Precambrian of South Boulder and Coal Creek, Colorado: [specimens] 15977-15988. No. 102 1890

Lakes, Arthur, 1844-1917
[s.l.]: [s.n.], 1890

U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

No. 102.

July 1890

Pre-Cambrian of South Boulder and Coal Creeks, Colorado.

Arthur Lakes

15977–15988

LAKE SUPERIOR DIVISION.

INSTRUCTIONS.

1. Ordinarily at least two pages of this book will be devoted to one section. On the left-hand page, place a map of as much of the section as has *actually been seen.* Denote rivers, lakes, marshes, etc., by the usual topographical signs. Denote the ledges of rock, when no structure is made out, by cross-hatching, making the cross-hatching cover as nearly as possible the areas occupied by the exposures. If the rock is a massive one, but still more or less plainly bedded, use the same sign with a dip arrow and number attached, showing the direction and amount of the dip. Denote a shaly or other very plainly bedded ledge by right parallel lines, and a ledge having a secondary structure by wavy parallel lines running in the direction of the strike, with dip arrow and number attached as before. The greatest care must be taken to avoid confusing slaty or schistose structure with bedding, and in all cases where there is the least doubt about the true bedding direction, indicate it by a query. To each exposure on the face of the map attach the number of the specimen representing it. In mapping the section count each of the spaces between the blue lines as 100 paces, and twenty of these spaces to one mile, or 2,000 paces. Usually the southeast corner will be placed at the bottom of the page, or at the first black line above the bottom of the page, and at the right-hand side. If, however, for any reason, it is desirable to show portions of an adjoining section, the southeast corner may be shifted up, or the map may be turned around and the north placed at the left-hand side of the page. The ruling of the left-hand page is also arranged so that, if desirable, a smaller scale can be used, two inches, one inch, or even one-half inch to the mile. With the two-inch scale, the squares outlined in black represent sections, and those in red, quarter sections and "forties," while the space between the blue lines is 200 paces.

2. On the right-hand page place the notes descriptive of the exposures. Begin in each case with the number of the specimen, placing the number on the left-hand side of the red line, after which give in order on the right of the same red line the position of the ledges as reckoned in paces from the southeast corner of the section, and the dip and strike when observable, for instance 4025, 250 *N.*, 300 *W.*, *Strike, N.* 6° *E., Dip,* 50° *E.* Then follow with as full a description of the ledge as possible. When topographical maps are used for locations this paragraph applies only in part.

3. Collect a specimen from every ledge, or wherever there is a change of rock on any one ledge, taking care to get fresh material, unless for a special purpose the weathered surface is desired. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be specimened, but chips of them must be taken. The position and extent of the ledges not specimened should be marked on the map, with notes that each is of a rock identical with specimen so-and-so. Under the same conditions small sized specimens, trimmed to a uniform size of 2 x 2½ x ¾ inches will be allowed, but in all other cases *large sized specimens*, trimmed to a size of 3 x 4 x 1 inches, must be selected, in accordance with section 3, chapter IV, p. 44, Regulations of the U. S. Geological Survey. In all cases collect chips for slicing. Specimens should not be placed together without protection in the collecting bag as the fresh surfaces, important in determining the character of rocks, are thus destroyed. They should be damaged by no temporary mark, but the numbers should be at once marked in at least two places upon the inclosing paper or cloth bags. It is desirable that specimens be permanently marked in camp by painting the numbers upon them in white upon a black background, using Silver White and Ivory Black oil tubes for color, with turpentine as a diluent.

4. On the last twenty-five pages of the book give, as may seem desirable, a general account of the examination of the region mapped in the previous pages, correlation of observations, sketches, cross sections, etc.

5. Forward this note book as soon as filled as registered mail matter to C. R. Van Hise, U. S. Geologist, Madison, Wis.

Book #102

Informal report on pre Cambrian rocks in South Boulder & Coal Creek Canons, Colorado.

Went to South Boulder last Monday, June 23rd. We drove up the canon about two miles passing on our way the first and second exposures and stopped at the Saw mill just where the river bends sharply to the North west, and where a canon comes in from the south cutting diagonally across the dip of the pre-Cambrian and offering a good exposure and section, which I call in my notes exposure No. 8 and the canon - Wood road canon.

