

the difference of temperature between the liquid in ebullition and the condensed liquid. The weight of liquid condensed in unit time is independent of the interior pressure or of the mean temperature during distillation. Analysis shows that the gases have no power of solution on one another. M. Pictet was thus led to an industrial process for rectification of spirits.

GEOGRAPHICAL NOTES

At the meeting of the Geographical Society on Monday, Sir Bartle Frere read what may best be described as a suggestive paper on Temperate South Africa as a route to the Central Equatorial Region. After defining the temperate region as the vast tract of country extending to Cape Frio on the Atlantic coast and to the mouth of the River Tugela on the opposite side of the continent, and giving a brief account of its geography, &c., Sir Bartle addressed himself chiefly to the task of pointing out how it could be made available as a base of operations in exploring the country north of the Zambesi, and suggesting agencies which might be turned to account for the extension of geographical knowledge. These agencies are the traders and hunters, who have a wide acquaintance with many regions otherwise unknown, and missionaries of various denominations. The latter have no less than eighty-four fixed stations beyond the colonial boundaries, manned by 812 Europeans, many of whom are highly-cultivated and intelligent men, and have great opportunities for acquiring geographical information. Sir Bartle Frere also hoped that the Council of the Society might see their way to urging the Government to undertake a proper survey of the coast-line, as well as of the interior of the five colonies.

At the meeting of the Berlin Geographical Society on November 6 the safe arrival of Dr. Lenz at Timbuctoo (by a route not before taken by any European) was announced. Two of his followers were lost in the desert, and two had gone back. Dr. Stecker (who lately went to Massowah with Herr Rohlf's) will, according to circumstances, either push through the Galla regions or to the East coast, or to the Great Lakes. Major v. Mechow reached a town on the Quanza, in the territory of the Hollo, about 200 km. from Malange on July 19, after great difficulties, especially in carriage of the boat. The natives were friendly throughout. A little above the place reached are the two last falls of the Quanza, between which is the mouth of the Cambu. The Major seems to have been the first white to visit these waterfalls. He was going to Löpfung with a view to determine the course of the Quanza. Dr. Pogge and Lieut. Wissmann were also travelling in that region the same month, intending to reach Mussumba, the residence of the Muata Jambo; Dr. Pogge's object is to establish stations in the interior. Lieut. Wissmann will make journeys for topographical and collecting purposes. The Italian traveller, Dr. Matteucci, is seeking to reach Bornu from South Dar-Fur, going round Wadai and Bagirmi. *Inter alia* the Society resolved to memorialise the German Government to take part in the international project of systematic Polar investigation.

At the sitting of November 19 of the Société de Géographie of Paris M. Zweifel received the palm of Officer of the Academy as a reward for the discovery of the sources of the Niger, in company with M. Marius Moustier. The laureate declining to speak himself, an address was delivered on behalf of him and his companions by Dr. Harmand, the well-known explorer of Cochin China. It appears that MM. Zweifel and Moustier saw a granite rock from which the powerful stream takes its rise; but they were not admitted to the site, owing to the high priest of Tembi Saleh, who inhabits an island situated on a small lake formed by the stream at a very few miles from its source. So something more remains to be done to complete the work begun by Laing, Reade, and Blyden.

SIR ALLEN YOUNG leaves England next month in his yacht, and will visit, among other places, the Canary Islands, a portion of the West Coast of Africa, and St. Helena, extending his voyage as far as the Cape, where he will make preparations and inquiries for a projected expedition of discovery to be undertaken by him to the Antarctic regions. It will be remembered that the *Erebus* and *Terror*, commanded by Sir J. Ross and Capt. Crozier, penetrated in 1841 to 78° 4' S., a latitude which has never been reached before or since.

THE November number of *Petermann's Mittheilungen* has a long paper by Spiridion Gopčević, containing his ethnographical

studies in Upper Albania. A very fine map embodies the important results of Severzov's exploration of the Pamir in 1878, with accompanying text, followed by an account of Lieut.-Col. Pjevzov's journey through Mongolia in 1878-9, to Kuku-Choto and Kalgan. A summary is given of the Arctic work of 1880, followed by the usual monthly notes.

THE first *Bulletin* of the recently-formed International Geographical Institute at Berne consists of a programme of the projected Italian Antarctic Expedition under Lieut. Bone, which is to leave Genoa in March 1881. A sketch is given of what has been previously done in this region, showing that the field is practically virgin so far as scientific work is concerned. The programme of the Italian expedition is very comprehensive, and the ultimate object is to pave the way for the establishment of an Antarctic observing station.

No. 3 of vol. iii. of the *Deutsche geographische Blätter*, the organ of the Bremen Geographical Society, contains the continuation of the unfortunate Dr. Rutenberg's journal in Madagascar, and the lecture given at the Danzig meeting of the German Association by Dr. Neumayer on "Polar Expeditions or Polar Research?" To the latter able lecture we referred last week, the point insisted on being that while the two are perfectly congruous, the former should be subjected to the latter, which must be carried out on the system of Polar observatories advocated by Weyprecht, and to which nearly every civilised nation adheres except England.

