while the gates are up, but as soon as they are closed and the water becomes still, they decline the fly, but will still take the bait; at this time it is necessary to fish below the dam, where there is still a very rapid current from leakage and overflow. The brook trout, S. fontinalis, is taken in the same waters, and in the stiller waters above, a large lake trout, there called the Togue, which differs from the Salmo confinis of the northern lakes, by having a more deeply forked tail like the *S. siskewet* of Lake Superior.

Another striking characteristic in the history of this fish, is the remarkable development, in the male, of the point of the lower jaw, or chin, whereby it becomes elongated and hooked, during and previous to the seasons of sexual connexion and spawning, which are simultaneous in fishes. This peculiarity, which, so far as I am aware, has been heretofore considered to belong to the type of the genus alone, the *Salmo salar*, adds much force to the theory of Mr. Agassiz to which I alluded before, (and I believe I am correctly informed that he has advanced such a theory). This fact, which I can vouch for from personal observation as well as other undeniable testimony, will show the necessity of a very close and searching examination of the structure and anatomy of this fish, comparing it with the true salmon, before its new name is confirmed. This sexual development, so strictly analogous to the swelling of the neck in the genus *Cervus* among quadrupeds, seems to point to further research among other species of the genus, that is to say, whether there is not a similar development, though less marked, through the whole family, as at present arranged, or if found wanting in that portion of the genus *with very minute scales*, whether it may not characterise that portion consisting of *Salmo salar*, this fish and all those having *large scales*. I was struck the other day in looking over the figures of Richardson's Trout of the Arctic Regions, that there was more than one with the projecting lower jaw. Were not these fish taken during the spawning season? And may they not have received another name in the normal state? Of course the facts at present known are too scanty to found a theory upon, but should this suggestion ultimately prove to have a foundation in fact, it would be sufficient to authorise a division of the genus.

Dr. Morris mentioned in connection with this subject, that he had observed in the common brook trout (*Salmo fontinalis*) a similar elongation of the lower jaw in the spawning season.

June 29th.

Vice President BRIDGES in the Chair.

Twenty-nine members present.

The Report of the Secretary of the Biological Department was presented.

The by-laws reported by the Committee appointed March 30th, to draft a series of by-laws for the government of the Committee on Proceedings, were read for the third time, and passed.

Whereupon Dr. Fisher offered the following:

Resolved, That all previous resolutions of the Academy, prescribing the constitution, duties and powers of the Committee on Proceedings, be, and the same are hereby repealed.

Which was considered and adopted.

Dr. Leidy, by permission of the Academy, communicated the fact, that about one half of the chrysalides of the canker-worm (*Endalimia*), which had recently proved so destructive to the foliage of our shade trees, were infected by two species of *Ichneumon*. One of the latter is comparatively large; and a single individual occupies the body of a canker-worm chrysalis. The other species is minute; and numerous individuals occupy the interior of a chrysalis.

The death of Hon. J. R. Tyson, a member of the Academy, was announced.

The following papers were ordered to be printed in the Proceedings.

Descriptions of seven new species of Margaritanæ, and four new species of Anodontæ.

BY ISAAC LEA.

MARGARITANA ELLIOTTII.—Testâ lævi, ellipticâ, inflatâ, posticè subrotundâ, inæquilaterali; valvulis subtenuibus, anticè crassioribus; natibus prominulis, ad apices paulisper undulatis; epidermide micante, radiatâ, vel viridi vel tenebroso-fuscâ; dentibus cardinalibus parvis, tuberculatis, in utroque valvulo singulis; margaritâ cœruleâ et iridescente.

Hab.—Chatahoochee River, near Columbus, Georgia. Bishop Elliott.

MARGARITANA TRIANGULATA.—Testâ lævi, triangulari, valdè inflatâ, posticè angulatâ, subæquilaterali; valvulis subtenuibus, anticè crassioribus; natibus prominentibus, tumidis, ad apices rugoso-undulatis; epidermide tenebroso-castaneâ, valdè radiatâ; dentibus cardinalibus parvis, erectis, crenulatis, in utroque valvulo singulis; margaritâ vel albâ vel salmonis colore tinctâ et iridescente.

Hab.—Upper Chatahoochee, Georgia, Bishop Elliott. Columbus, Georgia, Dr. Boykin, and J. Postell. Potato Cr., Georgia, Rev. G. White; and Sawney's Creek, S. Carolina, Dr. Blanding.

MARGARITANA CONNASAUGAENSIS.—Testâ lævi, obovatâ, posticé inflatâ, anticè. et posticè rotundatâ, valdè inæquilaterali; valvulis pertenuibus; natibus prominulis, ad apices rugoso-undulatis; epidermide viridi luteâ, posticè obsoletè radiatâ; dentibus cardinalibus parvis, tuberculato-compressis, in utroque valvulo singulis; margaritâ cœruleo-alba et iridescente.

Hab.—Connasauga River, one of the head waters of the Alabama River, in Gilmer Co., Georgia. Bishop Elliott.

MARGARITANA ETOWAHENSIS.—Testâ lævi, ellipticâ, subcompressâ ad lateris planulatis, inæquilaterali; valvulis tenuibus, anticè paulisper crassioribus; natibus prominulis, ad apices rugoso-undulatis; epidermide luteolâ, posticè obsoletè radiatâ; dentibus cardinalibus parvissimis, erectis, tuberculato-compressis, in utroque valvulo singulis; margaritâ cœruleâ et iridescente.

Hab.—Tennessee, Dr. Troost; Etowah River, Georgia, Rev. G. White.

MARGARITANA GESNERII.—Testâ sulcatâ, quadratâ, inflatâ, posticè obtusè angulatâ, subæquilaterali; valvulis subcrassis, anticè crassioribus; natibus subprominentibus; epidermide tenebroso-fuscâ, micante, obsoletè radiatâ; dentibus cardinalibus parvis, lævibus, subcompressis, in utroque valvulo unicis; margaritâ albâ.

Hab.—Uphaupee Creek, Alabama, below Columbia, Georgia. W. Gesner and G. Hallenbeck.

MARGARITANA TOMBECBEENSIS.—Testâ lævi, ellipticâ, inflatâ, posticè obtusè angulatâ, anticè rotundatâ, subæquilaterali; valvulis subtenuibus; natibus prominentibus, tumidis, ad apices undulatis; epidermide tenebroso-olivâ, obsoletè radiatâ; dentibus cardinalibus parvis, tuberculatis; margarita albâ.

Hab.—Tombecbee River, near Columbus, Mississippi. Wm. Spillman, M. D.

MARGARITANA SPILLMANII.—Testâ lævi, obovatâ, anticè valdè inflatâ, posticè subbiangulatâ, inæquilaterali; valvulis subtenuibus, anticé crassioribus; natibus prominentibus, tumidis, ad apices rugoso-undulatis; epidermide rufo-fuscâ, eradiatâ; dentibus cardinalibus parvis, tuberculato-compressis, in utroque valvulo singulis; margaritâ albâ et iridescente.

Hab.—Tombecbee River, near Columbus, Mississippi. Wm. Spillman, M. D.

ANODONTA HALLENBECKII.—Testâ sulcatâ, arcuatâ, valdè inflatâ, posticè et anticè rotnndatâ, inæquilaterali; valvulis subtenuibus, anticé paulisper crassiori-

[Junc,

bus; natibus prominentibus, tumidis; epidermide micante, vel luteâ vel tenebroso-olivâ; eradiatâ; margaritâ albâ et iridescente.

Hab.—Uphaupee Cr., Macon Co., Geo. W. Gesner.

ANODONTA GESNERII.—Testâ lævi, ellipticâ, valdè inflatâ, posticè sub-angulatâ, valdè inæquilaterali; valvulis subcrassis, natibus prominentibus, tumidis; epidermide politâ, vel viridi vel luteâ, obsoletè radiatâ; margaritâ vel albâ vel aureâ et iridescente.

Hab.—Uphaupee Cr., Macon Co., Alabama. W. Gesner, of Milledgeville, Georgia.

ANODONTA DARIENSIS.—Testâ lævi, ellipticâ, ventricosâ, inæquilaterali, posticè obtusè angulatâ; valvulis subtenuibus, anticè crassioribus; natibus elevatis, tumidis, ad apices minutè undulatâ; epidermide tenebroso-olivâ, striatâ, obsoletè radiatâ; margaritâ cœruleo-albâ et iridescente.

Hab.—Hopeton, near Darien, Geo., J. Hamilton Couper; and Swift Creek, near Macon, Geo.; Bishop Elliott, and J. C. Plant.

ANODONTA DANIELSII.—Testâ lævi, ellipticâ, compressâ, posticè obtusè angulatâ, valdè inæquilaterali; valvulis subtenuibus; natibus prominulis, ad apices undulatis; epidermide tenebroso-fuscâ, micante, obsoletè radiatâ; margaritâ cœruleo-albâ et iridescente.

Hab.—Topeka, Kansas. Prof. Edward Daniels.

Explorations under the War Department.—Explanations of a second edition of a Geological Map of Nebraska and Kansas, based upon information obtained in an Expedition to the Black Hills, under the command of Lieut. G. K. Warren, Top. Engr. U. S. A.

BY F. V. HAYDEN, M. D.

Geologist to the Expedition.

In May of 1857, by permission of the War Department, I prepared and read before the Academy of Natural Sciences at Philadelphia, a few brief notes on the geological structure of the vast region drained by the Missouri River, with a section showing the different formations from Fort Benton to the mouth of the Platte. The geology, as far as it was known at that time, was represented by colors, on a topographical map constructed by Lieut. Warren. Since that time the expedition to the Black Hills under his command, has brought back many additional facts and much new material, which render a second edition of the map necessary, and enables me not only to add some geological formations, not previously known to exist in the West, but to enlarge to a considerable extent the boundaries of others. In my notes explanatory of the geological portion of the map, I shall endeavor, as far as possible, to avoid the repetition of material already made known, through numerous publications, in connection with Mr. Meek. A much larger surface might have been colored on the map with a good degree of confidence, but I have preferred to confine myself, for the most part, to the results of my own observations in the field, leaving the blank portions to be filled up by future explorations.

The rocks of Nebraska, as far as they are at present known, are referrible to the following geological systems:

I. Metamorphosed azoic rocks, including clear granite.
II. Lower Silurian. (Potsdam standstone.)
III. Devonian?
IV. Carboniferous.
V. Permian.
VI. Jurassic.
VII. Cretaceous, Upper, Middle and Lower (including Wealden?)
VIII. Tertiary.
IX. Post Pliocene or Quaternary.

I. GRANITIC AND METAMORPHOSED AZOIC ROCKS..

From the mouth of the Platte to Fort Laramie we meet with no indications of those disturbing influences from the subterranean forces which have wrought such changes in the physical features of the country in the vicinity of the mountain chains. But proceeding north and west from Fort Laramie, we soon find the different formations, older than the Tertiary, distorted and dipping at various angles. We observe, at first, a series of elevations in the form of isolated conical hills with rounded summits, varying from fifty to two hundred feet in height, for the most part, capped with Carboniferous limestones, which incline at various angles from 5° to 30°. Toward the main axis we find the elevations in the form of oblong ridges, frequently interrupted by narrow valleys, and presenting a full series of the formations known in this region, from the granite to the carboniferous limestones.

Winding around these conical peaks and ridges are numerous streams of pure water, margined with birches, poplars, and other trees, of the same species as those found in far northern latitudes. Not unfrequently the valleys formed by these streams are of considerable width, with a soil composed of the debris of the granitic and metamorphic rocks which sustains a quite luxuriant growth of vegetation. Laramie Peak,* the highest elevation in the Laramie range of mountains, is composed mainly of a coarse red feldspathic granite, surrounded by a series of azoic strata composed of gneiss, hornblende, micaceous and clay slates and quartz more or less pure, standing vertical, and inclining against the older granitic rocks. Raw Hide Peak, which is about 1,000 feet high, is also composed principally of granite which has been protruded upward through the overlying rocks, while all around the base of the peak, in regular sequence outward, may be seen the different azoic strata in a nearly or quite vertical position. Proceeding northward from Fort Laramie, the granitic and metamorphosed rocks cease to appear after passing the head of the Niobrara river, and from thence to the Black Hills we observe only slight local disturbances, sufficient to expose the Cretaceous beds down to No. 1, but showing most conclusively that the same subterranean forces that elevated the Laramie Mountains, raised the Black Hills also.

