230,000 acres, upon which, taking the present Ceylon figures, the eventual yield will be about 400,000 cwt., or 20,000 tons, about a quarter of the probable world's consumption at that date; and planting is going on at a very rapid rate.

The market for a short time looked askance at the biscuits, but they speedily came into favour, and have for a considerable time been receiving a higher price per lb. than the best wild rubber of the Amazon. But this must by no means be taken to mean, as it often is taken, that the plantation rubber is better than the "wild," for the latter contains about 20 per cent. of moisture, while the former is dry, so that in reality the wild rubber is getting about 16 per cent. more in price. Examination of the two qualities will at once show the reason for this difference; the plantation rubber is not quite so elastic, and when much stretched does not at once return, as does the wild rubber, to its exact pristine shape. What the reason for this difference may be is the great problem now before the scientific institutions working at the chemistry and botany of rubber in the tropics.

During the last four years the prices of rubber have continued to rise until they have now reached a height previously undreamt of. The result has been that the early pioneers of rubber cultivation have reaped enormous profits, amounting to as much, in some cases, as 60*l*. per acre per annum, and this has still further stimulated the rush into rubber planting.

The one topic of conversation in planting circles in the East is now rubber, and almost everyone, whether a planter or not, has invested in the industry, with the result that shares have risen very considerably, being, in the case of companies owning bearing rubber, now from three to eight times their par value. With this degree of interest excited in it, it is hardly surprising that a proposal was made that Ceylon, the country in which most rubber was cultivated, should hold a rubber exhibition, and this was actually held in the famous Royal Botanic Gardens at Peradeniya from September 13 to 27.

Buildings upon a fairly extensive scale were erected in Kandyan or mountain-Sinhalese style, and a large display of every kind of rubber was obtained, mainly, of course, from Ceylon and Malaya. There were also exhibits of tapping knives of every kind, and two large sheds were filled with the machinery that is rapidly coming into use upon rubber plantations. A very successful feature of the exhibition was the series of lectures upon every branch of rubber cultivation, shipment, and manufacture that was given during its progress, and which will shortly appear in a book, which should be at the hand of everyone interested in rubber.

The bulk of the Ceylon exhibits were in the form of biscuits, the form originally adopted by Mr. Parkin in the laboratory having been long adhered to. The Malayan were in the form of sheets of larger size; but the most conspicuous things in the show, from this point of view, were some large blocks of rubber exhibited by the Lanadron Estate, in Jahore, made by pressing what is known as crepe rubber (obtained by aid of a washing machine) into solid blocks by powerful hydraulic pressure. Not only does this form offer less surface to oxidation, but it packs more closely and thus saves freight, and it also sells for more upon the market.

The tapping knives for Para rubber exhibited much ingenuity, but not those for the other rubbers. It is worth pointing out here that persons interested—and who is not?—in introducing rubber cultivation into other countries should keep a sharp eye upon the development of the tapping knife in Ceylon and Malaya. Recent experiments in the West Indies, for instance, were carried out with a knife long since discarded in Ceylon, and the verdict was against this knife and in favour of the hammer and chisel, which form a very primitive tool indeed.

Some of the most interesting exhibits in the whole show were the samples of vulcanised and coloured rubbers, rubber and fibre mixtures, and other things shown by Mr. M. Kelway Bamber, Government chemist in Ceylon. These were referred to by Prof. Dunstan at the meeting of the British Association at York, and have aroused universal interest. Several technical papers have already given vent to the view that they can never be put to practical use, because each manufacturer has his own processes, which he will keep secret, for mixing and otherwise treating the rubber, apparently assuming that it is hopeless for the mere scientific man to find out such matters, or even to improve on them, or for one company, old or new, to take up the new process. Others, going on insufficient knowledge, have said that it is not possible to work with chloride of sulphur, or to mix other substances with the latex. In actual fact, the process is very simple, so simple that it seems a marvel that no one has found it out before. Instead of first drying the rubber into lumps or sheets, then macerating it, and mixing it with sulphur or other vulcanising material and colouring matters, these things are done *in the milk*, when the sulphur compounds will, of course, mix with the caoutchouc in a way that it is hopeless for any other method to equal, and when anything that can be wetted can also be easily incorporated, more especially colouring matters. In this way, by subsequent coagulation, a rubber is produced containing the vulcanising, colouring, and mixing reagents or substances in complete admixture. This can then be worked up in the ordinary way into any article that may be required, and finally heated, when it becomes vulcanised. Some of the most interesting exhibits shown by Mr. Bamber were the mixtures of rubber and fibre. The fibre is mixed with the milk in large quantity, the milk being previously sulphurised, and the mass is then dried, compressed under very great hydraulic pressure, and heated, resulting in a solid brick or tile containing but a very small proportion of rubber, and yet strong and elastic enough for the purposes of tiling or other uses.

