

force of the criticism is admitted by some of the professors. It is possible that the addition of a third year to the course of study may enable the authorities to relieve in some measure the congestion of the curriculum.—*Special Reports, Education Department, London.*

To be continued.

## THE UNSOLVED PROBLEMS OF ASTRONOMY.

BY PROFESSOR SIMON NEWCOMB.

Our readers already know what the solar system is: an immense central body, the sun, with a number of planets revolving round it at various distances. On one of these planets we dwell. Vast indeed are the distances of the planets when measured by our terrestrial standards. A cannon-ball fired from the earth to celebrate the signing of the Declaration of Independence, and continuing its course ever since with a velocity of 1,800 feet per second, would not yet be half-way to the orbit of Neptune, the outer planet. And yet the thousands of stars which stud the heavens are at distances so much greater than that of Neptune that our solar system is like a little colony, separated from the rest of the universe by an ocean of void space almost immeasurable in extent. The orbit of the earth round the sun is of such size that a railway train running sixty miles an hour, with never a stop, would take about 350 years to cross it. Represent this orbit by a lady's finger-ring. Then the nearest fixed star will be about a mile and a half away; the next more than two miles; a few more from three to twenty miles; the great body at scores or hundreds of miles. Imagine the stars thus scattered from the Atlantic to the Mississippi, and keep this little finger-ring in mind as the orbit of the earth.

One of the most beautiful stars in the heavens, and one that can be seen most of the year, is a *Lyrae*, or Alpha of the Lyre, known also as Vega. In a spring evening it may be seen in the northeast, in the later summer near the zenith, in the autumn in the northwest. On the scale we have laid down with the earth's orbit as a finger-ring, its distance would be some eight or ten miles. The small stars around it in the same constellation are probably ten, twenty, or fifty times as far.

Now, the greatest fact which modern science has brought to light is that our whole solar system, including the sun, with all its planets, is on a journey toward the constellation *Lyra*. During our whole lives, in all probability during the whole of human history, we have been flying unceasingly toward this beautiful constellation with a speed to which no motion on earth can compare. The speed has recently been determined with a fair degree of certainty, though not with entire exactness; it is about ten miles a second, and therefore not far from three hundred millions of miles a year. But whatever it may be, it is unceasing and unchanging; for us mortals eternal. We are nearer the constellation now than we were ten years ago by thousands of millions of miles, and every future generation of our race will be nearer than its predecessor by thousands of millions of miles.

When, where, and how, if ever, did this journey begin; when, where, and how, if ever, will it end? This is the greatest of the unsolved problems of astronomy. An astronomer who should watch the heavens for ten thousand years might gather some faint suggestion of an answer, or he might not. All we can do is to seek for some hints by study and comparison with other stars.