulfil this latter condition for various reasons. Let anyone project a straight rod on two fixed stars, and, holding the arm as steady as possible, close the eyes for about two seconds: it is surprising to find how far the rod has moved in this brief period. While estimating the number of degrees a wand projected on a meteor path passes from some fixed star (and too often it does not pass *through* any) a certain amount of movement is inevitable, which may sometimes vitiate the results. In addition, unless it be a very clear night, the distance from the projected path of the wand to a star may be many degrees, and the estimate can be considered approximate only.

The apparatus described is intended to overcome these difficulties. A friend, Mr. W. Harvey, was good enough to construct the greater portion of it from a design submitted to him, and the photograph shows the essential parts of the instrument.

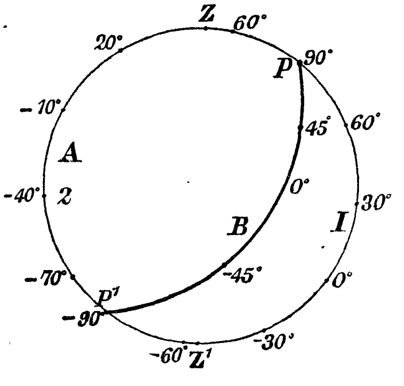
A wooden base *T*, clamped to a stand, is provided with a spindle, *H*, capable of revolving with gentle friction. On the top of the spindle is fixed a ball-and-cup arrangement, the steel rod *R* being capable of rapid movement in any direction through an arc of about 90 degrees. This range allows motion from zenith to horizon, and when it is necessary to move it more than 90 degrees in azimuth, the rotating spindle permits this. At the end of the rod, which is 16 ins. long, there is a semicircular strip of aluminium, *K*, which can be revolved; a small clamp, not shown in the photograph, is used to secure the amount of friction necessary to keep this strip anywhere it is placed, while making the rotation on the rod easy. At the back of the ball-and-cup arrangement there is a screw, which can be adjusted to grip the ball with sufficient force to maintain the rod weighted with the strip at the end in any position. A light piece of wood is fixed at each end to the semicircle, about 1 ft. from its centre, and the steel rod passes through a brass strip on this piece of wood; by holding the latter in the hand a combined lateral movement and a twist will place the aluminium semicircle in any position. It can be rapidly projected on the path of a meteor, and remains fixed when the hand is removed.

The following details are important to avoid errors. As the aluminium piece is $1\frac{1}{2}$ in. deep, its top is $\frac{3}{4}$ in. above the point on which it rotates on the rod. Hence the eye must be $\frac{3}{4}$ in.

above the centre of the ball at the back of the rod; this is provided for by the white strip seen in the photograph at *R*. Another small piece of metal is screwed to the wooden cross-piece on the same level as the top of the aluminium. By this arrangement, when the semicircle is revolved into any position, the eye will naturally move a little to the right or left, always looking over the two pieces at the back of the steel rod and on the wooden cross-piece: parallax is avoided in this way. The readings are taken from a white line painted along the centre of the strip. In addition to the parts described there is a circular piece of wood *A*, 2 ft. 8 ins. in diameter, graduated into degrees, and placed in the meridian. It is set in the same manner as a celestial globe is rectified; *i.e.*, in London the Pole is $51^\circ\frac{1}{2}$ above the horizon, and so, with the Pole marked 90° decln., the zenith *Z* is $51^\circ\frac{1}{2}$. It is easier to mark off the degrees first without assigning numbers to them, and then to place the circle on its stand and mark $51^\circ\frac{1}{2}$ decln. as the highest point and $-51^\circ\frac{1}{2}$ at the lowest. The small diagram shows how this is done. *P* and *P'* are the north and south poles respectively, and only a few degrees are marked in different places to illustrate the principle.

To the north and south poles is attached another semi-circular piece of wood *B*, with a radius the same as the circular piece *A*. By an easy device it can be quickly detached and fixed on to the meridian circle either in an eastward or westward direction, according as we are watching east or west. Its plane is at right angles to that of the meridian circle, and it is graduated from 90° to 0°, the zero point coinciding with the east or west points. The back of the ball is above the centre of the spindle and is also in the centre of the imaginary sphere formed by the meridian circle and the semicircle *B*; the height above the ground is selected as the most convenient for the observer; this is 1 in. less than the height of the eye.

The right ascension of a body is the sidereal time of its passage across the meridian, so if we take the time when a meteor appears and convert this into sidereal time, we know the right ascension of a point on its path prolonged, this point being



determined by the intersection of the aluminium strip with the circle *A*. The declinations can be read from *A* and *B*, and the right ascension of a point on *B* is 6^h greater than the sidereal time at the moment (6^h less if B is towards the west). Hence we have the R.A. and Decln. of two points separated by a considerable arc, along which the path of the meteor must lie. A few examples will make this clearer, and to facilitate the recording of an observation we shall name the portion of the circle A from P to P' to the north (1) and to the south (2) respectively, as shown in the diagram.

