SCIENCE.

FRIDAY, APRIL 18, 1884.

COMMENT AND CRITICISM.

TRAVELLERS in the west during the past few years will surely have met the statement that the rainfall of the dry region beyond the Mississippi is increasing. Many western settlers express the hasty conclusion that the change is a steadily progressing one, and is due to the cultivation of the ground; and the more venturesome theorists explain the increase as an effect of the better equalization of electric conditions of the atmosphere, as allowed by the laying of iron rails and the stretching of iron wires across the plains. The natural extension of these theories pictures the plains in the near future redeemed from their present unprofitable dryness by persistent occupation. It is well to set these unwarrantable fancies face to face with the matter-of-fact statistics lately published by the signal-service; for, whatever the doubtful possibilities of man's power may be, the connection of such small artificial changes with variation of rainfall in the relation of cause and effect is in the last degree questionable. There is not the least reason to think that the *régime* of the winds and rain can be permanently affected so easily, or that any progressive change is going on so rapidly as to make itself felt in a decade of years.

As to the fact of variation in rainfall from year to year, there is, of course, no question: this is a most ordinary condition, especially in regions of moderate precipitation, where a good share of the annual fall may be gathered from a single storm. But, beyond this, the tables lately published show certain wide-spread variations of importance. Signal-service note no. vii., prepared by Mr. H. A. Hazen, discusses the variation of rainfall west of the Mississippi River, as shown in the records of nearly seventy stations from 1871 to 1882 inclusive, with the conclusion that "many more years of observation will be needed, as well as many additional stations, . . . before any secular variation can be fully established." The tables show irregularities in the amount of rain roughly conformable over large areas. From 1871 to 1873 there was a general deficiency; about 1875, 1876, 1877, there was corresponding excess; 1878 or 1879 was notably dry again; and from then to 1882 there was a general increase, but not above the previous maximum. It is therefore now altogether premature to regard the variation of rainfall as any thing but what may be, in the present condition of meteorology, properly termed 'accidental;' that is, due to subordinate causes not yet determined, and not to any progressively increasing factor, like cultivation or rail-laying.

"THIS brings them dangerously near the American category of 'dead heads;' but, lest they should incur the additional reproach of being 'free lunchers,' they will be allowed to pay a sum not exceeding two shillings for a 'square meal.'" This, from the comments of the London *Times* on the great American or Canadian promised hospitality to the British association, on its approaching visit to Montreal, has reference to the alluring pictures held up of the trip west on the Canadian Pacific railroad. 'Allowed to pay two shillings' — what a favor! — for a meal in a crowded saloon of a crowded steamer, first table, second table, third table, as the promptness and skill of the traveller in 'jumping' a chair may justify. 'For a square meal' in a tent, two hundred miles from the nearest cow, how gladly the easy-going English traveller will pay his two shillings, — money which would bring a cup, a saucer, a plate, a knife, a fork, in England, but in Canada's backwoods restaurant may only secure a saucer. How happy our English cousin with a saucer, and a blushing rustic before him to inform him that there is bread,

perhaps, to fill it, but no beer, no milk, no good water, only bad tea and bad coffee! A few days of such living, a glance into a 'muskeag,' a ride over the streets of Winnipeg, and how mistaken will appear the managers of the association in planning an American meeting!

The visits of foreign astronomers to observatories on American soil have of late years been very frequent; and it is not, perhaps, too much to say that the impressions they have carried away have in the main been of a pleasantly favorable and in some instances of even a surprising character. Occasionally they have made free to express themselves with regard to the somewhat rapid development of, and the future outlook for, their science in this country; but only infrequently have their opinions and criticisms been placed on permanent record. During the latter part of the summer of 1883, Dr. Ralph Copeland, astronomer to the Earl of Crawford and Balcarres, and editor of the lately discontinued journal *Copernicus*, passed through the United States, and visited a goodly number of the more active observatories, among them those at Cambridge, Washington, Princeton, Albany, and Clinton. His general impressions, as he modestly styles them, are far from uninteresting; and, while there is much that has been suggested before, American astronomy has not yet advanced to a stage where no opportunity offers for advantage from such suggestions.

The decision of our treasury department, by which fine weights, such as are necessarily used by every chemist, are for customs purposes not to be regarded as 'philosophical apparatus,' but as articles worked in metal, is as plain a violation of the spirit of the law as could well be imagined. A similar case presented itself a few years ago, when a college imported bottles for use in the chemical laboratory. There was no doubt about the fact that the bottles were to be used for purely scientific purposes. They were without question 'philosophical apparatus' in the sense in which that expression is used in the tariff law; and yet the secretary decided that the bottles were to be classed as bottles, and not as 'philosophical apparatus;' and the college had to pay duty on them to the extent of forty per cent *ad valorem*. If the law, as it stands, has any object, that object is, by relieving educational institutions from certain burdens, to encourage the spread of knowledge. Without this object, the law is meaningless. By what right, then, does the secretary of the treasury decide that educational institutions shall not have the benefit of the law?