At the beginning of the canon the pre-Cambrian is on one side i.e. south; and the massive heavy bedded gneiss on the other i.e. north. The river for about 1/2 a mile forming the dividing line between the two formations. Then it turns sharply south and cuts through nearly the

entire series and again turning west follows along the strike towards the upper portion of the pre-Cambrian.

At the beginning of the section I found the lower schistose zone resting or rather grading into a brown schistose gneiss becoming more and more compact and gneissic.

As it receded from the schists without any symptom of unconformity, I was wrong in my last letter in supposing the conglomeratic quartzite to be the base of the system. At all the exposures I examined it is separated from the gneiss by a zone of the peculiar pre-Cambrian schists and these graduate almost imperceptibly into a coarser dark brown or purplish schist which gradually becomes more compact till it shades into a schistose gneiss and finally the lines of lamination become almost extinct in a compact gneiss the change

seems optically to be one of color from a light grey to a brown or purplish and reddish a coarser fine a greater development of red feldspar crystals and a generally increasing compactness and more gneissoid character with more and larger pegmatitic veins sometimes 2 feet in diameter either coincident with the bedding or traversing it diagonally. Taking the quartzitic conglomerate as a point of departure, the series above it becomes more and more truly quartzitic with apparently few or no schistose zones but at intervals several zones of conglomerate which shade off into quartzite. These quartzites are also profusely veined with a dark blood color or purple veinlets and streaks of some iron substance Sometimes they are nearly white and very very hard but a dark blue grey is the prevailing hue. with frequent bands of dark lines apparently mica gives these

a banded gneissoid look.
Veins of quartz mica and some
feldspar not unfrequently cross
them. The quartzose schist is
generally thin bedded and pre-
serves a very uniform charac-
ter for great thickness.
Below the quartzite conglomerate
which is a belt from one to five
feet thick the transition is more in-
teresting. Grayish white quartzose
schist well laminated lies im-
mediately beneath and adherent
to the quartzite conglomerate. It
presents a singular blotched
appearance The blotches of purple
hematite from greater hardness
rising above the softer schist
like so many big boils and
giving the rock quite a spotted
and mammillated appearance
most singular to behold.
This red iron material however
does not in this zone appear
to take the definite form of
garnets but rather blotches
and stains the schist.

This however, is followed below by a similarly colored schist of a yellowish pale grey with many black specks in it apparently mica and well formed crystals of garnet.

This grades into the brownish purplish and coarser and more roughly laminated schist in which to the eye the garnets are not distinct and this again into a compacter schistose gneiss with seemingly a greater development of mica and a more definite development of feldspar crystals and the feldspathic element. The rock becoming of a more reddish hue in consequence. This again into still compacter gneiss with more mica and a true gneissoid structure. Whether again this grades as I think into the very heavy bedded massive granitic gneisses or is unconformable to them, I know not.

or whether again the latter are unconformable to the great grey domes of amorphous very coarse granite 3 or 4 miles west of the series, I had not good opportunity for judging. Such is the general relation of this lower schistose pre-Cambrian series to the gneissoid rocks, and I found the same at three different points a considerable distance apart.

From the junction of the series we continued our course up the Wood road canon passing through a thickness of about 1800 feet of quartzites of a general uniform character; then the canon turned more to the right in a north westerly direction following the strike of the series and here I found a hill of granitic rocks lying conformably upon the back of the uppermost quartzites, showing as I again found later that a great granitic or gneissoid series intervenes between the pre-Cambrian quartzites and the Trias

apparently in a wedge like form as in Boulder canon proper. The quartzites are in direct contact with the pre-Cambrian granites.
I examined a little of this granitic series and got specimens of it in direct contact with and on the back of the quartzite with which it conforms in dip and strike. At one point it may be local. but where I got the nearest and actual contact it appears to be a granitoid rock intensely reticulated by small quartz veins. 100 feet perhaps further on and apparently above this the rock is more red or dark granitic gneiss bedded and showing gneissic epidotic seams. At this point about 8 miles up the Wood road canon I stopped and returned to dinner. and after dinner again returned to the canon and climbed some 600 to 800 feet up the hill where I had noticed the exposure of the schistose series to obtain at

a certain point a place where the schistose series very distinctly passed down into the gneissic without any break, erosion, or debris covering ~~covering~~. Thus I had an admirable opportunity of observing for at least 100 feet below the schist and took specimens at intervals of 20 or 30 feet, and obtained the conclusions I have given. which were confirmed later at other exposures I visited where schists graded into gneisses.

