greatest possible number, if from one locality and horizon, be included together.

There are not wanting altogether, however, indications of other species, and among them *G. rigida*, *G. rotula*, and *G. micromera* seem to be distinct, but the great majority are simply pectinato-pinnatifid, and possess no really distinctive specific characters. In addition to this, fourteen species from one locality and horizon appear a very unlikely number to have existed together, for although the plants are sociable and grow massed together, but few species are ever met with living together in the same vicinity. The whole of America, which is the richest continent in species, contains but nine, the varied lands grouped as the Malayan region but seven, New Zealand five, Australia four, &c.; the total number recognised by Hooker in the "Synopsis Filicum" being but twenty-three. The greatest number growing in a restricted area is in North Caledonia, where there are four; but I am not aware whether these are actually associated together.

These Gleichenias are repeatedly alluded to by Prof. Heer as indicating a tropical nature for the Arctic cretaceous flora, but so far as their presence goes, they by no means imply that a high temperature prevailed. Although no Gleichenia now ranges into high northern regions, they flourish south in the rigorous climates of the Magellan and Falkland Isles, S. lat. 53°, which have an isotherm of less than 45°, and are also found on the high mountains of Tasmania and on the Andes at 10,000 feet, which is, according to Humboldt, the level of gentians and near the limit of arborescent vegetation. The group of Gleichenias from the colder regions of South America all resemble each other in much the same degree as those of the Arctic regions did, and all possess small, hard, rigid, pectinato-pinnatifid pinnæ. Among them are *G. pedalis*, *G. cryptocarpa*, and *G. quadripartita*, all of which, but especially the former, vary considerably, being either long or shortly pectinate. It is a suggestive fact that the existing representative of these Arctic Gleichenias is the only one that still ranges into northern temperate regions, such as China and Japan, while the representative of the English Eocene species is an essentially tropical form.

The Arctic group of Gleichenia appears to have very little affinity with European fossil plants of similar age, except through *G. Zippei*. Heer connects one with *G. comptoniæfolia*, from Aix-la-Chapelle, although there is little discoverable resemblance between them. To do so he has to point out a discrepancy between the drawing and the description, and although he had never seen the specimens, prefers to rely on the drawing which Dr. De Bey now disclaims as incorrect. The Aix-la-Chapelle types are really quite different and more varied, and link them with our own eocene species. This latter is an essentially tropical type, and completely distinct from either the fossil Arctic group or the existing forms from the cold southern latitudes, since it closely approaches *G. dichotoma*, the only type of a well-defined section of the genus, now almost universally distributed over the tropical world.

The Gleichenias seem first to have appeared in the Jurassic, to have passed away from Europe before the close of the Eocene period, and to be now decidedly characteristic of the southern hemisphere—very few species crossing the equator, although the representative of the fossil Arctic species still extends as far north as Japan. It is obvious that we need not, from their presence, assign a very high mean annual temperature to the older cretaceous period in Greenland. J. S. GARDNER

METEOROLOGY IN JAPAN

WE have read carefully and with great pleasure the *Memoirs* of the Science Department of the University of Tokio, Japan, vol. iii. Part i., which gives the report of the meteorology of Tokio for 1879, by Prof. T. C. Mendenhall. The observations, which are carried on in the west wing of the small observatory attached to the University, were commenced in January 1879, and this is the first report issued by the Observatory. The instruments are from Negretti and Zambra, and, with the exception of the thermometers, they appear to have been placed in suitable positions. The thermometers are mounted outside the north window of the second floor, and are separated from the observing room by glass doors, which are opened for observation. This position of the thermometer is in several respects objectionable, but particularly as it precludes any comparability, beyond a rough one, between the temperature observations at Tokio and at other stations which are or may be established in Japan.

The hours of observation are 7 a.m., 2 and 10 p.m., an arrangement of hours, it may be remarked, which states the mean temperature of the six warmest months of the year about three-fourths of a degree too high, and further does not approximate with the desired closeness to the important diurnal turning-points of the barometric pressure. It is however right to add that it is declared desirable to increase the number of the observations to at least five or six during the day as soon as the necessary arrangements can be made, and to institute a series of hourly observations for approximately determining several of the diurnal curves. An arrangement, if possible to be carried out, for the erection of continuously-recording instruments, would be an important gain to Japan meteorology.