THE new number of the Marseilles Geographical Society's *Bulletin* contains a very voluminous account by Messrs. Zweifel and Moustier, of their expedition to the sources of the Niger. This memoir is illustrated by a map showing their route, and supplemented by an appendix containing information as to the natural resources of the country traversed, the races of the interior, &c.

THE last part of *Le Globe* contains a paper (with map) on the Island of Cyprus, by M. Paul Chaix, and some account of recent researches in the Pamir, furnished by M. Veniukoff.

IN the current number of *Les Missions Catholiques*, M. Armbruster has commenced a series of papers on Corea, drawn from information furnished from time to time by the Romish missionaries, the only Europeans who have ever had any opportunity of acquiring a real knowledge of the interior.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The preliminary examination in the Natural Science School begins on Monday next, November 29. The Final Honour School begins on Monday, December 6.

The Brakenbury Scholarship in Natural Science at Balliol College has been awarded to Mr. William Stroud, from Owens College, for proficiency in physics and chemistry. *Proxime accessit* Mr. A. D. Hall, from Manchester Grammar School. Mr. J. J. Hart, Manchester Grammar School, and Mr. J. E. Marsh of Balliol, are honourably mentioned.

ON A METHOD OF DETERMINING THE CRITICAL TEMPERATURE FOR ANY LIQUID AND ITS VAPOUR WITHOUT MECHANISM*

A PIECE of straight glass tube—60 centimetres is a convenient length—is to be filled with the substance in a state of the greatest purity possible. It is to contain such a quantity of the substance that, at ordinary atmospheric temperatures, about 3 or 4 centimetres of the tube are occupied by steam of the substance, and the remainder liquid. Fix the tube in an upright position, with convenient appliances for warming the upper 10 centimetres of the length to the critical temperature, or to whatever higher or lower temperature may be desired; and for warming a length of 40 centimetres from the bottom to some lower temperature, and varying its temperature conveniently at pleasure.

Commence by warming the upper part until the surface of separation of liquid and steam sinks below 5 centimetres from the top. Then warm the lowest part until the surface rises

* By Sir William Thomson, British Association, Swansea, Section A. Tuesday, August 31.

again to a convenient position. Operate thus, keeping the surface of separation of liquid and solid at as nearly as possible a constant position of 3 centimetres below the top of the tube, until the surface of separation disappears.

The temperature of the tube at the place where the surface of separation was seen immediately before disappearance is the critical temperature.

It may be remarked that the changes of bulk produced by the screw and mercury in Andrews' apparatus are, in the method now described, produced by elevations and depressions of temperature in the lower thermal vessel. By proper arrangements these elevations and depressions of temperature may be made as easily, and in some cases as rapidly, as by the turning of a screw. The dispensing with all mechanism and joints, and the simplicity afforded by using the substance to be experimented upon, and no other substance in contact with it, in a hermetically sealed glass vessel, are advantages in the method now described. It is also interesting to remark that in this method we have continuity through the fluid itself all at one equal pressure exceeding the critical pressure, but at different temperatures in different parts, varying continuously from something above the critical temperature at the top of the tube to a temperature below the critical temperature in the lower part of the tube.

The pressure may actually be measured by a proper appliance on the outside of the lower part of the tube to measure its augmentation of volume under applied pressure. If this is to be done, the lower thermal vessel must be applied, not round the bottom of the tube, but round the middle portion of it, leaving, as already described, 10 or 20 cms. above for observation of the surface of separation between liquid and vapour, and leaving at the bottom of the tube 20 or 30 cms. for the pressure-measuring appliance.

This appliance would be on the same general principle as that adopted by Prof. Tait in his tests of the *Challenger* thermometers under great pressure (*Proceedings*, Royal Soc. Edin., 1880); a principle which I have myself used in a form of depth-gauge for deep-sea soundings; in which the pressure is measured, not by the compression of air, but by the flexure or other strain produced in brass or glass or other elastic solid.

ABNORMAL VARIATIONS OF BAROMETRIC PRESSURE IN THE TROPICS, AND THEIR RELATION TO SUN-SPOTS, RAINFALL, AND FAMINES

IN the first part of his work on the Meteorology of the Bombay Presidency, which was submitted to Government in August, 1875, Mr. Charles Chambers pointed out that the variation of the yearly mean barometric pressure at Bombay shows a periodicity nearly corresponding in duration with the decennial sun-spot period (see "Meteorology of the Bombay Presidency," § 26, p. 12), and in August, 1878, in a letter to NATURE, vol. xviii, p. 567, I drew special attention to this relation, pointing out that the observations of the winter and summer half-years, separately as well as conjointly, show that the pressure is low when the sun-spot area is great, and *vice versa*, but that the pressure curve lags behind the sun-spot curve.

