adopting the doctrine of the dissipation of solar energy, and citing the paleontologic evidence of warm tertiary climates in arctic regions.

Search is made for proofs of recent changes of temperature corresponding to the recent changes in precipitation. The thermometric record is rejected, because the conditions of observation have not been constant; but certain circumstantial evidence is admitted. The northern limit of the grape and other cultivated plants is observed to be now farther south than formerly, and the northern limit of human habitation has been crowded somewhat southward. The people of Greenland and Iceland are emigrating, and icebergs are multiplying in arctic waters.

This theory of the continuous fall of general temperature is evidently inconsistent with the prevalent assumption that the glacial epoch was a period of exceptional cold, and a considerable share of the book is devoted to the setting-aside of that assumption. To this end the present glaciation of the earth is reviewed at some length, and the conditions of glacier formation are discussed. It is shown that mere cold, whether it pertain to high latitude or to high altitude, is not sufficient, but that an abundant precipitation must accompany it; and, since a lowering of general temperature tends to check precipitation by checking evaporation, it should not be predicated as the cause of the glacial epoch. A higher general temperature is quite as likely to be a favorable condition for producing the demonstrated effects.

For a series of decades there has been a general shortening of the glaciers of the Alps, the Caucasus, and the Pyrenees. In some localities the retrograde movement began about fifty years ago; in others, twenty-five; and the longer glaciers have receded several thousand feet. This is ascribed to a slight diminution of precipitation, caused by the general cooling of the atmosphere, and is correlated with the desiccation of the shores of the Mediterranean.

The phenomena of the glacial epoch are then reviewed; and it is stated that only in western Europe and north-eastern America was the glaciation so extensive as to demand the assumption of conditions considerably different from the present. The environments of individual glacier districts are discussed, and the prevalent ideas with reference to the magnitude of the phenomena of the glacial epoch are combated.

In particular are the phenomena of Greenland, Scandinavia, and the Ural contrasted. Precipitation is now small in the district of the Ural, large in Scandinavia, and probably large in Greenland. This accounts for the extensive glaciation of Scandinavia and Greenland, and the absence of glaciers, both ancient and modern, from the Ural. The present conditions of Scandinavia and Greenland differ chiefly in that the latter is somewhat higher and more maritime; and to account for the ancient extreme glaciation of Scandinavia, it would be natural to suppose that it then resembled Greenland in these respects. According to the Swedish geologists, this was the case. Its altitude was greater, and during at least a portion of the glacial epoch the plain at its eastern margin was submerged.

The description of the glaciation of north-eastern America is somewhat meagre, and is chiefly characterized by a tendency to estimate lower than other geologists the magnitude of the phenomena. The existence of an ice-sheet is not denied; but the difficulties attending the glacial hypothesis are emphasized, and great importance is attached to the work of icebergs and rivers.

Incidentally the book is replete with illustrations of the independence of the author's opinions. He ascribes no erosive power whatever to glaciers, but refers the multitudinous rock basins of Canada and Finland to chemical decomposition and orographic displacement, and asserts that the tendency of streams is to deepen these basins rather than obliterate them. He has a theory of glacier-motion in which water plays an important part; and he ridicules the idea that different layers of a confluent ice-mass can move in different directions. The statement that most, if not all, of the detrital material of north-eastern North America is destitute of any true morainic character, will sound strange to the geologists who are now studying the moraines of that region.

In a succeeding number some of the author's more comprehensive conclusions will be discussed.

THE GOVERNMENT AGRICULTURAL REPORT.

Report of the commissioner of agriculture for the years 1881 and 1882. Washington, *Government printing-office.* 1882. 704 p., 84 pl. 8°.

INASMUCH as the present commissioner, when he entered upon his duties, "found the work for the season, both regular and special, elaborately laid out by my [his] successor," his report not unnaturally bears a strong resemblance to the reports of preceding years. It

contains the usual reports of the entomologist, the superintendent of grounds, the botanist, the chemist, and the statistician, besides special reports relating to the diseases of animals and to the boring of artesian wells on the arid lands of the west. The tone and matter of the special reports and of the reports of special character compare so favorably with most of those of the old-style 'regulars,' that the thought suggests itself, that a much larger proportion of the work of the department than has hitherto been customary could best be done by special commissioners outside of Washington and far away from its influences. From the very nature of the situation and surroundings of the Department of agriculture; the irregularity of its income; and its dependence for support upon the favor of political parties, — let alone the merciful dispensation that the tenure of office of its chief is short, — it cannot be accounted competent to carry on continuous scientific researches; and it is in no sense desirable that it should do so. Works of *longue haleine* such as must necessarily run on consecutively from year to year are beyond its powers; and it will be well for Commissioners of agriculture, present and future, to accept the fact. Rather than try to grasp the unattainable, it will assuredly be wiser to study special finite questions as they present themselves; and to this end the best means is the employment of special scientific men of approved competency, each one to grapple with his own particular question in such place and manner as he may deem fit.

One commendable feature of the present volume is the comparative brevity of the reports of the superintendent of grounds and the botanist (of the report of the entomologist we shall speak at another time). The report of the chemist, on the other hand, is extended, and it has somewhat the effect of a twice-told tale. It was interesting and important to prove that the proportion of true sugar in sorghum-stalks increases continually until the plant is well advanced toward maturity; but the evidence of this fact presented in previous reports seemed convincing, and many of the results recorded in the present volume have the effect of being little more than refinements upon good work. The reader is inclined to ask whether it is not about time for the department to let its scientific corps drop sorghum, and to relegate the subject to the artsmen proper; that is to say, to those farmers and manufacturers who are specially interested in this line of business.

From a letter of the 'commissioners for locating artesian wells upon arid and waste lands,' as well as from the statements of the commissioner of agriculture himself, it appears that in their opinion the first trial-well at Fort Lyon in Colorado was not a success. The onus of this 'failure' is made to rest, of course, on the shoulders of a preceding administration; but the lesson it teaches is none the less instructive. It suggests the reflection, that while one important function of the Department of agriculture has been to show the American people 'how not to do it,' there are various ways in which the lesson is enforced. Impracticable borings in Colorado undoubtedly represent one mode of tuition, but in the appointing and changing of employés for political reasons we have another; and to the same end must inevitably work all changes of base which are hasty, spasmodic, and inconsequent. It will be of interest to notice how far down the next borings will be permitted to reach before a new incumbent says, 'Hold, enough!'

From a couple of modestly printed tables on pp. 25 and 692, it appears that the Department of agriculture disbursed $256,129.68 during the year ending June 30, 1881, and $353,748.60 during the year ending June 30, 1882. It will convey no new information, either to scientific men or to the agricultural community, when we say that the results obtained by this class of expenditures have hitherto been, out of all proportion, small.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

The polar quadrilateral. — As a geometrical interpretation of a property of the roots of an equation of the fifth degree, A. Brill shows that the six points in which a conic circumscribing a triangle can be made to osculate a fixed conic are the same for certain five triangles connected with a polar quadrilateral of the fixed conic. — (*Math. ann.*, XX. 331.) C. L. F. [288

Ruled spaces. — In a thesis presented to the Sorbonne, M. Koenigs studies the infinitesimal properties of an extensive class of linear complexes, basing his researches upon the earlier investigations of Plücker, Kummer, etc. M. Koenigs observes, that in punctual space, tangential space, and in space of which the sphere is an element, every infinitesimal property is expressed as a property of involution. He commences by defining certain primordial elements which he regards as necessary and sufficient for the expression of all mutual relations of the infinitesimal prop-