The next day, Wednesday, after breakfast I went to the exposure No. 2. of my previous trip that is about 1½ miles up the canon of S. Boulder from the entrance. Here I obtained much clearer ideas as to the relation of the schists and quartzitic conglomerate to the gneisses than before. I found that the quartzitic conglomerate was not as I supposed in direct contact with the gneisses but a space of 15 feet

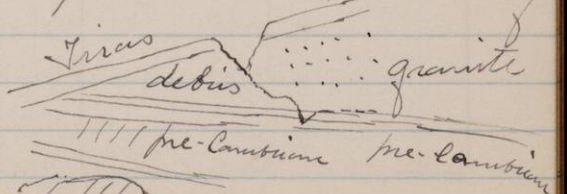
intervenes occupied as is Wood
wad canon by the blotched and
garnetiferous schists which graded
into a similar manner into the
gneissic rocks. I made some
sketches here and an accurate
section and also took specimens
of the gneissoid rocks for about
100 feet at intervals of 20 to en-
deavor to trace any progressive
series. I noticed here
what is not so patent at
Wood wad canon that after
passing the Camo schistose
gone, - gneissic schists al-
ternate with the more com-
pact gneisses at intervals.
Pegmatite veins also occur.
It does not appear to me
that the granitic pegmatite
veins in the granitoids are
necessarily eruptive but rather
the results of heated siliceous
waters and perhaps segregative
processes. though be it said their
character is very similar to that in the
underlying gneisses and they contain a

greater amount of feldspar crystals than might be supposed to come from the ~~crystals~~ quartzites.

I felt after these two experiences that I was pretty well satisfied as to the schistose series grading by pressure and metamorphic action into the schistose gneiss and that there was no real unconformity.

Thence I walked down the creek to exposure No. 1. of my first visit about 1/4 mile up the canon.

I now saw that a wedge shaped granitic area intervenes between the Quartzites and schists and the Trias on the south side of the creek probably rising up to a sharp apex whereon the south side of the creek the quartzites run diagonally as I said in a former letter, right up against (and unconformably strike + dip) the Trias, something like this.



Moreover as in Wood road canon this gneissoid granite appeared to be conformable in bedding to the pre-Cambrian.

I had only time to examine it hastily and make hasty sketches, but the nearest approach within 50 to 60 feet of the pre-Cambrian was also a very reticulated quartz ore and granite and in other specimens quite fine grained. Took specimens.

One more point I made here, and that was that the bedding of the granitic gneiss at point A which is rather heavy bedded at the north side of the creek - of whose direction I was doubtful last time - proves clearly to be generally conformable to that of the overlying pre-Cambrian. Any transition between the pre-Cambrian and this heavy bedded gneiss was obscured by debris.

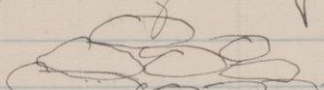
It thus appeared from these S. Boulder and Wood road canon that the pre-Cambrian generally lies between two

granitic gneissoid dikes almost like a huge vein and that these granites are generally conformable to it.

On coal creek we made still other discoveries relating to this relation of which presently.

Wednesday afternoon we left our quarters at S. Boulder and ascended the creek for about a couple of miles with a view to crossing over the mountains into Coal Creek (south). After leaving the pre-Cambrian the gneissoid soon take a heavy bedded massive character and show frequent porphyritic crystals of red orthoclase feldspar in a rather fine granitoid base. So far as I could observe these heavy beds conform to the general dip of the country and pre-Cambrian. After passing through these for about 1½ miles or more we left south Boulder and turned off to the south by a rough unfrequented road, ascending rapidly

from the summit, I gained a view of the northwestern extension of the Dias stretching toward North Boulder From what I saw, I doubt if the pre-Cambrian extends far that way or much beyond its occurrence at South Boulder for it appeared to me that north, the red granite gneisses came up in close contact with the Dias. At the top of the hill massive amorphous granite appears in dome like hillocks, apparently horizontally bedded? and consisting of



