but coming out with an equation of the same nature as 7. As I understand it, he proceeds as follows:

Combining (1) and (2), for any velocity,

$$dE = vdM,$$

and replacing dM from (6) and dE from (5),

$$V^2dm = vmdv + v^2dm.$$

Integrating,

$$m/m^0 = V/\sqrt{V^2 - v^2}, \qquad (8)$$

in which as before, when v is zero, m is m^0, the mass of the object at rest, and when v^2 is V^2, the mass is again equal to infinity, for the same reason as given previously. Professor Lewis interprets this equation thus: "According to equation (8), any body of finite mass increases in mass as it increases in velocity, and would possess infinite mass if it could be given the velocity of light."

Consider a body in a rarefied atmosphere and set in motion by the gas particles. It seems to me that Professor Lewis's reasoning will apply equally here, and then a body moving with the velocity of the gas particles should gain infinite mass. According to my interpretation of the equations, when the body did gain the velocity of the gas particles, an infinite number of them, an infinite mass, would have accumulated on the object.

I am inclined to think myself that these troubles of mine are due to unfortunate wording. If so, Professor Lewis ought to make the thing clearer, as it is very important, and I am sure many others have the same difficulty I have in harmonizing the article with one's experiences and reasoning powers.

CLARENCE L. SPEYERS

CAMBRIDGE, MASS.,
December 14, 1908

MARS AS THE ABODE OF LIFE[1]

ALTHOUGH it is improbable that these lines will be read by more than a small proportion of those who have seen or heard of Mr. Percival Lowell's "Mars as the Abode of Life," it seems worth while to point out to the scientific workers of the country the gross errors which this book is propagating. In this I shall confine myself to geological matters, leaving the astronomical and other questions to those who have special acquaintance with such things. It is not surprising that Mr. Lowell, an astronomer, should have only a layman's knowledge of geology; but that he should attempt to discuss critically the more difficult problems of that science, without, as his words show, any understanding of the great recent progress in geology, is astonishing and disastrous. One can not but recall the adage that "fools rush in where angels fear to tread."

Mr. Lowell is an implicit believer in the Laplacian theory of planetary evolution, a hypothesis now on the defensive, to say the least, and utterly abandoned by some of our best cosmogonists.

On an adjacent page he says that the minerals of the metamorphic rocks "show by their crystalline form that they cooled from a once molten state." The fallacy in this statement is evident to the average college student of geology or chemistry. Metamorphic rocks are produced by processes which involve more or less pressure and heat, but not melting.

Turning to consider the evolution of life on the earth, the author tells us that "the geologic record proves that life originated in the oceans. . . . Whether life might have generated on the land we do not know; on earth it certainly did not." The truth is that the geologic record proves nothing whatever about the origin or even the infancy of life. It may be fairly doubted whether it takes us back even to the middle age of the animal kingdom. Such a dogmatic assertion is, therefore, wholly unjustified. In this connection it is hard to resist pointing out that among the oldest known fossils are certain Eurypterids (Walcott's *Beltina danai*) which are generally interpreted as fresh-water rather than marine forms.

Farther on we read, of the plants which formed the Carboniferous coal beds, "Only a warm, humid foothold and lambent air could have given them such luxuriance and im-

[1] A series of lectures delivered before the Lowell Institute, Boston; later published in the *Century Magazine*, 1908; and subsequently issued as a volume by the Macmillan Company, New York, 1908.

pressed them with such speed." Neither Mr. Lowell nor any one else knows whether the vegetation in the Carboniferous swamps grew slowly or rapidly. We know only that they produced a certain body of coal. That may have taken a short time at a rapid rate, or a long time at the slow rate; the results would be the same. As to the warmth, it may be remarked that coal seams are now in process of growth in Alaska and Labrador and that many of the Carboniferous plants show by their structures an adaptation to severe rather than genial climatic conditions. Only a little later than the Carboniferous period most of the lands adjacent to the Indian Ocean experienced a glacial period, comparable to that of recent times in Canada; and in Australia the coal seams are interbedded with layers of glacial drift. Does this bespeak a torrid climate in middle latitudes at that time? Even the moist conditions seem to have been, as now, of local prevalence only, for aridity is indicated by the Carboniferous red beds and gypsum of Colorado and some other regions.

One of the terrestrial conditions which Mr. Lowell finds it necessary to postulate in order to bolster up his theory of Martian evolution is a perpetual cloud envelope around the earth down to about Mesozoic times—"a shady half-light" which he says is attested "by the habit of the ferns of to-day." That tree-ferns now stand out isolated on the brushy hills of equatorial Africa under the blazing tropical sun is evidently unknown to the author. Under the circumstances he would have found the services of a botanist advantageous.

With the hypothesis of a perpetually damp cloudy atmosphere we can hardly reconcile the existence of deserts in India in the Cambrian, in New York in the Silurian, in Michigan and New Brunswick in the Carboniferous, and in Germany in the Permian period. Yet the testimony of the rocks is emphatic that they did exist in those times and places.

