so often been the single purpose of so-called exploration; nor is it carried out by sinking shafts in the centre of a mound, or cutting a ditch or two through it: but every foot of earth is removed, and the whole structure laid bare foot by foot. This mode of work has led to the discovery of singular and remarkable structures, not only in the mound and at the natural level of the surrounding land, but for six feet beneath this, to the underlying gravel-deposit. These operations have brought so many novel facts to light, that we have now the right to class all former mound-explorations in the Ohio valley as so superficial as to be scientifically worthless, until further thorough work on groups not yet destroyed shall give the means of comparison, and place the partial results that were formerly obtained in their proper relations.

The recent explorations have shown conclusively that the mounds and earthworks in various parts of the country were made at greatly different periods of time, and presumably by different peoples, even should it be ascertained that they all belonged to the great Mongoloid stock, of which our Indians probably represent more than one subdivision. This, however, is not yet proved; and the conclusions that have been drawn from time to time, that there has only been one people on this continent who made the earthworks of various kinds, are too hasty deductions from the present imperfect knowledge of our archeology. That some Indian tribes made mounds and earthworks and fortifications is not to be questioned, and that others did not is probably equally true; but this does not give us the right to throw overboard other facts tending to show that peoples of various stages of development, and, so far as craniological and artistic conclusions can be at present drawn, of distinct ethnical stocks, were also former inhabitants of this continent. One man will class all the past and present native inhabitants of all America, both north and south, as Indians; the next, with equal assurance, will state that the ancient Mexicans, the builders of the stone structures in Yucatan, the old Peruvian and other South-American nations, etc., were races distinct from the North-American Indians; and there have been many variations from these theories.

The fact is, we do not know who the Indians are, or who were the old builders of Palenque, of Uxmal, of Tiahuanuco, and numerous other old cities from Mexico to the eastern side of the Andes in South America. Until we awake to the fact that America has an interesting past, and can arouse ourselves to the effort of making out the ancestors and descendants of all these peoples, who have left us such marked differences in their architecture, their works of art, their customs and their languages, we act the part of amateurs, when from a little knowledge of a few of these different conditions, and from superficial or very general resemblances, we draw hasty conclusions. Only the most thorough explorations, conducted by men who have broad views and careful methods of work, — men who are above being led by theories to be maintained; who will look at facts in the same manner as a geologist or a biologist looks at his facts, letting them lead him where they will, — will solve for us the great problems of American archeology. The days of collectors of curiosities and hasty writers are over. Archeology is a science, and no longer in the hands of the mercenary dealer and the equally avaricious collector of curiosities. Give the proper institutions the support they ask for, and the near future will bring valuable results.

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.*

Gyration of a vibrating pendulum.

IF a body move in any curve about any centre of curvature, the inertia of the body is manifested as a force acting in the plane of the curve, and in a direction opposite to that of the centre of curvature; and if v denote the lineal velocity of the body, and ρ its distance from the centre of curvature, the force thus manifested will be represented by $\frac{v^2}{\rho}$, and is called the centrifugal force due the motion.

If the body move in a straight line on a limited portion of the earth's surface while the earth is rotating on its polar axis, its motion may be regarded, without sensible error, as being on a tangent plane; and because any tangent plane rotates about an axis

normal to that plane, with a constant angular velocity $\omega \sin \lambda$, where ω is the angular velocity of the earth about its polar axis, and λ is the latitude of the normal axis, the path of the body, in space, will evidently be a spiral curve; and from the properties of that spiral, the centrifugal force at its origin, which is the deflecting force resulting from the earth's motion on its axis, is readily found to be $2\omega v \sin \lambda$ (see *Science*, iii. No. 57).

The same result that is here found from the properties of the spiral which the body describes in space was found by Mr. Ferrel from the equations of motion on a spherical surface (see eq. 53, Professional papers of the signal-service, No. viii., 1882, p. 30); but, by assuming that the motion of the body in space is in the circumference of a circle, he finds for the time, τ, of a revolution in that circumference, —

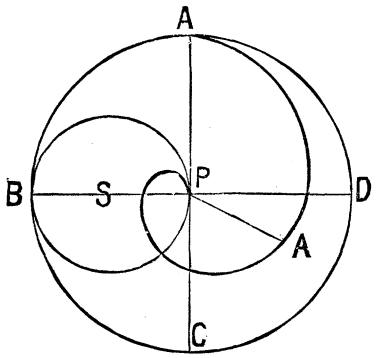
$$'\tau = \sec \theta \times \tfrac{1}{2} \text{ day};'$$

and he says, "The gradual gyration of a vibrating pendulum is caused by this same deflecting force, and hence the time of gyration is the same as that of τ in the preceding equation."

But it is well known that the time of gyration of a vibrating pendulum is $\sec \theta \times 1$ day.

This discrepancy may be explained as follows: —

Let P represent the position of the normal axis or centre of the tangent plane $ABCD$, which therefore rotates about P with the velocity $\omega \sin \lambda$, or $\omega \cos \theta$, if we adopt Mr. Ferrel's notation; and because the radius of curvature at P is the same for the spiral $PA'A$ as for the circle s, the centrifugal force at P will be the same, whether the body move in the spiral, or in the circumference of the circle s: but if we suppose the body to describe the circumference of the circle s by moving along the radius vector PA', while the radius vector rotates about P, the circumference of s will obviously be described while the



radius vector makes a half-revolution about P; that is, in the time $\tau = \sec \theta \times \tfrac{1}{2}$ day. The time τ' of gyration of a vibrating pendulum, however, does not correspond with the time τ in which the circle s would be described, but is the time in which the spiral $PA'A$ is described, and hence —

$$\tau' = \sec \theta \times 1 \text{ day},$$

as has been abundantly proved by experiment.

J. E. HENDRICKS.

Des Moines, Io., May 29.