ending at the apex of the modiolus. A larger *spiral canal* traverses it just behind and along the course of the spiral lamina, for the accommodation of the spiral ganglion. Numerous fine canals, communicating with the minute foramina of the spiral tract, likewise traverse the modiolus, for the transmission of the filaments of the cochlear nerve. The canals in their advance are successively reflected to open into the spiral canal of the modiolus.

The spiral lamina is composed of two delicate compact layers, with an intervening delicate spongy layer, which is traversed with numerous fine radiating and anastomosing canals. These communicate with the spiral canal of the modiolus, and terminate in minute apertures at the free edge of the spiral lamina.

The tympanic passage of the cochlea is directed from the round window downward, forward, and inward. It is crossed below, just in advance of the window, by a little crest,[1] to the inside of which is the aperture of the fine venous canal communicating with the pyramidal pit of the jugular foramen. The vestibular passage communicates with the vestibule internally to and above the tympanic passage, and below the position of the oval window.

The round window looks outwardly from the tympanic passage into the arched recess at the back of the promontory. It is beneath and a little external to the position of the oval window, from which it is separated by a vaulted arch formed by the upper part of the promontory. It is irregularly circular or somewhat oval, and about a third less in size than the oval window.

[1] Crista semilunaris.

GLACIAL DEPOSITS OF THE BOW AND BELLY RIVER COUNTRY.

DURING the progress of the geological examination of the Bow and Belly River country, which lies for the most part in the drainage-area of the South Saskatchewan, north of the 49th parallel, and immediately east of the base of the Rocky Mountains, several points of considerable interest and importance in the history of the glacial period have been observed. These observations, though made in the summer of 1881, have not yet been published; and, as it is hoped that the work of the coming season may add largely to our knowledge of this and neighboring districts, a detailed report is likely to be still further deferred. A brief general notice may in the mean time be of interest to the readers of SCIENCE.

A systematic account of the 'surface geology' of this and other districts in the vicinity of the 49th parallel was first given by the writer in 1875.[1] Observations were, however, at that time, necessarily confined more or less closely to the neighborhood of the 49th parallel. The late examination of the Bow and Belly country has been much more complete, embracing an area of about 20,000 square miles. The surface of this region declines, but not uniformly, from a height exceeding 4,000 feet along the base of the mountains to about 2,500 feet in its eastern and north-eastern parts. With the exception of a strip of country which may be designated as the foot-hills of the Rocky Mountains, the whole of this tract is covered more or less deeply with material which may be generally referred to as 'drift.' Over considerable areas this covering is from 100 to 200 feet in thickness; but in other places it is comparatively scanty, particularly on some of the more elevated plateaus of cretaceous and Laramie rocks. During later tertiary time the country has evidently been subjected to very extensive denudation; and its surface must have been much more diversified at the onset of the glacial period than it is at present. The drift deposits have evidently filled pre-existing hollows and low tracts; and the general effect has been a filling-up of its irregularities, and the production of wide areas of almost level prairie country. In cutting out their beds anew in the modern period, the rivers have in some places exposed fine sections of the cretaceous and Laramie rocks, while in others the base of the drift deposits has not been reached.

Resting immediately on the surface of the cretaceous and Laramie rocks in a number of localities on the Bow, Belly, Old Man, and other rivers, is a deposit of well-rolled pebbles or shingle, consisting, for the most part, of hard quartzites, and derived entirely from the paleozoic rocks of the Rocky Mountains. These pebbles are seldom more than a few inches in diameter, and often very uniform in size. The deposit has been observed to extend to a distance of over a hundred miles from the base of the mountains. Whether it has been carried from the mountains entirely by the action of rapid streams of preglacial times, or has been distributed in some more extended body of water, I am as yet unprepared to decide; but the fact that it occurs at very different elevations above the present water-level in neighboring sections on the same river, would appear to point to the latter conclusion. No marks of ice-action have been found on the stones of this deposit, which at one place on the Belly

[1] Quart. journ. geol. sce., Nov., 1875. Geology and resources of the 49th parallel.

was observed to be associated with stratified sand-beds.

