

8
INSTRUCTIONS, AND EXPLANATORY REMARKS.

WASHINGTON, September 1, 1847.

To Col. J. J. ABERT,
Chief of the Corps of Topographical Engineers:

SIR: The following order was received by me June 5th, 1846:

BUREAU OF TOPOGRAPHICAL ENGINEERS,
Washington, June 5, 1846.

SIR: You will repair, without delay, to Fort Leavenworth, and report yourself and party to Colonel Kearny, 1st dragoons, as field and topographical engineers of his command. In addition to yourself, the party will consist of—

First Lieutenant Warner, now at Washington;
Second Lieutenant Abert, do.
Second Lieutenant Peck.

Lieutenant Peck is at West Point, but he has been ordered to repair to St. Louis, and report to you at that place. Should Colonel Kearny be at St. Louis, which you will ascertain on passing through that place, you will report to him at St. Louis.

Although ordered to report as field and topographical engineers, under the regulations, you will not consider these in the light of exclusive duties, but will perform any military duty which shall be assigned to you by Colonel Kearny in accordance with your rank.

Should Colonel Kearny have moved on the prairies with his command, you will make every effort to overtake him.

Respectfully, sir, your obedient servant,

J. J. ABERT,

Colonel Topographical Engineers.

To Lieut. W. H. EMORY, *Top. Eng.*

Anticipating that the route of Colonel Kearny's command would be through unexplored regions, your suggestions required, that in all cases where it did not interfere with other and more immediate military demands of the service, the attention of myself, and the officers assigned to duty with me, should be employed in collecting data which would give the government some idea of the regions traversed.

The column commanded by Colonel Kearny, to which we were attached, styled "The Army of the West," to march from Fort Leavenworth, was destined to strike a blow at the northern provinces of Mexico, more especially New Mexico and California.

It was supposed we would barely reach Fort Leavenworth in time to join the army, and but twenty-four hours were allowed us

in Washington to collect the instruments and other conveniences for such an expedition. This was quite sufficient for all the objects appertaining directly to our military wants, but insufficient for the organization and outfit of a party intended for exploration. In submitting the following notes, they should be received as observations made at intervals snatched from other duties, and with an expedition whose movements were directed by other considerations than those which would influence the views and conveniences of an explorer.

We left Washington on the 6th of June, unable to procure a pocket chronometer, or telescope of power sufficient to observe eclipses; but through your intercession, and by the kindness of the Chief of Hydrography, U. S. N., we were provided with two excellent box chronometers, No. 783 and No. 2,075, by Parkinson and Frodsham, and we received from the bureau two of Gambey's $8\frac{1}{2}$ -inch sextants.

Crossing the Alleghanies the stage capsized with us, and placed the chronometers in great danger, but the prudence of Mr. Bestor, who carried them in a basket on his arm, saved them from destruction. Their rates were changed very materially by the accident, but subsequent observations showed no other injury had been incurred.

Elaborate observations for time and rate were made at St. Louis; from which place, being tolerably well established in geographical position, it was intended to carry the longitude by chronometer, but, on reaching Fort Leavenworth, the chronometers were again found to have changed their rates materially, owing to the peculiarly unsteady and jarring motion of the steamer upon which we ascended.

The meridian of Fort Leavenworth, as determined by Mr. Nicollet, is therefore taken as that to which all the determinations of longitude as far as Bent's fort, by the chronometer, are referred, and any change which subsequent observations may make in the longitude of Fort Leavenworth, will be common to them. The travelling rates of chronometer 783 were, as the observations will show, very uniform, and longitudes deduced from it, compared with direct measurements of lunar distances made at various points, give satisfactory comparisons as far as camp 70, October 9th, on the Rio del Norte. At this point we left the wagons, thence crossing the mountains to the Gila river, some irregularity in the rates is discoverable, until we reach camp 83, October 26th, on the Gila river.

From that point (camp 83) to San Diego, on the Pacific, the rates were very uniform. Assuming Captain Belcher's determination of that point, 7h. 48m. 44s., west from Greenwich, and carrying my longitudes back, they compare well with the longitudes derived from the direct measurements of lunar distances made at different points on the route.

The longitude between the camps of October 9th and October 26th, are derived from direct measurements, and from lunar distances.

Of the latitudes.