This method of vulcanising will doubtless have to be modified in detail, but in principle is absolutely new, and is much simpler, and also much cheaper, than the present one.

Taking it altogether, the creation of the now great rubber industry, and its rapid progress from very rough and crude methods to a highly progressive and scientific spirit, is entirely the work of the botanical departments of Ceylon and Singapore, and they may justly pride themselves upon the result.

Recent Important Literature of Rubber.

"Para Rubber." By W. H. Johnson. (London.) Price 7*s*. 6*d*. A very good account of the industry as it was in Ceylon a few years ago, but already more or less out of date.

"Para Rubber." By Herbert Wright. Second edition. (Colombo: A. M. and J. Ferguson.) The best and most up-to-date account of the industry.

"The Book of the Rubber Exhibition of 1906." By J. C. Willis, M. K. Bamber, and E. B. Denham. (London: Dulau and Co.) Price 7*s*. 6*d*. To appear shortly. This book will contain the lectures given at the exhibition by numerous specialists, carefully revised and edited, many pictures, reports of judges, and other valuable features.

J. C. WILLIS.

METEOROLOGICAL NOTES.

"COLD Waves and Frosts in the United States" is the title of an important bulletin recently issued by the chief of the U.S. Weather Bureau. The work was prepared by Prof. E. B. Garriott; it includes a chronological account of historical cold periods in the United States since 1717, but deals more especially with the frosts that occurred from 1888 to 1902 inclusive, the conditions of which are illustrated by 328 charts. We have occasionally very cold spells in our own country, but these can scarcely be compared with those frequently experienced in the United States; as Prof. Moore has elsewhere pointed out, the area and intensity of cold waves depend upon the size of continents and their distance from the tropics. The author of the paper considers that the cold of the northern interior of the American continent is chiefly due to air that flows over that region from the northern Rocky Mountains, where its moisture has been precipitated, and to the process of radiation in its passage over Canada. The high barometer caused by the stagnant state of the air in this locality is one of the conditions that produce cold waves, another

necessary condition being the development of low barometric pressure near the southern margin of the cold-air belt, and the production of strong northerly currents, due to cyclonic circulation. To quote only one instance of the value of forecasts in connection with these cold waves:—from January 6–12, 1886, a cold wave swept the country east of the Rocky Mountains and produced the lowest temperatures noted for the last fifty years in the south-eastern States. Speaking of this wave, Prof. Moore has stated that on January 7 there was a difference of 1·1 inch in barometric pressure between Montana and southern Texas, while the isotherm in Montana was −30° and on the Texas coast 50°. The people of the Gulf States knew nothing of the danger that threatened them until warned by the telegraphic weather forecast; on January 8 the temperature in parts of Texas had fallen to zero, and, notwithstanding the timely notice. the estimated damage to crops was 3,000,000 dollars in Florida alone.

Diurnal Range of Temperature in the Tropics.—Prof. J. Hann recently presented an important treatise on this subject to the Vienna Academy of Sciences. In continuation of a former work dealing with the district between lat. 15° N. and S., the one now in question relates to places in Africa and America (including the West Indies, Madagascar, and Mauritius) lying north and south of the above latitudes, and extending to the limits of the tropics, and in some cases beyond them. The work is divided into two parts, containing, *inter alia*, (1) tables of the daily range of temperature in the form of departures of the hourly from the daily means, with a general discussion of the results, and (2) tables of the periodical and non-periodical amplitudes, and of the epochs of the daily maxima and minima, in connection with cloudiness, sunshine, and rainfall. The mean occurrence of the minimum temperature at all places in the tropics (mountain stations excepted) is approximately at 5h. 30m. a.m., both on the coast and inland. The time of the maximum differs; on the coast and in rainy districts it mostly occurs soon after midday, at inland and dry stations it is at 2h. or even after 2h. 30m. p.m. At places on the West Indian coasts the maximum occurs about 42m. after noon; somewhat more inland, at Puerto Principe (Cuba), nearly an hour later, and at the City of Mexico about 2h. 48m. p.m. The occurrence of the daily mean is retarded according to distance from the equator; twenty-seven stations in the central zone (lat. 15° N. to 15° S.) give the mean time of 8h. 26m., twenty stations in the outer zones give 8h. 40m. as compared with 9h. 27m. at fifteen places in Austria.