Arriving at the base of the Black Hills, we ascend by a series of stair-like ridges to the central or highest portion, and find that it is composed of a similar coarse red feldspathic granite as a nucleus, with a series of azoic strata resting against the granite. At the foot of the Black Hlls, Cretaceous bed No. 5 is but slightly disturbed; dipping, perhaps, at an angle of 5°, and forming the first of a series of upheaved ridges which surround the principal axis. Passing over the first ridge we descend somewhat abruptly into a valley, and gradually ascend a second ridge, composed of Cretaceous beds Nos. 5 and 4, from eighty to one hundred feet in height, inclining at a still greater angle. The third ridge is formed of Nos. 4 and 3, and so on through all the different formations to the Potsdam sandstone, which is sometimes nearly vertical, and at others so elevated as to hold a nearly horizontal position. The granite of the Black Hills contains much more mica than that forming the nucleus of the Laramie Mountains, and might perhaps be more properly called a micaceous granite.

The Black Hills furnish the only examples on our route of the outburst of trappean rocks. Stone Peak, on the north eastern side of the Black Hills, is an isolated protrusion, composed of every variety, from a most cellular or vesicular porphyritic lava, to a rather compact rock, which sounds under a blow of a hammer like clink-stone. The highest portion of the peak is composed of trap rock of greater age than that above described, very compact, contains much iron, and assumes the form of pentagonal columns very similar to those described in Dr. Owen's report as occurring around Lake Superior. Near Bear

* Elevation unknown.

Peak, on the north-eastern side of the Black Hills, is another example of the protrusion of these basaltic columns which are also five-sided, the sides varying from eight to twenty inches in width. Some of the columns lie in a nearly horizontal position, the greater portion, however, inclining at an angle of 20° to 40°. Bear Peak is an outburst of porphyritic trappean rocks, specimens of which closely resemble the Tertiary lavas of the Pacific coast. All the Cretaceous beds and all the Jurassic to the blue limestone *E* of vertical section* are upheaved around Bear Peak.

From the foregoing examinations I am led to the conclusion, that the main body of the Black Hills and the Laramie range is composed of granite of very ancient date. That it is older than the oldest fossiliferous rocks is obvious from the fact that in both localities several hundred feet of stratified azoic rocks are interposed between it and the Potsdam sandstone. I am also of the opinion that the azoic strata overlying the granite on the eastern slope of the Rocky Mountains are similar in lithological characters, and hold the same geological position as the azoic rocks so largely developed around Lake Superior and in Canada.

II. Lower Silurian Rocks—Potsdam Sandstone.

The evidence of the existence of this formation in the region of the Rocky Mountains was ascertained, for the first time, in the summer of 1857, during Lt. Warren's Exploration of the Black Hills, as has already been shown in a paper read before the Acad. Nat. Sci., in March 1858. Its largest developement and only fossiliferous condition is found in the Black Hills, where by upheaval it is exposed in the form of a narrow belt or zone engirdling the azoic and granitic rocks which form the central axis of elevation. I observed no positive indications of this formation in the Laramie Mountains or at Raw Hide Peak, but in most places the Carboniferous strata rested unconformably upon the metamorphic rocks, except in a few localities, where a quartzose limestone which may be of Devonian? age was interposed. But at the head of the Niobrara river, a series of horizontal beds were exposed, resting upon the vertical edges of the metamorphosed rocks, which from their lithological characters I have considered as belonging to the Potsdam sandstone.

The following section will show the descending order of the beds.

c.—A yellow and reddish yellow, heavy bedded, friable sandstone, composed of an aggregation of quartz grains, cemented by calcareous matter, sometimes becoming a conglomerate, consisting of rounded quartz pebbles, ... 22 feet.

b.—Fine compact, reddish clay slate, ... 5 feet.

a.—Very nearly like bed *c*, only more compact and heavy bedded, of a light gray color, sometimes yellow with a reddish tinge, . . . 37 feet

A series of metamorphic vertical strata, consisting of gneiss with silvery mica in large plates, micaceous and talcose slates, white quartz, &c.

Proceeding on our route northward, this formation was not again seen until we arrived at the main axis of elevation of the Black Hills. Near our camp, of September 24th, on the southeastern side, I observed resting unconformably upon gneiss, hornblende, mica slate, &c., a variegated, gray and reddish gray quartzose sandstone filled with small plates of mica. Some parts of it were compact and silicious, others a coarse friable grit, and at this locality seldom becoming a conglomerate, but containing seams almost entirely composed of comminuted fragments of shells, cemented with a fine grit. The more compact masses contained some fossils that were quite well preserved, among which were species of *Lingula*, *Obolus* and *Trilobites*, similar to, or identical with, those found in the Potsdam sandstone in other well known localities.

* See vertical section of rocks in the Black Hills, in a paper by F. B. Meek and F. V. Hayden, Proc. Acad. Nat. Sci., March, 1858.

The following section at this point may serve to render more clear the order of succession of the beds.

c.—Yellow magnesian limestone,	50 feet.
b.—Yellowish gray arenaceus limestone,	40 feet.
a.—Potsdam sandstone, as described,	30 to 50 feet.

Azoic rocks standing vertical.

Beds *b* and *c* are Carboniferous and conformable to bed *a*. We continue to see this formation whenever we approach the central portion of the Black Hills, and in some localities the greater part assumes the character of a coarse conglomerate composed of worn fragments from all the varieties of rocks beneath. Sometimes the lines of lamination are very irregular, as if the materials had been deposited by ocean currents. I observed this bed on the northeastern side of the Black Hills near Bear Peak, dipping at an angle of 20° to 30°.

Inasmuch as we have no paleontological evidence of the existence of this formation in the Rocky Mountain range, we must depend upon the somewhat uncertain data of lithological resemblance and position, for its geographical distribution. Prof. Hall, in Stansbury's Report, often describes a bed of sandstone corresponding in its lithological characters and geological position to the Potsdam sandstone in the Black Hills. Stansbury's Island, (Great Salt Lake) the summit of which is three thousand feet in height, is capped with carboniferous limestone, which also rests upon a coarse sandstone and conglomerate. Again, north of Great Salt Lake City, the "limestone overlies a coarse sandstone or conglomerate, which almost invariably accompanies it." "In several localities, as at Promontory Point, and near Mud Island, the metamorphic strata appear to be overlaid by a coarse conglomerate or coarse sandstone, which is partially altered and assumes the character of a quartz rock." Marcou, in the third volume of Pacific R. R. Reports, page 156, speaks of a sandstone occurring near the Aztec Mountains. He says: "We travelled seven miles upon the granite, and on our right we found a cliff twelve hundred feet high. From the base to the middle we found the granite, then a band of red sandstone, (Devonian or Old Red.) Above this, the beds of limestone and gray sandstone, belonging to the mountain limestone." The following day "we travelled three miles on the granite, the remainder on the Old Red Sandstone."

The diagram given, showing the order of the superposition of the different rocks, would apply equally well to the similar beds in the Black Hills. Many other less evident indications along the base of the Rocky Mountains might be cited from published Reports, but what has been said will be sufficient to show what we may hereafter expect with regard to its geographical distribution in the far west.

III. Devonian? Formation.

The evidence of the existence of the Devonian formation near the eastern slope of the Rocky Mountains, is, as yet, quite obscure. Owing to the metamorphosed condition of the rocks, the fossils have been wholly obliterated, or only indistinct traces of them remain. About twelve miles west of Fort Laramie, the Platte river cuts through a series of strata three to four hundred feet in thickness, resting unconformably upon metamorphosed azoic rocks. The upper members of the series contain undoubted carboniferous fossils, which are sufficient to fix, with a good degree of precision, their age; but resting upon the azoic rocks, is a very hard, compact quartzose limestone, evidently metamorphosed to some extent, which, from its position and lithological character, I am disposed to refer to Devonian, though it may be of Silurian age. On the Platte river, it holds a horizontal position for the most part, but in a few localities the underlying azoic rocks are thrust up through it, distorting it at every angle. About ten miles north of Fort Laramie, near Raw Hide Peak, it is again exposed, the strata being vertical, alternating with soft, dark, blue clay slate. I did not see any indications of it in the vicinity of Laramie Peak, or in the Black Hills.

In regard to the geographical distribution of the formation, very little can be said. Mr. Englemann, geologist to Lieut. Bryan's Expedition to the South Pass, often mentions a similar rock occurring at various localities between Fort Laramie and the South Pass.* Dr. Shumard, after an examination of some specimens placed in his hands by Mr. E., says: "The specimens from the metamorphosed silicious strata, on the north side of Medicine Bow Butte, are Paleozoic types, belonging to the genera *Spirifer*, *Chonetes*, *Orthis*, *Orthoceras*, *Conocardium*, &c. They were very badly preserved, and their specific characters almost wholly obliterated. From their general appearance, however, I am strongly of the opinion that they represent the Devonian period." The evidence of its existence in the vicinity of Fort Laramie and other localities is so slight, that I have thought it not prudent to color any portion of the map as Devonian.

IV. Carboniferous System.

This system, as it is developed in the region of Fort Laramie, has been discussed so fully by Mr. Meek, and the writer in our paper published in March last, that I need only refer to it in a very brief manner. The town of Desoto is the highest point known on the Missouri where these limestones are exposed. Ascending the valley of the Platte river, we find them quite well developed as far as the mouth of the Elkhorn, when they pass beneath the bed of the river, and the sandstone No. 1 occupies the country. Several small seams of coal have been found in these limestones at Bellevue and other localities; and in the valley of the Platte, about ten miles above its mouth, I noticed a bed of very dark carbonaceous shale two feet in thickness, cropping out near the water's edge. This was considered by the inhabitants as a sufficient proof of the existence of a workable bed of coal in the vicinity. The evidence now points to the conclusion, that, though these limestones belong to the true coal measures, they hold a position above the workable beds of coal, and that it is not probable a valuable seam of coal will be found north of the southern line of Nebraska. A bed of coal, of inferior quality, has been wrought near Leavenworth City, Kansas Territory, but it holds a lower geological position than the limestones of the southern portion of Nebraska, the dip of the strata being toward the northwest.

The exact position in the Carboniferous system, to which the limestones around Fort Laramie and in the Black Hills belong, is not sufficiently clear from the evidence yet obtained. They do not seem to be the equivalents of the beds above described along the Missouri, though they may be. The texture of the rock is quite unlike that of any of the limestones of the coal measures with which we are acquainted, and there seems to be an absence of the fossils characteristic of the coal measure limestones on the Missouri, and in northeastern Kansas. The latest opinion, however, of my associate, Mr. Meek, is, that they belong to the true coal measures.

The following sections may serve to show the relations of the limestones at Fort Laramie with those in the Black Hills.

d.—Vertical section of carboniferous rocks near Fort Laramie.

Yellow magnesian limestone, hard and rather granular in its structure; contains several species Rhynconella, ... 50 feet.

c.—Very compact bluish gray limestone, with a deeply sinuate Productus, and a Productus like *P. cora* in the fineness of its striæ, . . 20 feet.

b.—Rather friable, flesh colored, arenaceous limestone, with an abundance of a smooth Terebratula, like *T. subtileta*, ... 4 feet.

a.—Yellowish and whitish arenaceous limestone, containing *Spirifer*, *Rocky montani*, (Marcou) allied to Lower Carboniferous forms; a second species very much like, perhaps identical with, *S. cameratus;* a third, with a high area like *S. cuspidatus;* also a species of Productus very closely allied to *P. semirettculatus*, ... 30 to 40 feet.

* President's Message and Documents, 1857, page 417.

Vertical section of Carboniferous rocks in the Black Hills.

2.—Yellow magnesian limestone, rather hard and compact, passing down into a somewhat friable arenaceous limestone, underlaid by a bluish limestone, very hard, and containing a Productus like *P. cora*, and a Rhynconella.

1.—Yellowish gray arenaceous limestone, with a reddish tinge, splitting into thin slabs parallel with the lines of stratification ; containing a Spirifer, perhaps identical with *S. cameratus;* a Productus like *P. cora;* corals, a Zaphrentis, Syringopora, &c. In the middle of this bed there is an eight foot layer of very hard compact bluish limestone, filled with comminuted crinoidal remains.

The lower portion of bed (1) is the same as bed *a* of the Laramie section, and contains fossils at both localities which are similar to Lower Carboniferous types, along with some well marked Carboniferous species. In the Black Hills it contains a species of Euomphalus, resembling a species common in the Encrinital or Burlington limestone of the Lower Carboniferous series of the Western States, but perhaps distinct.

Bed 2 includes beds *a* and *b*, of the Laramie section, bed *c* being absent in the Black Hills section.

From the geological position, texture of the rocks, similarity, and in some cases identity of species of fossils, I think it quite certain that the limestones at Fort Laramie and in the Black Hills are the same as those so well developed in the vicinity of Salt Lake, in Utah Territory.

