gives some useful hints as to the best modes of travel over the ice, which, if followed, he believes would without any difficulty take the explorer to the east coast.

IN Heft 3 of this year's *Deutsche Geographische Blätter* will be found the first part of a detailed study of the Schwarzwald by Prof. Platz, of Carlsruhe. It deals with the orography and geology.

THE Portuguese explorer, Jose Anchieta, is at present in the Quinsumbo region of the Portuguese West African territory, on his way to Bihe. He intends to investigate the flora of the region, which has never been adequately studied.

IN the Danish Budget for 1888-89 a sum of 68,000 kroner has been allotted for research in Icelandic waters. Several large fjords of great commercial importance are entirely unexplored, and are therefore full of danger to navigation. The fishery grounds around the various islands will also be investigated. This exploration will have great interest for science, as it is likely to accumulate much valuable information in oceanography, as well as zoology and meteorology. The work will be carried on freely from May to August, and it is hoped will be completed in five or six years.

THE Roman Catholic missionaries on Yule Island have been exploring the region of New Guinea opposite their station. They found that the Ethel and Helida are insignificant streams; but they discovered a new river, the St. Joseph, which rises at the foot of Mount Yule in 8° 15′ S. lat. and 146° 40′ E., and which flows in a southerly direction. The land on both sides is highly fertile and the natives peaceful. They visited fifteen villages, several with a population of over 2000.

IN a paper in the last-issued *Bulletin* (vol. ii. No. 6) of the Californian Academy of Sciences, Mr. George Davidson gives some interesting information on submarine valleys off the Pacific coast of the United States. He points out that within 40 or 50 miles of the coast to the south of Cape Mendocino the plateau of the Pacific reaches a depth of 2000 to 2400 fathoms. Generally there is a marginal plateau for 10 miles out to the 100-fathom curve, and then the descent is sharp to 500 or 600 fathoms. In this marginal plateau there has been discovered by the Coast Survey several remarkable submarine valleys. Notably that in Monterey Bay, heading to the low lands at the great bend of Salinas River; and that off Point Hueneme at the eastern entrance of the Santa Barbara Channel, and heading into the low coast at the wide opening of the Santa Clara Valley. Then there are one or two off the southern point of Carmel Bay, while the deepest one enters far into the bay. The latest discovered submarine valleys are near the high bold coast under Cape Mendocino. Just north of a submarine ridge extending from Point Delgada to Shelter Cove is a deep valley which breaks through the marginal plateau and runs sharply into the immediate coast-line under the culminating point of the crest-line of mountains. The head of this submarine valley is 100 fathoms deep at 1¼ mile from shore; when it breaks through the 100-fathom line of the marginal plateau it reaches a depth of 400 fathoms. The slopes of the valley are very steep. Midway between this and Point Garda there is another valley 300 to 150 fathoms deep. The opening of this valley through the outer edge of the 100-fathom plateau is 520 fathoms deep. Between Point Garda and Cape Mendocino is another valley, which, 6½ miles south-west by south from the cape, is 450 fathoms deep. This is a wide valley, the bottom of which is green mud, though in two places, at depths of 320 fathoms, broken shells were brought up with gravel.

BY the latest communication from Mr. Stanley's expedition it is evident that, unless some unexpected disaster has happened, he reached Emin Pasha some time in August. He found the Mabodi country, through which the Aruwimi flows, densely inhabited, while that river on the borders of the Mabodi country bends south, and again becomes navigable. This seems clearly to show that the Aruwimi can have no connection with the Wellé system.

THE last number of the *Izvestia* of the Russian Geographical Society (1887, 3rd fascicule) will be most welcome to geographers. It contains a preliminary map (70 miles to an inch) of the eastern parts of East Turkestan, Tsaidam, and the upper parts of the Yellow and Blue Rivers, embodying the results of the fourth journey of General Przewalski in Central Asia. The most interesting feature of the map is that it shows that the depression of the Lob-nor must not be confounded with the Eastern Gobi. This last is more elevated, and falls by a steep terrace towards the depression of the Lob nor, which has in the east of the lake a width of only 80 miles, and terminates at Lake Tchin-jen-he, where the desert reaches altitudes of 3700 and 4800 feet above the sea. The Tarim depression is thus well limited in the east, and the doubts which arose among geographers as to the possibility of embodying the Eastern Gobi and the Tarim depression under the same denomination of Hang-hai, as proposed by Richthofen, are thus settled. The well-known difference of characters of the two regions depends upon the differences of their orographical structures, and the Tarim region appears as a depression of the high plateau of East Asia, limited in the east as well as in the north, the west, and the south. Geographers will find on the map the series of chains named after Colombus, Marco Polo, Humboldt, and Ritter, discovered by General Przewalski; the high range to which the Russian Geographical Society gave the name of its Russian discoverer; the Burkhan-buda range; the lakes Jarin and Orin, 14,000 feet high, of the upper Hoang-ho; and all those minor features which, when mentioned in M. Przewalski's letters, excited so much interest among geographers. A list of sixteen places, the latitudes and partly the longitudes of which have been determined, and a list of ninety-five altitudes, accompany the map.

