2-11-1879

Letter from the Secretary of War, transmitting a communication from the Commanding General, Department of the Missouri, inclosing a report of C. A. H. McCauley, Third Cavalry, of his explorations in and about Pagosa Springs, Colorado.
LETTER
FROM
THE SECRETARY OF WAR,
TRANSMITTING
A communication from the commanding general, Department of the Missouri, inclosing a report of C. A. H. McCauley, Third Cavalry, of his explorations in and about Pagosa Springs, Colorado.

FEBRUARY 12, 1879.—Referred to the Committee on Public Lands and ordered to be printed.

WAR DEPARTMENT,
Washington City, February 11, 1879.

The Secretary of War has the honor to transmit to the United States Senate communication from the commanding general, Department of the Missouri, inclosing report of Lieut. C. A. H. McCauley, Third Cavalry, dated January 27, 1879, of his explorations in and about Pagosa Springs, Colorado.

The report containing much that is valuable and interesting, it is recommended that the same be printed.

G. W. McCRARY,
Secretary of War.

The President of the United States Senate.

HEADQUARTERS DEPARTMENT OF THE MISSOURI,
Fort Leavenworth, Kans., January 27, 1879.

GENERAL: I have the honor to forward herewith the report of Lieut. C. A. H. McCauley of his exploration in and about Pagosa Springs, Colorado.

You will find it a careful account of the physical and mineral character of that region, and especially of the remarkable hot springs. It also contains a description and views as well as plans of the cantonment established for the protection of Southwestern Colorado, and of the communications with the railroad. The proposed site for the consolidated agency for the Utes is about twenty miles south of the cantonment, on the Navajo River.

As this report is very valuable from the care devoted to it, the fullness of its details, and its entire reliability, I would be glad if it can be
published either by the War Department or Congress, and some copies sent to this department. I am sure you will find it of interest and value.

I am, general, very respectfully, your obedient servant,

JNO. POPE,

Brevet Major-General, U. S. A., Commanding.

Lieut. Gen. P. H. SHERIDAN,

Chicago, Ill.

[First indorsement.]

HEADQUARTERS MILITARY DIVISION OF THE MISSOURI,

Chicago, February 3, 1879.

Respectfully forwarded to the Adjutant-General of the Army.

P. H. SHERIDAN,

Lieutenant-General Commanding.

[Second indorsement.]

ADJUTANT-GENERAL'S OFFICE,

Washington, February 6, 1879.

Respectfully submitted to the Secretary of War, asking attention to General Pope's recommendation as to printing the report.

E. D. TOWNSEND,

Adjutant-General.
NOTES ON PAGOSA SPRINGS, COLORADO.

By Lieutenant McCauley, Third Cavalry, Assistant Engineer, Department Missouri.

December, 1878.

SITUATION, ETC.

Beautifully located in the finest part of the valley of the San Juan River, below its rugged mountain course, and just above its entering an inaccessible cañon of Cretaceous sandstone, is the great natural curiosity known as Pagosa Springs.

The main continental divide is to the north and east, approximating the arc of a circle, with Pagosa as its center. From this location, therefore, and its open situation in the river valley, its position assumes a strategic importance. A spur from the Snowy Range, or Great Divide, separating the waters of the San Juan and Piedra tributaries, passes to the southwest, terminating in Pagosa Peak, 12,670 feet—a clearly-defined pyramid from the south, and the most prominent point in the landscape approaching the springs, surmounting like a church-spire the lower adjacent mountains. (See Fig. 3.) Its longitude (approximate) is 107° west and latitude (approximate) 37° 15' north, it being also about four miles above the northeast corner of the Southern Ute Reservation, lying on the same meridian as its eastern boundary, and 19 miles north of the line of New Mexico. Its altitude is about 7,100 feet, or over 800 feet lower than Fort Garland, to which it is far preferable as a site for a military post. The river is here a clear and beautiful trout stream, with a fall of probably 50 feet per mile. It lies on the shortest line of communication from the East to the lower San Juan country, or the Pacific watershed, for whose waters in this region the stream of this name, signifying the River of Saint John, is the great receptacle. The wagon-road from Tierra Amarilla, N. Mex., to the Animas region passes by the springs, and, while a shorter route is obtainable, it is the one chiefly traveled, since it alone abounds in wood, water, and grass. Las Nutritas, the principal village of Tierra Amarilla, is to the southeast, about 57 miles, the Blanco, Navajo, and Chama Rivers being crossed on the way; while to the west Animas City and the park is 56½ miles distant, the Nutria, Piedra, Pinos, and Florida being passed en route. This wagon-road is on the route mainly of the Old Spanish trail, the great highway in olden times, leading from New Mexico to the Animas.

THE INDIAN WATERING-PLACE.

Aside from this, the springs must have always been to the aboriginal inhabitants a place of great resort, attracted by its wonderful healing properties, since Indian trails from all directions converge thereto, all deeply worn, doubtless in the various pilgrimages made by numerous bands and families.

An old Indian trail, now indistinct from desuetude, passes northeast up the San Juan River over the range and down the South Fork, reaching the Rio Grande by the shortest route, 49 miles distant, at a point 16
miles up the river (west) from Del Norte. To the northwest another trail passes to the Rio Piedra and up its west fork, or Weeminuche Creek, reaching the Rio Grande also, distant 52 miles via the Weeminuche Pass. A connecting trail from the Piedra ascends its middle fork and, passing northeast over the range, descends the West Fork of the Rio Grande, reaching that river at Antelope Park. These were the
routes used also by the tribes in their migrations from the South to the Gunnison, Uncompahgre (properly Un-ca-pah-gre), Grand and White Rivers and out-lying regions to the north.

All the Ute Indians, particularly the Weeminuche and Muache bands, are not the least superstitious of their kind and have always regarded the Springs with feelings akin to adoration, conceiving them to be the creation of the Great Spirit for the cure of the sick of all tribes, howsoever afflicted. Different families, bands, and tribes would at this point assemble, and the pipe of peace is said to have here had an unusual supremacy.

To the main spring, from the boiling appearance of its center, the Utes gave the name Pah-gosa (pah signifying water, and gosa boiling), which name, with corrupted orthography, it still retains.

What has evoked in the untutored savage a feeling of awe has called forth from the whites wonder and admiration, and at no distant day it is destined to be a great resort and to play no mean part in the sanitary economy of Colorado.