The latitudes were determined by measuring with one of the Gambey sextants the double altitudes of stars near the meridian, and at all important points by observations on north and south stars as nearly as they could be obtained of equal altitudes. At these

last points, where the observations are multiplied, their places may be depended upon to the nearest five seconds.

Of local time.

The local time was, in all cases, determined by altitudes of the heavenly bodies on different sides of the meridian.

The astronomical observations, in number, were computed, in the first place, by myself and Mr. Bestor, and subsequently by Professor J. C. Hubbard. The results, as given in the appendix, are the final computations of Professor Hubbard, whose well-earned reputation as a computer entitles his work to entire confidence. These observations establish the geographical position of 52 points, extending from Fort Leavenworth to the Pacific, most of which lie in regions before undetermined.

Heights above the sea.

At Fort Leavenworth, through the liberality of the medical department, I was furnished with a syphon barometer, by Bunten, No. 515, the comparison of which, with the standard at Paris, is given in the subjoined note.

Observatoire.—Comparaison du baromètre à Syphon, No. 515 de Bunten, avec le baromètre de l'observatoire.

Paris, le 1843
Le baromètre No. 515, donne des hauteurs plus grandes que celles qui sont indiquées par le baromètre de l'observatoire, la différence est de 0.45 centièmes de millimètre.

Baromètre,	{ No. 515	759.19
	{ Observatoire	758.74
		+0.45

Baromètre de.

	L'observatoire.		No. 515.	
	758.20	+0.40	758.60	12.5
12.9	758.20	+0.40	758.60	12.5
12.0	761.50	+0.50	762.00	11.8
11.3	762.14	+0.56	762.70	11.0
10.3	758.06	+0.44	758.50	10.0
8.7	753.80	+0.35	756.15	8.8
		2.25		
		+0.45		

PARIS, le 3 Fevrier, 1843.

GORYOZ.

The discussion of the data upon which the heights indicated by the barometer have been founded, would, if pursued, occupy some space; for the present, it will be sufficient to say that the basis of

comparison, as far as Santa Fé, is a series of observations made at Fort Leavenworth, with the same instrument, running through two years; and the height of the hospital at Fort Leavenworth above the sea assumed at 912 feet.

From Santa Fé, down the Del Norte, and thence west as far as camp 83, of October 26th, the basis of comparison is the series of observations, running through two months, at Santa Fe.

From the camp of October 26th, on the Gila, the basis of comparison is the mean of the observations made at San Diego, on the Pacific, near the level of the sea. The barometer was left on the Pacific, under the charge of Lieutenant Warner, topographical engineers; and the further observations made with it on that coast will afford, at some future time, data upon which to reconsider the results now given, particularly those in the last section. In the absence of corresponding observations, the object has been, to get a column of reference, progressing west, with the places observed at.

The formula used is that of Altman's. The heights deduced are marked on the map; but they should be considered, at best, but as near approximations to the truth.

The time of day at which the observations were made is not that which experience has shown to be best; but, the halts being beyond my control, I was compelled to yield to circumstances.

As far as Santa Fé, I received the assistance of Lieutenants J. W. Abert and G. W. Peck, of the corps of topographical engineers; both of whom had but too recently returned from an exploring expedition in less favored climates, and fell ill—the first at Bent's fort, and the last at Santa Fé.

From Santa Fé to the Pacific, I was aided by First Lieutenant W. H. Warner, of the topographical engineers, and Mr. Norman Bestor; all of whom deserve notice for the zeal and industry with which they performed their duty. Whilst with me, Lieutenant Peck made the topographical sketches; after he left, they were made by Lieutenant Warner.

I would here gladly avail myself of the opportunity of thanking Colonel Robert Campbell and Dr. Englemann,* of St. Louis, for the disinterested and efficient aid they rendered us in St. Louis in our hurried preparations for a long and tedious journey. The advice given us by Colonel Campbell, a gentleman of great experience in prairie life, was felt beneficially to the last of the journey.

The country between Fort Leavenworth and Santa Fé, traversed by the army of the west, may be divided into three great divisions, distinct in character, climate, and products, viz: from Fort Leavenworth to Pawnee fork, from Pawnee fork to Bent's Fort, and from Bent's Fort to Santa Fé.

The two first divisions have been so often traversed, that I have omitted my diary embracing them, contenting myself with a few general remarks; but the scientific, and especially astronomical observations referring to them, are as full as in regard to the other regions.