At a place 1° E. of Greenwith on April 10th, 1920, looking east a meteor was observed at $10^h\ 50^m$ G.M.T. moving from above β Draconis to south-east of γ Lyræ. The beginning and ending are defined roughly and the aluminium strip is projected on the path. The readings are then taken on A and B, the degrees intersected by the white line on the strip being carefully noted. We shall imagine these to be A (2) 61°, B 42°.

This is all that is necessary at the time, and next day the path could be more accurately determined as follows :—

	h	m	s
April 10th, Right Ascension of Mean Sun at Mean Noon - - -	1	13	39
G.M.T. at time of observation -	10	50	0
Add 2^m for the time since Noon -	0	2	0
Sidereal Time at $10^h\ 50^m$ - -	12	5	39

As the place is 1° E. of Greenwich, this Sidereal Time must be increased by 4^m, so we can take $12^h\ 10^m$ as the Sidereal Time. (We allow 2^m for each 12^h since noon and it is accurate enough to work to the nearest minute, ignoring small fractions of a minute). We then know that the path of the meteor was somewhere along the arc R.A. $12^h\ 10^m$, Decln. 61°, to R.A. $18^h\ 10^m$, Decln. 42°. Even if the beginning and ending are not accurately known, part of the path is determined, and this is the chief thing necessary for finding the radiant. Next, imagine we are looking for a radiant in the west at a place 1° W. of Greenwich on the same night, and at $11^h\ 25^m$ G.M.T., projected the strip on a meteor, the readings being B 45°, A (1) 40° : we find the Sidereal Time is $12^h\ 37^m$. The part B, therefore, shows that the path lies on R.A. $6^h\ 37^m$, Decln. 45°, and the circle A that it lies on R.A. $0^h\ 37^m$, Decln. 40°. In all cases where readings are taken from A (1) it is obvious that we must increase the Sidereal Time by 12^h.

The instrument can be made without much difficulty and observers who have not time to work out the R.A. and Decln. as illustrated could merely record their observations in the manner suggested, sending on the results each month. A small error in the time, say about five minutes, will not cause serious inaccuracy, because the extremities of the arc along which the meteor passes are usually far apart.

If the prolongation of the rod R be kept on a suspected radiant a mere rotation of the strip K will suffice to project it on the path of a meteor from this radiant. This opens the possibility of discovering if a shower from a particular radiant is broken up, which has been found to be the case with certain streams.

Observations can be conducted for positions east of the meridian at one time or west of it at another, but not over both at the same time. This could be done if another semicircle similar to *B* were fixed on the west, but with two such, one on either side, it would be impossible to place the eye conveniently in position. In practically all cases, however, it is both unnecessary and inadvisable to attempt looking all over the heavens for meteors, better results being obtained by confining the attention to some particular portion.

Correspondence.

THE COMPANION TO THE OBSERVATORY.—The Editors of the *Observatory* have under consideration at present the question of whether or not the publication of the *Companion* should be discontinued in future. Owing to the heavy increase in the cost of printing, the price of the *Companion* for 1920 had to be raised to 2s. 6d., which is the same price as that at which the *Nautical Almanac* is still obtainable. Much of the matter contained in the *Companion* is also to be found in the *Nautical Almanac* and it is questionable whether this duplication of publication is either desirable or necessary at the present time. Such portions of the *Companion* as are not readily available elsewhere and are found by observers to be of special value could be incorporated each year in the January issue of the *Observatory*. The economy so effected would enable the Editors correspondingly to increase the size of the monthly numbers.

It is probable that the *Companion* is used most in this country by amateur observers who are also members of the British Astronomical Association. The Editors of the *Observatory* would be glad to ascertain from such to what extent they use it, which portions of the *Companion* they would desire to be published in the January issue, should the publication of the *Companion* be discontinued, and whether, in the event of publication being continued, they can suggest any improvements in it.

The nature of the replies received will enable the Editors to estimate to what extent the *Companion* as at present published meets a real need and will help them in their decision as to whether its continued publication is advisable.

Replies should be addressed to the Editors of the *Observatory*, The Royal Observatory, Greenwich, S.E.10.—F. T. M. STRATTON ; H. S. JONES ; J. JACKSON.

METEORIC RADIANTS IN OR NEAR CORONA, APRIL–MAY.—There are showers in April or May from $231^\circ + 17^\circ$, $231^\circ + 27^\circ$, $232^\circ + 34^\circ$, $232^\circ + 38^\circ$, $243^\circ + 34^\circ$ and $247^\circ + 29^\circ$, and they are rather difficult to distinguish individually, the centres lying comparatively near and the meteors being short and swift and often moving in directions conformable with two or more of the radiants named.

There is another shower from the same region which forced itself on my attention on April 20 1917 and again on April 19