

into the reservoir; the connection of the bag with the outside air will remain as before, and when the bag is full the only work external to the reservoir will be that of lifting 2.4 ounces one foot.

When a balloon rises into the atmosphere, then, the gas does not expand, and in so doing perform an enormous amount of external work; but it simply displaces the air. The amount of work in this case would be very small indeed, and the consequent cooling of the gas slight. The conditions are precisely similar to what they were when we connected the bag with our reservoir having the air under pressure. In rising, the balloon continually arrives at a region in which the pressure is less and the expanding gas simply displaces the surrounding air. Every cubic foot expansion in the gas of the balloon at sea level displaces a cubic foot of air at a pressure of thirty inches. If the pressure of the outside air were suddenly diminished to ten inches, the work done would be that of lifting a gas weighing one-third of the air at normal pressure, or about .4 ounces to each cubic foot. This would cause almost an inappreciable cooling in the gas.

A very interesting point may be mentioned in this connection. What became of the energy stored in the reservoir in the air compressed to two atmospheres, after the air had expanded to normal pressure in the reservoir and bag?

PARADOX.

February 26, 1892.

The Loup Rivers in Nebraska.

I AM gratified that my article of Jan. 29 possessed some interest for so able an authority as Professor W. M. Davis of Harvard, albeit, he is somewhat critical.

My main propositions, and I think they will stand, notwithstanding the objections of my critic, are these:—

1. The Loup rivers were probably once "separate tributaries of the Platte, all independent of each other, as roughly indicated by the dotted lines on the map" (Fig. 1, p. 59, *Science*, Jan. 29, 1892).

2. Pliocene lacustrine deposition along the Platte "crowded the mouths of these tributaries eastward and made them coalesce into a single large tributary."

3. Headwater erosion "swept the upper courses westward by a series of captures."

Instead of my first proposition, Professor Davis ascribes to me the postulate "that at the beginning of the current cycle of river history the several branches of the Loup River all pursued independent courses to the Platte." He makes definite my indefinite "once," but not in a way that I can accept. The plain inference from my second proposition is that the period of separate existence of these tributaries was in the Miocene.

Whether that is equivalent to the "postulate" of Professor Davis depends upon the definition of "cycle." The facts, as I have read them in the field, are these: In Miocene times tributaries of the Platte, now constituting the Loup system, were developed only to the stage of young rivers, not mature rivers, as Professor Davis supposes. Then came submergence and partial obstruction of their valleys; partial only, because the Pliocene marls will not average more than fifty feet in thickness, not one-fourth of the depth of the valleys. When Lake Cheyenne retired, the rivers resumed business in their former channels, except near the Platte, where the excessive deposition turned them eastward. The silt in the Platte valley has been penetrated to the depth of five hundred feet without reaching the bottom.

Here then is a cycle of river history interrupted in its infancy, and subsequently resumed. Its course was not half run when the rivers were drowned, and, even now, after their emergence and resurrection, they are still young rivers, with abundant vigor and abundant opportunities for headwater erosion and river piracy. If this series of events may be accounted a single cycle, notwithstanding the Lake Cheyenne episode, then I can adopt the "postulate" as equivalent to my first proposition.

If I understand him right, Professor Davis does not raise any objections to my second proposition. He does indeed argue against a supposed contention of mine, which is not mine at all, namely, that the coalescence of the lower courses into one Loup River was due to headwater erosion.

The effects which I did assign to headwater erosion were limited to the "upper courses," as stated in the third proposition. In spite of all objections, that proposition seems to be reasonable and valid. No region on this continent is more favorable for the study of simple, unobstructed headwater erosion than these western plains. The rivers are young. Great blocks of table lands lie yet unbroken by drainage lines, and into these fresh ravines are constantly eating back. The tertiary beds are soft and practically homogeneous, so far as resistance to erosion is concerned, so that no question need be raised about dip, strike, folds, or alternations of hard and soft strata. Upon such a terrane the Miocene rivers established themselves with a south east course consequent upon the slope to the south-east. The Rocky Mountain upheaval, together with excessive deposition along the Platte, changed the slope to the north-east, transverse to the established direction of the rivers. Cross-cutting and captures of westerly headwaters was the natural result of this change of slope.

The eastward tilt which the whole country got at the time the Rocky Mountains were elevated also affected the development of the main Loup. Without that upheaval the northern tributaries would have been dammed back by the silt along the Platte, and formed a series of swamps, instead of coalescing in a free-flowing stream.

That objection of Professor Davis, which is based upon the "systematic location" of Prairie Creek "between two parallel and larger rivers in a district of horizontal beds," is not serious. In the first place, I never dreamed of ascribing it to headwater erosion. It is obviously the result of Pliocene deposition crowding the Loup so far from the Platte that subsidiary drainage was developed on the intervening space. In the second place, this latest product, appearing upon the surface of a great mass of Pliocene silt, cuts no figure in determining the primitive course of channels lying at the bottom of that mass of silt.

Further criticisms from Professor Davis will be most welcome
L. E. HICKS.

The Aboriginal North American Tea.

IN *Science* for Jan. 23, 1892, is an abstract of Bulletin No. 14, United States Department of Agriculture, on "The Aboriginal North American Tea," *Ilex cassine*, which recalls to me that during our civil war, when the Confederate soldiers were encamped in the vicinity of the Rappahannock River, especially during the winter of 1862-3, that not only they, but also the inhabitants of that region, used freely the leaves of the American holly tree, *Ilex opaca*, in the preparation of a decoction as a substitute for China tea. This species of holly is not only abundant in that region, but grows to a large size, trees of eighteen inches in diameter and over being not uncommon in the thickets bordering the low grounds of the Rappahannock.

I do not know how they came to begin the use of this decoction, whether from a local handing down of the Indian custom of using the cassena tea, as Wood styles the *Ilex cassine*, or whether it may not have been suggested by soldiers from Alabama, who were numerous in the Confederate army, and who would be more likely to know of the use the Creeks made of the leaves of the shrub holly.

In this connection the question arises as to whether any use was made during our civil war of the leaves of the New Jersey tea, *Ceanothus Americanus*, which were used during the Revolution as a substitute for Chinese tea.

JED. HOTCHKISS.

Staunton, Va., Feb. 24.

AMONG THE PUBLISHERS.

THE laboratory course in psychology, by Dr. E. C. Sanford, which is being published in parts in the *American Journal of Psychology*, is to be issued at a later date in book-form. It is the only practical course ever published.

—Messrs. J. Wiley & Sons, publishers of scientific works, New York City, have just issued the fourth edition of Thurston's "Manual of Steam-boilers," and the fourth edition of his "Friction and Lost Work in Machinery and Millwork." These works, like all others on their list, are kept under constant revision, and