The child, seeing for the first time the evening star, exclaims, 'O mamma! God has made a star.' How should this wondering admiration of the novelties to the opening mind be received? The parent has seen many a star, has possibly a great objection to stars from being obliged to watch them for hours. Next morning the child may rush in with open eyes, and demand the mother's sympathy, in its excitement over a passing wagon heavily loaded, and drawn by six horses; or at the quaint humanism of the organ-grinder's companion at the street-corner. These, again, are familiar experiences to the mother, and of themselves would only call forth a moan at the rumbling of the wheels or at the squeaking of the pipes. The child feels hurt if sent away with only a 'Yes, dear,' or 'Run along,' and next time wonders to itself, and another time not at all. To the teacher and to the editor rushes the boy of all ages, and with trembling voice announces that 'the thickness of a mercury-drop on a glass plate is constant,' and suggests its adoption as a standard of length, or that a rotating wheel resists a change in the plane of its rotation, and immediately builds upon his experiment a perpetual motion, or that he has found some relation between the physical constants of a few bodies, and warps the others to fit some preconceived theory. How is all this enthusiasm to be met? With the child, it is the evidence of an active intellect, and gives promise for the future, and may be enjoyed with it; with the boy of tender age, there is no harm in pointing out that he has

come on the stage at a comparatively late period in the world's activity, and that it would be well to inquire, before bounding with joy at his new possession, whether it may not be an old one in the world's stock of knowledge, or even valueless; but for the old boy, the incorrigible old boy, who is constantly popping up with his theory of comets, his theory of the gyroscope, or his very important measurements of the thickness of a mercury-drop, what can be done? His questions and talk may show evidences of an active mind, but of a mind working within a Chinese wall of self-sufficiency. He feels intensely indignant when told to examine the records, and compare his work with that of others. He is only working as every philosopher formerly worked, within himself; but at this age he is — a bore.

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The use of the method of rates in mathematical teaching.

IN *Science* for March 28, Professor Wood, referring to the method of rates, says, "There is the same difficulty in the fundamental conception as in the infinitesimal method;" and he represents a student as asking the questions, "'In a mathematically perfect engine, does the piston stop at the end of the stroke?' 'Does it remain at rest at any time?' 'How can it reverse its motion, if it does not stop?' 'How can it cease going in one direction, and move in the opposite direction, without stopping between the two motions?'" This difficulty, if it exists, must be met in the teaching of mechanics, and may therefore be discussed apart from the question whether it be advisable to found the differential calculus upon the conception of velocity. The form of the questions which Professor Wood puts into the mouth of the student somewhat puzzles me. I can but suppose that Professor Wood answers 'Yes' to the first question; but, in that case, how can the student ask the third or fourth question? The difficulty must lie in the answer to the second question, 'Does it remain at rest at any time?' It would not be safe to answer this question at all in this form, because it indicates a confusion of mind in the use of the word 'time.' 'At any time' might mean 'at any instant;' but the use of the word 'remain' shows that the student probably meant 'remain at rest *for* any time;' that is, for any interval of time. To the question thus amended, we can safely answer, 'No.' But having already admitted that the piston does stop at a certain instant, namely, 'the end of the stroke,' the student has no occasion to ask the third or fourth question. Of course, a student may be easily puzzled by the metaphysical subtleties and sophistries by which a certain school of philosophy persuaded itself that motion was impossible; but, left to himself, he has no more difficulty in appreciating the difference between an 'instant' and an 'interval' of time than he has in distinguishing between a point and a line in geometry.

Farther on in his letter, Professor Wood asks, 'Does change in the rate of motion take place *at* an instant, or *during* an instant?' It seems to me that if he will dispense with the colloquial use of the word 'instant' for a small interval of time, and substitute 'during an interval,' the so-called difficulty will disappear. Do his students ever ask whether the positive and negative parts of the axis of x are separated by a point, or by a space?

WM. WOOLSEY JOHNSON.

Annapolis, April 5.

Paleozoic high tides.

Your reviewer of the *Geographisches jahrbuch*, referred to by Professor Newberry in *Science* (No. 61, p. 402), was led, by the evidence given in brief below, to the conclusion that tides higher than those now observed, produced in the way explained by G. H. Darwin and illustrated by Ball, had occurred within paleozoic time. It was not, however, his intention to accept the gigantic tides described by Ball, but simply tides *significantly* stronger than those of the present time; for these seem not only warranted, but required, by the spread of paleozoic strata.

Soundings and dredgings, as summarized, for example, in the *Lithologie du fond des mers*, by Delesse, prove that the coarser land-derived sediments, such as form conglomerates and sandstones, are deposited within a moderate distance of their origin, excepting in narrow tide-ways, such as the English Channel, where they stretch out farther; elsewhere, pebbles especially fall within a very narrow fringe along shore. The paleozoic strata of the eastern United States give ample evidence of submarine transportation of land-derived sediments certainly three hundred miles from their source, of sands at least half this distance, and of clean sands with pebbles certainly a hundred miles; and this when measuring only from the present south-western margin of the Cambrian strata. In this regard, the Medina, Oriskany, and carboniferous sandstones and conglomerates, which overlie calcareous or shaly strata, from which their siliceous elements could not have been derived, give very much stronger evidence than that obtained from the Potsdam sandstone, which was formed during the advance of the sea over an old land-surface, whose local waste may have formed this basal deposit close along shore. I must consequently persist in believing that the spread of pebbles and sand over the old sea-floor during the above-named epochs implies a greater transporting-force than is now known in the modern oceans.

The Jurassic sandstones of the Colorado plateau were, according to Capt. Dutton, deposited with very little shaly admixture over an area of thirty-five thousand square miles. A liberal estimate of the Bay of Fundy gives it under four thousand square miles, and its deposits are rather muddy than sandy; that is, muds such as were washed out of the old Jurassic basin are allowed to accumulate in the Bay of Fundy. Whether the tides were much stronger in Jurassic time than now, is perhaps an open question; but that marine transportation was then stronger seems, at least from this example, very probable.

In looking for a cause of former greater activity in the ocean, we find it only in the possible variation of the tides and currents, unless recourse be had to the older cataclysmic theories. Increase in the velocity of currents needs stronger differences between polar and equatorial temperatures, or an advantageous con-