Wrested from its hereditary possessors by perjury, misrepresentation, or fraud, in the Brunot convention or treaty with the Utes in 1873 for the cession or purchase of what is known as the San Juan region, the location of the springs was subsequently claimed by various squatters, as agricultural land, omitting the springs on their plat prepared for file and record. To doubly hold the place it was entered by a confederate as a mill-site, and lest this too should be invalidated, the ground was taken up as a placer claim. To legally establish the latter, at a convenient point to the Springs, the ground was duly “salted,” in the most approved manner, by firing gold-dust from a shot-gun into the earth, after which, in the presence of a witness, a pan of the earth was washed and “color” found by the merest accident. The last and strongest claim, and still in litigation, was the placing of Valentine scrip upon some forty acres of land including the most valuable springs.

As an offset to the various claims, the President directed that the place be reserved as a town site; and in May, 1877, a square mile, including the springs, was duly reserved by Executive proclamation.

The various squatters have encountered bitter opposition from the Indians; the latter threatening, and burning their cabins. To the monopoly of the waters by any one they will never be reconciled. During the past month, at the grand council held by the Ute commission with the Weeminuche, Capote, Muache, &c., bands of Utes, they informed the chairman, General Edward Hatch, U. S. A., that they had learned of the claim upon the springs by Valentine scrip, and that their united wish was for the Tata Grande or Great Father in Washington to retain possession of the place, so that all persons, whether whites or Indians, might visit it, and when sick come there and be healed, firmly believing its waters to be a panacea for all diseases or afflictions.

**TOPOGRAPHY.**

The immediate locality of the principal springs is upon the east side of the river in a contracted valley or park, about three-fourths of a mile above the bridge-crossing of the river by the road to Animas. The main spring, by many considered to be the only actual or individual one—all others being subsidiary thereto—together with a number of others, including outlets and principal openings may, for convenience, be termed the group of hot springs, all of which—nineteen in number—have a temperature above blood-heat. They lie in the angle made by a sharp bend.
in the river and upon its left bank (see Fig. 1). Upon the opposite side, less than three-fourths mile distant and nearly south from the main one, is a group of cold ones, three in number, upon a small bench above and adjacent to the river, all of a temperate degree.

Less than half a mile down the river, a small creek from the east flows into the San Juan (see Fig. 1), which tributary has been named Ojo Frio from the number of cold springs at various points along its banks. Near its mouth is a small open area, below which sharp mesas and masses of vertical rock of Cretaceous age—all with timbered summits—close in upon the river, forming a cañon, which is inaccessible, or has not been explored by any one as far as known.

Above the mouth of the creek a line of short rolling hills runs nearly due north, with increasing steepness above, their height several hundred feet, heavily wooded, with pine upon the higher slopes. These with rolling hills upon the west side, some with sharp escarpments advancing to the stream itself (see Figs. 1 and 2), limit and contract the valley of the river in this immediate vicinity to an area of a few hundred acres.

Up the river, beyond and east of the range of steepest hills, embraced between the San Juan and Ojo Frio Creek, is a large and gently outspreading valley on a bench above the river, finely grassed, with an area of several thousand acres, all of which can be easily irrigated.

**BOTANY, ETC.**

Timber is abundant, being chiefly cottonwood (*Populus monilifera*), limited of course to the river-bottom, and the great pine of the Pacific slope (*Pinus ponderosa*), abundant upon nearly all the hills. Of its lesser vegetation, constituting the usual underbrush along the larger rivers of that section, as alder, willow, &c., a border of wild currants was observed along the edge of the great sloping deposit of calcium carbonate or carbonate of lime, west of Spring 17, Figs. 1 and 4. They furnished an agreeable accession to our table when there encamped during a reconnaissance in 1877. Its flowering botany is the usual one indigenous to the altitude and southern trend of the mountain slopes, with some accessions due to proximity to the heated waters. The plant observed in largest numbers was the delicate and beautiful blue flower, commonly called the American flax (*Linum perenne*), which, thickly clustering with slender waving stalks, covered the angle between the hills and the river north of the main spring in July, 1877.

Of the Cacti, the variety of *Mammillaria vivipara*, with its rose-colored flower, alone abounded about the springs, the only other variety being one of the well-known "prickly pear" (*Opuntia Missouriensis*), a slender stalk of which hung over one of the cavernous openings, as if to absorb all of its warm ascending vapor.

The waters of the river abound in several varieties of the speckled trout (*Salmo fontinalis*), which may be taken at Pagosa of largest size in the fall. In July and August they are very abundant in the narrow cañon of the river, some 12 miles above.

Specimens of other varieties of existing fish, popularly called "whitefish" and "suckers," taken from 12 to 20 inches in length, were preserved and sent for identification to Professor Baird, secretary Smithsonian Institution, and president of the National Fishery Commission. He informed me last spring that one of the former species resembled in some respects, the "Gila trout," belonging to the family of the Cyprinidae, but would give his decision during the fall. No answer has as yet been received.
TOPOGRAPHICAL SKETCH

OF

PAGOSA SPRINGS,
COLORADO,
SHOWING LOCATION OF

DRAWN BY
Lieut. McCauley, Third Cavalry,
Capt., Eng'r Dept., Missouri.

Scale, (approximate) ... 1 Inch = 150 yards.