* An interesting account of the cacti observed on the route, furnished by Dr. Englemann, will be found in Appendix No. 2, continued.

For the information of detachments moving on that route, a table of distances has been prepared; which, with the map, (though on rather too small a scale for military purposes,) may enable movements to be made without other guides.

Between Fort Leavenworth and Pawnee fork, the country is a high, rolling prairie, traversed by many streams, the largest of which is the Kansas, or "Kaw;" and all but this river may be forded, except during freshets.

The beds of the streams are generally deeply indented in the soil, and their banks almost vertical, developing, where the streams make their incisions in the earth, strata of fossiliferous limestone, of various shades of brown, filled with the remains of crinoidea.

On a branch of the Wah-Karrussi, where the Oregon trail strikes it, a seam of bituminous coal crops out. This is worked by the Indians, one of whom we met driving an ox-cart loaded with coal, to Westport. For the most part, the soil is a sandy loam, covered with rich vegetable deposits; the whole based upon a stratum of clay and limestone.

Trees are to be seen only along the margins of the streams, and the general appearance of the country is that of vast, rolling fields, enclosed with colossal hedges. The growth along these streams, as they approach the eastern part of the section under consideration, consists of ash, burr oak, black walnut, chesnut oak, black oak, long-leaved willow, sycamore, buck-eye, American elm, pig-nut hickory, hack-berry, and sumach; towards the west, as you approach the 99th meridian of longitude, the growth along the streams becomes almost exclusively cotton-wood. Council Grove creek forms an exception to this, as most of the trees enumerated above flourish in its vicinity, and render it, for that reason, a well-known halting-place for caravans, for the repairs of wagons, and the acquisition of spare axles.

On the uplands the grass is luxuriant, and occasionally is found the wild tea, (*amorpha canescens*), and pilot weed, (*silphium laciniatum*;) the low grounds abound in prickly rush, narrow leaved asclepias, white flowering indigo, flowering rush, spotted tulip, bed-straw, wild burgamot, spider wort, pink spider wort, pomme blanche, (*psoralea esculenta*), scarlet malva, pilot weed, hazel, button bush, wild strawberry, cat-tail, and arrow rush.

As you draw near the meridian of Pawnee Fork, 99° west of Greenwich, the country changes, almost imperceptibly, until it merges into the arid, barren wastes described under that section. The transition is marked by the occurrence of cacti and other spinose plants, the first of which we saw in longitude 98°.

Near the same meridian the buffalo grass* was seen in small quantities, and, about noon, our party was cheered for the first time by the sight of a small "band" of buffalo, two of which we killed, at the expense of a couple of fine horses, which never recovered from the chase. Horses occasionally fed on grain become very weak feeding on grass alone, and should never in that condition be subjected to quick work. A violation of this precept

* For a description of this famous grass, see Appendix No. 2.

has cost many volunteers their horses, and entailed trouble without end on many inexperienced travellers "westward bound." The next day immense herds of the buffalo were seen.

We were now on ground (see map of July 10th) which is traversed by the nomadic tribes of Pawnees, Sioux, Osages, and occasionally the Comanches. Their range is seldom farther east than Council Grove. The country thence, to the western borders of Missouri, is in the hands of Indians owing allegiance to, and receiving stipends from the United States; they live in log-houses, cultivate the soil, rear cattle, and pursue some of the arts of peace. They form the connecting link between the savage of the plains and the white man of the States.

The latitude of our camp, a few thousand feet southeast of where the road crosses the Pawnee Fork, is $38^{\circ} 10' 10''$; and the longitude, by chronometer, is $98^{\circ} 55' 22''$. The height above the sea, indicated approximately by the barometer, is 1,932 feet; the point, as will be seen on the map, is but a short distance from the junction of the Pawnee Fork and the Arkansas river.

The section of country embraced between this point and Bent's Fort is totally different in character from that just described, but the change is gradual, and may be anticipated from what has been said in reference to the appearance of the country so far east as the 98th degree, or even the 97th meridian.

The position of our camp near Bent's Fort, determined by 29 altitudes of polaris and 35 circum-meridian altitudes of alpha aquilæ, is $38^{\circ} 02' 53''$ and the longitude, by the measurement of distances between ϵ and the \ast alpha aquilæ and the \ast spica virginis, is $103^{\circ} 01'$, agreeing within 34s. with the chronometric determination of the same point.—(See Appendix.)