V. Permian Rocks.

Although but a short period has elapsed since, through the collections of Maj. Hawn, the evidence of the existence of this system of rocks in the West has been given to the world, it has already been shown to occur over a wide geographical area. In addition to Maj. Hawn's discoveries in northeastern Kanzas, which were announced in February last, and the paper published March 2d, by Mr. Meek and the writer, Dr. Shumard stated, at a Meeting of the Academy of Natural Sciences, at St. Louis, March 8th, that he had been studying a group of fossils from a white limestone in the Guadalupe Mountains, of New Mexico, and arrived at the conclusion that they were of Permian age. He also says, that several of the species are identical with Permian forms from England and Russia; also identical with species obtained from the Permian rocks in Kanzas. It is now known to occur in a number of localities in the central portions of Kanzas ;* also along the Missouri River and opposite the northern boundary of the State of Missouri, and the evidence is quite conclusive, that it is developed in the Black Hills. Many stray masses of compact silicious rock were found in and around the Black Hills, containing fossils identical with those described from Kanzas. This question has already been discussed in a former paper, and I have considered the two beds E and F of the Section as Permian, with a query, the evidence not being sufficient to establish its existence with certainty. In a letter to the Academy of Sciences at St. Louis, dated March 31st, Dr. Norwood announced the discovery of Permian fossils in Illinois, and at the Meeting of the American Association for the Advancement of Science at Baltimore, Mr. A. H. Worthen, State Geologist of Illinois, read a paper on the Permian rocks of that State, and exhibited a fine collection of fossils, which he considered as belonging to that system. We have, therefore, reliable evidence of the existence of these rocks in Kanzas, Nebraska, New Mexico and Illinois, and future investigations will, I think, prove them well developed in Missouri and other Western States.†

* I have endeavored to represent this formation on the map, in Kansas, from information derived from Major Hawn's explorations.

† In our remarks of the 2d of March, upon the discovery of supposed Permian rocks in the West, both Mr. Meek and myself wish to be understood as referring to their existence in Kanzas and Nebraska. Our object being simply to announce our conclusions derived from the study of fossils col-

lected from these rocks in the West, we did not refer to their supposed prior discovery in Pennsylvania and on the Atlantic coast, nor were we able to judge of the evidence of their existence in those localities, it being based, for the most part, upon the remains of Vertebrata, which are out of our line of investigation. We also merely wished to announce the existence in the West of rocks which were on a parallel with the so-called Permian system of Europe, without touching the great question whether or not there is actually a Permian *system* distinct from the Carboniferous.

VI. JURASSIC SYSTEM.

The Black Hills has, up to this time, afforded the most satisfactory evidence of the existence of this system in the West. It is there brought to the surface by the upheaval of the older rocks in the form of a belt or zone, five to fifteen miles in width, engirdling the principal axis of elevation. None of the organic remains already discovered, which are quite numerous in species, are known to be positively identical with those found in the same system in the old world, but they belong to the same genera, and many of the species are so closely allied to forms characteristic of the Jura of Europe, that we cannot now hesitate to admit this system into our series. I will here repeat the palæontological evidence, which was read before the Academy in March last by Mr. Meek and myself. with such additional proof as we have been able to secure by our investigation of the undescribed fossils in the collection, up to the present time.

1st. *Pentacrinus asteriscus*, n. sp., is so nearly like the Liassic *P. scalaris*, Goldfuss, that it is with some hesitation we have regarded it as new.

2d. *Avicula* (*Monotis*) *tenuicosta*, n. sp., is very closely related to *M. substriata*. of Munster, from the Lias.

3d. *Arca* (*Cucullœa*) *inornata*, n. sp., is very similar to *C. Munsteri* (Zeiten,) also from the Lias.

4th. *Panopœa* (*Myacites*) *subelliptica*, n. sp., is similar to the Liassic forms *M. liasensis* and *M. Alduininus*, of Quensted.

5th. *Ammonites cordiformis*, n. sp., is the same type as the Oolitic species *A. cordatus*, (Sowerby).

6th. *Belemnites densus*, n. sp., is scarcely distinguishable from the Oolitic species *B. eccentricus*, Blainville, if, indeed, it is really distinct.

We have, also, in the collection from the Black Hills, a species of Hettangia. a genus not known to occur in the old world in formations newer than the Lias. and a Trigonia more nearly resembling Jurassic types than those of any other formation.

Although it is not yet known to occupy a large geographical area in this country, we have indications that it will be found extensively developed on the eastern slope of the Rocky Mountains, from the northern part of British America to New Mexico. That it exists toward the head waters of the Yellow Stone, around Panther and Big Horn Mountains, I cannot doubt.

In the summer of 1854, while exploring the valley of the Yellowstone, as far as the mouth of the Big Horn River, I received, from intelligent traders. masses of gypsum precisely like that characterizing the Jurassic beds in the Black Hills.

VII. CRETACEOUS SYSTEM,*—UPPER, MIDDLE AND LOWER (INCLUDING THE WEALDEN?)

The beds of sandstone impure lignite, &c., which we have hitherto described as resting upon the Upper Carboniferous limestones, near Council

*In a paper recently published by Maj. F. Hawn, in the St. Louis Acad. Sci., I observe he refers the whole of formation No. 1 of the Nebraska section to the Trias; and alludes to the fact that Mr. Meek and I had referred it to the Lower Cretaceous. He also states. that he found in some of the lower beds included by us in this series in Kanzas, fossils indicating relations rather to the Permian below than the Cretaceous above.

In justice to Mr. Meek and myself, I would state, that these lower beds in Kanzas

Bluffs, and extending above the mouth of the Big Sioux River, have, until recently, been considered of doubtful geological age, on account of the paucity of their organic remains. The discovery, during the past year, at Blackbird Hills, of dicotyledonous leaves in this formation, allied to the oaks, willows, and others of our deciduous forest trees, together with their position with regard to other well-known Cretaceous formations, renders the evidence quite clear that a large portion of the strata which we have included in No. 1 of our vertical section, are of Lower Cretaceous age.* In ascending the Platte Valley, No. 1 is first observed five miles above the mouth of that river in the form of an outlier, resting upon the Carboniferous limestone and gradually increasing in thickness to the mouth of the Elkhorn; it then covers the surface of the country as far as Beaver Creek, a branch of Loup Fork. We have already mentioned its exposure by elevation in the valley of Old Woman's Creek; and it also forms a belt around the Black Hills, presenting its usually variable lithological characters, and for the most part destitute of fossils. No. 2, 3, 4 and 5 also occur in their order of sequence outward from the Black Hills, as is shown by colors on the map. We have therefore arrived at the conclusion, that No. 1, as it is revealed from Council Bluffs to the Big Sioux, is Lower Cretaceous; although two or three beds of yellow and ash-colored clays, exposed at low water, near Blackbird Hills, may be Upper Jurassic, no organic remains having been found in them to fix with certainty their age. We also consider a large portion of No. 1?, as seen at the mouth of the Judith, Lower Cretaceous, though some of the beds are probably Jurassic. Should the Jurassic system be found to exist in the Judith country, of which fact there is room for very little doubt, we may look for a large development of it in the Great Lignite basin, which stretches northward toward the Arctic Sea.

The discovery during the past year in the Black Hills, of beds containing fresh water fossils of the genera Unio, Planorbis, Paludina, &c., in the lower portion of Cretaceous formation No. 1, or the upper part of the Jurassic, points to the conclusion that there probably are deposits in the West equivalent to those of the Wealden of Europe. The existence of this formation in the West, was first suggested by Dr. Leidy after an examination of some Saurian rem ains discovered by me near the mouth of the Judith river, in the summer of 1855. At that time the evidence seemed to be conflicting in its character, the Mollusc ous fossils appearing more closely allied to Tertiary forms, while the Verteb rate remains were related to those of the Wealden periods.

The fact that several species of shells from the Estuary beds of the Judith

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were included in No. 1 by us, solely on the strength of information furnished by Maj. Hawn, who had informed us that he had found in these beds, or rather in still lower beds, *Ammonites, Baculites, Ancyloceros, Caprinella, Inoceramus, &c.*, an association of fossils never met with in older rocks than the lowest Cretaceous. The fossils, however, sent us from these lowest beds by Maj. Hawn, proved, on examination, to belong to quite distinct genera from those to which he had referred them; being all Permian and Carboniferous types. Unfortunately, they did not come to hand until after our paper was published.

That the higher beds constituting the type of our No. 1, as seen near the mouth of the Big Sioux, on the Missouri, containing numerous well-preserved leaves of unquestionable dicotyledonous trees, apparently belonging to the genera *Quercus, Salix*, &c., and closely resembling existing species of those genera, cannot be Triassic, or even Jurassic, will, of course, be understood by geologists. Although we have as yet no conclusive, palæontological evidence that any portion of the beds we have provisionally included in No. 1, in the region of the Judith River is Jurassic, still I am inclined to think that some of the beds of this system are there exposed by upheaval in several localities. While exploring this wild, rugged country in the summer of 1855, I often noticed a series of non-fossiliferous variegated beds of clays and grits, thrust up from beneath the fossiliferus sandstones, which we have called No. 1?, with the same lithological characters as the Jurassic strata, developed in the Black Hills. I have little doubt, that they are exposed around Little Rocky, Snowy and Girdle Mountains in the same manner as about the Black Hills.

*Maj. Hawn also found the same or similar leaves in this formation in Kansas.

were so closely related to forms occurring in the Great Lignite Basin, which we knew to be Tertiary beyond a doubt, that there was a question whether they were not specifically identical; also that a species of Ostrea found in the upper Judith beds could not be distinguished from a species observed in the lowest bed of the Lignite Basin, and a species of Trionyx was considered by Dr. Leidy common to the two deposits, led both Mr. Meek and myself to express the opinion that the Judith beds were probably Tertiary, and were on a parallel with the lowest beds of the great Lignite Basin. Other facts have now been brought to light which lead us rather to suspect that the suggestion first made by Dr. Leidy, that Judith River beds, or at any rate a portion of those containing the estuary fossils, as well as those occurring in the Black Hills, may be the American representatives of the Wealden of England. On the map I have not distinguished the Wealden deposits by a separate color, but included them with Lower Cretaceous formation No. 1.

From the evidence thus far obtained in regard to the Laramie Mountains and the Black Hills, I have inferred that there have been the following oscillations of the surface of the country in this region. In the first place, after the deposition of the azoic strata, there was an upheaval of the granitic rocks, which threw into a highly inclined position these older strata. If this upheaval elevated the old azoic strata above the ocean level, there must have been a subsequent subsidence, after which the Potsdam Sandstone was deposited. Then there was a later elevation that raised the Potsdam Sandstone above the surface of the ancient sea, which was followed by a long period of repose, sufficient for the deposition of all the formations from the Potsdam to the Upper Carboniferous, when there was another subsidence followed by the deposition of the formations of the Upper Carboniferous, Permian, (possibly the Triassic,) Jurassic and Cretaceous Periods. After all these disturbances, and probably at the same time that most of our continent was raised above the ocean level, the whole of these strata were again elevated to nearly their present position previous to the dawn of the Tertiary period.

What changes may have occurred in the physical features of the country during the long period which must have elapsed between the deposition of the Lower Silurian and the Carboniferous rock, it is impossible now to determine. We know that in our present seas there is a constant deposition of sediment going on, forming sandstones, &c., or a calcareous precipitation forming limestones. In order to account for the hiatus between the Potsdam sandstone and the Carboniferous rocks in this region, we must suppose that either the surface occupied by the former was above the waters during this long interval, or that the intervening formations were deposited and subsequently removed by erosion and denudation, prior to the Carboniferous era. It seems quite improbable that so great thickness of strata could have been removed, so as to leave no trace of their former existence over so large an area. We are, therefore, inclined to the opinion that they were never deposited in this region.

VIII. Tertiary Basins of the Upper Missouri.

Our present knowledge of the geological formations of the far west, leads me to modify, to some extent, the divisions of the Tertiary Basins given in my notes explanatory of the first edition of the geological map of Nebraska, published in May, 1857. Considering the fresh water and estuary deposits at the mouth of the Judith as probably the equivalents of the Wealden of Europe, we have the following subdivisions:

1st. Great Lignite Tertiary Basin.
2nd. White River Tertiary Basin.

1*st.* *Great Lignite Tertiary Basin.*

As this formation, in its extensive development on the Upper Missouri, has been described quite fully in several preceding papers, I will here simply

notice its occurrence in the only locality where it was observed during the explorations of the past year, near the source of the South Fork of the Shyenne river. It here rests conformably upon Cretaceous bed No. 5, and in no place exhibits any indications of having been disturbed by the subterranean forces which have wrought such changes in the physical features of this region. The following section will represent the descending order of the beds as seen at this locality:

e.—Yellow arenaceous bed, holding the same position, I think, as the one at Fort Clark, which contains numerous fresh water shells.
d.—Light gray grit, with numerous iron-rust concretions, same bed, seen on Cherry Creek, Fort Clark, on the Missouri above Fort Union, and on the Yellow Stone, ... 20 to 30 feet.
c.—Very impure Lignite, ... 4 to 6 feet.
b.—Dark ash colored clay passing up into the Lignite, . . . 20 feet.
a.—Fine yellow sand: about 6 feet exposed.