In November of the same year the eminent physicist, the late Mr. John Allan Broun, regarding the relation thus established between the variations of barometric pressure and sun-spots as one of very great importance, in that it gave a probability to the existence of similar laws in the variations of other meteorological elements which he believed was previously wanting, communicated to the same periodical (NATURE, vol. xix. p. 6) an article in which he showed, from the observations recorded at Singapore, Trevandrum, Madras, and Bombay, that the years of greatest and least mean barometric pressure are probably the same for all India, and from this he inferred that the relation to the decennial sun-spot period found for Bombay holds for all India.

In December, 1878, Mr. S. A. Hill supplemented and confirmed Mr. Broun's communication by giving similar data for Calcutta (NATURE, vol. xix. p. 432).

In May, 1879, Mr. E. D. Archibald communicated to NATURE, vol. xx. p. 28, the fact (brought to his notice by Mr. S. A. Hill) that at St. Petersburg the mean annual barometric pressure is high when the sun-spots are numerous, low when they are few, but that the pressure epochs lag behind the sun-spot epochs.

In December of the same year Mr. Blanford presented to the Asiatic Society of Bengal a paper (*Journal of the Asiatic Society of Bengal*, vol. xlix. part ii. 1880, p. 70) in which it was shown that the barometric observations recorded at Batavia from 1866 to 1878, at Akyab, Chittagong, and Darjeeling from 1867 to 1878, at Port Blair from 1868 to 1878, and at Singapore from 1869 to 1878, afford more or less confirmation of the results previously obtained for other stations in India.¹ And in the same paper Mr. Blanford brought forward the observations recorded at the Russian observatories at Ekaterinburg, Slatoust, Bogolowsk, and Barnaul from 1847 to 1877, and showed that at the two former stations during the whole period, and at the two latter during the first half of it, the barometric variations were similar to those previously obtained by Mr. Hill for St. Petersburg.

In a subsequent letter to NATURE, published in March, 1880, Mr. Blanford discussed the same observations in greater detail, dealing with the summer and winter observations separately, as well as conjointly, and showed that the decennial variation of the barometric pressure found for St. Petersburg was exhibited only by the observations of the winter months. He also obtained similar results for Ekaterinburg and Barnaul, but he appears to have overlooked the very important facts that the range of the winter curves rapidly decreases in passing from St. Petersburg, through Ekaterinburg to Barnaul, that the summer curves for the two latter stations are, on the whole, of the same character as the summer curves of the Indian stations, as may be seen by comparing the dotted curves for Ekaterinburg and Barnaul, given in NATURE, vol. xxi. p. 48, with the summer curve for Bombay, given in vol. xviii. p. 568 of the same periodical. He also showed that the barometric curves for Batavia, Singapore, and Port Blair were, as at other Indian stations, of the same character both in winter and summer.

In 1873 and 1874 (see British Association Reports for those years) Mr. Meldrum showed that there was strong evidence of a connection between sun-spots and rainfall, and he has recently (see *Monthly Notice of the Meteorological Society of Mauritius* for December 1878) put this question beyond all reasonable doubt by showing that the mean yearly rainfall of Great Britain, the continent of Europe, America, India, and the Southern Hemisphere, varies in the same way as the sun-spots, being on the average great when they are numerous, small when they are few.

In my "Brief Sketch of the Meteorology of the Bombay Presidency"² in 1876, I pointed out that the abnormal variations of the monthly mean barometric pressure in that year were mainly variations in the intensity of the usual seasonal movements, although at least some portion of the variations influenced a wider area than the Indian monsoon region, and in the Sketch for 1877 I attributed the uniformly high barometric pressure and the deficient rainfall of that year to a weak development of the equatorial belt of minimum pressure, probably induced by a diminution of the solar heat.

In the Report on the Meteorology of India in 1877 Mr. Eliot showed that the high pressure of that year was characteristic of the whole Indian area and also of Australia.

In my meteorological sketch for 1878 I showed that the abnormal barometric movements observed at Zi-ka wei in China and at Manilla in 1878 were similar to those recorded in Western India; that the latter largely influenced the rainfall of the Bombay Presidency; and that in former years of deficient rainfall at Bombay the barometer had been relatively high, not only at Bombay, but also at Mauritius and Batavia.

In the paper (*Journal of the Asiatic Society of Bengal*, vol. xlix. part ii., 1880, p. 70) already quoted, Mr. Blanford has confirmed the fact that the excessive pressure observed in the Indian area in the years 1876 to 1878 extended to China and Australia, and he has also shown that it affected Western Siberia also.

In my sketch for the year 1879 I have shown that these uniform variations of barometric pressure are accompanied by a nearly uniform variation of the percentage rainfall of all portions

¹ During the first half of these periods the results for Singapore, Akyab, Chittagong, and Darjeeling differ so much from each other and from the remarkably accordant results obtained from the more widely separated stations of Bombay, Calcutta, Port Blair, and Batavia as to suggest that the former are of doubtful validity during the earlier years.

² These sketches are submitted annually to Government in August of the year following that to which they refer. See notices in NATURE, vol. xviii. pp. 199 and 619, vol. xxi. p. 384. The sketch for 1879, containing some further important conclusions with reference to the variations of rainfall and barometric pressure, has recently been submitted to Government.