Our route from Pawnee Fork to this point, was along the Arkansas river. The approximate height of Bent's Fort above the sea is 3,958 feet, and the height where we first struck the river, at the bend, is 1,658 feet, the distance between these two points being 311 miles, the fall of the river is about seven feet and four-tenths per mile. Its bed is of sand, sometimes of rounded pebbles of the primitive rock. It is seldom more than 150 yards wide, and, but for the quicksands, is every where fordable. The bottom land, a few feet above the level of the water, varies in width from half a mile to two miles, and is generally covered with good nutritious grass. Beyond this the ground rises by gentle slopes into a wilderness of sand hills on the south and into prairie on the north. There are one or two exceptions; for instance, at the great bend, the sand hills from the south impinge abruptly on the course of the river; at Pawnee rock, a long swell in the ground terminates in an abrupt hill of highly ferruginous sand stone; and ten miles above Choctau's island, the hills along the river are vertical, as if the river had cut a passage through them; and as you approach Bent's Fort, the hills generally roll in more boldly on the river, and the bottoms become narrower, and the grass more precious.

At these places the geological formation can be seen distinctly. On the lower part of the river it is a conglomerate of pebbles, sometimes shells cemented by lime and clay overlaying a stratum

of soft sand stone, which, in turn, over lays a blue shale, and sometimes the richest description of marl.

Higher up the river, we find the same formation, but in addition argillaceous lime stone, containing ammonites and other impressions of shells in great variety, and in more than one instance distinct impressions of oyster shells. The dip in both cases about 6° , and a little north of east.

The soil of the plains is a granitic sand, intermixed with the exuvia of animals and vegetable matter, supporting a scanty vegetation. The eye wanders in vain over these immense wastes in search of trees. Not one is to be seen. The principal growth is the buffalo grass, cacti in endless variety, though diminutive, yucca angustifolia, (soap plant,) the *Darlingtonia brachyloba*, *schrankia uncinata*, prairie gourd (*cucurbita aurantia*), and very rarely that wonderful plant, the *Ipomea leptophylla*, called by the hunter man root, from the similarity of its root in size and shape to the body of a man. It is esculent, and serves to sustain human life in some of the many vicissitudes of hunger and privation to which men who roam the prairies, as an occupation, are subjected.

July 24—Near the dry mouth of the Big Sandy creek, the yucca angustifolia, palmillo of the Spaniards, or soap plant, first made its appearance, and marked a new change in the soil and vegetation of the prairies.

The narrow strip which I have described as the bottom land of the Arkansas, varying from half a mile to two or three miles wide, contains a luxuriant growth of grasses, which, by the judicious selection and distribution of the camps, sustained all the animals of the army of the west whilst on the river. The only tree of any magnitude found on its course is the cotton-wood, (*populus canadensis*), and it frequently happens that not one of these is seen in a whole day's journey, and the buffalo dung and wild sage constitute the only fuel to be procured. About 35 miles before reaching Bent's Fort is found what is called the "big timber." Here the valley of the river widens, and the banks on either side fall towards it in gentle slopes. The "big timber" is a thinly scattered growth of large cotton woods not more than three quarters of a mile wide, and three or four miles long. It is here the Chyennes, Arapahoes, and the Kioways sometimes winter, to avail themselves of the scanty supply of wood for fuel, and to let their animals browse on the twigs and bark of the cotton-wood. The buffaloes are sometimes driven by the severity of the winter, which is here intense for the latitude, to the same place to feed upon the cotton-wood. To this point, which has been indicated to the government as a suitable one for a military post, Mr. Bent thinks of moving his establishment.

In addition to the grasses and cotton-wood mentioned, we find in the bottoms wild plum, wild cherry, willow, (*salix longifolia*), summer grape, (*vitis æstivalis*), cat-tail, (*typha latifolia*), scouring rush, (*equisetum hyemale*), a powerful diuretic upon horses, *commelina angustifolia*, Mexican poppy, (*argemone Mexicana*), *monarda fistulosa*, *coreopsis tinctoria*, *psoralea esculenta*, *cassia chamaecrista*,

several varieties of *solidego*, *œnothera*, and *helianthus*; among which was the common sunflower.