By reference to the colored map, the boundaries of this great basin will at once be seen north and east of the Black Hills. It will also be seen that my former explorations show its full development on the Yellowstone, as high up as the mouth of the Big Horn river. It will then appear probable that its existence on the South Fork of the Shyenne indicates its extension from the Yellowstone, along the western base of the Black Hills, and that it adapts itself to the rugged features of the country, caused by the upheaval of the older formations, in the same manner as the Miocene Tertiary near Raw-Hide Peak and Laramie Peaks.

2*d*. *Tertiary Basin of White and Niobrara Rivers.*

In a former paper* I gave a vertical section of the different beds of this basin as far as they were known at that time. During the past year, many additional facts, and a large collection of new organic remains have been secured, which enable me to present a section more accurate and complete. It will be at once apparent from the list of localities for the different beds, how extensive a geographical area this basin occupies.

Vertical Section, showing the order of superposition of the different beds of the Tertiary Basin of White and Niobrara Rivers.

	Subdivisions.	Localities.	Estimated thickness.
POST PLIOCENE.	Yellow silicious marl, similar in its character to the loess of the Rhine, passing down into variegated indurated clays and brown and yellow fine grits; contains remains of extinct quadrupeds, mingled with those identical with recent ones; also a few Mollusca, mostly identical with recent species so far as determined.	Most fully developed along the Missouri river, from the mouth of the Niobrara to St. Joseph; also in the Platte Valley and on the Loup Fork.	300 to 500 feet.

*Notes on the Geology of the Mauvaises Terres of White River. Proceedings of the Academy of Nat. Sc. Philadelphia, June, 1857.

		Subdivisions.	Localities.	Estimated thickness.
Pliocene Tertiary.	Bed F.	1st, dark gray or brown sand, loose, incoherent, with remains of Mastodon, Elephant, &c.; 2d, sand and gravel, incoherent; 3d, yellowish white grit, with many calcareous, arenaceous concretions; 4th, grey sand with a greenish tinge; contains the greater part of the organic remains; 5th, deep yellowish red arenaceous marl; 6th. yellowish gray grit, sometimes quite calcareous, with numerous layers of concretionary limestone from two to six inches in thickness, containing fresh water and land-shells, Succinea, Limnea, Paludina, Helix, &c., closely allied and perhaps identical with living species; also much wood of coniferous character.	Covers a very large area on Loup Fork, from the mouth of North Branch to source of Loup Fork; also in the Platte Valley. Most fully developed on the Niobrara river, extending from the mouth of Turtle river three hundred miles up the Niobrara. Also on Bijoux Hills and Medicine Hills. Thinly represented in the valley of White river.	300 to 400 feet.
Miocene.	Bed E.	Usually a coarse grained sandstone, sometimes heavy bedded and compact; sometimes loose and incoherent; varies much in different localities. Forms immense masses of conglomerate; also contains layers of tabular limestone with indistinct organic remains; very few mammalian remains detected, and those in a fragmentary condition. Passes gradually into the bed below.	Most fully developed along the upper portion of Niobrara river and in the region around Fort Laramie. Seen also on White river and on Grindstone Hills.	180 to 200 feet.
	Bed D.	A dull reddish brown indurated grit, with many layers of silico-calcareous concretions, sometimes forming a heavy bedded fine grained sandstone; contains comparatively few organic remains.	Niobrara and Platte rivers; well developed in the region of Fort Laramie; also in the valley of White river. conspicuous, and composing the main part of the dividing ridge between White and Niobrara rivers.	350 to 400 feet.
	Bed C.	Very fine yellow calcareous sand, not differing very materially from Bed D, with numerous layers of concretions and rarely organic remains, passing down into a variegated bed, consisting of alternate layers of dark brown clay and light grey calcareous grit, forming bands, of which I counted twenty-seven at one locality, varying from one inch to two feet in thickness.	White river, Bear creek, Ash Grove spring, Head of Shyenne river. Most conspicuous near White river.	50 to 80 feet.

	Subdivisions.		Localities.	Estimated thickness
Miocene.	Turtle and Oreodon Bed B.	A deep flesh colored argillo-calcareous indurated grit; the outside when weathered, has the appearance of a plastic clay. Passes down into a gray clay, with layers of sandstone; underlaid by a flesh colored argillo-calcareous stratum, containing a profusion of Mammalian and Chelonian remains. Turtle and Oreodon Bed.	Old Woman's creek, a fork of Shyenne river; also on the head of the South Fork of the Shyenne; most conspicuous on Sage and Bear creeks, and at Ash Grove Spring. Well developed in numerous localities in the valley of White river.	80 to 100 feet.
	Titanotherium Bed. A.	Light gray fine sand, with more or less calcareous matter, passing down into an ash-colored plastic clay, with large quantities of quartz grains disseminated through it, sometimes forming aggregated masses like quartzose sandstone cemented with plaster; then an ash-colored clay with a greenish tinge, underlaid at base by a light gray and ferruginous silicious sand and gravel, with pinkish bands. Immense quantities of silex in the form of seams all through the beds. Titanotherium Bed.	Old Woman's creek; also in many localities along the valley of the South Fork of Shyenne. Best development on Sage and Bear creeks. Seen at several localities in the valley of White river.	80 to 100 feet.
Cretaceous.	Nos. 4 and 5.	Cretaceous beds 5 and 4, with their usual lithological characters and fossils.	Exposed underneath the Tertiary Beds on the South Fork of Shyenne and its Southern Branches, also in White river valley near its source.	

By reference to the map it will be seen that our route, which is indicated by a dotted line, led us up the Loup Fork of the Platte river to its source, thence a little west of North to the Niobrara river, and up the latter river to Fort Laramie. From Fort Laramie we proceeded nearly north to the Black Hills, and, on our return, crossed the Shyenne and White rivers, striking the Niobrara again above the mouth of Little Rapid river. We then passed down the Niobrara to its entrance into the Missouri river. Inasmuch as the surface deposit of the greater portion of the country thus passed over, is composed of the different beds of the Tertiary basin of which I am now treating, I think I can show more clearly the geographical area of this formation and that of its subdivisions, also the changes in the lithological characters, by giving a brief digest of my journal as we proceeded from point to point.

Ascending the Loup Fork, the first indication we observed of this formation was near the old Pawnee village, about eight miles above the mouth of Beaver creek. Here we found, near the bed of the river, large masses of pebbly conglomerate, cemented with a calcareous grit, which undoubtedly belongs to bed

[June.

E of the vertical section. The distant hills, on either side of the river, are covered with a considerable thickness of Pliocene and Post Pliocene beds.

Near the mouth of North Branch the following section of the strata, in descending order, were observed :

d.—Yellowish brown laminated argillaceous grit ; effervesces briskly with muriatic acid. - - - - - - - - - - -

c.—Similar to the bed above, but of a deeper color, more compact, containing a greater per cent. of clay, with numerous calcareous concretions disseminated through it, - - - - - - - 70 to 100 feet.

b.—Light brown clay, filled with fine whitish particles like magnesia. 70 feet.

a.—Gray, coarse sand, forming a heavy bedded sandstone, reaches to the waters edge, - - - - - - - - - 30 feet.

In the upper beds of the above local section, fragments of Mammalian and Chelonian remains were found, and all but the lower bed, which is bed *E* of the vertical section, are Pliocene. Lt. Warren explored the North Branch thirty miles above its mouth, and met with a similar series of beds, containing the same organic remains. Above the mouth of North Branch, bed *a* of the local section appears, in the form of large ledges of light gray arenaceous limestone, filled with silicified tubes like the stems of plants, and seeds resembling cherry stones In the Pliocene beds, on the distant hills, when exposed by erosion, I found numerous fragments of bones and teeth of Hipparion, Cervus, &c.

About lon. 99° we enter the desolate region of the Sand Hills. I measured the heighth of these hills at one locality and found them to be two hundred and thirty feet above the bed of Loup Fork, and composed of Pliocene beds as a base, then a thin bed of Post Pliocene marl, overlaid by a great thickness of loose incoherent sand and gravel, derived from the erosion of the different Tertiary beds. The whole country from the head of Loup Fork presents a similar character, consisting of movable sand hills, the true Tertiary beds being very seldom exposed. On the South Branch, the stream cuts though the following Pliocene strata.

c—Yellowish brown grit, containing *Mastodon micificus*, (Leidy.)

b—White chalky stratum, charged with fresh water and land shells of the genera *Helix*, *Planorbis*, *Limnea*, *&c.*, probably identical with recent species, - - - - - - - - - - - - 3 feet.

a—Heavy bedded gray sandstone, - - - - - 8 to 10 feet

From the head of Loup Fork to the Niobrara river the whole country is covered with this superficial deposit of sand, which is blown by the wind into ridges and high conical hills, rendering travelling quite difficult. On reaching the Niobrara we find bed *E* quite well developed, also a full series of the Pliocene beds filled with Mammalian remains. Passing up the Niobrara about fifty miles, the Pliocene strata gradually disappear, and the whole country is occupied by the Upper Miocene beds *E* and *D*. A Butte near this point affords a fine detailed section of the gray sandstone bed *E*, which, measured from the base, with a pocket level, I found to be one hundred and sixty-six feet in heighth. It is composed mostly of a gray coarse grit, sometimes quite incoherent, containing many layers of concretionary sandstone. On the summit is a thin bed of shelving limestone similar to that containing organic remains at Pinau's spring, though probably not holding the same geological position. Indistinct traces of freshwater shells and numerous remains of fishes, scales, vertebræ, &c., were visible in the tabular masses. It seems to form the upper portion of bed *E*, and to vary much in its character in different localities. It presents every variety from a translucent chalcedony to a fine grained sandstone or compact limestone, and furnishes those chalcedonic masses which meet the eye of the traveller so often and have the appearance of erratic blocks. Farther from the river, and holding a higher position than the summit of the Butte, are thin beds of yellow and yellowish gray calcareous grit undoubtedly of Pliocene age, containing numerous fragments of teeth and finely preserved bones of the *Mastodon* and *Elephant*. As we pass up the river the gray sandstone bed *E* presents a great variety of lithological characters. Sometimes it forms a coarse

conglomerate, then an aggregate of grains of quartz cemented by calcareous matter.

About sixty miles above the point where we struck the Niobrara, bed *D*, of the vertical section, is revealed to the water's edge. The dip of the strata towards the east gradually brings this bed to view quite conspicuously. It is composed of a flesh colored calcareous grit, and the eroded material of this bed gives to the country a dull reddish yellow tint. It also contains many layers of silico-calcareous concretions, forming large ledges which break into irregular masses on exposure. The more incoherent material has much the color and appearance of that composing the Turtle bed at Bear creek, but contains much less clay. It does not differ materially from its equivalent in the White river valley, of which Eagle Nest Butte forms a part.

Leaving the Niobrara river for Fort Laramie, we pass over a large area covered with sand hills, which have a dull ferruginous tinge, and are evidently composed of the eroded materials from bed *D*. One of these hills measured one hundred and eighty feet in heighth, with very steep sides, its present conformation being preserved by the roots of vast numbers of a species of Yucca, which cover the hill and seem to find their maximum growth in this sandy soil. Near Spoonhill creek bed *E* is composed mostly of a very coarse conglomerate, formed of angular and water-worn fragments similar to those seen in the granitic, metamorphic and carboniferous rocks, in the Black Hills, the fragments varying in size from one-eighth of an inch, to four inches in diameter and cemented with rather coarse silicious sand. It here forms huge overhanging ledges, large masses of which have fallen to the base of the hills, and are scattered over the plains below, giving to the scenery a very rugged appearance.

On Raw Hide Butte creek, bed *D* approximates more closely in its character to the turtle bed *B* of the vertical section. On an exposed area, not more than eight or ten yards square, in the valley of the creek, I observed fragments of at least eight turtles (*Testudo nebrascensis*) with a few mammalian remains similar to those found so abundantly in bed *B*, at Ash Grove Spring. The upper Miocene beds *E* and *D* occupy the country around Fort Laramie, exclusively, and extend to the base of the Laramie range of mountains. Bed *D* attains by far the greatest thickness, bed *E* having been eroded away to a great extent, and losing its conglomerate character, while bed *D* becomes one hundred and eighty to two hundred feet in thickness. The incoherent materials are here much more calcareous and of a finer grit, while the concretionary layers are formed of a sandstone coarser grained than at localities heretofore mentioned.

From Fort Laramie to Laramie Hills, August 22d.

