tricks that he could perform them four times a day. He had a vessel full of lukewarm water brought and fifteen or twenty glasses. First he opened his mouth in order to show that he had nothing between his teeth, then from his mouth came red wine, water, brandy, rose water, orange water, white wine, and the like, which could all be recognized by the taste; but it was noticed that on every occasion he began with red wine. Sometimes, after taking water to the extent of twenty glasses, he would squirt it aloft from his mouth like a fountain. Cardinal Richelieu imprisoned this Manfred, and threatened to hang him if he did not prove that his tricks were performed by natural means and not by magic. Manfred revealed the *modus operandi* in secret, and was set free.*

Scotus has given an account of the means of production of different colored liquids in his "Natural Magic." When he was in Rome he was invited, together with Kircher, to the house of a certain antiquarian. The latter produced a roughly-carved cup, of which he wished to know the use. Kircher asked for water, and found that the cup, which was made of light wood from Mexico, changed the color of the water which was poured into it, and that various colors could be shown by varying the light and shade, and by placing it against various colored pieces of cloth. At first the water poured into the cup became pure blue—the longer it stood the deeper it became. If the water was poured into a glass bowl and placed in the light all trace of the blue color vanished; but if the bowl was placed in the shade the water took a beautiful green tint; it became red, and afterward it assumed the color of various colored cloths placed against it.†

The second of the two conjurers referred to above was celebrated for his fountain tricks. Jean Royer of Lyons could send forth from his mouth, according to the account given of him by Abraham a S. Clara, twelve or fifteen different colored liquids, leaves, and flowers; also he exhibited a fountain playing high

*For this description Abraham a S. Clara quotes the "Grosser Schauplatz Lust- und Lehrreicher Geschichte," Part II., Section 126, p. 96.

†Scotus, "Magia Naturalis," p. 1. l. 4.

from his mouth, and for as long as it would take a man to say twice over the fifty-first Psalm.*

Royer, like Manfred, was said to have aroused suspicion that his performances were practised by devil's aid, and to have saved himself by revealing the tricks to Scotus and Kircher, who accepted his explanation and undertook to keep the secret during Royer's lifetime. After a time Scotus appears to have too hastily concluded that, as he had heard, Royer was dead, and to have revealed the trick while Royer was still living.

An explanation of Royer's trick is given in the "Zeit-kurtzende Lust- und Spiel-Haus," the performer being supposed to take on an empty stomach water colored with certain substances which, being diluted with the varying quantities of the water which he drank, produced liquids like in color to varying kinds of wine. Vinegar, lemon juice, and brandy were added to give a flavoring.

Another performance of the same kind as those of Manfred of Malta and Jean Royer of Lyons is described in what appears to have been a book leaf preserved among the prints in the British Museum. It is a portrait of Floram Marchand, who is styled Le Grand Boyeur de Tours, and beneath is printed:

"See here the pourtrait of this man of Tours,
His art and reasons here are published.
What makes this glass look white and that so red:
And all the progress of the works displaid—
The whole deceit is here now open laid."

The book, or pamphlet, dated 1650, is by Mr. Thomas Peedle and Mr. Thomas Cozbie, who brought the conjurer "into England from Tours, in France; and after Wednesday next, being the 26th of this present June, will be constantly ready every afternoon, if desired, in their own persons to work an experimental proof of what is here declared."

Wier, in "De Præstigiis," says: "The many feats which minstrels and jugglers perform every day by agility and swiftness of hand seem to those who are skillless to be miracles, and we are lost in admiration

*The duration of the operation of this mouth fountain is estimated in Paullini's "Curieuses Cabinet" as the time it takes to cover two hundred paces.

of them." Pomponatius states that at Mantua and Padua he saw a man of this kind, called Reatius, who did incredible things which seemed to the vulgar to be performed by the aid of demons; accordingly he was given over to the authorities on a charge of heresy, and showed in secret that his actions were only illusions, and were either tricks of legerdemain or carried through by secret confederacy with many other persons.* Reginald Scot divides confederacy into two kinds—private and public, the private being some pre-arrangement† and, further, when another person or other persons are in league with the performer. As an example of private confederacy he gives a card trick. "The conjurer will show you a card or any other like thing, and will saie further unto you, Behold, and see what a marke it hath, and then burn-eth it; and nevertheless fetcheth another like card so marked out of some bodie's pocket, or out of some corner where he himself before had placed it, to the wonder and astonishment of simple beholders, which conceive not the kind of illusion but expect miracles and strange works."

A trick of public confederacy is such as telling "wether one cast crosse or pile‡ by the ringing" of a coin. This is done by the form of questions asked by the confederate; according as the question is, "What is it?" or "What is't?" the performer knows which way the coin has fallen. Another confederacy trick mentioned by Scot is "How to tell where a stollen horse is become." To perform this it was necessary to get a confederate to steal the horse first, and the conjurer knew then where it could be found.

*Multa insuper imperitoribus visa miracula, manuum expedita agilitate et industria quotidie ab histrionibus et ioculatoribus fieri videbimus, miramur: narrat Pomponatius, se Mantue et Patauij quendam ejus generis hominem Reatium nuncupatum vidisse, qui incredibilia operabatur, ea; demonum arte perfici vulgo credebantur: quare ab hereticæ pravitate inquisitoribus subditus questionibus bona fide occulto ostendit fraudulentas esse suas actiones, merasque manuum agilitates, et multis secreta intelligentia colludentibus peragi.