very coarse material, white feldspar often in largest distinct crystals and black mica also in largest crystals with no distinct ground mass. This I judge was about 2 to 4 miles below and west of the pre-Cambrians. I had no opportunity of seeing the junction of the heavy bedded gneisses with this amorphous granite. We turned down then to the south and

stopped at a ranch near the head of the canon and the head waters of Coal Creek. From the hills we could see the pre-Cambrian sketching away to the southwest as an independent hogback or ridge but unfortunately the mountains prevented us from seeing the continuity of its line with the S. Boulder ridge some five miles distant a point I particularly wished to see. The following morning, Thursday, we were up very early and I climbed the hill opposite the house in hopes of getting a view of this point but was again disappointed by an intervening mountain. From here, however, I made a panoramic sketch of as much of the pre-Cambrian and its relation to the granite rocks as I could see and was able also to sketch part of its continuity to the southwest. I here returned and began descending the canon at a point about 6 or 7 miles from its outlet.

Going down the canon, the gneisses are very heavy bedded and crossed by pegmatite veins. Further down we come in view of part of the lower series of the pre-Cambrian consisting of about 500 feet of granitids and schists; the latter not more than ten feet thick. These rest upon or rather pass into as before the granite gneisses though the transition is sharper, the schistose element less and the gneisses become more quickly compact. They are however in perfect conformity with the lower schistose series.

The quartzite conglomerate retains the same place and relation but is not more than 10 feet from the schistose gneiss. It is followed also below by a belt of the blotched purple schist and I think that by the quartzose pale grey granitiferous schists though I could not decide the latter point owing to the talus; but among the talus were pieces

of the mica schist clearly showing that it as elsewhere grades into the schistose gneiss, and that into compactine gneiss.

The section of this 500 feet of lower pre-Cambrian was in the main identical with that in S. Bowlder except that there was less of the schistose element.

After passing through this 500 feet I was surprised to find a granitic gneiss country over 600 feet thick separating it from an exceedingly thick series of the more massive quartzitic series. This granite was red and stood up somewhat in lofty isolated masses. It seemed somewhat heavy bedded, but the bedding conformed to the pre-Cambrian which formed a lofty ridge to the south east stretching Southward underlaid by the red granite.

Just at the junction of the two formations, i.e. of this granitic gneiss with the Easterly dipping quartzites of the lower series, a huge pegmatitic vein occurs on the east side

of the canon consisting of coarse crystals of white feldspar, large crystals of black mica and great nobs of white quartz as big as a mans head and often a foot in diameter.
On the west side of the canon the continuance of this rim ~~so~~ which appeared to conform to the bedding of the series is obscured by talus and moss but the last stratum of the Quartzites of the lower series which should be in contact with it shows a highly quartzose development about 100 feet above this on the west side I found the gneiss somewhat heavy bedded and unconformable.
I had not time to examine the junction of this red gneiss with the overlying upper quartzitic series; whose great thickness cannot, I think be less than 2000 feet and I think even more.
It consists of fine grey hard quartzites, frequently banded with

black lines is rather thin bedded
The beds not often over 1 foot
or 2 feet thick. It is streaked with
that purple iron substance and
at intervals bands of quartzitic
conglomerate occur shading into
quartzite proper. It is sometimes
contorted and is intensely cross
fractured. It makes lofty moun-
tains and cliffs of a sombre grey
color. It appeared to me for
so thick a series, remarkably
uniform in general characters.
Pegmatitic veins are not un-
common, sometimes conformable,
sometimes crossing the bedding.
The stream follows the strike
for some distance, then cuts
diagonally across the dip toward
the extreme upper portion.
Contorted schists with garnets
appear and above these the red
granitic gneiss, which afterward
appears to occupy the country to the
southeast in the direction of
the Sias. This schist which
may be pre-Cambrian or