Our course was 10° south of west from Fort Laramie ; travelled over Tertiary beds *E* and *D* for twelve miles, until we came to the head of Warm Spring, where we observed a bed of carboniferous limestone seventy-five feet in thickness. The strata seem to dip gently each way from a central axis, and are exposed at this locality over an area of only five or six hundred square yards. The upheaval is evidently a local one, the limestones being revealed by the erosion and removal of the Tertiary beds from the valley of the stream, which are every where undisturbed, resting unconformably upon the limestones on all sides. Nine miles farther on our route, another upheaval is exposed by the wearing away of the Tertiary beds in the valley of the Big Cotton Wood creek. Here we have eighty feet of carboniferous limestone, with a similar central axis of elevation from which the strata dip in all directions, while the Tertiary beds again rest unconformably upon their inclined edges. As we approach the Laramie Hills, no carboniferous rocks were seen in place, but the whole country is covered with a heavy deposit of drift, consisting of gravel and water-worn boulders from all the formations in this region.

Descending the Laramie Fork toward Fort Laramie, we again find the country covered with a thick deposit of drift, composed of a great variety of more

or less water-worn materials derived from the mountains. The true Tertiary beds are revealed, by erosion, occasionally near the bed of the river, but no indications of the upheaval of the carboniferous rocks.

About twelve miles above Fort Laramie, both on the Laramie river, and the Platte a remarkable deposit is seen, composed of a coarse conglomerate, fifty to one hundred and fifty feet in thickness, of a recent character, and evidently formed since the scooping out of the present river valleys. Indeed the form of the deposit is that of a basin twelve or fifteen miles in length, and reaching its greatest thickness only in the valleys of the rivers, while the more elevated portions of the country between the Forks consist of the true Tertiary beds. It seems to vary from an aggregation of particles of quartz to an exceedingly coarse conglomerate made up of every variety of material, much of which I have not yet seen in place.

Fort Laramie to the Black Hills.

Proceeding north from Fort Laramie, we pass over Tertiary beds for the first seven miles, and then come to an extension of the Laramie range of Hills, which exhibits many peculiarities. The whole range appears to be composed of a group of conical elevations, and ridges which seem to illustrate very clearly, the irregular effect of the subterranean forces by which they were upheaved. A considerable thickness of carboniferous limestone was observed upon the sides and summits of these elevations, inclining at various angles, depending upon the power of the disturbing force from beneath, and when unchanged by heat contain numerous fossils. We can here see every variety of carboniferous limestone, from the unchanged fossiliferous rock, to that of a completely metamorphosed character, with the indications of stratification nearly or quite obliterated. Sometimes the melted material is thrust up through fissures in the unchanged rock, so that in a single hand specimen we have the changed and unchanged rock. The metamorphosed carboniferous limestones are usually of a deep red color, very compact, sometimes assuming a vitreous aspect, but never the thoroughly crystalline character of the older azoic rocks. Sometimes the limestones are elevated, so as to leave the strata horizontal, then again they are inclined at an angle of ten to thirty degrees. At the base of these ridges, the upper Miocene beds are seen insinuating themselves into ravines, or deposited high up on the sides of the elevations, thus filling up the irregularities formed by the numerous local disturbances.

In all cases the Tertiary beds are undisturbed, and not unfrequently rest directly upon the vertical edges of the azoic or granitic rocks. About eight miles west of Raw Hide Peak, the carboniferous limestones present a peculiar appearance, not unlike that of some Tertiary strata upon the Yellowstone, which have been fused or semi-fused by the burning out of the Lignite beds. The fused masses are very compact and heavy, varying in composition and color, red, yellow and mottled, oftentimes containing small fragments of partially changed rock, thus forming a sort of breccia.

After crossing the Niobrara river, the upheavals nearly cease, the blue carboniferous limestone only being exposed in a few places. The Tertiary beds occupy the larger portion of the country. Passing the dividing ridge, between the Niobrara and Shyenne rivers, into the Valley of Old Woman's creek, we find the Tertiary attaining its full development, and assuming a variety of fantastic forms from erosion, like the Bad Lands at Ash Grove Spring. The hills were covered with small pines.

On the east side of Old Woman's creek is a high ridge, trending southwest and southeast, composed of variegated sandstone, varying from a fine compact silicious rock to a coarse reddish conglomerate or sandstone, with no fossils, except indistinct traces of vegetable remains. This ridge, which belongs to Cretaceous formation No. 1, is the result of a less violent upheaval, and is exposed by the erosion of the Tertiary beds from the valley. On the distant hills, on each side of the valley, the denuded Tertiary beds are visible, while near the bottom of the stream the Titanotherium bed was observed by Lieut. War-

ren, presenting its usual lithological characters, and containing bones and teeth of the animal from which it derives its name. The following section of strata, in descending order, will show the details of this upheaval.

g.—Layers of whitish oolitic limestone, doubtless Tertiary.
f.—Compact ferruginous sandstone, ... 80 feet.
e.—Yellow friable sandstone, ... 2 feet.
d.—Light gray fine clay, ... 4 feet.
c.—Yellowish white sandstone, quite friable, ... 5 feet.
b.—Drab or ash colored indurated clay, passing down into red clay, 6 feet.
a.—Variable incoherent clays, red, yellowish, &c., which may be of Jurassic age, ... 50 feet.

Passing down the valley toward the Shyenne, the Tertiary beds disappear, and the Cretaceous bed No. 5 occupies the country. At one locality an upheaval was observed, exposing all the subdivisions of the Cretaceous rocks, as will appear from the following section:

No. 5. Presenting its usual lithological characters, with numerous fossils; strata but slightly disturbed, ... 100 to 150 feet.
No. 4. Presenting same characters as on the Missouri river, . 100 feet.
No. 3. . . . . 150 feet.
No. 2. . . . . 200 feet.
No. 1. . . . . 250 to 300 feet.

No. 5 is but slightly disturbed, as will be seen by examining the illustrative section. Nos. 4, 3 and 2 present only the vertical edges of this strata, across which the above measurements were taken. The strata of No. 1 seem to have been elevated so as to retain a nearly horizontal position. No. 3 at this locality contains numerous fossils, the most abundant of which are *Ostrea congesta* and *Inoceramus problematicus*. This bed does not present altogether the same lithological character as on the Missouri river, but possesses a more laminated and gritty structure, sometimes approaching to a calcareous sandstone. Crossing the Shyenne, on our way northward, we have the commencement of a series of ridges of upheaval, which surround the Black Hills.

I could not ascertain that there was any regularity in the dip and strike of the strata, each ridge or local upheaval differing from the other in that respect. As we approach the southern base of the Black Hills, the strata incline very nearly to the southeast. No. 1 does not appear, but we have a fine development of No. 2, possessing all its characteristics of plastic clay, with ash-colored grit concretions, containing an abundance of well preserved fossils; No. 3, with large quantities of *O. congesta* and *I. problematicus*, in an exceedingly comminuted condition; No. 4 also appears, and No. 5 caps the hills on all sides. Nos. 2 and 3 are exposed only by the upheaval. On a branch of Beaver creek we find No. 2. one hundred and fifty to two hundred feet in thickness, and presenting its usual characters in full.

Inasmuch as the principal facts relating to the Geology of the Black Hills have already been discussed, I will omit the details of our exploration of them, and pass on to a description of the country along our route, from Bear Peak, on the north eastern base of the Black Hills, to the entrance of the Niobrara river into the Missouri.

Near Bear Peak, No. 2 is quite largely developed, presenting its usual lithological characters, and containing great quantities of fish remains, but no other fossils were seen in it. No. 1 is composed of variegated clays, grits and sandstones, with indistinct vegetable-impressions, fossil wood, and a few uncharacteristic Saurian bones. No. 3 is also exposed by the upheaval of the beds, with its usual fossils, but possessing the character of a laminated calcareous sandstone, instead of the soft homogeneous calcareous marl of the Missouri river. From thence to the Shyenne, No. 4 forms a surface of the country, for the most part undisturbed.

I will not here dwell upon the influences which the eroding power of water must have exerted, in modifying the physical features of the country in and

around the Black Hills. I am inclined to the opinion, however, that prior to the convulsion that upheaved the fossiliferous rocks, only the Cretaceous beds Nos. 4 and 5 were exposed in any portion of this region.

Along the Shyenne River, No. 4 contains most finely preserved fossils in the greatest abundance. Large Ammonites, two to three feet in diameter, still preserving their original pearly lustre, *Scaphites*, *Baculites*, *Ostrea*, &c. Ascending the valley of Sage Creek, we pass over the Cretaceous beds for the first five miles, which contain an abundance of fossils similar to those found on the Shyenne. We then meet with the lowest bed of the great Tertiary Basin of White River, resting conformably upon Cretaceous strata, which appear to be a blending of Nos. 4 and 5. We have, first, the dark clays of No. 4, then the yellowish brown, gritty shale of No. 5, with numerous ferruginous concretions; then the Titanotherium bed which sets regularly upon No. 5, and exhibits its highest development in the valleys of Sage and Bear Creeks. It is here composed, 1st, of a band of argillaceous grit weathering to a pink color, two feet in thickness, passing up into an ash colored plastic clay with a greenish tinge, full of chalcedony and calcareous concretions, altogether 50 to 80 feet in thickness; then a light gray calcareous grit upon which rests the Turtle Bed. A considerable deposit of drift consisting of water-worn bowlders, and loose sand and gravel, is distributed over the surface of the Bad Lands to a greater or less extent.

Proceeding up the valley of the Shyenne, we see only the Cretaceous beds Nos. 4 and 5, until we pass the mouth of Bear Creek, when the Tertiary makes its appearance, crossing the Shyenne and stretching off toward the base of the Black Hills in long ridges or isolated Buttes. The belt of Tertiary on the left side of the Shyenne is about thirty miles in width. A section fifteen miles above the mouth of Bear Creek, on the Shyenne, presents the following characters.

c.—Light gray indurated clay, ... 6 feet.
b.—Seam of gray sandstone, ... 18 inches.
a.—Ash-colored plastic clay with a greenish tinge, and a pinkish band of fine grit at the base, ... 30 feet.

The Titanotherium Bed varies much in its lithological characters in different localities. The layer of gray sandstone is sometimes two to four feet in thickness, composed of an aggregate of water-worn pebbles, with granular quartz, and small particles of mica, forming somewhat conspicuous ledges. On the western side of the Shyenne, the Titanotherium bed presents the following characters proceeding upward from No. 5: First, alternate seams of small pebbles and loose sand, two to six inches in thickness, passing up into a fine ferruginous grit, containing small scales of mica, weathering to a light gray color, then a band of pinkish gritty clay, six inches in thickness, passing up into ash-colored clay which has also alternate gritty layers. The pink band is quite persistent, and being exposed whenever the Titanotherium Bed is worn through, marks with a good degree of precision the base of the Tertiary. The surface in many places is covered with water-worn pebbles, varying in size from an eighth of an inch to eighteen inches in diameter, though mostly small, and representing all the varieties of metamorphosed rocks, with rounded masses of lime and flint rock, fossil wood, &c., so that No. 5, when the Titanotherium Bed is eroded away, is paved with this loose material. The Turtle Bed alone does not seem to be so marked in its character here as at Bear Creek. It weathers to a light yellow color and passes almost insensibly into the bed above. I have marked the line of separation at this locality, between the Turtle bed and the one overlying it, by a layer of very porous argillaceous sandstone of a dull brown or drab color. The Turtle bed contains much more sand than at Bear Creek, and the upper portion consists of alternate layers of calcareous concretions and indurated argillaceous grit with one band, eight feet in thickness, of ash-colored clay. Disseminated through the bed in every direction, are thin seams of chal-

cedony. A few mammalian remains were found, mostly of Oreodon and Rhinoceros.

On the right or east side of the Shyenne, as we pass over to White River, the Cretaceous bed No. 5 presents some peculiarities which may be worthy of notice, inasmuch as the upper portion seems to form a transition or bed of passage into the Tertiary. We have, first, No. 4, black laminated clay gradually passing up into dark brown clay, then becoming deep ferruginous; again a dull purplish hue, with seams half an inch to an inch in thickness of ferruginous matter passing up into a deep yellow arenaceous clay; lastly, a brown clay underlying the Titanotherium bed. I have been thus minute in describing these beds, from the fact that the transition from the Cretaceous to the Tertiary period seems as gradual and as natural as that of any of the subdivisions of the Cretaceous system into each other; and were it not for the organic remains which characterize each, we would scarcely be aware that we were passing from one great geological period to another.

At another locality the Titanotherium bed at the base consists of clay with a purplish tinge, filled with angular grains of quartz and water-worn pebbles, two feet; then a loose incoherent gravel, with pebbles, four inches; then six to eight feet of light gray clay, filled with pebbles and angular grains of quartz, sometimes forming a sort of quartzose sandstone, passing up into a dark ash-colored clay, with a greenish tinge.

