Here the facts actually known are duly set forth, and among other things it is shown that the rats were destroyed in great numbers, while it seems doubtful whether the 'ground-birds' were actually exterminated in any instance.

T. D. A. COCKERELL.

EAST LAS VEGAS, N. M.,
May 16, 1901.

AN EARTHWORK DISCOVERED IN MICHIGAN.

MR. G. N. HAUPTMAN, of Saginaw, Michigan, in a letter dated May, 1901, reports that 'there is on section 34, T. 21, N., R. 1 E., Ogemaw county, Mich., an earthwork [of horse-shoe shape]. The trench * * * is three feet' deep, and in it stand forest trees.

If any notice of this has ever been printed I should be glad to receive references to the same. I believe no note of this earthwork has previously been made, although four earthworks in the same county are well known and are recorded in the literature of archeology.

HARLAN I. SMITH.

PHYSIOLOGY IN THE SCHOOLS.

TO THE EDITOR OF SCIENCE: The writer has a 'horrible suspicion' that T. Hough imputes the physiological questions, to which he demurs, to him. He did not propound them. The high-school questions were taken from the text-book which the pupils had used, and if the text was legitimate, the questions were.

It is the writer's conviction that public school teachers are not generally qualified to teach physiology; that physiology proper is too abstruse for the grammar grades; and that the teacher in every grade should be expected to have a better knowledge of his subject than can be obtained from the elementary text placed in the hands of his pupils. Finally he may venture to express his fear that a little elementary knowledge of the reasons for the non-increase in stature of the human skeleton throughout life might not be amiss to his learned critic even.

S. W. WILLISTON.

SHORTER ARTICLES.

WHAT IS LIFE?

SOME thoughts, started by reading an article with the above title in *Nature*, Vol. 57, p. 138, 1898, by Horace Brown, and jotted down at that time, but laid aside, I have thought might perhaps interest the readers of SCIENCE, especially as the subject continues to be agitated.*

Heretofore in cases of dormant life, as in seeds kept for years, perhaps for centuries, or in dessicated infusoria, etc., in which under favorable conditions active life is revived, it has been supposed that very slow metabolic changes still go on during the state of dormancy—life is supposed to be feeble, but not extinct. The same was supposed to be the case in seeds or bacteria exposed to intense cold of — 180° to — 200° C. by Pictet or even — 250° by Dewar.

But it is now proved that at this temperature chemical affinity is destroyed and all chemical changes arrested, and therefore the chemical changes characteristic of life—metabolism—also must cease. But with the return of heat they revive. Therefore, in this case, life seems to spring spontaneously from dead matter. Must we then revive the old doctrine of spontaneous generation? If not we must change or greatly modify our conceptions of life.

From such experiments it is evident that, although life is, indeed, a distinct *form of energy*, yet its nearest alliance is with chemism. For as chemism is completely destroyed by extreme cold and again revived by heat, so life may be completely arrested by cold and again revived by heat—*if the molecular structure characteristic of living protoplasm* (whatever that may be) *remains unchanged.*

What then is the necessary condition of life—or, to put it clearly, what is the difference between *dead* protoplasm and *living* protoplasm, or rather protoplasm *capable of life?* Evidently it is not a difference in chemical composition, for no change in this regard takes place in the act of death. It is, I suppose, a difference in *molecular arrangement*—a difference in *allotropic condition.* As the necessary condition of chemical properties is a certain equivalent composition: so the necessary condition of vital properties is, in addition, a certain molecular constitution. But as equivalent composition may

**Nature*, Vol. 61, p. 67, 1899; Vol. 63, p. 420, 1901. *Revue Scientifique*, Vol. 15, p. 201, 1901, and SCIENCE, Vol. 12, p. 774, 1900.