Resting upon the shingle deposit in some localities, but in other places directly on the cretaceous and Laramie, is the bowlder-clay, a mass of sandy clay, often very hard, and not infrequently showing a pretty well marked relation in colors and material to the underlying soft rocks, from which it has evidently been largely formed, but packed irregularly with bowlders and fragments of Laurentian and Huronian origin, often distinctly glaciated, and with quartzite pebbles resembling those above described. While generally rather massive in character, the bowlder-clay is frequently more or less evidently divided by stratification-planes, and is quite distinct in appearance from the morainic accumulations which occur in the foot-hill belt.

The upper part of the bowlder-clay is usually much more distinctly stratified than the lower, and often more or less markedly lighter in color, though still holding numerous stones and bowlders of mingled Laurentian and Rocky Mountain origin. In the region through which the lower part of the Belly River cuts, a series of well-stratified sands and sandy clays are intercalated between these two divisions of the bowlder-clay; and in several sections these were observed to include an irregular layer of impure lignite or indurated peat a few inches in thickness, evidently the accumulation in a swamp or shallow lake which must have covered many miles of surface. A thin nodular deposit of ironstone was also found in association with the lignite at one place. This is the first evidence of an interglacial period, or interruption of the severity of the glacial conditions, which I have met with in the area of the great plains; but the facts are here perfectly clear and conclusive.

The surface of the plains generally is often strewn more or less thickly with erratics, which, except in the immediate vicinity of the mountains, are usually derived from the Laurentian axis; and, as they are frequently larger than any of those characterizing the bowlder-clay of the neighborhood, there is reason to believe that they belong to a subsequent period of dispersion. Several very large bowlders of Huronian quartzite occur near the Waterton River, not far from the western limit of the Laurentian and Huronian drift. One of these measured $42 \times 40 \times 20$ feet; and as no rocks at all resembling that of which these bowlders consist, or the gneisses and granites of the Laurentian, occur in the eastern ranges of the Rocky Mountains (which are everywhere here continuous and wall-like), there can be no doubt as to their eastern or north-eastern origin. As already stated in my Boundary commission report, the western margin of the region characterized by Laurentian and Huronian drift is here about seven hundred miles from the nearest part of the Laurentian axis, and within a few miles of the base of the Rocky Mountains.

In the publications above alluded to, a number of cases have been instanced, of the great elevations reached by erratics of eastern origin in the western portion of the Great Plains. The following additional examples from the district now in question may be added. The heights given are barometric, but have been worked out by comparison with the U. S. signal-service observations at Fort Benton, and may probably be depended on to within fifty feet. At the summit of the high ridge crossed by the trail between Fort MacLeod and Pincher Creek, Laurentian stones were found at an elevation of 4,390 feet; near the summit of the Rocky Spring Ridge, on the trail from Benton to MacLeod, and at several points about the intersection of the 49th parallel with the western branch of Milk River (long. 113°), at elevations between 4,100 and 4,200 feet. On the flanks of the W. Butte (lat. 49°, long. 111° 30′) Laurentian bowlders of small size, and pale limestone resembling that of the Winnipeg basin, are abundant at an elevation of 4,600 feet, while the highest actually observed fragments attained an elevation of 4,660 feet.

Evidence of the fact that glaciers of considerable size debouched from the valleys of the Rocky Mountain range is found in many places. The grooving and fluting of the limestone rocks near the efflux of the Bow River from the mountains, and the moraines strewn with bowlders of local origin near the mouth of the South Kootanie Pass, and thence for thirty miles or more northward along the base of the range, may be specially noted.

In the foregoing notes no theoretical explanations of the facts have been advanced. These have been elsewhere discussed. In the publications above referred to, I was, I believe, the first to define the so-called Missouri côteau as one of the most gigantic monuments of the glacial period of the continent, though arguing against its formation as a moraine. In whatever way the origin of the côteau may eventually be decided, it is, however, well to remember that it holds a position on the northern plains scarcely more than midway between the Laurentian axis and the western margin of the Laurentian drift, and that the transport of material to a much greater distance, and to twice the altitude of the côteau region, has also

to be accounted for,— facts, possibly, best explained on the supposition of a greater subsidence of the western as compared with the eastern regions leading to submergence of the plains under water sufficiently deep to carry icebergs of large size.

GEORGE M. DAWSON.

