must all who use their material. It is impossible to go back of their record. As they (the vertebrate paleontologists), although fully aware of the fragmentary condition of the material they dealt with, gave not only generic but specific names and made certain deductions from their use, I do not quite understand why I was so sadly misled in using the names as I did, unless, as I said in my paper, vertebrate paleontology is of no use to the stratigraphic geologist. I wish to state here that I thoroughly believe in the value of the evidence of vertebrate paleontology.

While upon this subject, I wish to refer to another point, not, however, mentioned by Dr. Matthew. By some I have been criticized for not including in the lists of vertebrate fossils in my paper all that have been in any way referred to the Judith River formation, from all localities in Montana and in Canada, but it was my idea to limit the list to those found in the typical region of the Judith River formation, and on page 753 of my article on the "Stratigraphic Position and Age of the Judith River Formation" it is distinctly stated that Hatcher's list of Judith River vertebrates is used after the elimination of "all the species which are duplicated under other names" and also of all which come from beds not certainly of Judith age or that occur outside the typical area (the Judith Basin of Montana).

A. C. Peale

ICE CAVES

The contribution to *The Popular Science Monthly* for March on "The Sweden Valley Ice Mine," by Marlin O. Andrews, calls for some comment and criticism. In the first place it is calculated to convey the impression that such phenomena as he describes are exceedingly rare, whereas they are fairly common in middle latitudes—especially in limestone districts. In the second place the explanation given of such phenomena is faulty.

The writer of the above mentioned article appears to have come to his subject rather poorly equipped as regards geological knowledge, and though by his own statements supplied by the Federal Survey with information concerning the literature of the subject, to have availed himself very little of it. To begin with, his introduction detailing tradition as to presence in the region of silver mines known only to the Indians, in regard to the reliability of which he appears to have little doubt, does not serve to enhance our confidence in his ability to describe or explain geological phenomena.

Such traditions of "lost silver mines" prevail in nearly every community, but we hardly expect to find a man of science giving credence to them; especially if it is in a region where such mines are a geological impossibility. Potter County, Pa., is in such a region. It may be true that the county has never been covered by a detailed geological survey (a portion of it however has been covered by the Federal Survey and an account given of it in the Gaines Folio), but enough is known geologically of that portion of Pennsylvania to enable us to postulate the presence there of unaltered and little deformed sandstones and shales of Devonian and Carboniferous age, and to assert the entire absence from them of deposits in appreciable amounts of either lead or silver ores. Will the time never come when the diffusion of elemental geological knowledge is such as to render impossible the floating of such absurd "lost-silver-mine-known-only-to-the-Indian traditions"? Where did these Indians acquire their expert mineralogical and metallurgical knowledge that would enable them to detect silver in an ore or extract it therefrom? We know that when discovered by white men the American Indian was living in the "Stone Age" and utterly unacquainted with the extraction of metals from their ores.

When it comes to the account of the ice mine itself, the description in the article must be considered very inadequate from a geological point of view. Was the shaft sunk on undisturbed strata or on talus accumulation? If on the latter, we appear to have here a case of "talus ice accumulation," of which there are many instances. There is at least one other of these in Pennsylvania, if I remember cor-

rectly, either in Center or one of the adjoining counties.

The finding of "petrified wood" and "bones" possibly "human," in sinking the shaft, would seem to indicate talus deposits, but the "fern impressions" point to little shifted carboniferous strata.

Is the wood really "petrified," that is silicified, or does it consist of sandstone casts of same? If the latter, and in strata in place, it indicates carboniferous, and there could be no human bones associated with it. The reference to "loose shale, sharply inclined" up (?) the hill, might indicate overplacement due to creep. The nature of the strata (sandstone and shale) composing the Devonian and Carboniferous of that region would preclude the possibility of extensive underground channels or caverns, which require limestone and would consequently render very problematic the explanation proposed by Mr. Andrews for this Potter ice mine phenomenon.

If a seasonal reversal of underground air currents is to be invoked as an explanation, his diagrams introduced to illustrate this had better be inverted. Every "freezing cave" that has been represented in vertical section shows the more remote recesses of the cave lower than the mouth, and the more nearly vertical the circulation of the air is in consequence of this, the better the conditions for ice accumulation.

This may be illustrated by the conditions which prevail in a "freezing cave" near Gap Creek, Wayne Co., Ky., visited in August, 1898, by the author of this criticism. The cave is in the nature of a vertical sink, the opening of which is situated on the top of a Knob, called "mountain" in that section. The top is about 1,260 feet above sea level (220 above the drainage at the base). Descent into this cave was made by means of rough ladders. Various channels ramify from the main body of the sink, mainly downward. The "mountain" which consists of Mammoth Cave Limestone capped by a thin coping of Kaskaskia Sandstone, appears to be honeycombed with subterranean passages.

Into these passages the cold air tends to descend in winter and from them to rise in summer, due to changes in relative density conditions of the internal and external atmosphere. It appeared also to the writer (and this is the only contribution he wishes to offer to the explanation of ice caves) that the descent of the water through the underground passages during the winter, when this region has its abundant rains, would aid in the intake of cold air at the mouth of the sink somewhat after the manner of a Sprengle pump, and hence would contribute to the thorough refrigeration of the mountain or knob. This agency would operate with little force in summer, when the stage of cave waters is low.

We did not find that the inhabitants in the neighborhood of this Gap Creek ice cave attributed any of the accumulation of ice in it to the summer months, and while it is not impossible in accordance with the theory usually advocated for the explanation of such accumulation, that it might continue after freezing temperatures had disappeared on the outside, there is no indication that this condition of affairs has persisted into the summer, either in the case of this or of any other genuine "glaciere." The result of all actual investigation thus far is in support of this negative. Mr. Andrews fails to offer any first-hand observation in favor of his contention, for by his own statement his visit was made to the "ice mine" in the *spring*. His belief in *summer* accumulation still rests on hearsay evidence.

In view of the fact that such phenomena as we have been here discussing are by no means uncommon (Balch in his work, "Glacieres or Freezing Caverns," cited and quoted from by Mr. Andrews, lists some three hundred instances) it would appear that the subject is important enough to deserve treatment in our text-books on physical geography, where it would appropriately come up under the head of "caverns."

ARTHUR M. MILLER

KENTUCKY STATE UNIVERSITY,
LEXINGTON