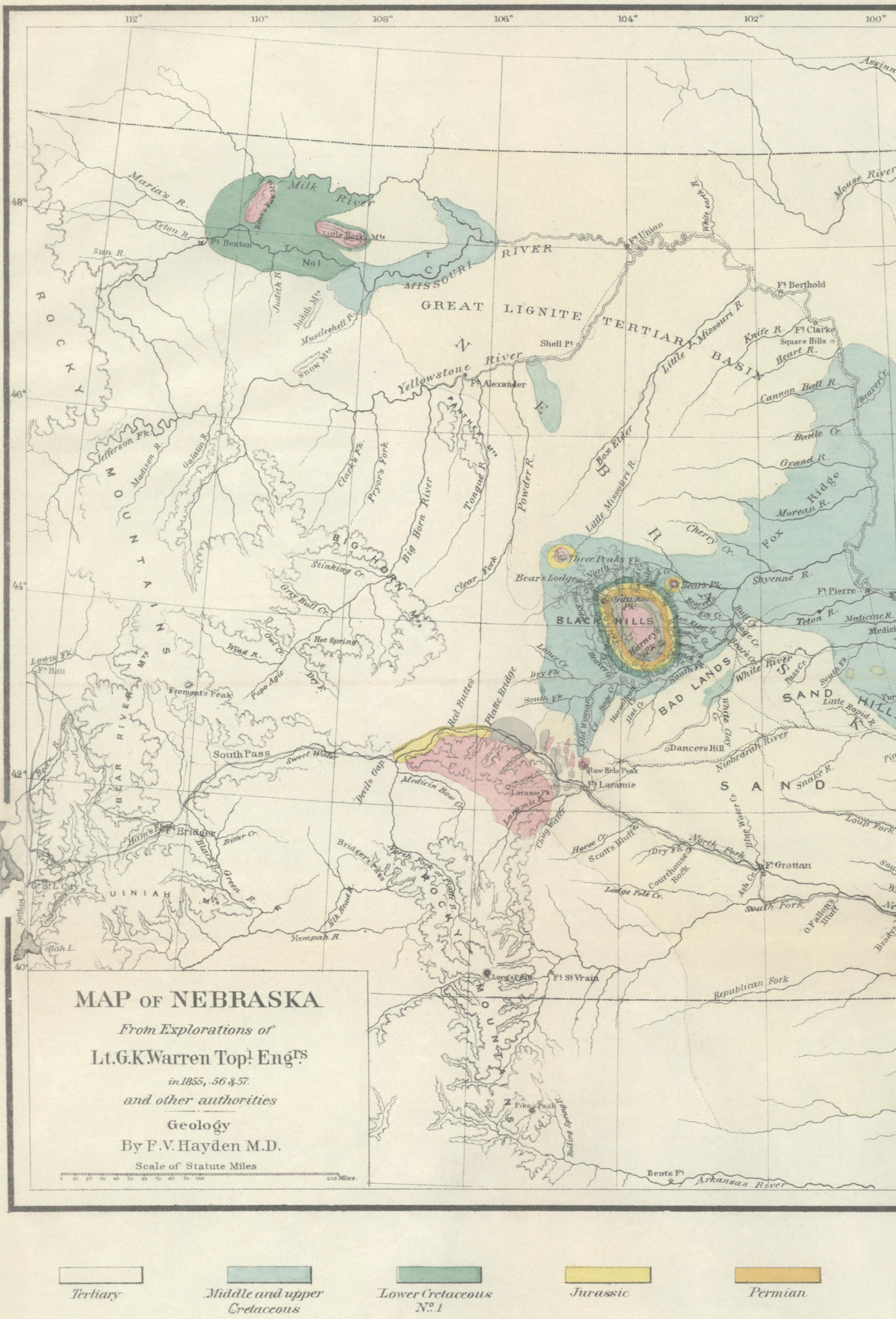
A section of the different beds, as shown on White River, would be as follows:

Bed C.	Flesh colored marl,	10 feet.
	Bluish laminated clay with a yellowish tinge,	2 feet.
	Flesh colored indurated marl,	15 feet.
	Light gray, indurated, argillaceous grit, with nodules of clay,	4 to 6 feet.
Bed B. Turtle	Flesh colored indurated grit,	20 feet.
	Bluish argillaceous grit,	10 inches.
	Flesh colored marl,	4 feet.
	Argillaceous grit,	6 to 12 inches.
	Flesh colored marl,	30 feet.
Bed A.	A fine light gray calcareous grit, passing down into an ash-colored clay, with micaceous and silicious sandstone at base tinged with a purplish hue,	80 to 100 feet.

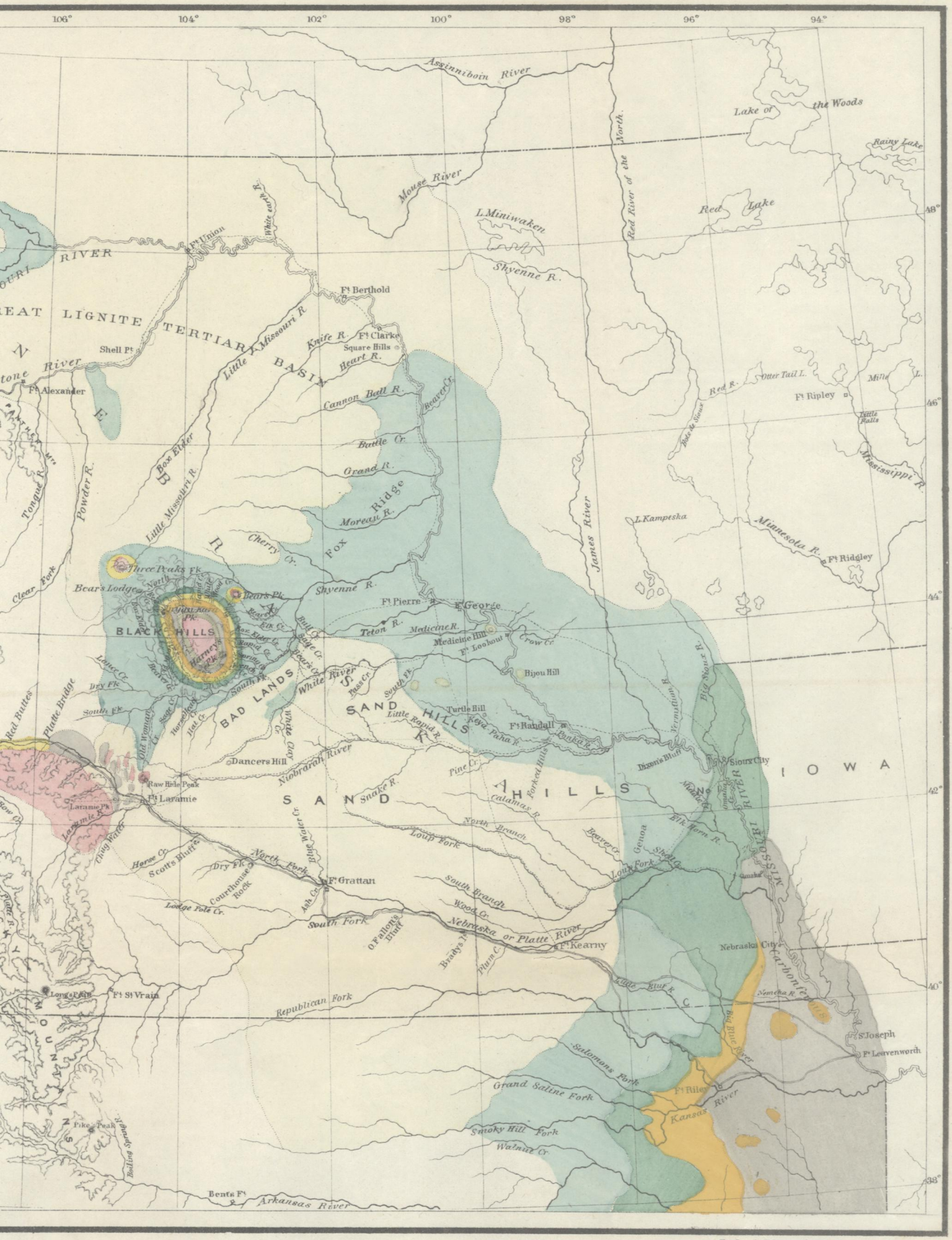
Cretaceous Beds Nos. 5 and 4.

In the valley of White River the Cretaceous beds Nos. 5 and 4 are exposed by the erosion of the overlying Tertiary beds, as may be seen by reference to the accompanying map. No. 5 reveals numerous fossils in similar tough argillaceous concretions, as those observed on the west side of the Shyenne. All the calcareous matter has been dissolved away from the shells, leaving only casts. The upper portion presents a variety of lithological characters, and is destitute of fossils.

Leaving the valley of White River, we proceeded nearly a south-east course, ascending gradually to the dividing ridge between White and Niobrara Rivers, where we find the largest development of bed *D*, which exhibits its usual lithological characters, but contains very few fossils. Passing the head of wounded-knee creek, we begin to see indications of the Pliocene formation, with a few mammalian remains, and on reaching the Niobrara, the upper Miocene beds are covered with a thick deposit of Pliocene strata. This more recent formation presents at this locality the same lithological characters as those given in the vertical section, and extends nearly to the mouth of Turtle Hill creek, where Cretaceous beds Nos. 4 and 3 gradually rise to the surface and cover the country. Outliers of Pliocene are visible, however, on both sides of the Missouri River in many localities, the principal of which are Medicine and Bijoux Hills, the latter of which has yielded several very interesting species of Mammalia



MAP OF NEBRASKA
From Explorations of
Lt. G.K. Warren Topl. Engrs
in 1855, 56 & 57.
and other authorities
Geology
By F.V. Hayden M.D.
Scale of Statute Miles
GREAT LIGNITE TERTIARY BASIN
MISSOURI RIVER
Yellowstone River
BLACK HILLS
BAD LANDS
ROCKY MOUNTAINS
BIG HORN Mts
Ft. Laramie
Ft. Benton
Ft. Union
Ft. Pierre
Milk River
Arkansas River
Republican Fork
Tertiary
Middle and upper Cretaceous
Lower Cretaceous No. 1
Jurassic
Permian



Lith. of J. Bien, 60 Fulton St. N.Y.

taceous | Jurassic | Permian | Carboniferous | Potsdam Sandstone | Igneous and metamorphic.

Upper Miocene bed *D* is not unfrequently revealed in the channel of the Niobrara, presenting a very irregular outline, showing most conclusively the great erosion that must have taken place prior to the deposition of the Pliocene beds. It would seem that after the deposition of the materials that entombed the Miocene fauna, this whole region was eroded so as to present the same rugged features as the Bad Lands of White River, and that the Pliocene beds were deposited upon this irregular surface entombing a second fauna, specifically distinct from, yet intermediate between that of the Miocene and our present period. I have attempted, in the illustrative section* along the Niobrara, to show the irregular outline of the bed *D*, prior to the deposition of the recent beds. The greatest thickness of Pliocene is always found in the valleys of the streams, and in consequence of its loose incoherent character is much denuded, forming the principal part of the material of the sand hills.

Catalogue of all the Fossils hitherto described, from the Tertiary Formations of White and Niobrara Rivers, with a table showing their stratigraphical position.