LEGEND

No. 1.—Main Hot Spring, Temperature, 140°.
No. 2.—Marble Hot Springs, Temperature, 110° to 120°.
No. 3.—Cold Springs, Scorp., 90° to 100°.
No. 4.—Post Office, 80° to 90°.
No. 5.—Main Cold Spring, 50° to 60°.
No. 6.—Post Office, 40° to 50°.
No. 7.—Post Office, 30° to 40°.
No. 8.—Post Office, 20° to 30°.
No. 9.—Post Office, 10° to 20°.
No. 10.—Post Office, 0° to 10°.
No. 11.—Post Office, -10° to 0°.
No. 12.—Post Office, -20° to -10°.
No. 13.—Post Office, -30° to -20°.
No. 14.—Post Office, -40° to -30°.
No. 15.—Post Office, -50° to -40°.
No. 16.—Post Office, -60° to -50°.
No. 17.—Post Office, -70° to -60°.
No. 18.—Post Office, -80° to -70°.
No. 19.—Post Office, -90° to -80°.
No. 20.—Post Office, -100° to -90°.
No. 21.—Post Office, -110° to -100°.
No. 22.—Post Office, -120° to -110°.
No. 23.—Post Office, -130° to -120°.
No. 24.—Post Office, -140° to -130°.
No. 25.—Post Office, -150° to -140°.
No. 26.—Post Office, -160° to -150°.
No. 27.—Post Office, -170° to -160°.
No. 28.—Post Office, -180° to -170°.
No. 29.—Post Office, -190° to -180°.
No. 30.—Post Office, -200° to -190°.
No. 31.—Post Office, -210° to -200°.
No. 32.—Post Office, -220° to -210°.
No. 33.—Post Office, -230° to -220°.
No. 34.—Post Office, -240° to -230°.
No. 35.—Post Office, -250° to -240°.
No. 36.—Post Office, -260° to -250°.
No. 37.—Post Office, -270° to -260°.
No. 38.—Post Office, -280° to -270°.
No. 39.—Post Office, -290° to -280°.
No. 40.—Post Office, -300° to -290°.
No. 41.—Post Office, -310° to -300°.
No. 42.—Post Office, -320° to -310°.
No. 43.—Post Office, -330° to -320°.
No. 44.—Post Office, -340° to -330°.
No. 45.—Post Office, -350° to -340°.
No. 46.—Post Office, -360° to -350°.
No. 47.—Post Office, -370° to -360°.
No. 48.—Post Office, -380° to -370°.
No. 49.—Post Office, -390° to -380°.
No. 50.—Post Office, -400° to -390°.
No. 51.—Post Office, -410° to -400°.
No. 52.—Post Office, -420° to -410°.
No. 53.—Post Office, -430° to -420°.
No. 54.—Post Office, -440° to -430°.
No. 55.—Post Office, -450° to -440°.
No. 56.—Post Office, -460° to -450°.
No. 57.—Post Office, -470° to -460°.
No. 58.—Post Office, -480° to -470°.
No. 59.—Post Office, -490° to -480°.
No. 60.—Post Office, -500° to -490°.
No. 61.—Post Office, -510° to -500°.
No. 62.—Post Office, -520° to -510°.
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No. 68.—Post Office, -580° to -570°.
No. 69.—Post Office, -590° to -580°.
No. 70.—Post Office, -600° to -590°.
No. 71.—Post Office, -610° to -600°.
No. 72.—Post Office, -620° to -610°.
No. 73.—Post Office, -630° to -620°.
No. 74.—Post Office, -640° to -630°.
No. 75.—Post Office, -650° to -640°.
No. 76.—Post Office, -660° to -650°.
No. 77.—Post Office, -670° to -660°.
No. 78.—Post Office, -680° to -670°.
No. 79.—Post Office, -690° to -680°.
No. 80.—Post Office, -700° to -690°.
No. 81.—Post Office, -710° to -700°.
No. 82.—Post Office, -720° to -710°.
No. 83.—Post Office, -730° to -720°.
No. 84.—Post Office, -740° to -730°.
No. 85.—Post Office, -750° to -740°.
No. 86.—Post Office, -760° to -750°.
No. 87.—Post Office, -770° to -760°.
No. 88.—Post Office, -780° to -770°.
No. 89.—Post Office, -790° to -780°.
No. 90.—Post Office, -800° to -790°.
No. 91.—Post Office, -810° to -800°.
No. 92.—Post Office, -820° to -810°.
No. 93.—Post Office, -830° to -820°.
No. 94.—Post Office, -840° to -830°.
No. 95.—Post Office, -850° to -840°.
No. 96.—Post Office, -860° to -850°.
No. 97.—Post Office, -870° to -860°.
No. 98.—Post Office, -880° to -870°.
No. 99.—Post Office, -890° to -880°.
No. 100.—Post Office, -900° to -890°.
The formation of the vicinity is that of the great area to the south and west—sedimentary rock of Cretaceous age. The youngest of this series, called the Upper Cretaceous, locally forms the Continental Divide, and gives a series of table lands south of the West Fork of the Chama, where the eruptive rock, terminating in what is called the Chama Peak (its altitude 12,250), leaves a depression of nearly 4,000 feet—a very low pass, used in the Navajo “cut-off” from the east to Pagosa. Blocks of yellow sandstone, fine grained and beautiful, belonging to the Upper Series, line the wagon-road from Tierra Amarilla through the cañon or pass over the Continental Divide.

At the crossing of the Rio Blanco a noteworthy feature is remarked in the obstruction from the river bank on the left (south side) of a great dike of hornblendic trap. It is mentioned, on account of “high vertical walls,” which may be the same formation, having been reported by one of the Wheeler survey as observed below the Navajo River to the south, and also because I observed in July, 1877, what was probably a portion of the same dike on the upper part of Ojo Frio Creek, east of the springs, finding its direction to be north 18° east, and south 18° west (magnetic).

At Pagosa, owing to the descent made from the Continental Divide, the oldest rocks of the Cretaceous are reached, and below Ojo Frio Creek, in the cañon of the San Juan, are exposed sandstones, with their sides nearly vertical, over 400 feet in thickness, adjudged the Lower or first series of the Cretaceous formation.

West of the main spring the erosion by the river of the bordering “slate hills” has exposed in steep escarpments the dark-blue, apparently black shales, belonging to the Middle Cretaceous series, which, of later origin, rests upon the Lower Series, and is the one prolific of fossils. They are abundant about the springs, numbers being collected there in August, 1877; those most frequently found being Ostrea and various species of Inocerami—the latter plentiful.

The black “slate hills” offer, in the summer particularly, a violent contrast to the great white carbonate deposit or plain upon the opposite bank of the river, and constitute a prominent local feature of the landscape. Upon the north end of the steep hills, east of the Springs, the river has also eroded and laid bare similar strata of the Cretaceous shales.

The geological age of the Springs is very great, being doubtless older than the river. It is believed by a distinguished geologist* to be without doubt the seat of an ancient volcano, from whose crater now issues the main spring.

In its earlier existence, the mass of rising water had only a surface outlet, pouring forth over the sides of the orifice. The hot waters containing large quantities of mineral matter in solution, and solubility being a function of and increasing with temperature, the deposition was necessarily greatest at the edge of the springs, decreasing with an increased flow. The incrustation of mineral therefore extended over the surface in thin sheets or lamina, hardening by atmospheric exposure, forming a great deposit, mound or plain, mainly of calcium carbonate and sodium sulphate (Figs. 1 and 4), of greatest thickness near the spring, giving a crater-rim (see Fig. 5), and decreasing, as will be seen, toward the river to the west.

*Dr. J. S. Newberry.—Explorations in New Mexico, Colorado, Utah, and Arizona, under Captain (now Colonel) Macomb, U. S. Engineers, 1859-60.
Fig. 2.—Camp Lewis.
Cantonment at the Pagosa Springs, Colorado. Sketched from a hill on the north (A, Fig. 1.) (Drawn by Lieutenant McCauley, Third Cavalry, assistant en- gineer, Department of Missouri. December 1, 1878.)
Fig. 3.—CAMP LEWIS.

Headquarters Company D, Ninth Cavalry. The new buildings and Pagosa Peak, from the opposite bank of the San Juan (B, Fig. 1). Drawn by Lieutenant McCauley, Third Cavalry, assistant engineer, Department Missouri. December 1, 1878.
This formation, whose exact thickness is unknown, essentially of slow growth, necessitated a vast and unknown period of time.