†When one (by a special plot paid by himselfe without anie compact made with others) perswadeth the beholders that he will suddenly and in their presence doo some miraculous feat, which he hath already accomplished priuillie.

‡Or, as we say, "head or tail."

THE ROTATION OF THE EARTH.

HOW IT IS MECHANICALLY PROVED BY BLUM'S APPARATUS.

BY J. G. DAVIS AND H. F. PURDAY.

EXPERIMENTS have lately been made by M. Blum, with a simple apparatus, designed to demonstrate the effect of the rotation of the earth on the plane of oscillation and support of a simple pendulum.

The apparatus reproduces in all particulars the well-known observations of Foucault, an account of which was published in February, 1851.

The deductions then made by him were based on the results of suspending a heavy weight by a fine wire from the dome of the Pantheon, the upper extremity of the wire being attached to a steel point bearing in a steel cup. The pendulum being thus free to swing in any direction, a trace of its path was left in sand by a fine point attached to the bob.

The marks made by successive swings showed that the plane of oscillation of the pendulum revolved with respect to the building.

Foucault concluded that the plane of oscillation must in any latitude appear to make a complete revolution in 24 hours $\times$ cosec. lat., so that at the equator the plane was stationary, and at the poles revolved once in 24 hours.

It is clear from the above that the latitude of any point on the earth's surface can be obtained by finding the angle whose cosec. is equal to (time in hours for a complete revolution of the plane of oscillation and support of a simple pendulum freely suspended at that point) $\div$ (24 hours).

These results have lately been verified by M. Blum's simple apparatus, consisting essentially of a pendulum which can oscillate on a sphere at any latitude.

A small pendulum, composed of a slender strip of wood, $2\frac{1}{2}$ inches long, weighted by a small wooden ball, is employed.

This is carried by a gibbet attached to a rectangular platform, mounted on a carriage. The latter slides in a groove cut along a demi-meridian of a sphere about 9 inches in diameter, which can rotate in either direction about a vertical axis, so that the pendulum can be placed in any desired latitude by means of a clamping screw. The pendulum, whose axis passes through the center of the sphere, is suspended from the gibbet by a thread, and is controlled by a spiral spring attached to the bob. When displaced from its normal position, it oscillates in a circular opening cut in the platform. A steel hook, which can be fixed at any

point on the circumference of the hole in the platform, is used to hold the pendulum displaced from the normal position prior to releasing it, so that it may be started oscillating at any azimuth angle desired. This is supplemented by a self-starting gear releasing the pendulum after it has been set to the required azimuth by the hook.

When the globe is motionless, the hook can be lifted

DIAGRAM I.

INDEX OF PARTS.

A, clamping screw; B, carriage; C, gibbet; D, thread; E, wood strip; F, wood sphere; G, fixed great circle; H, ball joint; J, starting rod; K, spring; L, demi-meridian slot; S, hook and catch.

DIAGRAM II.

with the hand, and, when rotating, it is lifted by a catch engaging with the inner edge of a fixed great circle surrounding the globe.

The following results are recorded:

- (a) The plane of oscillation of the pendulum is invariable in direction, whatever may be the latitude of the pendulum and the azimuth in which it has been launched. This would, of course, be observed on a star without rotation.

- (b) 1.—With the globe rotating, after a quarter of a turn, it is noticed that if the pendulum is at the north pole its plane of oscillation remains fixed in space—turning relative to the globe in the opposite sense, and at the same rate.
- 2.—With the pendulum at any other northern latitude, the plane of oscillation rotates relative to the globe with a speed proportional to the sine of the latitude.
- 3.—The speed of the plane of oscillation of the pendulum relative to the globe is zero at the equator for all speeds of the globe.
- 4.—In the corresponding southern latitudes the rates of rotation of the plane of oscillation are the same, but their sense is changed.

The proportionality of the speed of rotation of the plane of oscillation to the sine of the latitude is readily proved by the representation of angular velocities by vectors.

Let the vector a represent the angular velocity of the globe about the axis AB .

The vector representing the angular velocity of the globe about CD is the resolved part of a along CD , and is equal to $a \sin \theta$ (i. e., $a \sin \text{lat.}$). This is β .

Clearly when $\theta = 0$ $\beta = 0$, agreeing with (3).

Also when in the southern hemisphere the apparent sense of β is changed, as observed in 4.

Another piece of apparatus, simpler than the preceding, but which does not yield such good results; may be used to demonstrate the change in sense of the deviation as one passes from one hemisphere to the other.

A gibbet carrying a pendulum similar to the one described above, but larger, is held in the hand, and its axis is caused to describe a cone with a vertical axis.

The conical motion of the axis of the pendulum causes the plane of oscillation to revolve with respect to the gibbet, the sense of rotation of the plane of oscillation being clockwise or anti-clockwise, according as the apex of the cone of revolution points upward or downward, or *vice versa*.—Knowledge and Scientific News.