sity, St. Louis, who constituted the transit-of-Venus party in New Zealand in 1882, carried on, under the auspices of the coast survey, a series of gravity determinations after the transit of Venus was over, swinging pendulums—the same that had been used by Major Herschel in India, England and America—in New Zealand and Australia, at Singapore, Tokio, San Francisco and Washington.

This series served the valuable purpose of connecting together, differentially, several independent systems of gravity determinations, and when finally reduced may slightly change Professor Mendenhall's Tokio value, but is not likely to alter it materially. It is of some importance to note that, of the determinations in the vicinity of Japan, the excess at Tokio is the smallest; those at Sapporo and Kagoshima, near the northern and southern extremities of the principal Japanese islands, come next; that at Naha, out in the ocean off the Chinese coast, is still larger; while the Bonin islands, well out in the Pacific, give the greatest excess yet observed. The value coming nearest to this was also determined by Captain Leutke at Ualan, one of the most south-eastern of the Caroline group of islands, and about 5° north of the equator. It would certainly be well to reoccupy this and others of Captain Leutke's stations, in order to determine whether these abnormal values of g may be actually increasing in the Pacific.

The eclipse party, under Professor Holden, to Caroline island, 10° south of the equator and in mid-Pacific, also made, under the auspices of the coast survey, pendulum observations there, and at Honolulu and San Francisco. These results, together with those of Messrs. Smith and Pritchett will be awaited with interest.

The more we study our globe the more irregular do we find it in figure and density; and it is evident that such work as that inaugurated by Professor Mendenhall at Tokio, and that prosecuted of late years by the coast survey in all parts of the globe—where it could be economically done in connection with other necessary scientific work—is among the most important of modern contributions to our knowledge of the figure and dimensions of the earth, and is a class of work which must be carried out in connection with triangulation and astronomical determinations of latitude and longitude, before we can be at all sure that we know with sufficient precision the average value of the earth's radius, which is the unit of length or base line from which we strike out from the earth into celestial spaces, and upon which all our values of planetary and stellar distances depend.

H. M. PAUL.

GEOLOGICAL CHANGES IN NEW SOUTH WALES.[1]

From the close of the Pleistocene period to present times the main physical features of New South Wales have remained pretty constant. In the Carboniferous period a large part of the country was a stretch of ocean, the New England mountains being but little older. The last main elevation occurred early in Mesozoic times, and from that time to the Pleistocene period unceasing atmospheric denuding, faultings and volcanic eruptions have been at work shaping the country into valleys and hills. The Pleistocene deposits are indicated by vast accumulations of drift and diluvial sediment derived from the erosion of the deep valleys in the highlands when the rainfall was greater than at present. That the rainfall in this period was much greater than it has since been is proved by the evidence of great erosion in the highlands.

The cause of this interesting pluvial period over a large portion of the southern hemisphere—for its effects have been observed in New Zealand, South America and South Africa—is directly connected with the Glacial period of the northern hemisphere. While the northern winter was so long and cold as to induce a large accumulation of snow and ice, that of the opposite hemisphere was short and mild with long and cool summers. There was a perpetual spring in the southern lands. When the alternation took place, 10,500 years after, the Antarctic ice was so extended as to produce on a larger scale and nearer to the Australian continent, the fogs, rain and snowstorms which now prevail in the Antarctic ocean. The present glaciated condition of the Antarctic regions being due to the winter of the southern hemisphere being in aphelion, it may readily be perceived how these conditions must have been intensified in the Pleistocene period when the eccentricity was three and a half times greater than it now is. It is also thought that owing to the extreme difference between the temperature of the south pole and that of the tropics, the south-east trade winds would blow with a greater force over a larger area, and so the upper counter trades would return more heavily laden with moisture.

In the highest Australian mountain, Mount Kosciusko, Dr. R. von Lendenfeld has recently found proof of former glacial action. Traces of glacial action were not seen lower than 5,800 feet above the sea, and they did not cover an area of more than 150 square miles. No glaciers exist there now; but patches of snow lie on the sheltered slopes and never disappear. It is interesting

[1] Extract from President C. S. Wilkinson's address before the annual meeting of the Linnæan society of New South Wales, January 28, 1885.

to know that patches of eternal snow are here found in a latitude of 37° S., about 1,500 feet lower than in the European Alps in a latitude of 47° N. In Australia the snow comes as far down in 37° as in Europe in 52°. In New Zealand the snow and ice are much more extensive than in Europe at a similar latitude. This proves that the southern hemisphere is colder and damper than the northern.