The river, in assuming its present channel, cut through the deposit, flowing west and south, and, skirting the plain, separated that on the west side from the main portion (Figs. 1, 3, 4, and 6). Accretions from the main spring discontinuing, being isolated and subject to erosion (see Fig. 6), it is still about 20 feet thick upon the west side, where it is being constantly undermined. While the calcareous rock is visible alone at this point (a, Fig. 6), it doubtless is of very considerable extent.
to the north and west, being covered and hidden by pebbly drift of the river or detritus from the hills above. No rock of this nature exists, or, rather, is visible in the river bed, having long since been replaced by sand and gravel. An examination of the topographical sketch (Fig. 1) will show the extent of this bench or level upon the western side.

The great mound or gentle knoll upon the opposite bank, with a downward slope from the main spring in all directions (Figs. 4 and 5), has an area of about 40 acres, cliff-like edges, caused by erosion, bordering the river. It has a lesser height than the exposed portion on the western side, indicative of the greater erosion it has suffered from the river or other agents. At the point 9, Fig. 4, the cliff is 15 feet above the river's level; at the point 10, same figure, about 10 feet, decreasing in height to the west. The river is constantly making inroads upon the edges of the plain and undermining it at various points. At one place (E, Fig. 4) this has caused a huge crevice of considerable extent along the bank, as shown in Fig. 7. It has long since ceased to increase in height, save from vapory deposition; the channel cut by the river presented a shorter exit; the hot waters percolating the honey-combed rock finally offered another passage, and the waters possessing a subterranean outlet the height of the upper part of the knoll is not at present being augmented.

About the main spring the mass of stalagmitic rock is honey-combed and cavernous, especially on the north towards the river bank. In this vicinity so many openings exist—now mere shells and again of considerable size, almost hidden by tufts of grasses growing between—that some little caution must be exercised in passing to and fro. Elsewhere, with one exception, the general surface is solid and will bear the weight of horse and rider, although a hollow sound is heard in passing over it. The exceptional area is of a swamps nature and several acres in extent, slightly east of south from the main spring (see Fig. 4), and filled with a rank growth of sedges, rushes, and other plants indigenous to wet ground. Calcareous deposition is here rapidly in progress. This area will eventually be a portion of the solid knoll and the swamp be a thing of the past.
The group of Hot Springs occupies an area of about 21 acres upon
the western side of the river (Figs. 1 and 4), being situated upon the
central and higher portions of the knoll or plain. For convenience of
reference, the main and subsidiary springs, including outlets, are designated by a series of numbers.

This is the Main Hot Spring (No. 1, Fig. 4), and is said to be the largest
thermal spring and possessing the highest temperature of any in the United States.

The crater is an irregular depression approximating a pear-shape (Fig. 8), and is about 69 feet long by 45 wide—the depth of the waters being unknown—many and varied attempts to solve the mystery having been unsuccessful. It cannot well be positively ascertained, owing to the honey-combed rock and stalagmitic masses beneath the surface, obstructing the way. Columns of bubbles rise constantly everywhere over the surface, the water's appearance resembling on a huge scale a freshly decanted glass of extra dry Mumm.

The great basin is subdivided (see Fig. 9), the partition, as will be seen, being capped by a projecting cone of sulphur, from which sprouts and puffs a tiny jet of water. This may be observed at b, Fig. 9. Near the center a furious boiling appearance is presented, from which circumstance did the Indians baptize it "Pah-gosa."

The popular idea exists that here the waters possess a boiling temperature, which at this altitude, as nearly as memory serves me, is less than 199° F. (92°.8 C.).

It is, however, erroneous; the ebullition is wholly gaseous, at points within an area of 12 feet square masses of soft, pulpy matter floating at the edges. The waters rise highly charged with hydrogen monosulphide and carbon.
dioxide, or sulphureted hydrogen and carbonic acid gases. They contain in solution calcium, sodium and magnesium carbonates, sodium and potassium sulphates, and sodium chloride, the largest mineral constituent being the sodium sulphate. It is also possible that in this—more probable in some others of the springs—a small proportion of the ferrous carbonate will be found to obtain. Some of the depositions are indicative thereof, but a thorough analysis will alone decide the question.

Around the eastern edge of the water (see Fig. 8), are a number of holes or cavities in the honey-combed rock, which, in their laudable ambition, have served the Red-men as bathing-houses. Those marked a (Fig. 8) are circular and separated from the main spring by a partition, rising almost to the surface (c, Fig. 9). With mud or sod, the water is dammed and allowed to cool in these holes to a temperature sufficiently low for use. That at the southern end of the spring (marked c, Fig. 8) is a point of escape for hot vapor, and has been used as a "sweat-hole," the Indians crouching within and covering themselves with a blanket above, exemplifying the Turkish bath of the untutored savage, enjoyed without expense.

A popular idea exists that the main spring at Pagosa is the outlet of streams of various thermal waters, with differing constituents, which meet at this point; another impression prevails that all other springs or outlets in the vicinity are but the exits of portions of the main spring. Both theories are doubtless erroneous, in part at least. This will be thoroughly decided by the qualitative and quantitative analyses of the various waters which are to be made by Dr. Charles Smart, assistant surgeon, United States Army, who has kindly promised his time and labor gratis.

The temperature of the spring, including the center, was found to be 141° F. (60.6° C.), that of the river being 40° F. (4.4° C.), and the highest of the air (shade) 49° F. (9.4° C.). This was found to be the general temperature resulting from frequent and careful observations during six days in December. The greatest diurnal variation (0.5° F.) was the minimum temperature December 5, 10 a.m., 140.5° F. (60.3° C.), that of the air (shade) being 33° F. (0.6° C.).

The same thermometer—manufactured by Taylor Brothers, Rochester, N. Y., range —40° to 240° F.—was used without breakage in obtaining the temperatures of all the springs. On returning to this point (Fort Garland, Colo.)—nearly 900 feet greater altitude—it was carefully compared with the standard at the post hospital, issued from the Surgeon-General’s Office, Washington, D. C., maker Charles Wilder, Peterboro, N. Y., range —35° to 125° F. The former was found to record in a range of 0° to 20° F., a lower temperature by about 10.5° F.

Another impression prevails that the waters have both a seasonal and diurnal variation, the level of the spring being a function of the rise and fall of the river, which, like every mountain-stream flowing from the Snowy Range, is highest in the spring, mainly in June. Of the former variation of course nothing is known; as to the latter it was found to be inconsiderable. During the morning, 10 a.m. temperature air 33° F. (shade), and evening, 4.30 p.m., air 31° F. (sun below horizon), it was found to be from 0.5 to 0.7 inch higher than at 1.30 p.m., when the temperature of the spring was 141° F. and the air (shade) 49° F.