IN a short note accompanying the above map, General Przewalski mentions certain facts brought to light during the last three months of his journey. The Khotan-daria of East Turkestan does not make a bend towards the west, as shown on several recent maps. It flows due north through a sandy desert, and its course on Klaproth's and D'Anville's maps was more in accordance with reality than the indications on more modern maps. Its water reaches the Tarim only during the summer. A new oasis, Tavek-kel, grew up some fifty years ago on the Yurun-kash; its population numbers about 500 families. The lake Yashil-kul does not exist where it is shown on our maps. The most important statement is, however, the following. By the beginning of October 1885—that is, at low water—the Tarim had, at the confluence of the Yarkand and Khotan Rivers, a depth of 3 to 5 feet, and a width of about 185 yards. In the summer, according to information obtained from the natives, and confirmed by the state of the river-bed, the depth and width of the Tarim are thrice the above. Taking into consideration the fact that the lower Tarim, followed by M. Przewalski in 1876 and 1877, has throughout a depth of no less than 14 feet, it may be maintained, M. Przewalski writes, that the Tarim is navigable for steamers on its whole length from the above junction to the Lob-nor. It seems probable also that steamers may be able to ascend a short distance up the Aksu River and further up the Yarkand-daria.

THE same number of the *Izvestia* contains an elaborate paper by M. A. Eliséeff embodying the ethnological results of his journeys in Asia Minor since 1881. In this paper there are able descriptions of the various populations of Asia Minor—the Turks, the Armenians, the Kurds, the Kurmanjis, the Greeks, the Arabs, the Chaldæans, the Tsiganes, and the Jews. The numerous anthropological measurements and other observations which the author made during his journeys in the interior of the country will be published separately in full. Two papers, on the Manych and the steppes of Northern Caucasus, by D. Ivanoff, and on the vegetation and geology of the same, by W. Fausek, are valuable contributions towards a better knowledge of the nature of this interesting region.

METEOROLOGICAL NOTES.

Symons's Monthly Meteorological Magazine for October contains a fifth annual table of the climate of the British Empire, giving a summary of the daily observations at sixteen stations, distributed over the globe, for the year 1886. The extremes show some very interesting facts, from which we select the following:—Adelaide has the highest maximum temperature in the shade, viz. 112°·4; the highest temperature in the sun, 174°·5; the least rainfall, 14·42 inches; and the lowest humidity, 56 per cent. Winnipeg has the lowest shade temperature, −44°·6; the greatest annual range, 147°·6; and the lowest mean daily temperature, 33°·2. Colombo (Ceylon) has the highest mean daily temperature, 81°·0. Bombay has the greatest rainfall, 99·74 inches. London occupies the unenviable position of the dampest station, 80 per cent. The same magazine contains a discussion of the severe thunderstorm which visited London on

August 17. The greatest rainfall on this occasion was 2·08 inches at Wimbledon, and the least at Hackney, 0·27 inch. In connection with the climatology of the British Empire, it may not be generally known that the Annual Reports of the Army Medical Department contain meteorological summaries for a number of stations mostly in the northern hemisphere, *e.g.* the Mediterranean, Africa (including Egypt), and the East and West Indies. The last Report published is for the year 1885, and contains the results of observations and the extremes from nineteen stations.

IT is stated in the *Meteorologische Zeitschrift* for October that a new edition of Prof. H. Mohn's "Grundzüge der Meteorologie" has just been published by Reimer and Co., of Berlin. The fact that the work has reached a fourth edition in twelve years shows the favour with which it has been generally received. The plan remains the same as before, but both the text and the plates have been corrected to correspond to the recent progress of the science.

