the earth's mass, the polar regions shifting from west to east relatively to the equator.

Numerical calculation shows that the rate of distortion must have been so slow in latter times, that no perceptible effect can have thus arisen within geological history. It is, however, just possible that the N. and S. trend of the great continents may be connected with this cause, for the continents may be the great wrinkles left by former twisting.

In a second part of the paper the amount and distribution of the heat generated within the earth by friction is investigated. It appears that in the course of the prolongation of the day from $5\frac{1}{2}$ hours to 24 hours, enough heat must have been generated within the earth to heat the whole mass 3000° Fahr., supposing it to have the specific heat of iron and the heat to be all applied at once. It would seem at first sight that we have here an explanation of the observed increase of the temperature of the earth as we go downwards; but a more careful examination of the question shows that only a very small fraction of that increase can possibly be referred to this cause.

The dynamical investigation, of which a slight sketch has now been given, yields results which obviously point to a great modification of the nebular hypothesis of Laplace and Kant. It would as yet be premature to examine the solar system to see how far this tidal theory of evolution can explain the configuration of planets and their satellites; for it remains to investigate the secular changes of the inclinations and eccentricities of the orbits of satellites due to tidal reaction. I hope in a few months' time to have completed at least a partial investigation of these points; and the results already attained appear of considerable interest.

The proof or disproof of the theory will turn on numerical results, and to obtain those results in the cases of other planets will entail much work. At present I will only remark that the anomalous satellite of Mars, which revolves faster than its primary rotates, appears to present a case strongly confirmatory of these views; for it seems probable that its extreme minuteness has preserved it as a standing memorial of the primitive time of rotation of Mars round his axis. On the other hand, the system of Uranus is very perplexing; and so little is really known about that planet and his satellites, that it will be difficult to put the theory to the test. G. H. Darwin.

Occultation of Antares.

The rarity of occultations of bright stars at any given place is well illustrated by the case of α Scorpii, this star having been covered by the Moon, as seen from some point on the Earth's surface, at every lunation for the past four or five years; whereas only once, viz. on the evening of July 28 next, between $9^h\ 37^m$ and $10^h\ 7^m$, is the

phenomenon observable from our own country. On this occasion the emersion appears to take place about 1½ hour before the Moon sets. Occultations of Antares are of course rare in these northern latitudes, owing to the star's considerable southern declination. One is recorded in the 'Historia Celestis' of Tycho Brahe; this was on the evening of August 30, 1595, and the observer appears to have been Mœstlin; we are told that on this occasion "Cor ♏ prope cornu ☾ australe occultatum. Hor. 9 noctis, paulo antequam horizontem subirent." One occurred on August 27, 1800, and another on March 21, 1805. Nothing of much interest seems to have been noticed on these occasions; but on April 13, 1819, Prof. Burg, of Vienna, had the impression that the star had a curious appearance on the Moon's disk at emersion. He states, "At $23^h\ 3^m\ 17^s$ I observed the emersion of a star 6·7 mag., which, about 5^s after, suddenly appeared to me like a star of the first magnitude; and it is from this transition that I have dated the time of emersion. Perhaps Antares is a double star, and the first observed small one is so near the principal star that both, viewed even through a good telescope, do not appear separated." But no star of the brightest class was then known to have a minute close companion. Bode, therefore, remarks on the above, "Antares is no double star;" and he enters into an explanation about the vapours of the Moon's atmosphere to account for it, that "the star first appeared through the vapours of the Moon's atmosphere, at her dark limb, along which, however rare it may be, this atmosphere must have occupied a long track in the direction of the rays that entered the observer's eye from Antares, which, when clear thereof, suddenly appeared in its full splendour:" and he goes on to remark, "Had that limb of the Moon, behind which Antares emerged, been enlightened, the Moon's atmosphere would also have been enlightened and have become visible to us, appearing a continuation of the Moon's limb, but sufficiently transparent for us to have seen the star through it; so that after observing its emersion, we should still have seen it within what we considered to be the Moon's disk."

In the year 1856 there were three occultations of Antares visible at Greenwich; but the last of the three happening in daylight was of no great interest. At the beginning of the year the Astronomer Royal called attention to these, because, "in the accounts of observed occultations of Antares by the Moon, it had been remarked that the light of the star did not disappear or reappear entirely at one instant, but at two instants." There was no need now to resort to any ingenious explanations about the vapours of the Moon's atmosphere, as the small companion star had been detected by Grant in India in 1844, and confirmed by Mitchell at Cincinnati in 1846. The occultation of March 26, 1856, was watched by several observers through haze. In the 'Monthly Notices' for April 11 of that year will be found some of their recorded impressions. Dawes says, "The small companion appeared instantaneously at its full bright-

ness; but from its diffused condition it was not possible to form any correct judgment of its magnitude, which, however, could scarcely exceed the 7th. Its bluish-green colour was very conspicuous. When I had counted about 18 beats of my pocket-chronometer, equal to $7^{s}\cdot2$, Antares itself suddenly blazed forth, and completely enveloped its companion in its enormously diffused image. Vision was even worse than at the disappearance; and I could not afterwards obtain a glimpse of the companion, though the strong twilight favoured its visibility." Mr. Whitbread "saw a small speck emerge from behind the dark limb, which I should describe as like a star of the twelfth magnitude, and in seven seconds Antares burst forth in full splendour." Captain Shadwell at Portsmouth says, Antares at emersion on March 26 appeared to "hang on the Moon's limb about two seconds." But on June 13 he says the disappearance was instantaneous. On this occasion there was the disadvantage of the Moon being at the full. It was considered about this time that accurate observations of the companion star could hardly be got in this country; but on July 20 and 30, 1856, Mr. Hippisley at Ston Easton, Bath, seems to have observed it fairly. A rough diagram of the position of the larger and smaller stars will be found in the 'Monthly Notices' for November of that year. Since 1856 no occultation of Antares has taken place that has been visible from this country. At the two earlier occultations of that year, the Moon's altitude was about 13°; at the coming one, on July 28 of the present year, her elevation above the horizon is less than that; consequently there will be more difficulty in detecting the small blue companion, the real point of interest in occultations of α Scorpii. S. J. Johnson.

Upton Helions Rectory, Crediton,
1879, May 17.

[The *comes* is of 7 mag., pos.-angle 276°, dist. $3''\cdot7$, and will reappear 6^{s} or 7^{s} before Antares (*cf.* 'Observatory,' No. 26, p. 63). Ed.]

Double Stars for July.

The most important pairs between 13^{h} and 16^{h} are as follows:—

Σ 1728=42 Comæ Ber. R.A. $13^{h}\ 4^{m}\cdot1$, Dec. +18° 10′.

Mag. 6, 6. Colours, yellow.

Binary. Common proper motion $-0''\cdot433$ in R.A. and $-0''\cdot18$ in N.P.D. (OΣ). Period about 25 years.

1876·41	195°·2	$0''\cdot42$	Washington Obs.

Σ 1777. R.A. $13^{h}\ 37^{m}$, Dec. +4° 9′.

Mag. 5·8, 8·2. Colours, A yellow, B blue.