The vapor of the spring, or ascending "steam," as it is popularly called.
is of course not visible on a July or August midday. During early morning or evening, however, and in winter, the column is very distinct, the sketch (Fig. 10) made from the opposite river-bank representing it when the temperature of the air was 10° F.

The outflow of this spring is subterranean; its course to the river on the north will be seen by an examination of Figure 4. The honeycombed nature of the plain or mound is here very decided—there being large numbers of openings on the line, many emitting vapor, where rapid formations of stalagmites and stalactites are in progress. At three points under the cliff exit occurs—Nos. 9, 9½, and 10, Fig. 4, to be mentioned in detail hereafter; of these the most western conveys the largest
volume of water to the river, no measurement of which was made. The
temperature at the various exits was 127° F. (52° 8 0.).
The beds of all outlets of the various springs and openings are coated
with mineral matter, deposited in the water's rapid flow, largely sulphur
from decomposing hydrogen sulphide. The formation, however, of the
matter of the great plain may be best observed in its various stages in
springs 1, 11, 12, &c., of which the main spring is best adapted to the
purpose.
The little vessels constituting the bubbles are of gaseous interior—the
outside of mineral constituent. Rapidly rising and bursting at the sur­
face, the tiny pellicles are wafted by the great agitation at the center of
the spring towards its edges. The disruption of the bubbles, immediate
in the center, is slightly delayed at the sides and edges where the surface
is more tranquil, allowing there a greater deposition. Accretions occur;
a thin scum appears.
With accessions from below and its sides a mass is formed, constantly
growing broader and thicker—a thick, pulpy mass of spongy consistency
floating on the water—breaking and dropping apart if lifted by hand.
This is, in general, dark brown in color, often with ferruginous tint,
and again of a dull greenish hue. It floats at the edge of the spring
until, with accretions of the calcareous matter and alkaline salts in solu­
tion, its specific gravity is so increased that it sinks to the bottom of
the spring, making way for other above. Becoming compact below, it
gradually hardens and becomes a part, eventually, of the solid rock.
That which sinks and rests upon the shelves of stalagmite removed from
the edges—samples being obtained from as near the center as possible—
was found to be of a perfectly spongy nature, being perforated with holes
by the ascending gases. In some portions of the spring, bright shining
masses are seen glittering beneath its waters on the shelving bottom;
these were found to be deposits of sulphur in heavy streaks or films
overlying a dark greenish mass of the consistency of liver, but lacking
the spongy character already referred to.
This general deposit of pulp is everywhere present in all the springs
beneath the water's surface, varying in thickness from one to several
inches, with the size of the stream and velocity, stagnation favoring its
more rapid formation. Wherever the normal condition of the water is
disturbed it will appear, subsequently settling. It is the matter of
the great cliff or mound in its primary stage; its ultimate condition is the
laminated or honey-combed portion of the huge plain, presenting a dull
gray hue.
Specimens of all kinds were obtained in August, 1877, during the
examination of the springs. Subjected to heat, the bright colors of the
surfaces in general faded and the soft and pulpy masses became shriveled
and hard. This was universally the case with the specimens of the mud
at the outlets, with an overlying crust of reddish-brown or ferruginous
tints and those of attractive greenish hues, none of which are permanent,
removed from the waters.
Various theories are advanced as to the source of the spring. Owing
to the great heat of the water its flow must of necessity be from an
extreme depth; while its large proportion of hydrogen sulphide, or sul­
phuretted hydrogen, &c., indicates a passage through the Coal Measures
and other rocks of Carboniferous age.
One gallon of the water of this spring was obtained for the analysis
by Dr. Charles Smart, U. S. A.
The following analysis of Pagosa is published in a popular work on
Colorado—the authority therefore not being given. The water is doubt-
less that of the main spring, No. 1. The names of the chemical constituents, according to the new nomenclature (Fownes), are interpolated.

Temperature, 150° F.

Constituent parts in one gallon of water.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of soda (Sodium Carbonate)</td>
<td>2.74</td>
</tr>
<tr>
<td>Carbonate of Lithia (Lithium Carbonate)</td>
<td>0.42</td>
</tr>
<tr>
<td>Carbonate of lime (Calcium Carbonate)</td>
<td>34.42</td>
</tr>
<tr>
<td>Carbonate of magnesia (Magnesium Carbonate)</td>
<td>3.83</td>
</tr>
<tr>
<td>Sulphate of potassa (Normal Potassium Sulphate)</td>
<td>4.16</td>
</tr>
<tr>
<td>Sulphate of Soda (Sodium Sulphate)</td>
<td>128.32</td>
</tr>
<tr>
<td>Chloride of sodium (Sodium Chloride)</td>
<td>17.66</td>
</tr>
<tr>
<td>Silica</td>
<td>3.33</td>
</tr>
<tr>
<td>Organic matter</td>
<td>Trace</td>
</tr>
</tbody>
</table>

Total solids: 194.27

Gases:
1. Carb. Acid. (Carbon dioxide.)
2. Hydro. Sul. (Hydrogen monosulphide.)

No. 2.

This is an opening on the north line from the main spring to the river and about 60 feet distant; it is 5 feet square and the water 6 feet below the surface of the mound. (See Fig. 4.)

The honeycombed surface hereabout may be illustrated by the fact of there being between this and the rim of the crater some fifteen holes, from all of which vapor can be seen issuing when the temperature of the air is below the freezing point. The largest, about 3½ feet in diameter and 6 feet deep, is utilized as a "sweat-hole."

To the right (east) of No. 1 (a, Fig. 4), near the rim of the crater, are some seven more openings or vents, while still farther down the slope to the northeast are a series of pools (b, Fig. 4), lukewarm and hot, all evidently dependent upon the main spring.

The stalacritic formations on the sides of No. 2 are of whitish-gray hue, being largely sodium sulphate; the depictions at its bottom are of a dark green tint.

At 4:15 p. m., December 4, the temperature of the air, in the shade, being 50° F. (10° C.), in the sun, 54° F. (13°.2 C.), that of this opening was 138° F. (58°.9 C).

No. 3.

An opening (see Fig. 4) about 10 feet from No. 2, of irregular shape, about 4 feet long, 1½ wide, and 6 feet below the surface. Its temperature was 140° F. (60° C.), taken at the same time as that of No. 2. In one of this set of holes (No. 2 or 3) noticed in August, 1877, the surface of the water completely covered with an odd-looking scum, which, on descending into the place, was found to consist wholly of grasshoppers (Orthoptera). As the aperture was too small for them all to have collected and fallen there, and they were not plentiful about the opening, it is probable that they came from the main spring. Here, however, no immediate outlet is visible, and they would have to be sunken before an escape would be possible.