	Beds in ascending order.					
RUMINANTIA.	A	B	C	D	E	F
1. Oreodon gracilis, Leidy	...	*	*	*	...	...
2. Oreodon Culbertsoni, Leidy	...	*	*	*	...	...
3. Oreodon major, Leidy	...	*	...	*	...	...
4. Agriochœrus major, Leidy	...	*	...	*	...	...
5. Agriochœrus antiquus, Leidy	...	*	...	*	...	...
6. Poebrotherium Wilsoni, Leidy	...	*	...	...	...	...
7. Leptomeryx Evansi, Leidy	...	*	...	*	...	...
8. Leptauchenia decora, Leidy	...	...	...	*	...	...
9. Leptauchenia major, Leidy	...	...	...	*	...	...
10. Protomeryx Halli, Leidy	...	...	...	*	...	...
11. Merycodus necatus, Leidy	...	...	...	...	...	*
12. Megalomeryx niobrahensis, Leidy	...	...	...	...	...	*
13. Merychochœrus proprius, Leidy	...	...	...	*	...	...
14. Procamelus occidentalis, Leidy	...	...	...	...	...	*
15. Procamelus robustus, Leidy	...	...	...	...	...	*
16. Procamelus gracilis, Leidy	...	...	...	...	...	*
17. Merychyus elegans, Leidy	...	...	...	...	...	*
18. Merychyus medius, Leidy	...	...	...	...	...	*
19. Merychyus major, Leidy	...	...	...	..	...	*
20. Cervus Warreni, Leidy	...	...	...	...	...	*
MULTUNGULA.						
21. Chœropotamus (*Hyopotamus*) americanus, Leidy	*	...	...	...	...	...
22. Entelodon Mortoni, Leidy	...	*	...	*	...	...
23. Entelodon ingens, Leidy	...	*	...	*	...	...
24. Titanotherium Prouti, Leidy	*	...	...	...	...	...
26. Paleochœrus probus, Leidy	...	*	...	*	...	...
27. Leptochœrus spectabilis, Leidy	...	*	...	*	...	...
28. Rhinoceros occidentalis, Leidy	...	*	*	*	*	...
29. Rhinoceros (*Hyracodon*) nebrascensis, Leidy	...	*	*	*	*	...
30. Rhinoceros crassus, Leidy	...	...	...	...	...	*
31. Mastodon (*Tetralophodon*) merificus, Leidy	...	...	...	...	...	*
32. Elephas (*Euelephas*) imperator, Leidy	...	...	...	...	...	*

*The section along the Niobrara river, as well as the more important one through the Black Hills, has been omitted in this paper, and will appear in Lt. Warren's forthcoming Report.

	Beds in ascending order.					
SOLIDUNGULA.	A	B	C	D	E	F
33. Hipparion, s. Hippotherium occidentale, Leidy	...	...	...	...	...	*
34. Hipparion, s. Hippotherium speciosum, Leidy	...	...	...	...	...	*
35. Anchitherium Bairdi, Leidy	...	*	...	...	...	...
36. Anchitherium (*Hypohippus*) affinis, Leidy	...	...	...	*	...	...
37. Anchitherium (*Parahippus*) cognatus, Leidy	...	...	...	*	...	...
38. Merychippus insignis, Leidy	...	...	...	...	...	*
39. Merychippus mirabilis, Leidy	...	...	...	...	...	*
40. Equus excelsus, Leidy	...	...	...	...	...	*
41. Equus (*Protohippus*) perditus, Leidy	...	...	...	...	...	*
RODENTIA.						
42. Steneofiber nebrascensis, Leidy	...	...	*	*	...	...
43. Ischyromys typus, Leidy	...	...	*	*	...	...
44. Palæolagus Haydeni, Leidy	...	...	*	*	...	...
45. Eumys elegans, Leidy	...	*	...	...	...	...
46. Hystrix (*Hystricops*) venustus, Leidy	...	...	...	*	...	*
47. Castor (*Eucastor*) tortus, Leidy	...	...	...	...	...	*
CARNIVORA.						
48. Hyænodon horridus, Leidy	...	*	...	...	...	...
49. Hyænodon cruentus, Leidy	...	*	...	...	...	...
50. Hyænodon crucians, Leidy	...	*	...	...	...	...
51. Amphicyon vetus, Leidy	...	*	...	...	...	...
52. Amphicyon gracilis, Leidy	...	*	...	...	...	...
53. Leptarctus primus, Leidy	...	...	...	...	...	*
54. Deinictis felina, Leidy	...	*	...	...	...	...
55. Machairodus primævus, Leidy	...	*	...	...	...	...
56. Felis (*Pseudælurus*) intrepidus, Leidy	...	...	...	...	...	*
57. Ælurodon ferox, Leidy	...	...	...	...	...	*
58. Canis sævus, Leidy	...	...	...	...	...	*
59. Canis temerarius, Leidy	...	...	...	...	...	*
60. Canis vafer, Leidy	...	...	...	...	...	*
61. Canis (*Epicyon*) Haydeni, Leidy	...	...	...	...	...	*
CHELONIA.						
62. Testudo nebrascensis, Leidy	...	*	*	*	*	...
63. Testudo (*Stylemys*) niobraensis, Leidy	...	...	...	...	...	*
MOLLUSCA.						
64. Helix Leidyi, Hall and Meek	...	*	...	...	...	...
65. Planorbis nebrascensis, Evans and Shumard	...	...	...	*	...	...
66. Lymnea diaphana, Evans and Shumard	...	...	...	*	...	...
67. Lymnea nebrascensis, Evans and Shumard	...	...	...	*	...	...
68. Physa secalina, Evans and Shumard	...	...	...	*	...	...
CRUSTACEA.						
69. Cypris Leidyi, Evans and Shumard	...	...	...	*	...	...

Prodromus descriptionis animalium evertebratorum, quæ in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgold et Johanne Rodgers Ducibus, observavit et descripsit

W. STIMPSON.

Pars VI. *CRUSTACEA OXYSTOMATA.*

Leucosidea.

245. Leucosia vittata, nov. sp. Carapax rhomboides, perconvexus, subcæruleus, rubro quinque-vittatus, superficie punctatus, apice productus. Margines crenulati; granuli marginis antero-lateralis sursum non conspicui. Margo posterior rectus, granulatus, angulis in adultis obtusus, in junioribus dentigerus. Frons tridentata, dente mediano magis prominente. Sinus thoracicus profundus, pubescens, antice productus, incisura interna profunda, rimata, externa marginem carapacis attingente. Chelipedum merus angulis et parte basali inferiore sparsim tuberculatus, basi dense tomentosus, superne tuberculis quinque, duobus magnis, tomento pœne celatis ornatus. Manus grandior. Pedum ambulatoriorum articuli sat dilatati. Abdomen ei *L. rhomboidalis* simile, gracilius, magis minuens; tuberculo segmenti penultimi minuto. Appendices abdominis maris primi paris spiraliter plicatæ, anfractibus duobus. ♂ Carapacis long. 0·97; lat. 0·85. poll. *L. craniolari* affinis sed brachio ad basim tomentoso. *L. rhomboidali* differt fronte tridentata.

Hab.—In sinibus prope portum "Hong Kong" Sinensem; in fundis limosis ad prof. quinque org. vulgaris.

246. Leucosia maculata, nov. sp. Parva. Carapax bene rhomboides, glaber, cæruleo-fuscus, decem-maculatus, maculis parvis, rubris, in seriebus duabus longitudinalibus antrorsum divergentibus dispositis. Frontis dens medianus prominens, paullo deflexus. Sinus thoracicus profundus, pubescens, non tuberculatus, angulo antero-interno rotundato. Margo posterior convexus, leviter granulatus, utrinque obtusus. Chelipedum merus ei *L. vittatæ* similis, tuberculis marginalibus vero magis confertis. Abdominis maris segmentum antepenultimum versus extremitatem paulo contractum; tuberculum segmenti penultimi sat grande antice excavatum. Appendices abdominis maris primi paris spiraliter plicatæ, anfr. duobus. ♂ Carapacis long. 0·58; lat. 0·50 poll. *L. rhomboidali* valde affinis, differt abdominis formâ.

Hab.—Prope oras Sinenses meridianas; in fundo conchoso-limoso prof. 20 org. vulgaris.

247. Leucosia parvimana, nov. sp. Carapax longior quam latior, postice valde convexus, latere rotundatus, apice compressus et sursum flexus; colore luteus, utrinque albo 2–3-maculatus, postice nigro bimaculatus, maculis rotundatis. Frons ante orbitas bene producta, tridentata, dente mediano prominentiore. Margines laterales serie granulorum crenulati, retrorsum post pedes amb. primos non producta. Margo postero-lateralis inferior obscure crenulatus. Margo posterior obtusus, superne subtiliter crenulatus, subtus lævissimus. Sinus thoracicus antrorsum brevis, fissuris anterioribus rimatis; margine supra brachiorum insertionem granis tribus magnis et duobus v. tribus parvis ornato. Manus parva, extus margine acuta, intus obtusa, paulo crenulata, digitis brevibus, debilibus, hiantibus, intus inermibus. Dactyli pedum ambulatoriorum graciles, non dilatati. Sterni suturæ profunde impressæ; anguli postero-laterales prominentes, tuberculiformes. Abdomen maris sat latum, segmento antepenultimo utrinque turgidulum; segmento penultimo marginibus paulo dilatato, medio tuberculato, tuberculo acuto retrorsum tenso. Appendicium abdominis maris primi paris anfr. septem. ♂ Carapacis long.

0·84; lat. 0·73 poll. *L. pallidæ* affinis, margine minus crenulato, et sinu thoracico tuberculis tribus solum magnis ornato.

Hab.—Ad insulam "Selio" freti "Gaspar."

248. LEUCOSIA HÆMATOSTICTA, Adams et White; Voy. Samarang, Crust. p. 54, pl. xii. f. 2.—In sinu "Kagosima;" e fundo arenoso prof. 22 org. lecta.

249. MYRA FUGAX, Leach; De Haan; Fauna Jap. Crust. 134, pl. xxxiii. f. 1. —In mari Sinensi boreali; in fundis limosis et conchosis prof. 6–25 org. vulgaris.

250. MYRA AFFINIS, Bell; Lin. Trans., xxi. 296.—In sinu "Kagosima": fundo conchoso, org. 20.

251. PHILYRA TUBERCULOSA, nov. sp. *Fœminæ* carapax orbiculato-rhomboidalis, flavo-cinereus, convexus, superficie inequalis; regionibus branchialibus, post-gastrica, genitalique tumidis, confertim tuberculatis. Margines angulati, granulis crenulati. Margo posterior rectus. Frons concava, lævis, quam epistoma brevior. Angulus pterygostomianus prominens, marginibus granulatis. Maxillipedes ext. rugulosi, linea longitudinali barbata ornati. Chelipedes breves; mero forte granulato, prope extremitatem medio lævi; manu fere lævi, punctata, intus margine non granulata; digitis profunde sulcatis, ad basin hiantibus. Sternum confertim tuberculatum. Abdominis segmenta primum secundumque granulata; linea transversa granulorum in segmento tertio. Carapacis long. 0·49; lat. 0·47 poll.

Hab.—In sinibus prope "Hong Kong"; in arenis submersis prope litora.

252. PHILYRA PLATYCHEIRA, De Haan; loc. cit. p. 135. pl. xxxiii. f. 6.—In portu "Hong Kong"; fundo limosa, org. sex.

253. PHILYRA UNIDENTATA, nov. sp. *Fœminæ* carapax suborbicularis, antice paulo productus; superficie glaberrima, sparsim punctata; marginibus lateralibus et posteriore continuis, crenulatis, crenulis parvis, æqualibus, obtusis. Color pallide badius, partim cœruleo-albus. Frons medio unidentata. Maxillipedes ext. planati. Chelipedes carapace non duplo longiores; mero superne granulato, tertia parte antica excepta; manu sat convexa; digitis brevibus, depressiusculis, intus acutis, obsolete 1- vel 3-dentatis, tertia parte anteriore solum contiguis. Carapacis long. 0·54; lat. 0·50 poll.

Hab.—In mari Sinensi, lat. bor. 23°; e fundo arenoso prof. 30 org. lecta.

254. EBALIA MADERENSIS, nov. sp. *Fœminæ* carapax octagonus, vel rhomboides angulis truncatis. Latera antero-laterale et postero-laterale paullo concava. Margo posterior fere rectus, granulatus. Dorsum valde convexum, carina lævi mediana e fronte ad tuberculum cardiacum acute prominens producta. Regiones branchiales prominentes, summo granulati, granulis externis acutis. Frons concava, subtiliter granulata. Spina parva ad angulum pterygostomianum. Maxillipedes ext. obsolete granulati. Chelipedes granulati, granulis marginalibus subspiniformibus sparsis; mero plus duplo longiore quam latiore. Carapacis long. 0·28; lat. 0·30 poll.

Hab.—In sinu "Funchal" insulæ Maderæ; fundo subuloso, prof. 22 org.

255. PHLYXIA QUADRIDENTATA. *Ebalia quadridentata*, Gray; Zool. Misc. p 40. —In portu "Jackson" Australiensi; fundo conchoso, prof. 2 org.

256. ARCANIA GLOBATA, nov. sp. *Fœminæ* carapax (apice excepto) globosus, æqualis, confertim spinosus, spinis parvis, acutis, vix granulatis, decem in marginibus et una in regione post-cardiaca quam reliquæ majoribus. Regio frontalis pœne lævis, postice spinulosa vel granulosa. Frontis margo arcuatim concavus, angulis externis dentiformibus. Chelipedes confertim granulati, granulis plerumque subspiniformibus, in manu quam in mero multo minoribus. Digiti graciles quam palmæ non breviores. Pedes ambulatorii lævos. Carapax ruber; fronte et linea mediana albidæ. Carapacis long. 0·46;

[JUNE.

lat. 0·44 poll.; (spinis inclusis.) Ab *A. erinacea* differt pedibus ambulatoriis non spinulosis.

