irregular way, with a tendency very often toward the tangential direction at the lower parts of the rifts. The photographs extend about a diameter and a half from the sun's limb, and a comet appears on the plates about a solar diameter and a half from the sun's centre. It must have been very bright, as it appears clearly in the photographs. Measurements seem to indicate a small shift in its position during the interval between the first photograph and the last.

Turning now to the photographs taken with the camera and prism in front, — an instrument which gives an image of the prominences as oft repeated as there are rays in the prominence, — the plates employed were sensible to the infra-red as well as violet rays. One prominence gave a great number of lines in the ultra-violet. The fact was brought out in this eclipse, that the brightest lines in the prominences are due, not to hydrogen, but to calcium. Besides these and the hydrogen lines, there is the line D_3 in the yellow, and the C line of hydrogen in the red, and also a photograph of two prominence-lines in the ultra-red. In addition to the prominences, there are visible in the photographs certain short rings round the moon, which mean that at these places the light sent out by the gaseous part surrounding the moon is not confined to the prominences. It is, as would be expected, the green coronal line which chiefly corresponds to one of those rings. This green line, K 1474, is a true coronal line, and is only very faintly traceable in one of the prominences.

In considering the results obtained with the complete spectroscope, it is a striking fact that some of the lines cross the moon's disk, and especially the two lines H and K. This proves that the calcium-lines, H and K, were so strong in the prominences that the light was scattered in our atmosphere, and reflected right in front of the moon.

The prominence-lines are very numerous: thirty such lines appear in the photograph. The hydrogen-lines are there, including those in the ultra-violet photographed by Dr. Huggins; also H and K, and other calcium-lines; and still others, chiefly unknown.

Close to the sun's limb we can only trace a continuous spectrum, a very strong one, going up to about a quarter of a solar diameter. The photographs bear out the distinction between the inner and the outer corona, the former being much stronger in light. The boundary at which this continuous spectrum ends corresponds to the extension of the inner corona. The continuous spectrum is stronger on the side where the prominences are weaker. In the corona we first of all see a very faint continuous spectrum, and in that continuous spectrum one can trace at G the reversal of the dark Fraunhofer lines. In addition, a series of faint true coronal lines can be traced in the outer regions of the corona. We have not traced any known substances in the solar corona. The greater number of the prominence-lines in the ultra-violet are also unknown, but they seem to be present in Dr. Huggins's photograph of the spectrum of α Aquilae.

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The relative ages of planets, comets, and meteors.

The theory that the sun was once a gaseous mass extending beyond the most distant planet, and that it has contracted to its present dimensions by the continuous action of gravity, and is still so contracting, is now very generally accepted by astronomers. It is well known, moreover, that the condensation of a gaseous body produces heat, and that the impact of solar matter in consequence of its motion towards the centre of gravity is one cause, at least, — perhaps the principal one, — of the sun's high temperature. The modern law of the conservation of energy affords data for determining the amount of heat produced by the condensation of the sun's mass from one volume to another. It is thus found that the contraction to its present dimensions, from a primitive volume extending indefinitely beyond the orbit of Neptune, would have kept up a uniform supply of heat equal to the present for twenty millions of years.[1] The age of the solar system, however, may be greater or less than this, as the sun's radiation may not have been constant.

In any form of the nebular hypothesis, Neptune is the oldest planet known, and the innermost of the number has had the most recent origin.

A majority of comets probably move in hyperbolas, and visit the solar system but once. Some orbits have been changed into ellipses by planetary perturbation.

For any thing we can know to the contrary, cometary matter has been falling towards the centre of our system in all ages of its existence. Whenever the perihelion distance has been less than the radius of the solar spheroid, the comet's orbital motion must have been arrested, and transformed into heat.

As the limits of geological dates are determined by the strata of the earth's crust, so the superior limits of the age of periodic comets are fixed by the planetary orbits next exterior to their perihelia. Of the comets known to be periodic, the perihelion distances of thirteen are less than the earth's distance from the sun. The ages of all these must therefore be less than that of the earth. In like manner the ages of others are shown to be less than that of Venus, while those of a few are found to be less than the age of Mercury. We may conclude, then, in general, that the ages of comets, as members of the solar system, are less than those of planets.

But as meteoroids, partly at least, are derived from comets, their origin as separate bodies in connection with our system must be still more recent: in fact, meteoric matter is being constantly detached from comets at each successive return to perihelion. The indications of this process were unmistakable in the case of the great comet of 1882, and many meteoroids of the Biela group have been separated from the comet in our own day. Daniel Kirkwood.

Bloomington, Ind.

First use of wire in sounding.

Professor Verrill is quite right in supposing that I was unaware that any report of the sounding expedition of Walsh had been published. A casual reference to Walsh in the 'Depths of the sea' led me to inquire,

[1] A contraction of the radius equal to a hundred and twenty-nine feet per annum would yield the present supply of heat. See Monthly notices of the R. A. S., April, 1872.