No. 4.

Under this is included a series of 5 holes from No. 2 distant 6 feet (see Fig. 4), their aggregate surface being 10 feet square. The water
within is 5¼ feet below the surface, the depositions on the sides being white and dull gray in color. Its temperature, taken at the same time as No. 3, was two degrees less, or 138° F. (58°.9 C.).

No. 5.

An opening to the north of No. 4 (see Fig. 4) is of the same size, separated by but a small portion of the honeycombed rock. Here the largest and most beautiful specimens of the stalactite formations were obtained (a, Fig. 11). Owing to their delicate crystals, largely of sodium sulphate, they are difficult to remove in their natural condition. The general color of the stalactites was white, with tinges of a lovely green; at

![Diagram of stalactite and stalagmite formations](image)

...Figure 11. Section and elevation showing stalactite and stalagmite formation of calcium carbonate, sodium sulphate, &c. Group Hot Springs, Nos. 5 and 6: a, stalactites of sodium sulphate; b, bases of stalactites—stratification black; d, stalagmites.

their bases, where altered to solid rock, the lamination was thoroughly marked with horizontal streaks of a black tinge throughout the strata.

The temperature of the water, taken at the same time as No. 4, was 136° F. (57°.8 C.).

No. 6.

This opening adjoining No. 5 on the north (see Fig. 4) is of the same size, separated by but a small portion of the honeycombed rock. It has also the same temperature, but does not abound in as beautiful crystallizations as the former.

No. 7

issues from the ground, without a chamber, in the nature of a spring (see Fig. 4), about 45 feet north from No. 6. The aperture is 4 feet square, and the water taking a surface outlet toward the northwest, soon disappears, sinking into or being absorbed by the calcareous plain. The casual observer will at once remark the distinctive character of its deposits in comparison with those already mentioned. They are chiefly...
of a salmon color, others possessing a bright red. In general the red prevails underneath near the water's surface, a whitish color existing at the upper edges. At a little distance from the spring this reddish appearance is lost from atmospheric exposure, when the hardened rock assumes the general dull gray and the honeycombed character of the plain. Here may be obtained handsomer specimens than elsewhere, bright and attractive in color, and of coralloid form.

Drooping grasses are here prettily incrusted, red in and near the water, white without. A few specimens of beetles (Coleoptera) were also found with their coat of mail. The waters, obstructed at their very exit, deposit their mineral matter, and apparently sink into the upper surface of the plain which they are locally—almost imperceptibly—aiding to form.

A half gallon of the water of this spring was obtained for analysis by Dr. Charles Smart, assistant surgeon, U. S. A.

The temperature of the air, 3.30 p. m. (sun), being 47° F., that of this spring was found to be but 101° F. (37°.2 C.).

A series of openings beyond this to the north are located in Fig. 4, as

No. 7A,

being 20 feet distant from No. 7, and on the line from No. 1 to the cliff. They are about 1 foot square, with the water 2 feet below the surface of the plain. The deposits on the sides are of a white and gray color. The temperature taken at the same time as that of No. 7 was 135° F. (56°.7 C.).

No. 8,

in position, is 30 feet north of No. 7. In August, 1877, this was a small opening, similar to No. 7 in the color, &c., of its depositions. It is now entirely closed up; a dampness on the surface and the distinctive red character alone remain.

No. 9

is the most eastern outlet of the main spring (see Fig. 4), issuing forth at the base of the cliff or edge of the plain, here 15 feet above the water's level. Having been dammed for bathing purposes, the water has backed up, being 10 feet wide and 6 inches deep for some distance, the outflow over the dam being a little less than a foot wide and 2 inches deep. The depositions within the dam itself are a dark velvet green, covering a brown sulphur mud; here and there patches of light pale pink appear, and streamy films of white matter, the latter sulphur of decomposing hydrogen sulphide. The green and pink of lovely hues beneath the water disappear on contact with the atmosphere.

At the point of exit from the cliff, the air in the shade of the rock, 1 p. m., being 47° F., and the river 40° F., that of the water was 127° F. (52°.8 C.). In the bath-house, midway between the exit and the river, the temperature of the water, constantly running, was 115° F. (46° C.).

A half gallon of this water was obtained for analysis by Dr. Charles Smart, assistant surgeon, U. S. A.

Just above the junction of this outlet with the river a bridge of ice existed early in December, the only point in the vicinity of the springs where the river was frozen across.

Some distance down the river on this bank, issuing from the cliff and hidden from view by masses of rock fallen from the edge of the plain, issues a little rill,
No. 9½

(see Fig. 4), its width about 3 inches, evidently the escape of a portion of the water diverted from one of the other outlets. Its channel is white with sulphur deposition.

No. 10,

the principal outlet of the main spring, is about 350 feet to the northwest; the cliff at this point being 10 feet above the river, and the stream emerging 4 feet below its upper surface. It is nearly 2 feet wide, 4 inches deep, with a very rapid flow, passing a large volume of water.

The depositions for 50 feet are the white and streaky films of sulphur—one end apparently fastening itself to the bottom, while the other seems to waver to and fro in the passing current. Beyond that, where the flow is slower, in a pool by the river bank, as at No. 9, the greenish, with some pink tints, prevail in the mud beneath the water.

At the edge of the cliff the temperature of the air (shade) being 52° F., that of the river was found to be 127° F. (52°.8 C.). A half gallon of the water at this point was obtained for analysis by Dr. Charles Smart, U. S. A.

Not far distant and south from No. 10 (see Fig. 4) are a number of small holes designated as

No. 10⅓,

all of which are of a low temperature, and are apparently part of the outflow of some water of the main spring.

No. 11.

On the southern slope of the mound, nearly south from No. 1 and distant some 200 feet, is an opening giving forth a strong current. It is apparently a vent for the escape of some of the waters of No. 1. (See Fig. 4.)

Its temperature, November 30, 4.30 p. m., air being 31° F. (sun below horizon), was found to be 137° F. (58°.3 C.); no variation was found in this during several visits, save a single decrease (in the morning), not exceeding 2° F.

A half gallon of this water was secured for analysis by Dr. Smart, U. S. A.

No. 12

is situated about 50 feet east from No. 11 (see Fig. 4), its overflow being in a westerly direction, meeting the waters of Nos. 11, 13, 14, and 15. A longitudinal section, Fig. 12, shows the mammillary form of the depositions along its bed. At 4.30 p. m., the air being 31° F. (sun below the horizon), the temperature of this spring was found to be 102° F. (38°.9 C.).
is an opening like No. 11, situated about 50 feet to its west, issuing from a hole 2 feet in diameter. (Fig. 4.) Its outflow is a rapid current, 6 inches wide by 2 deep, its waters mingling with those of Nos. 11 and 12.