The observations are published *in extenso*, and are illustrated with great fulness by excellent diagrams, which show in a clear manner the main results of the year's observations, the diagrams being lettered and numbered so as to serve for both the English and the Japanese editions which are issued.

The mean pressure for the year at 32° and sea level is given at 29·952 inches, the monthly maximum, 30·093 inches, having occurred in January, and the minimum, 29·809 inches, in August, thus showing a tendency in the atmospheric pressure to be assimilated to the annual march of pressure in the continent adjoining. There having occurred no typhoon during the year, the lowest barometer was only 29·087 inches, which happened on February 23, and the highest, 30·515 inches, on April 21, the range for the year thus being 1·426 inch. The mean diurnal range from 7 a.m. to 2 p.m. is large, being 0·059 inch for the year, regarding which Prof. Mendenhall remarks that "this same relation exists in each set of monthly means with two exceptions." These exceptions are May and September, the ranges for which being, as printed in the means, 0·028 inch and 0·019 inch. On comparing these ranges with those for the other months, they are at once seen to be physically impossible; but by averaging the observations themselves for these months these exceptionally low ranges turn out to be due solely to errors of computation. The true range given by the observations for May and September are 0·047 inch for each month. The exceptionally large range for July, viz., 0·085 inch, is also an error of computation; the true range was only 0·052 inch, the mean range at Tokio being, as in corresponding latitudes of the Atlantic, less in the summer than in the winter months.

The lowest temperature for the year was 24°·1 on January 2 and 7, and the highest 93°·0 on August 15. The temperature fell to or below freezing (32°) on 46 days, 27 of these days being in January, and rose to or above 90°·0 on 12 days, 7 of these days being in July and 5 in August. The mean annual temperature deduced from the 7 a.m., 2 and 10 p.m. observations was 58°·5, and from the maximum and minimum observations 58°·0, the higher temperature of the former being due to the 7 a.m. observations. If this were changed to 6 a.m. the hours of observation would then be equidistant, which would furnish data for a more exact determination of the mean temperature.

Perhaps the most interesting part of the Report is what relates to the wind which is discussed with no little ability and fulness. The results establish beyond doubt that the wind blows more frequently from N. and N.W. than from any other directions, and that these are especially the directions from which winds of high velocity come. This is strikingly shown by the fact that 75 per cent. of all the high winds which occurred during 1879 came from N. and N.W. The N. and N.W. winds prevail from November to March, and S. and S.E. winds from May to August, the other months being transitional; and with reference to these S. and S.E. summer winds it is clearly shown that they blow with a much less absolute velocity than do the N. and N.W. winds of the winter months.

Of almost equal importance are the facts of the rainfall. The amount for 1879 was 58·98 inches, the rainiest months being May, June, September, and October, and the driest, November, December, January, July, and August. The rainfall is sorted according to the direction of the wind with which it fell; and the highly interesting results are arrived at that the greater number of rainstorms come from N. and N.W., that the heaviest rains come with N.W. winds, and that in no season are the S. and S.E. winds, not even in summer when they are the predominating winds, accompanied with the maximum rainfall as compared with other wind-directions. The rainfall partitioned in percentages according to the winds with which it fell were N. 18, N.E. 9, E. 9, S.E. 5, S. 7, S.W. 3, W. 17, and N.W. 32, there falling thus 67 per cent. of the whole rainfall with N., N.W., and W. winds.

Among the changes it is proposed by Prof. Mendenhall to be introduced are improved hygrometric observations, which were evidently not trustworthy for 1879; observations of earth-temperatures down perhaps to a depth of 40 feet; an extension of the anemometrical observations; observations of variations in the velocity of sound under different meteorological conditions, the data being obtained from the time-gun, which is fired at noon daily; and a systematic investigation of the phenomena of earthquakes.