The fossil remains furnish much evidence regarding the changes of climate from time to time. The fossil plants of the Pliocene indicate a much warmer climate, more humid and equable than the periods following. The sudden banishment of this semi-tropical flora shows that a great climatic change must have supervened in post-Pliocene times, due no doubt to the glaciation of the southern regions. A small pine (Pherosphœra) intermediate between a Lycopodium and a juniper is still found in one locality adhering to the cold, shady, constantly wet cliffs near the falls at Katoomba, on the Blue Mountain. This is a Tasmanian genus and is a remnant of the flora which succeeded the semi-tropical pliocene vegetation.

Much more conclusive evidence of such a change is furnished by the remains of extinct animals, which now live only in Tasmania, where the mean annual temperature is 7° lower than in the locality where these remains are now found. The Pleistocene inhabitants of New South Wales included many remarkable animals. There were the huge carnivorous pouched lion (Thylacoleo); diprotodon, an animal holding the same place amongst the Australian mammals that the pachyderms do amongst the fauna of other continents; the nototherium, another large herbiverous animal; the very large horned lizard, megalania; and the flesh-eating notiosaurus. The kangaroos, wombats and echinids attained far larger dimensions than at present, and the remains of crocodiles have also been found. Wherever the soil was favorable the country must have been covered with a rich vegetation for the support of this army of herbivores. The precise character of the flora cannot yet be determined; but this much is certain, that these gigantic animals have been extirpated by some means or other. Sir Richard Owen suggests that man was the cause, but of this there is no conclusive proof. On the other hand, striking evidence has been afforded by the dryness of the last few seasons, of how quickly, through want of rain, savannahs of waving grass may be converted into desert-like plains; and the immediate influence of these climatal changes on the fauna is fully attested by the numbers of kangaroos and emus which died last year through want of sustenance on the western plains.

Fragments of bones of the extinct mammalia are met with in the gravels and clays at a depth of over seventy feet from the surface, and their occurrence in such quantities and variety seems to point to a scarcity of water which would alone bring so heterogeneous an assemblage of animals together. The occurrence of remains of the crocodile attests to a previous abundance of water. Stinted in food supplies and unable, because of their great bulk, to migrate rapidly or adapt themselves readily to the altered conditions of life, diprotodon and the other large herbivores perished by degrees from the combined effects of want of sustenance, the raids of predatory beasts, and possibly the attacks of man. The last terrible struggle for existence as the supply of water failed, must have been beyond description. Now none of this vast horde remains; but their likeness may still be traced in the native bear, wombat, kangaroo, etc., which still survive on the mountain ranges and plains as the comparatively pigmy types of their gigantic predecessors.

A CONVENIENT SYSTEM OF RIVER NOMENCLATURE.

EVERY tyro in geography has learned that the Mattapony and Pamunkey are the two streams that flow into the head of the so-called York river, which is simply an estuary of Chesapeake bay; but few, I imagine, have ever been told how the first of the above names is compounded, since its tributaries are too small to be named on ordinary school maps.

A few weeks since, on approaching, the sources of the Mattapony from the north I was a little surprised at hearing the inhabitants place the accent on the last syllable in pronouncing it. Presently, coming to a brisk little mill stream and inquiring its name, I was informed that it was the *Ny* river. Soon crossing a second of about the same size, I learned that this was the *Po*. Still a third was passed not long after and this rejoiced in the name of *Ta*. Turning to the eastward soon after crossing the Ta, and proceeding some distance down the course of the river system to below the union of all three of these tributaries and crossing back over the combined stream, this was found on inquiry to be the *Tapony*. At last the mouth of the Mat was passed, only below which the river is recognized as the Mattapony. Between the junction of the Ny and the Po and above the confluence of the Ta it is said to be known as the *Pony*, although this particular portion was not traversed and this name not heard used by the in-