At 10.15 a. m., the temperature of the air in the sun being 45° F. and shade 34° F., that of its waters was 137° F. (58°.3 C.).

A half gallon of this water was secured for analysis by Dr. Smart, U. S. A.

is an opening 1 foot square, and about 15 feet west of No. 13. (See Fig. 4.) Its water, with a rapid current, flows southeast, meeting that of No. 13 at a distance of about 12 feet from the opening. Its temperature, taken at the same time as that of No. 13, was 135° F. (57°.2 C.).

This opening, about 5 feet distant from No. 14, is of the same size, character, and temperature—its current, at a short distance, uniting with that of the former.

Along the beds of the three last mentioned, for a distance of 25 feet, are seen the usual deposits of stringy films of matter of a whitish hue, approaching a lemon color; beyond that appears the brownish red already referred to.

![Fig. 13.—Longitudinal section along the joint channel of outlets of Springs 11, 12, and 13, showing formation and growth of stalagmites.](image)

The union of the waters of Nos. 11, 12, 13, 14, and 15, spreading over a slight depression, forms the swamp already mentioned as existing in the southern portion of the knoll. Along the course of their united current can be best observed the various stages culminating in the formation of stalagmites in the water (Fig. 13). A section already given (Fig. 12) indicates the mammillary deposits in the bed of No. 11. With a less rapid flow and the accession of other waters, the summits of these protuberances receive hairy-like accretions, taking the form shown at a, Fig. 13. The process of building continues, resulting in the tiny but complete stalagmite, b, Fig. 13. The portion at the surface of the water, receiving calcareous matter, hardens on contact with the atmosphere, so that a thin plate or shell is observed upon the watery surface, held and supported by a pillar of softer matter. Many of these specimens present an unusually odd appearance.

The backing of the water by the sedges and rushes interrupting its flow increases the deposit of mineral constituents, inerusting the vegetable matter everywhere, and the extension of the solid plain over this area is in rapid progress.
indicates on Fig. No. 4, a series of holes 110 feet west of No. 15, on the southwestern slope of the great calcareous knoll, where the depositions possess the yellowish-white and red hues already described.

At 10.15 a.m., December 5, the temperature of the air (shade) being 33° F., that of the different openings varied from 107° F. (41°.7 C.) to 112° F. (44°.4 C.).

No. 17, located 360 feet south 50° west from No. 16 (see Fig. 4), is a large spring issuing from an opening 5 feet square whose waters pass off in a stream 6 inches wide and 5 deep with a rapid current; the depositions grayish-white with a pink tinge. With lengthened flow its waters pass through a bed whose section is shown in Fig. 14, the deposits along it being very abundant, a Fig. 14. At several points deep enough for a natural bathing place, it was in former times a favorite resort and frequently utilized by visiting Indians. Its outflow is over the surface of the plains, where its waters gradually disappear.

December 2, at 10.45 a.m., the temperature of the air, no shade available, being in the sun 52° F., that of this spring was 110 F. (43°.3 C.). A half gallon of its water was obtained for analysis by Dr. Smart, U.S.A.

No. 18.

In an examination of the swamp in August, 1877, this spring was discovered, which, owing to its situation, cannot be seen from dry ground on the east or the hardened plain on the west, being hidden by the vegetation of the marsh. It is situated south 10° west and 300 feet distant from No. 13. (See Fig. 4.) From a circular opening a foot in diameter the water issues with considerable force, its current being rapid among the masses of sedges and reeds, 8 inches in width with a depth of 6. This spring undoubtedly varies in its constituency, in some degree, from those already described. At the outset, its bed is lined with a deposition of coal-black matter possessing the consistency of a mass of liver. This continues for 120 feet when the ordinary elements of the springs appear, and its bed changes in color from a black to the usual whitish line of the sulphur and the accompanying pink. This black deposit attracts myriads of insects (Diptera)* which flock here regardless of the season. Alighting upon this deposit or resting upon the water, they seem to feast upon it, returning when disturbed. A few varieties of spiders (Arachnida) were also noticed, on similar occupation intent. Below the region of this glossy black deposit, nor elsewhere, did insect life at the time obtain (Decem-

*Specimens for identification were sent to Dr. H. Hagen, in charge of the Museum of Comparative Zoology, Harvard University, Cambridge, Mass., who has informed me that "the flies belong to the queer genus Ephedrina, of which some of the larvae prefer to live in salt water and some in warm; E. gravilis inhabiting the Great Salt Lake."
number, 1878) excepting only a grasshopper or two about an opening near the main spring.

The course of the outlet is nearly south, the area being swampy, and but little of the water finding its way to the river direct.

With the air 48° F. in the sun (no shade being convenient) the temperature of this spring was 90° F. (37°. 2 C.)—the lowest of the hot series. A half gallon of its water was obtained for analysis by Dr. Smart, U. S. A.

No. 19

designates an opening about 20 feet west of the former (see Fig. 4), evidently an outlet for a little water of the same general current, there being but little overflow.

The black deposit and the same temperature prevail, and similar insects here also abound. Near this were found lovely specimens of mosses protruding from the watery earth, their ends white-tipped with sulphur.
from the hydrogen sulphide, beautifully contrasting with the bright green of the branchlets. To very many of these were fastened the tiny chrysalides of some insects, left most convenient to the spring and its warmth. This is the most southern and last of the group of hot springs.

Along the western edge of the plain, beyond No. 17, may be obtained handsome specimens of the calcareous rock, showing incrusted twigs, leaves, and various other vegetable matter; here, too, under the overhanging ledges, may be found lovely and delicate stalactites, perfect coraline in appearance.

The different hot springs and openings are now the daily resort of citizens using the baths for sanatory purposes in the various kinds of rheumatism, syphilitic affections in both primary stages and the constitutional symptoms, &c., for all of which it is said to be a panacea.

THE COLD SPRINGS.

Between half and three-fourths of a mile distant, and almost due south from the main spring, on the opposite bank of the river (see Fig. 1), is the group of cold springs, clustering in their isolation from the others. The bench, almost level, on which they lie is about 50 feet distant from the river, which bends at this point 20 feet above the water's surface and 6 feet higher than the general elevation near by, which is sloping towards the river (see Fig. 15). They are grouped compactly, forming a little plain or mound of their own of a hardened rock, similar to the great one above, but on a smaller scale, just as the springs themselves have a lower temperature and lesser mineral constituency. None of this group possesses much force, and while always open during the summer, has no overflow. No outlet is anywhere visible, and the uprising water is soon absorbed by percolation through the surrounding rock, which has the general dull gray of the plain to the north.