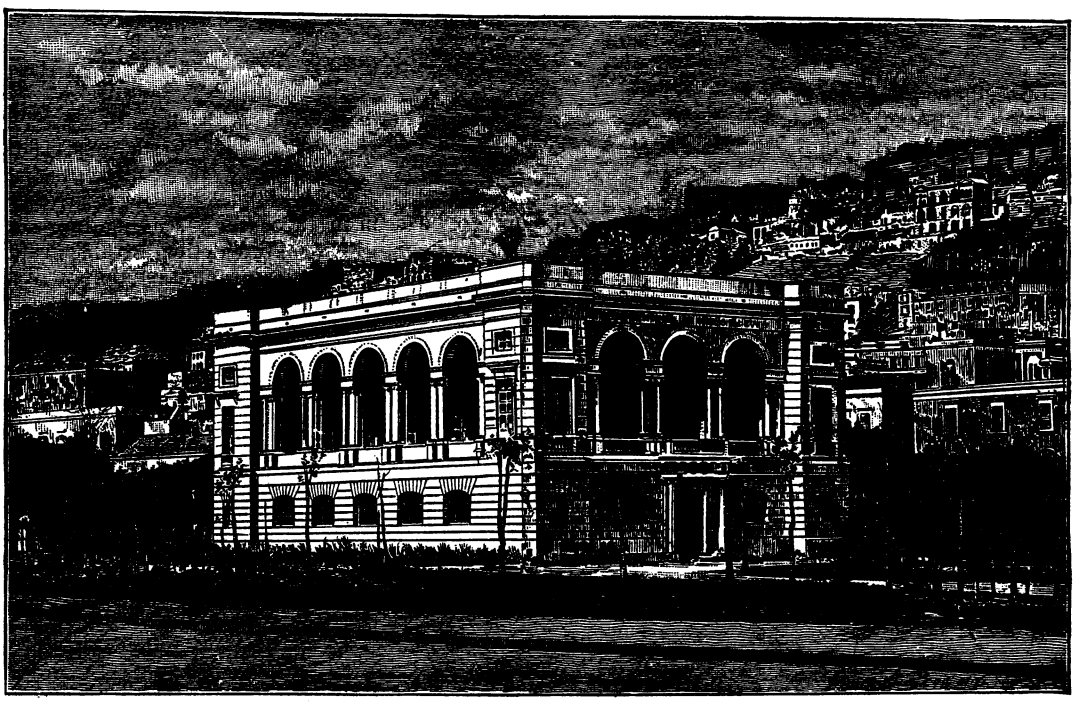
Geol. survey of Canada, Ottawa,
April 10, 1883.

THE NAPLES ZOÖLOGICAL STATION.

I.

FOR half a century past, Naples has been the favorite resort of the zoölogists of Europe on account of the wealth of the fauna of the neighboring waters. But the independent efforts of solitary naturalists were naturally unable to secure all the advantages for science which could be gained by suitable organization. Two old fishermen, who, forty years ago, were turned aside from fishing for the market, and trained to collect for science by Johannes Müller, are still at work in the gulf, not now alone, but with a dozen other men, collecting with dredges, nets, hooks, and scaphandra, material for nearly thirty investigators, studying with all the resources of a completely organized laboratory in the zoölogical station.

Dr. Anton Dohrn, in his voyages to the Mediterranean to carry out his researches, experienced, as others had done, grave difficulties which he could not, single-handed, overcome. To realize the conditions necessary for extensive and thorough work requires not only a large expenditure of money and time, but a permanent and growing institution, which provides all the instruments of research in a locality where nature furnishes in abundance and variety the material to be studied. To carry on biological work on a large scale in as many directions as possible, with a thoroughly equipped laboratory, permitting investigators to apply to their researches the most



elaborate technical processes, and to make use of the best modern methods, with all the material that these rich southern regions can supply, all the help that may be had from a well-furnished library, all the aid that can be obtained from well-trained attendants and subordinates, and all the stimulus and assistance that consciously and unconsciously comes from the intercourse of many minds giving their best powers to the same work, — this is the aim of the zoölogical station. To this object Dr. Dohrn has devoted the last fifteen years of his life, making even his own important researches a secondary consideration;