*General Remarks respecting the Sun—its Magnitude, &c.*—Of all the celestial objects with which we are acquainted, none make so strong and universal an impression upon our globe as does the *Sun*. He is the great centre of the Solar System—a vast and fiery orb, kindled by the Almighty on the morn of creation, to cheer the dark abyss, and to pour his radiance upon surrounding worlds. Compared with him, all the solar bodies are of inconsiderable dimensions; and without him, they are wrapped in the pall of interminable night.

The sun is 886,000 miles in diameter. Were a tunnel opened through his centre, and a railway laid down, it would require, at the rate of thirty miles per hour, nearly three and a half years for a train of cars to pass through it. To traverse the whole *circumference* of the sun, at the same speed, would require nearly eleven years. His diameter is 112 times that of the earth, and his mass 1,400,000 times as great. He is 500 times larger than all the rest of the Solar System put together. The mean diameter of the moon's orbit is 480,000 miles; and yet, were the sun to take the place of the earth, he would fill the entire orbit of the moon, and extend more than 200,000 miles beyond it on every side.

The *form* of the sun is that of a *spheroid*; his equatorial being somewhat greater than his polar diameter. The map referred to exhibits the relative diameters of the sun and planets.

*Spots on the Sun—their Number.*—By the aid of telescopes, a variety of *spots* are often discovered upon the sun's disc. Their *number* is exceedingly variable at different times. From 1611 to 1629, a period of eighteen years, the sun was never found clear of spots, except for a few days in December, 1624. At other times twenty or thirty were frequently seen at once; and at one period in 1825, upwards of fifty were to be seen; over one hundred are sometimes visible. From 1650 to 1670, a period of 20 years, scarcely any spots were visible; and for eight years, from 1676 to 1684, no spots whatever were to be seen. For the last 46 years, a greater or less number of spots have been visible every year. For several days, during the latter part of September, 1846, we could count sixteen of these spots which were distinctly visible, and most of them well defined; but on the 7th of October followin , only six small spots were visible, though the same telescope was used, and circumstances were equally favourable.

*Nature of the Solar Spots.*—The appearance of the solar spots is that of a dark *nucleus* surrounded by a border less deeply shaded, called a *penumbra*. They are both well represented on the map. When seen through a telescope, the sun presents the appearance of a vast globe, wrapped in an ocean of flame, with the spots, like incombustible islands, floating in the fiery abyss.

Concerning these wonderful spots a variety of opinions have prevailed, and many curious theories have been constructed. Lalande, as cited by Herschel, suggests that they are the tops of mountains on the sun's surface, laid bare by fluctuations in his luminous atmosphere; and that the penumbræ are the shoaling declivities of the mountains, where the luminous fluid is less deep. Another gentleman, of some astronomical knowledge, supposes that the tops of the solar mountains are exposed by *tides* in the sun's atmosphere, produced by planetary attraction.

To the theory of Lalande, Dr. Herschel objects that it is contradicted by the sharp termination of both the internal and external edges of the penumbræ; and advances as a more probable theory, that "they are the dark, or at least comparatively dark, solid body of the sun itself, laid bare to our view by those immense fluctuations in the luminous regions of the atmosphere, to which it appears to be subject." Prof. Olmsted supports this theory by demonstrating that the spots must be "nearly or quite in contact with the body of the sun."

In 1773, Prof. Wilson, of the University of Glasgow, ascertained by a series of observations that the spots were probably "*vast excavations* in the luminous matter of the sun;" the nuclei being their bottom, and the umbræ their shelving sides. This conclusion varies but little from that of Dr. Herschel, subsequently arrived at.*

*Magnitude of the Solar Spots.*—The *magnitude* of the solar spots is as variable as their number. Upon this point the map will give a correct idea; as it is a pretty accurate representation of the sun's disc, as seen by the writer on the 22nd of September, 1846. In 1799, Dr. Herschel observed a spot nearly 30,000 miles in breadth; and he further states, that others have been observed whose diameter was upwards of 45,000 miles. Dr. Dick observes that he has several times seen spots which were not less than $\frac{1}{25}$ of the sun's diameter, or 22,192 miles across.

*Revolution of the Sun upon his Axis.*—The axis of the sun is inclined to the ecliptic 7½°, or more accurately 7° 20′. He revolves in the same direction in which the planets revolve around him, and the time occupied in making a complete sidereal revolution is 25 days 10 hours. But when a particular spot has arrived opposite any particular star from which it is started, in the direction of which the earth was 25 days and 10 hours before, the earth is found to have advanced some 24°, or 1,700,000 miles in her orbit; and the sun must actually turn a little more than once round, to appear to make a complete revolution to a beholder on the earth. His *synodic* revolution consequently requires 27 days, 7½ hours, or near 46 hours more time than his sidereal revolution.

*Direction, Motions and Phases of the Solar Spots.*—As the result of the sun's motion upon his axis, his spots always appear first on his eastern limb, and pass off or disappear on the west.

The figure of the sun affects not only the apparent *velocity* of the spots, but also their *forms*. When first seen on the east, they appear narrow and slender, as represented on the left of Fig. 1. As they advance westward, they continue to widen or enlarge till they reach the centre, where they appear largest, when they again begin to contract, and are constantly diminished till they disappear.

Another result of the revolution of the sun upon an axis inclined to the ecliptic, and the revolution of the earth around him, is, that when viewed from our moveable observatory, the earth, at different seasons of the year, the *direction* of the spots seems materially to vary. This fact is illustrated by fig. 2. In June we have, so to speak, a side view of the sun, his pole being inclined to the *left*. Of course, then as he revolves, his spots will appear to ascend in a straight line. In September we have passed around in our orbit, to a point opposite the south pole of the sun, and the spots seem to curve upward. In December we have another side view of the sun, but we are opposite the point from which we had our first view, and on the other side of the ecliptic. The result is, that the poles, of the sun are now inclined to the *right*; and the spots, in passing over his disc, incline downward. The polar inclination of the sun, as given in the figure, is greater than it actually is in nature, the present design being merely to illustrate the *principle* upon which we account for the peculiar motion of the solar spots.

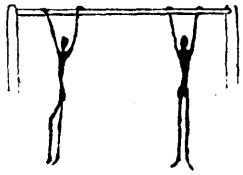
* Nichol's Solar System, pp. 122-126.

## PHYSICAL TRAINING IN SCHOOLS.

### GYMNASTIC EXERCISES.

CONTINUED.

No. III.

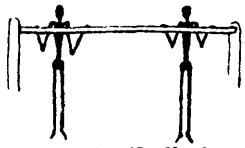


No. 2. Fig. 36. No. 1.

*Action* 63. In this action the gymnast walks on the hands along the pole; the hands being placed over the pole on the same side with the body (fig. 36. No. 1).

*Action* 64. This action is the same as the preceding; only that the hands are under, or grasping the pole on the opposite side of the body.

*Action* 65. In this the gymnast walks from one end of the pole to the other; the hands being placed over the pole on each side, face opposite the upright post; first forwards to one end, then backwards to the other (Fig. 36, No. 2).



No. 2. Fig. 37. No. 1.

*Action* 66. This action consists in rising up and looking over the pole, hands over, three times (fig. 37, No. 1).

*Action* 67. The same as the preceding, only with the hands under (fig. 37, No. 2).

*Action* 68. The hands are to be placed on each side of the pole, and then the shoulders are to be brought alternately up to the pole; each shoulder three times.