at twenty-five hundred, it forming the bed of the latter stream for twenty miles.

One of the most interesting portions of the Cascade Range is the region of the Santiam River, in latitude 44° 45′ north, — a tributary of the Willamette. The lower foot-hills there are composed of a yellowish volcanic ash, stratified in part, and which reaches a thickness of several hundred feet. Such deposits are very abundant on the western slope of the range, amply fulfilling Mr. King's acute prediction of their existence (see 'Survey of the 40th Parallel,' vol. i. p. 453). The ash rests upon basalt, which lies in thick layers conforming to the general westward slope of the range. As we advance into the mountains, the basalt thins out, and at a moderate elevation disappears entirely in its general form of surface outflows, and is seen only as scattered dikes penetrating older rocks. Undoubtedly the basalt rests, as a rule, upon the unaltered sedimentary rocks to be referred to in another connection; but I have not observed them at the precise locality of which I speak. At an altitude of perhaps one thousand feet, the later rocks are replaced in the bed of the stream by metamorphic rocks of a slaty texture, which appear to dip westward. Proceeding up stream, and approaching the axis of the range, we find in very deep cañons some excellent exposures which illustrate the geological structure in a most remarkable and cogent way. The cañons are clearly of glacial origin, and are cut down three thousand feet or more through rocks of various ages, the lowest ones visible being metamorphic slates similar in all respects to the auriferous slates of California, — a resemblance that is heightened by the fact that the Santiam slates are also auriferous, workable quartz veins existing therein. The slates are nearly vertical, with a slight westerly dip. Upon them rest unconformably a great thickness of clayey and sandy shales, and conglomerates, unaltered, and of course devoid of quartz veins, and occupying a nearly horizontal position in general. They are cut by deep cañons into great mountain-masses, and form probably the most important division of rocks at this part of the range. I should judge them to be fully two thousand feet thick, and perhaps three thousand. I have secured no fossils from which their age might be determined, but for statigraphical reasons, with which I will not trouble *Science*, I shall denote the terrane as cretaceous until its age be more satisfactorily determined. I am not aware of any description of this formation having ever been published, nor have I ever heard or read aught concerning it.

Of later sedimentary rocks, the only existing ones yet discovered are certain fossiliferous sandstones and associated shell limestones, which have been spoken of as miocene, and may well belong to that system. They appear in the Cascades as fossil sea-beaches, defining the limits of the miocene ocean. The maximum height at which I have noticed these rocks in the Santiam region is between eight hundred and a thousand feet.

As might be supposed, the metamorphic slates rest against granite, which here forms the backbone of the range, the upper central portions being entirely composed of it and slate, plus a proportion of recent lava, which seems to have come from crater eruptions, but of which I can say little. I desire to call attention to the prevalence of ancient lavas in contradistinction to the more modern basaltic flows. There are heavy bodies of probably augitic lava overlaid by and therefore older than the rocks I have denominated cretaceous. Other instances seem to prove associated lavas as old as the auriferous slates. Of these eruptive rocks, I recognize two or three general types, which I have forwarded for study and determination to Professor Jackson, the petrologist at Berkeley, Cal. Altogether, I believe that the eruptives, old and new, make up perhaps one-eighth or one-tenth of the bulk of the visible terranes of the Santiam.

It is evident that the Santiam section resembles neither the exclusively volcanic exposures cited, nor the Umpqua section, as described by Dr. Becker, who found granite and metamorphic rocks overlaid unconformably by miocene strata, without the presence of intermediate unaltered rocks. Besides, his metamorphic types were chiefly serpentine, which, notwithstanding its immense development in southern Oregon, I have not noticed north of the Calapooia Mountains. It seems not improbable that the serpentines may be the representatives of the unaltered shales and conglomerates of the Santiam.

From the above observations, and from other reasons which I will not take space to explain, I conjecture that the earliest mountain-making movement which affected the Cascades took place much farther back than the cretaceous, as held by some, and resulted in forcing up the granite nucleus, with its covering of slate or the representatives of slate, to a considerable height above sea-level; this movement being followed by extensive denudation, of which good evidence appears to exist. Then followed a submergence, total or partial, when the strata that I call cretaceous were laid down. The whole range could hardly have been ingulfed at the time, for I am told of tracts now existing where no intermediate strata are found between the early granite and the late basalt. I can suggest nothing as to the condition of affairs during the eocene time, the question of the existence of marine strata of that age in Oregon not having received attention.

It would seem that the miocene strata were deposited on rising areas, when the Cascades had reached to within a few hundred feet of their present height.

It is probable that there have been at least two upheavals, and one movement of subsidence, which, with attendant phenomena, I have grouped as follows: —

1. In paleozoic or early mesozoic time, primary elevation of granite axis with overlying sediments, accompanied by metamorphism of the latter.

1*a*. Denudation of range.

2. Subsidence beneath cretaceous sea, and deposition of cretaceous strata.

3. Elevation to within one thousand feet of present state.

3*a*. Deposition of miocene rocks.

3*b*. Outpouring of lavas through fissures.

3*c*. Era of crater eruptions, and deposition of beds of volcanic tuffs in late seas and lakes.

3*d*. Continued elevation of land to present height, accompanied by glacial and aqueous erosion. Diminished volcanic activity.

There are certain evidences, among them Captain Dutton's discovery of a rising surface at the Cascades of the Columbia, which make it probable that the mountain-making movements are still going on in the range.

HERBERT LANG.

Portland, Ore., Jan. 31.

Queries.

27. WASHINGTON'S LETTERS. — In the last number of the *Magazine of American History* there are two letters of Washington which I think are of doubtful authenticity. The first letter is printed on p. 162: the second immediately follows it. Both are claimed to be taken from originals in the collection of Dr. Thomas Addis Emmet. That forgeries are extant of Washington's letters, is well known to collectors. One prominent test of such forgeries is said to be in the autograph. Washington always abbreviated 'George' by writing 'G°,' and never used the initial *G* alone. Such a test, if reliable, applied to the letters, would prove them to be forgeries. This test will hold good in comparing the undoubtedly genuine letters copied from originals in the British Museum, and printed in the same number of the magazine. Again, the subject-matter of these letters is suspicious, especially where Washington is made to write of his troops at Cambridge, that they "are an *exceedingly dirty and nasty people*." I do not claim to be an expert on such matters. On the contrary, my disbelief in their authenticity is based more upon my wish that our beloved Washington did not write such a sentiment.

GEORGE GLENN WOOD, M.D.

Muncy, Penn., Feb. 7.

Answers.

23. DROPS OF WATER. — In answer to Mr. E. J. Pond's query in relation to floating drops of water upon the general surface (*Science*, xi. p. 38), I beg leave to refer him to the paper of Prof. Osborne Reynolds of Manchester (England), published in *Nature*, vol. xxv. p. 23, Nov. 3, 1881, where he will find an explanation of this capillary-film phenomenon, as well as a clear indication of the physical conditions necessary for its production.

JOHN LE CONTE.

Berkeley, Cal., Jan. 30.