SHORTER ARTICLES.

THE ORIGIN OF TRAVERTINE FALLS AND REEFS.

In a recently published article, Professor Davis, in speaking of certain travertine cascades and reefs, says: "We could not find any satisfactory explanation for the growth of these travertine reefs,"* and he refers to an occurrence of falls over travertine reefs in Central America as if such deposits were unusual.

In the limestone regions of East Tennessee travertine cascades are common. A creek that enters the Frenchbroad river a mile and a half above Dandridge, Jefferson county, has a series of travertine falls where the stream emerges from the hills upon the bottom lands of the river. The narrow valley of the stream is in places completely floored over with travertine. Similar deposits occur in the town of Dandridge, especially near the ferry over the Frenchbroad, where a small stream pitches over the edge of the bluff. At many of the falls the deposit has grown outward until the water pours over bellied protrusions of the travertine. It is worthy of note in that particular region that springs whose waters are equally charged with lime deposit no travertine where they flow quietly into the river.

In the vicinity of Stanford University, California, some of the streams descending from the calcareous areas of the Coast Range are heavily charged with lime and deposit travertine wherever the waters are thrown into spray. Like most mountain streams they descend by a series of terraces, or steps, represented by quiet stretches having little cascades at theirup-stream and down-stream ends. These cascades are made of rocks, frequently water-worn boulders, and in every instance the boulders at the cascades are covered with more or less travertine, while similar boulders along the quiet stretches and especially in the deeper waters are without the travertine.

The waters of Congress Springs, in Santa Clara County, California, are highly charged with carbon dioxide and carry much lime in solution. The water is now conducted through open wooden troughs to storage tanks, and wherever the troughs are so steep that the water is rippled the travertine is rapidly deposited and has to be removed from time to time in order to prevent the complete filling up of the troughs. The old stream bed along which this Congress Spring water formerly ran is covered with travertine wherever the water was rippled. At one place along this old channel there is a bank of travertine eight or ten feet high.

These phenomena are to be seen at many other places in the foothills around the sides of the Santa Clara Valley.

At Santa Cruz, California, a stream flowing out of a hilly limestone region, where it emerges from the hills, has deposited a bed of travertine that is probably fifty feet or more in thickness and covers an area of several acres.

Perhaps the most remarkable deposits of the kind are those along the western coast of Palestine and the southern coast of Asia Minor, where the streams pass over regions of limestone. They are frequently spoken of in works upon that region.*

Whether these deposits are all made in the same way or by a single process is doubtful. In the case of the highly carbonated waters of Congress Springs it seems most probable that the deposition of the lime is due chiefly to the escape of the carbon dioxide when the water is exposed to the air by rippling or spraying. In the cases of streams that run for some distances in open channels before giving up their lime it may be that the deposition is due, at least in part, to the increase of the temperature of the water and the loss of carbon dioxide. But inasmuch as the travertine is formed most abundantly at the falls, it appears that the spraying of the water is an effective agency in the escape of the gas. It is well known also that certain aquatic plants help precipitate lime from water by the absorption of carbon dioxide. An interesting case of the kind is mentioned by Clarke,† and other papers have lately been pub-

* 'An Excursion into Bosnia, Hercegovina and Dalmatia,' by W. M. Davis, Geological Society, Phila., III., 42–44.

* 'Karamania, or a Brief Description of the South Coast of Asia Minor,' etc., by Francis Beaufort, 2d ed., London, 1818.

† *Bull. New York State Mus.*, VII., 195–98.

lished by C. A. Davis * and by Blatchley and Ashley.†

My observations upon the growth of stream deposits of travertine in Tennessee and California led me to the following conclusions:

1. The deposits grow more rapidly in the summer and at low-water stages.

2. The channels become locally choked up with travertine and the streams are compelled to shift from side to side.

3. The thin horizontal beds of travertine are formed in the shallow waters immediately above the falls.

4. Although the larger streams appear to be eroding and do erode at high stages and at certain parts of their courses, the process on the whole is constructive.

5. The travertine tends to form a series of terraces along the streams depositing it.

J. C. BRANNER.

STANFORD UNIVERSITY, July 4, 1901.

PSEUDOSCOPIC VISION WITHOUT A PSEUDOSCOPE.‡

A METHOD of securing an illusion of binocular vision wholly without instrumental aid occurred to me recently, which is interesting in connection with the study of pseudoscopic vision. It is fully as startling as any of the results obtained with the lenticular pseudoscope, which I described in SCIENCE (about Nov., 1899), and, requiring the aid of no optical instrument, is very much more impressive. A lead pencil is held point up an inch or two in front of a wire window screen, with a sky background. If the eyes are converged upon the pencil point, the wire gauze becomes somewhat blurred and of course doubled. Inasmuch, however, as the gauze has a regularly recurring pattern the two images can be united, and a little effort enables one to accommodate for distinct vision of the united images of the mesh. To accommodate for a greater distance than the point upon which the eyes are converged requires practice, but the trick is very much easier in this case than in the case of viewing stereoscopic pictures without a stereoscope. As soon as accommodation is secured the mesh becomes perfectly sharp, and appears to lie nearly in the plane of the pencil point, which still appears single and fairly sharp. If now the pencil is moved away from the eyes, which are to be kept fixed on the screen, the point *passes through the mesh* and appears double, the distance between the two images increasing until the point touches the screen.

If now the pencil be removed it will be found that the sharp image of the combined images of the gauze persist, even though the eyes be moved nearer to or farther away from the screen. Move the eyes up to within six or eight inches of the plane in which the screen appears to lie and try to touch it with the finger. *It is not there.* The finger falls upon empty space, the screen being, in reality, a couple of inches further off. This is by all means the most startling illusion that I have ever seen, for we apparently see something occupying a perfectly definite position in space before our eyes, and yet if we attempt to put our finger on it, we find that there is nothing there.

It is best to begin by holding the pencil an inch or less in front of the screen. As the eyes become accustomed to the unusual accommodation the distance can be increased. The greater the distance, the greater the illusion, of course. I have succeeded in bringing up the apparent plane of the mesh five or six inches, but this requires as great a control over the eyes as is necessary in viewing stereoscopic views without an instrument.

R. W. WOOD.

* *Jour. of Geology*, Sept.–Oct., 1900, VIII., 485–503.

† 'The Lakes of Northern Indiana and their Associated Marl Deposits,' by Blatchley and Ashley, 25th Ann. Rep. State Geologist of Ind., pp. 43–51.

‡ Since writing this note I have learned that a similar illusion is described in Le Conte's 'Sight.' It may however be new to some.

THE BOTANIST'S JOURNEY TO THE DENVER MEETING OF THE A. A. A. S.

FOR the observing botanist (and what kind of a botanist is he who is not observing?) the journey to the Denver meeting of the American Association for the Advancement of Science will be of the greatest interest. Leaving the originally wooded country some distance east