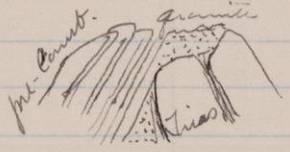
Archean is perhaps 2 miles from the entrance of the canon. At the entrance on the north side we encounter the Trias overturned and dipping 75° and to the West. The cause of this overturning is I think due to the basalt dyke of Ralliston which appears as a ridge on the south side of the creek coming in behind back of the Trias and apparently ending up here in somewhat in a tall conical hill.
The overturn is clearly local, as further north a mile or so the Trias maintains its usual Easterly dip.
Between the Trias and the pre-Cambrian is a hill and ground perhaps 500 to 600 feet thick grassed over and which may be made apparently of granitic gneiss and partly of the basalt dyke.
We now emerged on to the plains on Rocky Flat whose surface is profusely strewn with

with large boulders 90% of which are pre-Cambrian character.

Having business at Marshall we rode again north along the flat in the direction of South Boulder and had a good view of the 5 or 6 miles intervening between coal creek on the north and south Boulder on the south and could see somewhat of the relation of the Trias to the pre-Cambrian etc.

This intervening section of mountains is composed on the flanks of immense slabs of Trias dipping about 45° and to the east and striking NW and S.E. behind these for back of them appears to be a rather thin [illegible] lining or backing of red granite intervening between the Trias and the Quartzites. That the quartzites are unconformable to the Trias is as elsewhere evident. Their strike being to the S.S.W.

whilst that of the Trias is to the S.S.E. The flat sloping slabs of the Trias are seen in contrast to the edges of the differently striking and dipping pre-Cambrians, thus:-



The unconformity in strike and dip of the pre-Cambrian is so evident throughout this region that I did not spend time in testing the point by an arduous climb - which would have taken several hours - to the exact contact of the two formations. I was more devoted to the relations between the pre-Cambrian and the granite gneiss and of that I satisfied myself at several points.
It appears then that the pre-Cambrian is so far as I have seen, only a direct contact with the Trias on the north side of S. Boroldai.

That a wedge shaped granitic series intervenes between it and the Trias and moreover that in Coal Creek this same granitic series runs, that I cannot perhaps distinctly map out splits or divides the pre-Cambrian series in two, deviding the lower series of some 600 feet of quartzites and schists from a very thick upper series consisting wholly of quartzites.

2 ndly - that so far as observed this granitic gneiss series is everywhere in conformity with the pre-Cambrian.

3 rdly - that the lower pre-Cambrian grades into the granitic gneiss without unconformity. but there seems no distinct gradation series between the granite gneiss overlying or above the pre-Cambrian quartzites.

I have made and shall elaborate at my leisure several panoramic sketches

to illustrate my report which with sections and accompanying specimens, I hope will make things tolerably clear to you.

15977 Heavy bedded granite gneiss about 1/2 mile below lowest exposure of pre-Cambrian sines above 6 miles up the canon of Coal Creek, near Cockscomb Ranch (i.e. below it.

15978 Rather compact gneiss (bedded) 50 to 100 feet below pre-Cambrian schists, lower series. Upper part of Coal Creek canon 5 1/2 miles from entrance.

15979. Gneiss - a little above 15978 Coal Creek Canon.

15980 Gneiss - a little above 15979 and close the pre-Cambrian 5 1/2 miles up Coal Creek canon

15981 ~~no specimen~~ (Specimen lost)

15982 Blotched mica schist four or five feet from 15981 and next below the quartzite

conglomerate.
5½ miles up Coal Creek canon.

15983 Conglomeratic quartzite with 10 feet of gneiss and next above blotched schist.
5½ miles up Coal Creek canon.

15984. Quartzite passing into Quartz the upper contact with the intrusive granite. This forms the top of the lower 500 feet of pre-Cambrian.
5½ miles up Coal Creek canon.

15985 Thick vein of pegmatite occuring at contact of upper portion of lower series of pre-Cambrian between them and the granite.

15986 Granitic gneiss 50 to 60 feet above lower series of pre-Cambrian
Coal creek 5½ miles up canon.

15987 Thin bedded quartzite among

the thick upper series of Quartzites about 8½ miles up the canon of Coal Creek.

15988 Contorted garnetiferous mica schist many feet upper stratum of pre-Cambrian or belong to Archean. Quartzites lie below it. Red granite gneiss above. 2½ miles up Coal Creek canon.