long chapter of economic history. I think the statement on this point in the body of my article is essentially true. Nor can I agree with my critic that we do not need to stimulate the tendency in this country in favor of state interference. I think that we are prevented to-day from undertaking certain great reforms by the general feeling in the community at large that individual instead of state effort should be relied upon in all cases to secure economic advance. To present the conclusion of the matter in a word, it is perfectly possible, of course, for the state to interfere in such a way as to discourage and destroy industry. All of us agree to that. It is, on the other hand, we claim, perfectly possible for the state to interfere in such a way as to promote and create industry—nay, more: it must be continually interfering to do this, otherwise progress would stop and retrogression set in. Such action is economic in character, and the systematic investigation and discussion of it find their proper place in the science of economics.

E. J. JAMES.

CLIMATE AND COSMOLOGY.

No one should take up Mr. Croll's essays for light reading; not because his writing is not sufficiently clear and concise, but because the interaction of the many direct and indirect causes concerned in his physical theory of terrestrial climate requires so involved a conception that the reader must go slowly to possess himself of it fully. This is shown by Mr. Croll's frequent and just complaint that his critics fail to apprehend his points.

The essence of his argument is, that, during a time of great eccentricity of the earth's orbit, the hemisphere, having its winter in aphelion, will be subjected to glacial conditions as a result of the various physical processes then brought into play. Prominent among these is the diversion of the warm equatorial ocean-currents into the non-glaciated hemisphere by means of the increased velocity of the trade-winds in the glaciated hemisphere, and their extension well across the equator, on account of the then great difference between polar and equatorial temperatures on which they depend. For example: if our hemisphere be the cold one, it is supposed that the north-east trade would gain in strength, and extend south of the equator, so far as to carry all the equatorial currents into the southern hemisphere. "The warm water being thus wholly withdrawn from the northern hemisphere, its temperature sinks enormously, and snow begins to accumulate in temperate regions."

Discussions on climate and cosmology. By A. CROLL. New York, *Appleton*, 1886. 12°.

If this fundamental point be conceded, we may as well grant all that follows it; but it cannot be conceded for a moment. Our north-east trade will doubtless be strengthened, in winter at least; but so will the prevailing westerly winds of our temperate latitudes. Moreover, the heat equator, along which the trade-winds meet, will not migrate far south from the geographic equator, on a planet with as short a year, as moderately inclined an axis, and as large an equatorial water-surface, as ours — especially when the southern summer is moderated by coming in aphelion, and again, especially in the Atlantic, as long as the coast-line of Africa allows so much cool South Atlantic water to reach the central torrid zone, and as long as Cape San Roque stands in the way and turns so much of the equatorial current northward.

No sufficient reason, therefore, appears for granting the north-east trade strength and area enough at such a time to keep warm water out of the North Atlantic, summer and winter; and in this ocean, at least, the general eddy-circulation would be continued much in its present form, all the more because whatever aid is given by gravity to the wind-made currents is then intensified. The broad drift of waters that crosses the North Atlantic from our shores to Europe would then be accelerated by the stronger winter winds; it would then, as now, divide opposite Spain; and the northern branch on which the moderate temperature of north-western Europe so largely depends would then, as now, be supplied largely with water that had been warmed while crossing the equator. As long as this source of warmth prevails, a winter's snows in far aphelion cannot overreach the succeeding summer's melting in close perihelion, without the assistance of geographic or other changes which Mr. Croll deems unessential.

In view of such objections as this, it seems to me that Mr. Croll decidedly overstates the security of his position in saying that his theory contains 'no hypothetical elements.' The quantitative estimation of his causes is certainly often hypothetical. Until more is known, not only about winds and currents, but also about the behavior of the atmosphere towards radiant energy, and the part played by dust over the land (of which Mr. Croll takes practically no account) as well as by vapor over the ocean, there must naturally be much of hypothesis in the discussion of terrestrial temperatures.

Readers of Dr. Croll's work should examine also a *critique* by Woeikof in a recent number of the *American journal of science.*

W. M. DAVIS.