ART. XL.—*Note on the amount of Elevation which has taken place along the Rocky Mountain Range in British America since the close of the Cretaceous period;* by DR. G. M. DAWSON. (Reply of March 18 to a letter from J. D. Dana.)

BETWEEN latitudes 49° and 52° (or thereabouts) numerous infolds of Cretaceous rocks occur in the Rocky Mountains proper, or Eastern range of the Cordillera. (Laramide Range.) These consist chiefly of earlier Cretaceous (Kootanie) but in places strata as high up as Lower Laramie (St. Mary River beds) still remain. The actual elevation of these rocks is now in many places from 6000 to 8000 feet above sea-level. In the adjacent belt of foothills, to the east, the same Cretaceous rocks are found, but here still including strata as high as Upper Laramie. The actual elevation is here often between 5000 and 6000 feet above sea-level.

In the mountains, the Cretaceous rocks have been involved in all the flexure, faulting and overthrust suffered by the Palæozoic; and both in the mountains and foothills these rocks are found at all angles up to vertical and even overturned.

It is thus difficult to know to what elevations these rocks may have been thrust up in some places, but a minimum estimate may be arrived at by tracing the continuations of the beds over the less disturbed anticlinals or by adding their volume to the elevation of flat-lying ranges of the older rocks. About latitude 50° it may thus be shown that the *base* of the Cretaceous must in several places have considerably exceeded 10,000 in altitude, while in Mr. McConnell's section along Bow Pass (51° 15′) to the north of Devil's Lake, the same horizon must have been about 15,500 feet above sea-level, the beds at this place being nearly flat.

To ascertain the uplift of the beds which were at sea-level at the *close* of the Cretaceous, the volume of the Cretaceous strata must of course be added to such figures as the above. This was, in the eastern part of the mountains, at least 17,000 feet and may well have been 20,000 feet (See G. S. C. Report, 1885, p. 166 B), giving as a minimum estimate of greatest uplift for the region say 32,000 to 35,000 feet.

Farther north, Cretaceous infolds in the Rocky Mountains become less common, so far as known, but the foothills retain the same general character to Peace River and beyond. Probably the uplift was somewhat less in these latitudes, as the Rocky Mountain range proper is less important and narrower.

Still farther north, opposite the Mackenzie delta, Mr. McConnell describes the range as composed in its highest part

of Cretaceous rocks, but there only about 4000 feet above the sea. Several thousand feet have doubtless been removed by denudation, but we have no exact knowledge of the thickness of the Cretaceous in that region.

There are also some evidences of slight or moderate uplift in the Rocky Mountains proper of Alberta previous to or during the Laramie, such as the supply of material from the red rocks of the Triassic to the middle zone of the Laramie, opposite that part of the range in which these rocks occur, (see G. S. C. Report, 1882–84, p. 113 C.) as well as in the materials of the older Cretaceous conglomerates, although these last may in part have been derived from elevations west of the Laramide Range.

It is probably impossible to ascertain exactly how long the main uplifting process continued or to what extent its effect was counteracted by concurrent denudation, but some facts may be cited in this connection.—No deposits referable to the Eocene, as distinct from the Laramie, have been found in the foothills or over the Great Plains of Western Canada. It is probable that none such exist, and it may therefore be assumed that free eastward drainage, without arrest, obtained during this period. In the Early Miocene (White River) we find evidence that strong rivers were carrying coarse gravels from the mountains out over the plains to a depression some 200 miles east of the present base of the mountains, forming there a deposit of which outliers, like that of the Cypress Hills, still remain. These deposits, in their relation to the Laramide Range, resemble the Upper Siwalik Conglomerates of India, and it is probable that at this time a range comparable to the Himalayas in height, bordered the Great Plains of Alberta on the west.

During the Eocene and Miocene, orographic uplift may have been continuous, but sometime long before the close of the Pliocene it came to an end. Evidence of this is found in the following circumstances.—The Oldman, Highwood, Bow and other rivers flowing from the mountains, occupy notably wider valleys where they cross the eastern foothill belt. In these valleys Cretaceous and Laramie rocks, arranged often in compressed and complicated folds, are cut sharply off on planes nearly corresponding with the slopes of the present streams and upon the basset edges of these rocks bowlder-clay and other glacial deposits are spread. Since the Glacial period, the streams have cut out narrow new trenches in the floors of these valleys. The main valleys are therefore not only pre-glacial, but also involve a long antecedent period of erosion, during which the conditions changed little if at all. Had orogenic movements continued in the Pliocene, the flexed Cretaceous beds of the foothills (intimately connected with the general folding of the mountains) must have participated in them, and

no such uniform cutting out of wide valleys would have been possible. It was no doubt at this time also that much of the denudation of the Great Plains to the eastward occurred. In the vicinity of the western end of the Cypress Hills the general surface of the plain is now about 2200 feet lower than the Miocene capping of these hills.