MR. H. ALLEN HAZEN has contributed an article to the *American Journal of Science* for October on the relation between wind-velocity and pressure, giving a summary of the better class of experiments, the methods employed, and the results arrived at, from those of Borda, in 1763, to the present time. The methods of investigation generally adopted are (1) carrying a plate either in a straight line or in a circle; and (2) allowing a current of air to impinge normally upon the plate. The results of Borda's observations are expressed in the formula—

$$p = (\cdot0031 + \cdot00035c)sv^2,$$

in which p = pressure in pounds; c = contour of plate in feet; s = surface in square feet; and v = velocity in miles per hour. In some careful experiments made at Washington in 1866, the formula obtained, viz.

$$p = (\cdot0032 + \cdot00034c)sv^2,$$

shows a remarkable and unexpected coincidence with Borda's results, with an entirely different apparatus. By far the most careful experiments with a whirling machine were those of Hagen, in 1873, with plates varying in size from 4 to 40 square inches in area. His formula is—

$$p = (\cdot0029 + \cdot00014c)sv^2;$$

and these results have been used by Prof. W. Ferrel in his recent discussion of this question. Various other experiments are discussed, including those lately made in France on a train running at increasing velocities, which give the formula—

$$p = \cdot000535sv^2.$$

The author expresses the opinion that further experiments are much needed, with larger plates than 2 feet square, and with high velocities with a straight-line motion. In connection with this subject it may be mentioned that the Royal Meteorological Society have appointed a Wind-Force Committee to consider the relation existing between velocity and pressure, together with other anemometrical questions, and a preliminary report was read in the spring of this year.

THE publications of the Swedish Meteorological Office are somewhat in arrear, the volume recently published being for the year 1882. It contains observations *in extenso* from eighteen stations of the second order, and monthly and yearly results of 117 stations, among which are seventy-nine for temperature only and several that have been established in the interest of forestry. The Central Office has no station of the first order, but publishes the observations of the Upsala Observatory, which is an independent institution. From this Observatory we have very complete observations from 1855 to 1886, in addition to very valuable works on the classification of clouds and the movements of cirrus clouds, by Dr. Hildebrandsson. The Central Office publishes, however, a monthly weather report, in the service of agriculture, which is brought out to date. The Swedish network of stations was established in 1856, by the Royal Academy of Sciences of Stockholm, and in 1873 the present Office was founded, with Dr. R. Rubenson as Director. The Office for Marine Meteorology, established in 1877, is also an independent institution; the logs used are those of the English Meteorological Office, with the addition of the headings in Swedish. By mutual agreement, Sweden deals specially with the Baltic, while Norway takes the North Sea, the data collected being exchanged by the respective countries.

THE Report of the Meteorological Service of the Dominion of Canada for the year 1884, just issued by Mr. Carpmael, shows satisfactory progress in the various departments. Several new stations have been added, and the number for which monthly and yearly averages are given amounts to 136. Eighty-three per cent. of the storm warnings issued during the year have been verified; weather predictions have also been disseminated throughout portions of the country by means of large disks attached to the railway cars. These disks have the image of the sun, representing fine weather, the crescent moon, for showery weather, and a star, for wet weather, painted on them, in addition to words. The percentage of verification of these predictions is also very satisfactory. The climatological tables show that the highest mean annual temperature was 47°·81 at Windsor (Ontario), and the lowest at Fort Chipewan (North-West Territory), 26°·65. The records for Hudson's Bay Territory are not complete, but would probably have shown a lower mean. The maximum shade temperature was 100° at Chaplin (North-West Territory) in June, and the lowest at St. Andrews (Manitoba), −53°·3, in January; with one slight exception this station had also the largest mean daily range, viz. 24°·75. Sunshine-recorders are erected in five provinces only; in these Winnipeg has the maximum sunshine, 45 per cent., and Pembroke (Ontario) the least, 30 per cent., of the possible amount. The greatest mean rainfall in any whole province was 48·46 inches in Newfoundland, and the least, 9·90 inches, in North-West Territory on 48·6 days. The greatest average of rainy days was 151·5 in Prince Edward's Island. The distribution of rainfall in Ontario is also represented by maps for each quarter and for the year. With a view to enhancing the value of the tables, we suggest the desirability of arranging them according to the international scheme, instead of in the present form; or at least of printing the extreme values in thick type, as is usually done in other countries.