But what is urgently required in developing the meteorology of Japan is, beyond all question, the establishment of a network of stations over the Islands equipped with trustworthy instruments. The sub-tropical situation of Japan between the largest continent and the largest ocean of the globe is, from a meteorologist's point of view, unique; and the report now under review points to meteorological peculiarities in its climate of the highest interest. A satisfactory statement of its climatic peculiarities is, as our readers are aware, a desideratum; and the information which could not fail to prove of the highest utility to the Japanese, and is certain to cast important lights on the meteorology of Asia and the Pacific, and particularly on the meteorology of this ocean about latitude 33°, south to which the islands extend, can be furnished from no other source than from a network of meteorological stations overspreading Japan.

MINERAL STATISTICS OF VICTORIA

For some years past the yield of gold in the colony has been steadily decreasing. In 1868 the quantity of the precious metal obtained from alluvial deposits amounted to 1,087,502 ounces, and from quartz-veins 597,416 ounces, making in all 1,684,918 ounces of gold. Last year the quantities were respectively—alluvial, 293,310; quartz, 465,637: making a total of 758,947 ounces. The comparatively rapid diminution in the supply from alluvial sources is quite intelligible, as these would necessarily be soonest exhausted, though it is important to observe that in 1879 for the first time for eleven years the return from this source shows a decided advance on that of the preceding year, which is attributed to a better supply of water for sluicing operations, and to the opening up of deep mining ground. It is to quartz-mining, however, that the colony must look for the further development of her gold-fields. There has been a gradual decline in the yield from quartz-mines since 1872, when the amount obtained was 691,826 ounces. But the Secretary for Mines in his recent report speaks hopefully of the probable future of this important industry. Up to the end of 1879 the total quantity of gold raised in Victoria is estimated to have been 48,719,930 oz. 11 dwts., valued at 194,879,722*l.* The proportion of gold in the quartz varies considerably in different districts. Thus, last year at Castlemaine the average yield of each ton of quartz was 5 dwts. 18·45 grs., while in Gippsland it amounted to 1 oz. 2 dwts. 18·66 grs. The quartz of the latter locality is by much the most auriferous in the colony. The decrease in the supply of gold has been accompanied by a falling off in the number of miners. The men who found employment in gold mining in 1874 was 45,151; last year they numbered 37,553, which was an increase, however, of 917 over the number for 1878. The mining population includes an industrious and unpopular contingent of Chinamen, who last year amounted to 9,110, or 528 fewer than in the previous year. Taking the total annual yield of gold and dividing its value among the miners employed, the earnings of an alluvial miner are rated last year at 48*l.* 10*s.* 1½*d.* per annum., while those of the quartz miners are given as 118*l.* 8*s.* 7*d.* Deep mining in quartz reefs continues to make progress, and the mines are becoming every year deeper. Some shafts are now more than 2,000 feet deep. The revenue derived by the colony from the gold districts amounted last year to 15,641*l.* 16*s.* 9*d.*, being a slight advance on that of 1878.

PHYSICS WITHOUT APPARATUS[1]

II.

Amongst the elementary principles of mechanics which are capable of easy illustration without special apparatus is that of the centre of gravity. In every solid mass a point can be found such that the resultant of all parallel forces acting on the individual particles passes through it, and such forces balance themselves around this point. The gravitation-force of the earth is exerted towards its centre, but this being 4,000 miles away, the individual forces acting on the separate particles of a body on the earth's surface may be regarded as parallel forces. Hence the centre of the parallel gravitation-forces is termed the centre of gravity. If the centre of gravity be supported, that is to say, if the resultant force be met by an equal and opposite force of resistance, then the body will not fall. The leaning tower of Pisa does not fall because, in the first place, the mortar is strong enough to bind the masonry into a substantial whole, and, in the second place, because the obliquity of the inclination of the tower is not so great as to throw the centre of gravity beyond the supporting base. A vertical plumb-line dropped down from the centre of gravity of the tower would meet the ground inside the base. It is very easy to imitate the leaning tower by taking a common wooden roller and sawing off a piece with oblique ends. The toys which are sold under the name of the Toy Blondin also illustrate the principle of the centre of gravity. A metal figure slides or walks down a stretched string, being kept upright by means of a weight fixed to the end of the rod held in the hand of the figure, thus causing the centre of gravity of the whole to fall below the point of support. A simple way of showing the same thing with improvised material is illustrated in Fig. 3. A couple of forks are stuck into a cork.

[1] Continued from p. 322.