No. 20,

the most northern of the group, about 12 feet in diameter, was covered with ice save an opening 1 foot in diameter in the centre. (See Fig. 16.)

December 1, 12.30 p.m., the temperature of the air (sun) being 58° F., that of this spring was 46° F. (70.8 C.); August, '77, its temperature was 76°.5 F.

A half gallon of this water was sent for analysis by Dr. Smart, U. S. A.

No. 21

is the warmest and the middle spring of the group, being 18 feet distant from No. 20. Of an irregular shape, it is 17 feet in length and 7 in
width near the central part (Figs. 15 and 17). Its surface was also frozen except for 4 feet square in the middle. Taken at the same time the temperature of this spring was 52° F. (11°.1 C.).

In the examination of these springs in August, 1877, the temperatures were naturally somewhat higher. No memoranda taken at that time being at present accessible, and noting from memory only, the temperature of this spring was then about 79° F.

A half gallon of the water of this spring was secured for analysis by Dr. Smart, U. S. A.

No. 22,

the most southern of the group, is 50 feet distant from No. 21 (Fig. 15), and rudely elliptical or pear shaped, its diameters being 20 and 14 feet. (See Fig. 18.) A light covering of ice about half an inch in thickness was on its surface, except for 4 feet square.

The temperature taken at the same time as the preceding ones was 47° F. (8°.3 C.); in August, 1877, it was 73° F.

A half gallon of this water was also obtained for analysis by Dr. Smart, U. S. A.

At none of this group is the odor as strong as at the hot ones above or the cold ones below. It may therefore be inferred that they contain in solution a smaller quantity of the hydrogen sulphide.

**THE OJO FRIO SPRINGS**

are a number that arise in the stream itself and on the banks of Ojo Frio Creek, being all cold, or not exceeding “temperate” (60° F.), as the name of the creek implies. The two examined are adjacent to and on the opposite side of the road crossings and are slightly more than a mile by the wagon road from the main hot spring.

No. 23

is about 45 feet above the road crossing, and in the very bed of the creek itself, whose waters it discolors. (See Fig. 1.)

This is one of the strongest tasting springs in the vicinity, due of course to its hydrogen sulphide. Its outlet is 5 inches wide by 2 deep, soon intermixing with the water of the creek, the depositions, grayish-white, hardening into a substantial rock.

November 30, 11:30 a.m., the temperature of the air, shade, being 40° F., in the sun 53° F., that of this spring was 49° F. (9°. 4 C.).

No. 24

is on the southern side of the creek and not far distant—upon the slope of a knoll forming bottom-land between the creek and the river. (See Fig. 1.) Its uprising forms a pool 15 feet in length, 8 in width, and 3
in depth. Depositions of soft pulpy matter, black and white sulphur mud, and incrustations upon the sedges and various grasses in the swampy area formed, are all abundant. Its temperature taken with the air as above, was 44° F. (6°. 7 C.).

A half gallon of its water was obtained for analysis by Dr. Smart, U. S. A.

Another spring of feeble force may be observed by the wayside not many yards east of No. 23; others are adjacent to the creek some miles farther up its course; one or more may be seen in the great level valley between this stream and the San Juan, a few miles above Pagosa, and still another, several miles west of the river, along the road to Animas City.

CAMP LEWIS.

The new cantonment was so named in honor of Lieut. Col. Lewis, Nineteenth Infantry, killed in action during the raid of the Cheyenne Indians the past summer.

At the time of the examination of the springs, two companies of troops were encamped at Pagosa: I, Fifteenth Infantry, Lieutenant Cornish commanding, upon the east side of the river, and D, Ninth Cavalry, Lieutenant Guilfoyle commanding, upon the opposite bank—the position of their tents, &c., being indicated in Fig. 1.

The buildings of the new cantonment were being rapidly erected under the able superintendence of Capt. W. T. Hartz, Fifteenth Infantry, then commanding officer of the post, the location (see Fig. 1) being a bench upon the right bank of the San Juan, some 20 feet above the bed of the river.

Although the area is contracted, the site chosen is admirably adapted for the purpose of a winter camp. Very convenient to water, not far distant from the hot springs, and commanding a good view, its location is warmer than any other; a line of low hills on its immediate north provides shelter from cold winds descending from the high mountains of the Pagosa Range; its being open to the south gives it an all-day sun.

The buildings being erected agreeably to plans and specifications prepared at Fort Garland, are as follows:

- Ten for enlisted men,
- Two for company kitchens,
- Five for officers' quarters,
- Four for storehouses,
- One for officers,
- One for guard-house,
- One for hospital;

each to be 22 feet by 14 feet by 6 feet high; all inside dimensions in the clear. The materials, logs, well chinked, with a roof of shingles.

In addition thereto are to be built stables and corral, post bakery, laundresses' quarters. The sketch (Fig. 2) shows the condition of the buildings, December 1, the result of but three weeks' work—ten days later all of the line of men's quarters being under roof. The order of their erection decided upon by the commanding officer was:

1st. Soldiers' quarters;
2d. Stables and corral;
3d. Officers' quarters;

primarily insuring comfort for men and animals.

Each of the ten buildings for troops is calculated for ten men, having a door with a four-light sash opening on the parade, opposite which is an open-stone fireplace and at either end an opening 24 by 18 inches.
closed with the solid shutter. Similar to the ordinary guard-house at both ends of the room, about 15 inches above the pine flooring, is a raised platform intended for five men; its width 6 feet; its length the width of the cabin, 14 feet.

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Figures 19, 20, 21, 22, and 23 show the above in ground plan, with section and interior elevation, and front, side, and rear elevations.

Kitchens and storehouses will be similarly built, being lighted also by the sash of the door; each set of officers' quarters, the guard-house, and hospital will be divided into two rooms, the sides having each a four-light sash, the door being solid, with a sash upon either side; the office building will be partitioned into a hall and two rooms, lighted similarly to the above.

The general plan and arrangement of the various buildings is shown in Fig. 1, being arranged upon three sides of a rectangle, the open end upon the west, the parade being 70 yards wide.
During the past season a government road across the range from Alamosa, the terminus of the Denver and Rio Grande Railroad, to Pagosa was commenced by First Lieut. E. H. Ruffner, United States Engineers, chief engineer of the department, and the major part, including all of the eastern side in the Alamosa Cañon, the summit, and the most difficult portion of the western slope, completed. This route is by far the most direct line from the east to the springs, making it less than 90 miles distant from Alamosa.

The survey of the military reservation, a square of six miles, was made during the present month by Lieutenant Ruffner, chief engineer of the department.

In the event of the continued military occupation of Pagosa and the erection of permanent buildings therefor, the preferable location of the post would be in the spacious valley on the left bank of the San Juan, already described, lying above and to the east of the springs.