THE chief feature of the United States *Monthly Weather Review* for July last is the unusually high mean temperature over the central and northern parts of the country; in some portions it averaged from 4° to 7° above the normal values, and was the warmest that has occurred since the establishment of the Signal Service stations. This fact is interesting in connection with the weather experienced in some parts of this country, where there was an excess of 2° to 5° in all districts. Descriptions of the storms which occurred over the North Atlantic are given; the average number of areas of low pressure for July during the last fourteen years is nine, for July 1887 the paths of seven such areas are traced, being two less than the average. The storm of the 26th is the one in which the high wave struck the s.s. *Umbria* (see NATURE, vol. xxxvi. p. 508). This depression was first charted in N. 55°, W. 25°, on the 25th, and its presence was indicated northwards of the British Isles during the 27th and 28th. The *Review* also contains a discussion of the North Atlantic storms during 1885; of sixty storms which advanced over the ocean from the American continent, twenty-eight were traced to European waters. Fifty-nine storms first appeared over the ocean, of which about 65 per cent. were traced to the west coast of Europe. A table is given showing the positions of centres of areas of mean high and low barometer for each month, and explains why in March and October the storm areas moved northward before reaching European waters, and that in August the depressions did not move eastward owing to unusually high pressure along the middle latitudes. Attention is drawn to the fact that, as a rule, the storms which do traverse the ocean leave the coast north of the fortieth parallel; only a very small number of the storms which advance from southern latitudes cross to the northward of the trans-Atlantic ship routes.

A SERIES of very interesting articles, from the pen of Dr. Oscar Doering, on the inter-diurnal variability of temperature at places in the Argentine Republic and South America generally, are being published in the *Boletin de la Academia Nacional de Ciencias* of Córdoba. Investigations of this kind have been very seldom undertaken, although Dr. Hann and Dr. Supan have pointed out that the variability of temperature is a factor of eminent importance, affecting the habits and character of mankind, and also partially the distribution of plants. Dr. Hann, in his elaborate paper upon this subject presented to the Vienna Academy on April 15, 1875, and based upon such observations as were then available, defines the variability of temperature as the differences of temperature of two immediately succeeding intervals of time which do not belong to the daily and yearly period; or, in other words, as the differences of temperature between two short intervals that lie within the daily or yearly period, *minus* the amount of the periodical (or normal) variation. In part 4, vol. ix., of the above-mentioned Bulletin, Dr. Doering has calculated the variability for Concordia (lat. 31° 25′ S., long. 58° 4′ W.), but for three years only. The month of October has the maximum value, 4°·6, and April the minimum, 2°·8. The variability during spring is greatest, viz. 3°·9, and least during autumn, viz. 3°·0, and the mean for the year is 3°·6, or about 0°·4 above that for Buenos Ayres. The hourly observations published by the Meteorological Council, with the daily means ready calculated, afford excellent materials for similar investigations. The preceding number of the Bulletin contains the meteorological observations made at Córdoba during the year 1885. The absolute maximum shade temperature was 100°·9 in December, and the minimum 14°·9 in June, giving an annual range of 86°·0. The maximum solar temperature was 147°·4, in February. The mean relative humidity ranged between 81·7 per cent. in March and 61·1 per cent. in August. The rainfall amounted to 24·26 inches; the wettest month was March, 5·96 inches, and the driest, May, 0·04 inch. Rain fell on 71 days, and snow on one day. The times of rain at the moment of observation, an element much recommended by Dr. Köppen, are also quoted.

THE WORK OF THE INTERNATIONAL CONGRESS OF GEOLOGISTS.[1]

II.

MY only remaining subject is the representation of terranes on maps by means of colours. At present no two organizations and scarcely two individuals use colours in the same way; and it is probably true that every organization and individual publishing many geologic maps has at different times employed the same colour for different terranes, and different colours for the same terrane. It results that the map user can gain no information from the distribution of colours until he has studied the legend; before he can read a new atlas he must learn a new alphabet. The advantage to be gained by substituting a universal language for this confusion of tongues is manifest and great, and has justified the application of much time and attention by the Congress and its Committees. By a series of resolutions a partial scheme has been selected, one colour at a time, and the completion of the plan has been left to the Committee on the Map of Europe. That Committee has prepared a colour legend which is accessible to American geologists in the volume of information published by the American Committee. It is understood in a general way that the Congress reserves final action, and the published legend not only belongs specifically to the map of Europe, but is provisional; still, as this map, if generally approved, will unquestionably be declared by the Congress an authoritative pattern for the guidance of map makers, the plan should be freely criticized at its present stage. The selection of uniform colours is a far more delicate and important matter than the arrangement of taxonomic terms; for while ill-chosen words may quickly fit themselves to new uses, the adoption of an ill-arranged colour scheme must entail continual loss.

