and mode of occurrence, and also in their calcareo-siliceous varieties, to those of Barbados."

This previous publication clearly entitles Mr. Gregory to the original announcement of the radiolarian earths in Cuba, and had I known of its existence he should have received credit therefor in my papers, and my work has only resulted in the approximate determination of their age and mode of occurrence. The nature of Mr. Gregory's discovery is more fully explained, however, in a recent paper* in which he clearly sets forth the fact that he found these rocks, not in Cuba, but in Boston, in the collection made by Prof. W. C. Crosby in the Museum of Natural History, and refers to my preliminary paper for the facts concerning their occurrence and age. In this paper he also presents an interesting paleontologic study of this material showing the presence of 17 families, 25 genera and 33 species.

These are the facts concerning the knowledge of the radiolarian beds of Cuba: The material was first collected by Professor Crosby; their radiolarian nature determined from Professor Crosby's collections in Boston by Mr. Gregory; their geological occurrence and age described by the writer from studies on the ground, and their specific paleontology determined by Mr. Gregory.

On page 311 of Vol. 51 of the Quarterly Journal of the Geological Society of London, dated August, 1895, as a portion of the discussion following the delivery of Mr. J. W. Gregory's article on the Paleontology and Physical Geology of the West Indies, Mr. A. J. Jukes-Browne is quoted as follows:

"In view of these facts, we are quite prepared to accept Mr. Gregory's conclusion that the Oceanic Series is of Miocene age, the more so as Mr. Spencer has come to the same conclusion with respect to the Radiolarian Earths of Cuba, after a personal study of the geology of that island."

Inasmuch as Mr. Spencer makes no claim of having ever visited eastern Cuba, and has only seen the material from Baracoa which the writer collected, the above paragraph is liable to convey an erroneous impression concerning the discovery of the age and existence of these important beds.

ROBT. T. HILL.

WASHINGTON, D. C., October 16, 1895.

* Paleontology and Physical Geology of the West Indies. Quarterly Journal of the Geological Society of London, August, 1893, pp. 293–95.

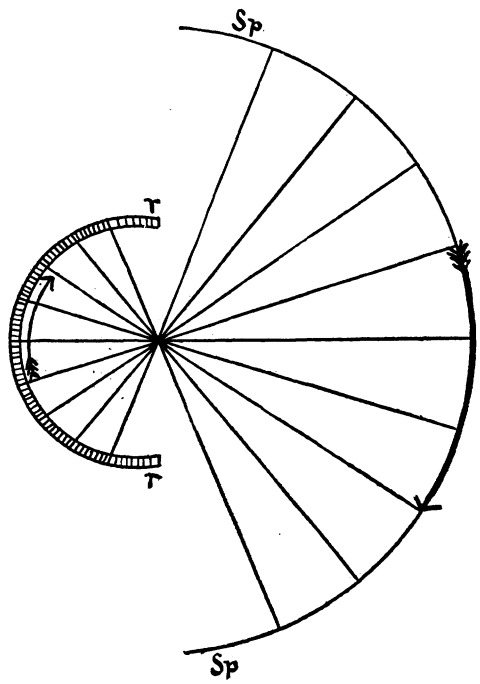
ERECT VISION AND SINGLE VISION.

PROF. CATTELL'S criticism of Prof. Brooks (SCIENCE for October 11, p. 487) in the matter of the inverted retinal image is undoubtedly just, but his reply has not made things any clearer. There is nothing specially inconceivable nor specially inexplicable about erect vision with inverted retinal image. It can be explained, too, without 'standing the soul on its head.' This may be a metaphysical but surely not a scientific explanation. In science what we mean by an explanation is a reducing of the phenomena in question to a law, which includes many other phenomena and especially the most common and familiar phenomena. Now, the seeing things in their natural or real position by means of inverted retinal images is a necessary result of the *law of direction*, and this law is the most familiar fact of common sensation. Let me explain:

Suppose I was standing on the plains of Arizona, captive, bound and blindfolded, surrounded by Apaches and a target for their arrows. I think I could tell with reasonable certainty the general direction of the Apache who shot any particular arrow. I would know it by the part struck and especially by the direction of the push of the arrow. I would refer the cause back along the line of the push to the proper place. There is nothing especially inconceivable in this. Now, suppose I look at the horizon. A star (I take this because it is a point) sends its ray into my eye through the optic center or nodal point, and it strikes a certain rod or cone on the lower half of the retinal concave. Is it anything specially strange that the impression—the punch—should be referred back along the line of the punch (ray line) to its proper place in space and, therefore, that I should see the star *above* the horizon? Now, objects are made up entirely of such stars—*i. e.*, radiant points—each sending its ray straight to the retinal concave, all crossing one another at the nodal point and therefore making an inverted image. But *each focal impression* (focal point) *of the image is referred back along its own*

ray line to its own place; and thus the external image is *reinverted in the act of external reference,* and reconstructed in space in its true position as the sign and facsimile of the object that made it.

These facts will perhaps be made still clearer by the following diagram in which *r*, *r*, and *sp*, *sp*, represent the retinal and spatial concaves.



Every point, every rod and cone of the retina, *has its fixed correspondents in space,* and these correspondents *exchange* with one another by impression and external reference. The arrow and its retinal image are introduced to render the subject, if possible, still clearer. Although, indeed, I thought I had already made it sufficiently clear in my little book 'Sight,' pp. 83–89.

It is seen, then, that there are two fundamental laws underlying monocular vision: First, the law of external projection of retinal impressions into space. Second, the law of direction, *i. e.*, the mathematically definite direction of this projection. These two laws explain every phenomenon of monocular vision except *color perception.*

So again the apparent anomaly in Binocular vision of single vision with two retinal images is, it seems to me, easily explained so far as sense perception is explicable by science at all. Those who observe closely their visual phenomena know perfectly that except under well known conditions we *do* see *two objects* or *rather two external images* of every object, and we know perfectly well which corresponds to, or is produced by, each retinal image. We *see objects single only when these two external images of the same objects are placed one on the other and made to coincide.* This takes place when the two retinal images of the same object fall on what are called corresponding points of the two retinæ; because then, *by the law of direction* already explained, *they are thrown to the same place in space* and their external corresponding images coincide. Anyone accustomed to binocular experiments can at will separate these images and then bring them closer and closer, observing them the while, until they coalesce and the object is seen single. Is not this a sufficient explanation?

Joseph Le Conte.
Berkeley, Cal., October 17, 1895.

SCIENTIFIC LITERATURE.

A Text-book of Mechanics and Hydrostatics. By Herbert Hancock, M. A., F. R. A. S., F. R. Met. Soc. New York, D. Van Nostrand Co. 1894. Pp. viii+409.

It goes without saying that the task of preparing a good elementary book on mechanics is now far easier than at any previous epoch in the history of the science. The clarification in fundamental ideas and the fixation of terminology which have come about during the past thirty years would seem to make it difficult for an author to depart very widely from sound definitions and logical development. It is somewhat surprising, therefore, to find a book whose author acknowledges his indebtedness to Maxwell, Thomson and Tait, and Clifford, marred by the very confusion of ideas which those eminent teachers have done so much to banish from mechanics.

Our suspicion of the author's fitness for his work is raised in the first paragraph of his preface, wherein he gravely affirms that "past experience leads me to conclude that no complete knowledge of mechanics can be got without some knowledge (however elementary) of