Another of the author's preconceived opinions of Mars, which the history of our own planet has been twisted and squeezed to fit, is the shrinkage of the oceans and the eventual disappearance of water in any form. According to Mr. Lowell, Mars had oceans but lost them, and the earth is merely in an earlier stage of the same process. As to the earth, he says, "observation proves this to be a fact," and goes on to cite Professor Dana, who many years ago propounded the opinion that the lands had grown steadily larger from small beginnings. If Dana were alive to-day he would doubtless repudiate the idea, for it is wholly contrary to the mass of facts more recently made known. If Lowell were right, land on the continent of North America would have been smallest in the Archean and be greatest now. The truth is that there have been fluctuations of land and sea throughout recorded geologic history, and these changes show no general tendency. Just before the Cambrian period the continent was nearly all out of water; at the close of that period it was at least half submerged. At the close of the Permian it emerged more extensively than ever and yet in the Cretaceous it was again deeply inundated. Examples of the same thing could be largely multiplied, but are too well known to make that necessary.

In the face of all these facts Mr. Lowell coolly states that "wherever geologists have studied them, the strata tell the same tale," viz., the land has spread, the ocean shrunk. . . . No competent geologist would admit a word of this. Yet on this comfortable basis of fallacy Mr. Lowell then proceeds "Now, a general universal gain of the sort can mean only . . ." One is tempted to direct the author's attention to his own preface wherein he seriously admonishes that "the cogency of the conclusion hangs upon the validity of each step in the argument." The reader can judge for himself of the cogency of this particular conclusion.

Having assured his readers that the earth is drying up and that it will sooner or later "roll a parched orb through space," he cites as proof the alleged fact that deserts are increasing in size. This is the beginning of the dreadful end which "is as fatalistically sure as that to-morrow's sun will rise, unless some other catastrophe anticipate the end." Here again the proverb applies, "a little knowledge is a dangerous thing." Mr. Lowell

has seen the petrified stumps and trunks of trees in the Arizona desert and jumps to the conclusion that deserts in general have been steadily invading once forested regions, from remote ages onward. Had he inquired into the recorded facts of geologic history he would have learned that deserts have existed in many parts of the world ever since the earliest periods, wherever the topographic and atmospheric conditions were favorable. It is not probable that our present deserts are more extensive than those of the Permian period, during which the saltest of salt lakes partially covered the site of Germany.

I think enough has been said to show what kind of pseudo-science is here being foisted upon a trusting public. "Mars as the Abode of Life" is avowedly a popular exposition of a science, not a fantasy. Its author is a highly educated man of distinguished connections and some personal fame. He writes in a vivid, convincing style, with the air of authority in the premises. The average reader naturally believes him, since he can not, without special knowledge of geology and kindred sciences, discern the fallacies. He has a right to think that things asserted as established facts are true, and that things other than facts will be stated with appropriate reservation. This is precisely the same as his right to believe that the maple syrup he buys under that label is not glucose, but is genuine. The misbranding of intellectual products is just as immoral as the misbranding of the products of manufacture. Mr. Lowell can not be censured for advancing avowed theories, however fanciful they are, for it is the privilege of the scientist; nor for making unintentional mistakes in fact, for that is eminently human. But I feel sure that the majority of scientific men will feel just indignation toward one who stamps his theories as facts; says they are proven, when they have almost no supporting data; and declares that certain things are well known, which are not even admitted to consideration by those best qualified to judge. Censure can hardly be too severe upon a man who so unscrupulously deceives the educated public, merely in order to gain a certain notoriety and a brief, but undeserved, credence for his pet theories.

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UNIVERSITY OF WISCONSIN,
March 26, 1909

SCIENTIFIC BOOKS

L'Europe Préhistorique. Principes d'Archéologie Préhistorique. By SOPHUS MÜLLER. Translation from the Danish, by EMMANUEL PHILIPOT. Paris, J. Lamarre, Editeur. 1907. Pp. 212, text-figures 161, colored plates 3.

There was a time when civilization did not exist. When did it begin to be and whence came it? Sophus Müller believes it was transplanted into Europe from the Orient. The author has endeavored to confine his work to those elements in prehistoric archeology about which authorities are in accord.

Not much space is devoted to the paleolithic period. France is taken as a center and as the region that shows to best advantage the various stages of paleolithic culture. The reindeer epoch is lacking in Italy, as one might expect, although specimens of the Solutrean and Magdalenian types are found there.

The first epoch of the neolithic period in Italy was synchronous with the last epoch of the paleolithic period in France; the culture of middle Europe being only the periphery of a civilization more advanced in the south.

According to Müller there was in central Europe only one great period of cold after the warm climate of the Chellean epoch when man appeared for the first time. The temperature dropped during the Solutrean and became very cold in the Magdalenian, to grow milder again until the present time. He also believes the paleolithic period to be much shorter than the time ascribed to it by many geologists, notably Penck.

A chapter is devoted to the changes that came with the appearance of the neolithic period in central and northern Europe, especially the differences in the fauna and the similarities among the artifacts. The importance of Piette's discoveries of a transitional industry in the cavern of Mas d'Azil