The animals of this section of the country are the buffalo, deer, antelope, elk, marmot, wolf, *agama cornuta*, &c.; but, for a more specific knowledge of the natural history and herbarium of the region from Fort Leavenworth to Bent's Fort, reference is made to the interesting notes of one of my assistants, Lieutenant Abert, in appendix No. 6.

Except the buffalo, game is very scarce, and cannot be depended upon to support a party of men, however small their number. The buffalo, where they range, may be relied upon to support a column of many thousand men; but their range is very uncertain. This year it was westward, between the 98th degree and the 101st meridian of longitude.

For an account of the country from Bent's Fort to the Pacific, I submit my notes, in which I have set down what passed under my own observation.

The accompanying map is also limited chiefly to the route followed, based upon the data exhibited in the appendices, and numbered from 3 to 5.

For a more specific knowledge of the plants peculiar to the country traversed than will be found in the journal, I refer to the catalogue prepared by that eminent botanist, Dr. John Torrey, to whom all the plants and drawings were submitted—forming appendix No. 2. The specimens brought home to aid me in elucidating the geology of the route, were submitted to Professor John Frazer, of the Pennsylvania University, to whose learning and knowledge I am under great obligation.

The military force under Colonel Kearny, destined for the conquest of New Mexico and the countries beyond, consisted of two batteries of artillery, (6-pounders,) under the command of Major Clark, three squadrons of the first dragoons, under Major Sumner, the first regiment of Missouri cavalry, under Colonel Doniphan, and two companies of infantry, under Captain Agney. This force was detached in different columns from Fort Leavenworth, and were concentrated with admirable order and precision on the 1st of August, at a camp nine miles below Bent's Fort.

And here I would take occasion to speak of the excellent understanding which prevailed throughout between regulars and volunteers, and the cheerfulness with which they came to each others assistance whenever the privations and hardships of the march called for the interchange of kindly offices among them. The volunteers, though but recently accustomed to the ease and comforts of smiling homes, bore up against fatigue, hunger, and the vicissitudes of a long and tedious march, through unexplored regions, with a zeal, courage, and devotion that would have graced time-worn veterans, and reflect the highest credit on their conduct as soldiers. There was a noble emulation in the conduct of regulars and volunteers, which, in no small degree, benefitted the service; while, at the same time, it promoted that cordiality in their interests which will make their future meetings, in the more peaceful walks of life, a gladsome event to both.

NOTES.

August 2, 1846.—I looked in the direction of Bent's Fort, and saw a huge United States flag flowing to the breeze, and straining every fibre of an ash pole planted over the centre of a gate. The mystery was soon revealed by a column of dust to the east, advancing with about the velocity of a fast walking horse—it was "the Army of the West." I ordered my horses to be hitched up, and, as the column passed, took my place with the staff.

A little below the fort, the river was forded without difficulty, being paved with well attritioned pebbles of the primitive rock, and not more than knee deep.

We advanced five miles along the river, where its bed slides over a black carbonaceous shale, which has been mistaken for coal, and induced some persons to dig for it.

Here we turned to the left, and pursued our course over an arid elevated plain for twenty miles, without water. When we reached the Timpas, we found the water in puddles, and the grass bad.

Colonel Doniphan was ordered to pursue the Arkansas to near the mouth of the Timpas, and rejoin the army by following the bed of that stream.

Near where we left the Arkansas, we found on the side of the slope several singular demi-spheroids, about the size of an umbrella, coated with carbonate of lime, in pyramidal crystals, which, at a distance, resembled the bubbles of a huge boiling caldron.

Along the Arkansas the principal growth consists of very coarse grass, and a few cotton-woods, willows, and *euphorbia marginata*. The plains are covered with very short grass, *sesleria dactyloides*, now burnt to cinder; *artemisia*, in abundance; *Fremontia vermicularis*; *yucca angustifolia*, palmillo, of the Spaniards; *verbena*; *eurotia lanata*, and a few *menzelia nuda*.

The only animals seen were one black-tailed rabbit and an antelope; both of which were killed.

Our march was 26 miles, that of the army 37; the last 20 miles without water.

The artillery arrived about 11, p. m.; both men and horses were parched with thirst. The teamsters, who had to encounter the dust, suffered very much. When water was near, they sprang from their seats and ran for it like mad men. Two horses sank under this day's march.

Our ascent was considerable to-day. The height, indicated by the barometer, being 4,523 feet above the level of the sea.

August 3.—We ascended the Timpas six and three-quarter miles,