Hab.—In mari Sinensi, lat. bor. 23°; in fundis sabulosis vel limosis prof. 16–25 org.

257. IPHIS SEPTEMSPINOSA, Leach. *Cancer septemspinosus*, Herbst.; Naturg. d. Krabben und Krebse, i. pl. xx. f. 112.—Prope oras Sinenses meridianas; in fundo limoso, org. 20.; vulgaris.

258. IPHICULUS SPONGIOSUS, Adams et White; Voy. Samarang, Crust. p. 57. pl. xiii. f. 5. Maxillipedes eis *Iphidis* et *Oreophori* fere similes.—In portu "Hong Kong"; in fundis limoso-lapillosis, prof. 10–20 org.

259. OREOPHORUS RUGOSUS, nov. sp. *Fœminæ* carapax perlatus, subpentagonus, rugosus, utrinque serie fossarum elongatarum quasi erosarum v. vermiculatarum ad margines antero-laterales parallela insculptus. Frons angustata, prominens. Regio branchialis lateraliter valde dilatata, postice tuberculis capitatis partim ornata. Chelipedes rugosi, irregulariter tuberosi vel erosi; digitis sulcatis, vix dilatatis, superne concavis, apicibus acutis curvatis; digito immobili quam dactylus latiore. Pedes ambulatorii marginibus tuberculati. Abdomen convexum, tuberculatum, tuberculis parvis, rotundatis, non confertis; lineis duabus interruptis carinam medianam minus convexam circumscribentibus. Carapacis long. 0·48; lat. 0·662 poll.

Hab.—Prope oras insulæ "Loo Choo."

260. NURSIA PLICATA, Bell; Lin. Trans. xxi. 307, pl. xxxiv. f. 4. *Cancer plicatus*, Herbst.—In portu "Hong Kong"; fundo conchoso, prof. org. 8.

261. NURSILIA DENTATA, Bell; Lin. Trans. xxi. 309, pl. xxxiv. f. 6.—In freto "Katona" prope insulam "Ousima"; fundo arenoso, org. 10.

CARCINASPIS, nov. gen. Carapax suborbicularis, latior quam longior, depressus, postice late rotundatus non laminato-expansus. Latera dilatata, sed pedes non celantia. Frons rostrata, rostro brevi, late truncato. Oculi sub carapace celati. Orbitæ rotundatæ, profundæ, intus completæ; fissuris nullis. Fossæ antennulariæ parvæ, ovatæ, transversæ. Epistoma sat amplum, ab apice maxillipedum externorum producto bi-partitum. Area buccalis æque lata ac longa. Canaliculus pterygostomianus margine sinuatus ad angulum antero-externum. Maxillipedum externorum exognathus parvus, quam ischium multo angustior; mero ischio quarta parte breviore. Chelipedes robusti, non cristati; digitis fere longitudinalibus. Abdominis *fœminæ* segmenta tertium, quartum, quintum sextumque coalita; segmentum secundum hastiferum. Sternum latum.

262. CARCINASPIS MARGINATUS, nov. sp. Carapax ruber, pedes albidi. Carapax chelipedesque serie duplice granulorum marginati. Superficies lævis, glabra; media parte carapacis parum convexa et punctata. Rostrum sat productum, paulo resupinatum. Regiones subhepaticæ, et margines maxillipedum sternique confertim depresso-granulati. Chelipedes robusti, angulati; digitis palma dimidia brevioribus, sulcatis. Pedes ambulatorii sat dilatati; mero superne unicarinato; reliquis bicarinatis; dactylis acutis, articulis penultimis non brevioribus. *Fœminæ* carapacis long. 0·25; lat. 0·28 poll.

Hab.—Ad Promontorium Bonæ Spei; sublittoralis in rupibus, sub lapidibus.

CRYPTOCNEMUS, nov. gen. Carapax latus, pentagonus, (vel triangularis, angulis lateralibus late truncatis,) retrorsum et lateraliter valde laminato-expansus, paulo resupinatus, pedes ambulatorios (extremitatibus exceptis) celans. Frons rostrata, rostro lato, triangulato, resupinato. Orbitæ minutæ, rotundatæ, marginibus integris. Antennæ externæ fere obsoletæ. Area buccalis æque lata ac longa. Canaliculus pterygostomianus margine antico integer. Maxillipedum externorum exognathus dilatatus, quam ischium non angustior, extus regulariter arcuatus; mero ischio tertia parte breviore. Cheli-

pedes laminato-cristati; digitis brevibus. Abdomen maris angusto-triangulatum, prope basin sub angulo recto flexum; segmentis totis, primo ultimoque exceptis, coalitis. Sternum latum. Dactyli pedum ambulatoriorum gracillimi.

263. CRYPTOCNEMUS PENTAGONUS, nov. sp. Carapax multo latior quam longior, pentagonus, latere postero-laterali antero-laterali dimidia breviore. Dorsum lævissimum, medio convexum, antice leviter carinatum, regione cardiaca parva, leviter prominente. Rostrum sub angulo 60° resupinatum, apice acutum, lateribus convexum. Superficies inferior tota lævis, nitida. Chelipedes valde depressi, glabri, cristis horizontalibus valde expansis, marginibus profunde sinuatis vel undulatis. Digiti palmæ tertiam partem adequantes; digitus immobilis latus; dactylus sulcatus. Pedes ambulatorii laminato-cristati. ♂ Carapacis long. 0·20; long. 0·29 poll.

Hab.—In sinu "Kagosima," Japoniæ; fundo conchoso-limoso, org. 25.

ONYCHOMORPHA, nov. gen. Carapax unguiformis, laminatus, longior quam latior, antrorsum angustatus, postice valde dilatatus. Frons brevissima, truncata, non rostrata. Orbita minutissima, superne profunde fissa, intus hiatu parvo interrupta. Fossæ antennulariæ obliquæ. Epistoma mininum. Antennæ externæ obsoletæ. Area buccalis longior quam latior. Canaliculus pterygostomianus margine antico integer. Maxillipedum externorum articulus basalis parvus; endognathus angustus, apice vix exognathum superante, ischio quam merus breviore; exognathus multo endognatho latior, extus arcuatus. Chelipedes depressi, manu laminiformi, digitis brevissimis, obliquis, fere transversis. Abdomen maris subtriangulare, prope basin latum utrinque tumidum, lateribus parum concavis; segmentis multis coalitis. Sternum angustius.

264. ONYCHOMORPHA LAMELLIGERA, nov. sp. Carapax lyratus, laminiformis, utrinque super pedes ambulatorios tertios profunde sinuatus; ad extremitatum posteriorem latior. Frons truncata. Margines antero-lateralis et posterior leviter convexi. Superficies glabra, media parce convexa, prope margines leviter striata, striis radiatim dispositis. Regio pregastrica depressa. Maxillipedes læves. Chelipedes læves; mero trigono, depresso, marginibus acutis; carpo parvo, extus acuto; manu laminato-dilatata, intus subtusque pubescente; digitis sulcatis, quartam palmæ partem adæquantibus. Pedes ambulatorii graciles, non laminato-cristati; dactylis gracillimis. Abdominis maris segmentum penultimum ad extremitatem acute unidentatum. ♂ Carapacis long. 0·242; lat. ad extremitatem posteriorem, 0·22 poll.

Hab.—In portu "Hong Kong"; fundo concho-limoso, org. 10.

CALAPPIDEA.

265. CALAPPA CRISTATA, Fabr.; Suppl. 346. M. Edwards; Hist. Nat. des Crust. ii. 105. *Lophos philargius*, De Haan.—In portu "Hong Kong"; fundo concho-limoso, prof. 6 org. Etiam ad insulam "Loo Choo."

266. CALAPPA TUBERCULATA, Fabr.; Suppl. 345. Herbst.; loc. cit. i. 204, pl. xiii. f. 78. *C. hepatica*, De Haan, loc. cit. p. 70.—In freto "Gaspar" et ad insulam "Loo Choo."

267. CYCLOES CRISTATA. *Cryptosoma cristata*, Brullè.—In sinu "Funchal" insulæ Madeiræ; fundo arenoso, prof. org. 20.

268. MATUTA LUNARIS, Leach; M. Edwards; Hist. Nat. des Crust. ii. 114. *Cancer lunaris*, Herbst. loc. cit. iii. 43, pl. xlviii. f. 6.—Ad insulas "Bonin."

269. MATUTA VICTOR, Fabr. Suppl. 369. M. Edw.; Hist. Nat. des Crust. ii. 115; Atlas Cuvier R. A. Crust. pl. vii. f. 1.—In mari Sinensi boreali.

DORIPPIDÆ.

270. DORIPPE QUADRIDENS, Fabr.; Suppl. 361, De Haan; Fauna Jap. Crust. 121, pl. xxxi. f. 3.—In portu "Hong Kong" in fundo limo-sabuloso prof. sex org.

271. DORIPPE FACCHINO, De Haan; Fauna Jap. Crust. 123. *Cancer facchino.* Herbst.; loc. cit. i. 190, pl. xi. f. 68. *D. sima*, M. Edwards; Hist. Nat. des Crust. ii. 157, pl. f. 11. (non Dana; Exp. Exp. Cr. i. 398.)—In mari Sinensi prope "Hong Kong"; in fundis arenosis et limosis prof. 6-30 org. vulgaris.

272. DORIPPE JAPONICA, Von Siebold; Spicilegia Faunæ Japonicæ, p. 14. De Haan; loc. cit. 122, pl. xxxi. f. 1.—In sinu "Hakodadi."

273. DORIPPE GRANULATA, De Haan; loc. cit. 122, pl. xxxi. f. 2.—In sinu "Hakodadi" Japoniæ; fundo limoso prof. sex org. Etiam prope oras orientales insulæ "Niphon," ad prof. org. 30; et in portu "Hong Kong" Sinensi.

274. DORIPPE SEXDENTATA, nov. sp. Parvula. Carapax sat elongatus, superficie inæqualis, non granulatus. Frons interocularis quadridentata, dentibus acutissimis subæqualibus. Fissuræ supra-orbitales profundissimæ, triangulato-apertæ. Dentes extra-orbitales graciles acuti, quam dentes frontales minus prominentes. Dens infra-orbitalis obsoletus. Pedes graciles, cylindrici, asperi, penultimi ultimique paris fere simplices. Abdomen maris nec tuberculosum nec nodulosum. ♂ Carapacis long. 0·275; lat. 0·242 poll.

Hab.—In sinu "Kagosima" Japoniæ Australis; fundo conchoso prof. org. 20.

TYMOLUS, nov. gen. Carapax oblongo-rotundatus, antice contractus, formâ fere ut in *Homola;* regione faciei angusta, prominente. Regiones hepaticæ branchialesque amplæ, tumidæ. Apertura branchialis afferens positione normalis, ad basin chelipedum. Frons quadridentata. Dens medianus marginis areæ buccalis antice inter dentes medianos frontis superne visus. Oculi parvi, longitudinaliter protractiles. Orbitæ profundæ, superne profunde interruptæ, dente in hiatu inferiore armatæ; hiatu interno magno. Antennulæ sat longæ, hiatum internum orbitarum occupantes; fossis nullis. Antennæ externæ breves, infra antennulas sitæ, articulis distinctis. Maxillipedes externi parum hiantes, valde elongati, maxillipedes internos in totum tegentes; endognathi mero quam ischium latiore, apice acuto ad vel ultra frontis marginem producto; palpo ut in *Leucosideis* celato; exognatho angusto, ischium endognathi vix longitudine superante. Pedes ambulatorii eis *Dorippes* fere similes, dactylis vix falciformibus, non sulcatis. Abdomen sex-articulatum, ei *Dorippes* simile, segmento ultimo dilatato.

275. TYMOLUS JAPONICUS, nov. sp. Carapax distincte areolatus, subtiliter granulatus, latere tridentato, dente primo majore ad angulum hepaticum. Dens validus in regione subhepatica. Dentes frontales parvi sed acuti, mediani prominentiores. Chelipedes maris asperi; carpo ad apicem unispinoso, manu brevi, alta, digitis magnis, palmâ longioribus, intus concavis. Pedes ambulatorii graciles. ♂ Carapacis long. 0·235; lat. 0·24 poll.

Hab.—In sinu "Hakodadi" insulæ "Jesso" Japoniæ; e fundo conchoso ad profunditatem octo orgyiarum lectus.

July 6th.

Vice-President BRIDGES in the Chair.

Twenty-four members present.

A paper entitled "Descriptions of twelve New Species of Uniones, and other Fresh-water Shells of the United States, by Isaac Lea," was presented for publication in the Proceedings.

Dr. Le Conte stated, in regard to the small collection of Coleopterous Insects of Japan presented this evening by Dr. A. A. Henderson, U. S. N., that several