was known to come from sonorous bodies, and light was known to come from luminous bodies. This was a relation—but a relation of the vaguest and most general kind. As compared with this vague relation the new relation under which we know them is knowledge of a more definite and of a higher kind. Light and Sound we now know to be words or ideas representing not merely any one thing or any two things, but especially a relation of adjustment between a number of things. In this adjustment Light and Sound, as known to sense do "in themselves" consist. Sound becomes known to us as the attunement between certain aerial pulsations and the auditory apparatus. Light becomes known to us as a similar or analogous attunement between the ethereal pulsations and the optic apparatus. Sound in this sense is not the aerial waves "in themselves," but in their relation to the ear. Light is not the ethereal undulations "in themselves," but in their relation to the eye.

It is only when these come into contact with a pre-arranged machinery that they become what we know and speak of as Light and Sound. This conception, therefore, is found to represent and express a pure relation; and it is a conception higher than the one we had before, not because it is either less or more relative, but because its relativity is to a higher faculty of the intellect or the understanding.

And, indeed, when we come to think of it, we see that all kinds of knowledge must take their place and rank according to this order of precedence. For, as all knowledge consists in the establishment of relations between external facts and the various faculties of the mind, the highest knowledge must always be that in which such relations are established with those intellectual powers which are of the highest kind. Hence we have a strictly scientific basis of classification for arranging the three great subjects of all human inquiry—the What, the How, and the Whence or Why. These are steps in an ascending series. What things are, how they come to be, and for what purpose they are intended in the whole system of Nature—these are the questions, each rising above the other, which correspond to the order and the rank of our own faculties in the value and importance of their work.

It is the result of this analysis to establish that, even if it were true that there could be anything in the Universe existing out of relation with other things around it, or if it were conceivable that there could be any knowledge of things as they so exist, it would be no higher knowledge, but infinitely lower knowledge than that which we actually possess. It could at the best be only knowledge of the "What," and that, too, in the lowest conceivable form—knowledge of the barest, driest, nakedest existence, without value or significance of any kind. And further, it results from the same analysis that the relativity of human knowledge, instead of casting any doubt upon its authenticity, is the very characteristic which guarantees its reality and its truth. It results further, that the depth and completeness of that knowledge depends on the degree in which it brings the facts of Nature into relation with the highest faculties of Mind.

It must be so if Man is part of the great system of things in which he lives. It must be so, especially if in being part of it, he is also the highest visible part of it—the product of its "laws" (as regards his own little corner of the Universe) the consummation of its history.

Nor can there be any doubt as to what are the supreme faculties of the human mind. The power of initiating changes in the order of Nature, and of shaping them from the highest motives to the noblest ends—this, in general terms, may be said to include or to involve them all. They are based upon the ultimate and irresolvable power of Will, with such freedom as belongs to it; upon the faculty of understanding the use of means to ends, and upon the Moral Sense which recognizes the law of righteousness and the ultimate Authority on which it rests. If the Universe or any part of it is ever to be really understood by us—if anything in the nature of an explanation is ever to be reached concerning the system of things in which we live, these are the perceptive powers to which the information must be given—these are the faculties to which the explanation must be addressed. When we desire to know the nature of things "in themselves," we desire to know the highest of their relations which are conceivable to us: we desire, in the words of Bishop Butler, to know "the Author, the cause and the end of them."

ASTRONOMY.

ELEMENTS OF SWIFT'S COMET.

COMPUTED BY PROFESSOR E. FRISBY, U. S. NAVAL OBSERVATORY, WASHINGTON.

[Communicated by Rear Admiral John Rodgers, U. S. Navy, Superintendent.]

To the Editor of SCIENCE:

The following elements of Swift's comet have been computed by Professor Frisby from three observations made with the Transit Circle at Washington by Professor Eastman on the nights of October 25th, November 7th and 20th, with these results. No assumptions about any periodic time have been made.

Epoch—Perihelion passage.
November 7.77568d, Wash. M. T.

$$\left.\begin{aligned} \Omega &= 296^\circ\ 48'\ 19''.9 \\ \pi &= 42\ 59\ 15\ .8 \\ \phi &= 42\ 26\ 48\ .5 \\ i &= 5\ 30\ 35\ .9 \\ \log a &= 0\ .517002 \\ \log \mu &= 2''.774504 \end{aligned}\right\} \text{Mean equinox 1880.0}$$

The comet approached very near to the Earth on November 20th, its distance being less than $\frac{1}{4}$th of the Sun's distance. We have for the dates given:

	log r	log Δ
October 25	0.035328	9.221510
November 7	0.029018	9.141693
" 20	0.034558	9.119295

Its perihelion distance thus appears to be a little greater than the distance of the Earth; and its aphelion lies just beyond Jupiter's orbit. The periodic time from these observations being about 2178d., or a little less than 6 years, there can be no doubt that the preiodic time of about 5½ years is the correct one.

U. S. NAVAL OBSERVATORY, WASHINGTON, D. C.,
January 6, 1881.

THE SOLAR ECLIPSE.—The last contact of the partial solar eclipse on the morning of December 31, 1880, was seen at Harvard College Observatory under quite favorable circumstances. The mean of six observations by as many different observers gives:

Last contact, December 30, 21h. 13m. 3s. Cambridge Mean Time.

At the United States Naval Observatory the last contact was observed by Prof. Hall, with a comet seeker of 4in. aperture and magnifying power of 19 diameters, as follows:

Last contact, December 30, 20h. 32m. 36s. Washington Mean Time. Owing to the extremely low temperature (11 degrees below zero, Fahr.) at Washington, the images were very poor and the observation somewhat uncertain. W. C. W.

NEW YORK MICROSCOPICAL SOCIETY.

The annual meeting for the selection of officers for the year 1881, took place on the 31st ultimo, when the following officers were elected: President, Romyn Hitchcock; Vice-President, E. C. Bogart; Recording Secretary, W. H. Mead; Corresponding Secretary, Benjamin Braman; Treasurer, W. C. Hubbard; Curator, Dr. Deems.

This Society will shortly give a public *conversazione*, when a variety of interesting objects will be exhibited, and an opportunity afforded to Microscopists to examine many new forms of Microscope stands which have been recently produced. Those who desire to assist or be present on this occasion should address Professor Romyn Hitchcock, 53 Maiden Lane, N. Y.