In my judgment the scheme provisionally chosen is defective in several particulars, to which I shall presently call attention; but it is necessary to introduce the discussion by a statement of the conditions to be satisfied by a standard colour scheme and a statement of the practical means available. The following are the principal conditions, arranged in an order embodying my estimate of their relative importance:—

(1) The map must be clearly and easily legible. Each colour must be so distinct from each other colour that it can be identified, whatever its surroundings; and all other conventions must be readily discriminated.

(2) The cartographic scheme must be adjustable to the geologic facts; it must not require that the facts be adjusted to it.

(3) The same scheme should serve both for general maps—as, for example, those representing only systems—and for detail maps, representing numerous smaller divisions.

(4) Undue expense should be avoided. The amount and consequent utility of colour cartography is largely limited by its cost.

(5) It should be easily fixed and retained in the mind. This is best accomplished by making it orderly.

(6) Other considerations permitting, the map should please the eye. Since the arrangement of colour areas cannot be foretold, this can only be accomplished by admitting a certain range of choice. If allowed sufficient latitude in the selection of tones, an expert colourist can ameliorate an offensive combination of hues.

(7) Other considerations permitting, the establishment of a universal system should involve the least possible inconvenience. But as the inconvenience of change is temporary, while the inconvenience of a bad system is lasting, this consideration should yield to every other.

The art of mapping geologic terranes by means of colour is well developed, and its methods, viewed from the geologist's stand-point, admit of easy characterization. Colour may be varied in two distinct ways—in hue and in tone. Hues differ in quality, as yellowish-green and bluish-green. Tones differ in strength, as pale green and dark green. A colour is printed either solid or broken; it is said to be broken when applied in a pattern, as in lines or dots, or when it is interrupted by a pattern. The difference between solid and broken colours is a difference of texture. The primary discriminations in mapping are through hue, tone, and texture.

The map engraver produces texture in three ways. In the first way a single impression is made with the broken colour. The white of the paper, displayed where the colour is interrupted, combines with the colour in the general effect, producing a paler tone of the same hue. In the second way two impressions are made, one with solid colour, the other with broken, and the two impressions have the same hue; they may or may not differ in tone. This is monochromatic over-printing, and its general effect agrees in hue with the single impression, but differs in tone, being darker. In the third way two impressions are made, one solid, one broken, and their colours differ in hue. This is bichromatic over-printing, and its general effect differs in hue as well as tone from each of the colours combined in it. The first and second ways produce texture monochromatically, and do not yield a new hue; the third way produces texture bichromatically, and yields a new hue. It is practically impossible to obtain a texture effect without modifying the original tone.

The natural gradation from hue to hue is absolutely continuous, and the number of hues is infinite; the number of tones of each hue is likewise infinite. The number of hues and tones the eye can discriminate is finite, but very great; it is stated that 1000 hues have been distinguished in the solar spectrum. But the number of hues and tones that can be combined in a map is small. As a matter of perception, every colour is modified by the colours adjacent to it. The same hue affords different sensations when differently surrounded, and different hues may afford the same sensation. The same is true of tones; and there is a certain interdependence of hues and tones in this respect. In a geologic map each colour is liable to fall into various combinations, and two colours little differentiated occasion confusion. There is therefore a somewhat narrow limit to the employment of hues and tones. The matter has not been fully worked out, but it is probable that twenty is as large a number of hues as can safely be employed in connection with tones. Texture admits of very great variation. The various colour schemes submitted to the Congress and printed in the report of the Bologna meeting afford, with their manifest permutations, about 200 distinct textures, and I am satisfied from a study of these and others that as many as 100 can be chosen that are not subject to confusion. It follows that a map or atlas expressing few distinctions need use only hues, or only hues and tones, but where numerous distinctions are to be made, recourse must be had to textures.

The printing of a large number of textures of the same hue produces a greater number of tones than can be discriminated, and its effect is to confuse and nullify any distinctions (within the range of that hue) based purely on tone. The printing of a large number of bichromatic textures causes the same result, and it also produces a greater number of hues than can be discriminated. Its effect is to confuse and nullify distinctions based purely on tone, or on hue, or on tone and hue together.

In the colour scheme prepared for the map of Europe, thirty-eight distinctions are made. There are twenty-four hues, and

[1] Vice-Presidential Address read to Section E of the American Association for the Advancement of Science, August 10, 1887, by Mr. G. K. Gilbert. Continued from p. 22.