Diurnal Variation of the Barometer.—In the *U.S. Monthly Weather Review* for April, Prof. Cleveland Abbe directs attention to an article in *Gaea* for August, 1905, by Dr. Korselt, of Annaberg, Germany, in which he attempts to show how the diurnal oscillation of the barometer is an important link in the chain of phenomena due to the unequal warming of the atmosphere by solar radiation, and its unequal cooling by terrestrial radiation. One of his conclusions, which may be recommended to the notice of meteorological organisations the telegraphic reporting stations of which generally possess self-recording barometers, is that the minute study of the daily barometric oscillation may be of great value for practical weather forecasting, because it ought to give information about conditions in the atmosphere at altitudes which balloons have not yet been able to attain. A weather chart showing the observed difference between the barometric ranges by day and by night during the preceding twenty-four hours would, he thinks, probably show that any temporary area of low pressure has a tendency to move toward the region where the difference of the ranges is a minimum. Prof. Abbe points out, however, that these ranges are so small that they would often be completely masked by larger non-periodic changes, so that misleading errors would seem to be inevitable.

Influence of the Ocean upon Continental Precipitation.—In the same number Mr. F. O. Stetson (assistant editor) directs attention to a recent paper read before the Société helvétique des Sciences naturelles on the interchange of moisture between land and sea, by Prof. E. Brückner. The author estimates that 93 per cent. of the water evaporated from the ocean is returned to it in the form of precipitation, leaving only 7 per cent. available for distribution over the land; and that of the total precipitation over the land 20 per cent. is supplied directly by the ocean, while the remainder is due to the re-condensation of vapour evaporated from the continents. We cannot give here the data upon which Prof. Brückner's figures are based, but if they are provisionally accepted as approximately correct, they indicate that the direct influence of the ocean upon rainfall over the land is less than has been generally supposed; but Mr. Stetson points out that the accurate determination of evaporation is a problem not yet solved, and that the rainfall over extensive tracts of land still remains unknown.

Wind Currents in the Vicinity of the Canary Islands.—In a recent note to the *Comptes rendus* of the Paris Academy, M. Teisserenc de Bort and Mr. Rotch have confirmed their opinion that the south-west winds observed on the Peak of Teneriffe correspond to a general phenomenon and are identical with those which would obtain over the open ocean, and consequently represent the regular anti-trade. This view is not in accordance with that held by Prof. Hergesell, to which he has again directed attention in *Beiträge zur Physik der freien Atmosphäre* (vol. ii., part ii.). He maintains that his observations with kites in 1904, and the balloon observations of the *Princess Alice* in 1905, show that in the latitude of the Canary Islands during summer north-west winds prevail to the greatest heights, and that there can be no question of a regular south-west current in that part of the Atlantic, the occasional south-west wind observed on the Peak of Teneriffe being due to local effects. Prof. Hergesell in no wise denies the existence of the regular south-west anti-trade wind, but maintains that at all seasons it is only to be met with some degrees south of the Canaries.

The Hong Kong Typhoon, September 18.—The Zi-ka-wei Observatory (near Shanghai) has sent us some interesting details relating to the progress of this most disastrous storm, which reached Hong Kong on September 18. The first signals of its approach were given by the Japanese observations in the islands east of Formosa on the morning of September 15, but owing to the distance of the stations from the central vortex it was not until the following day that it was clearly shown to be moving towards Formosa and China. The supplement to the Zi-ka-wei Daily Weather Report of September 30 contains some important extracts from ships' logs, which clearly show the definitive track of the storm. The U.S. transport *Caesar*, bound from Cavite (Bay of Manila) for Shanghai, was at noon of September 15 in lat. 19° 53′, long. 120° 20′; at 4h. p.m. she had a steady wind from N.W., freshening in force to 7; the usual diurnal barometric range was still observed, but at 8h. p.m. the barometer, which stood at 29·66 inches, began to fall, the wind freshened and veered to N.N.W., and the ship was forced to steer S.W. to avoid the centre of the approaching storm. The observations were:—at 1h. a.m. on September 16, barometer 29·36 inches, wind N.W. 11; at 2h. a.m., 29·37 inches, W.N.W. 11; at 3h. a.m., 29·40 inches, W. 11; during this period the rain was continuous and excessively heavy. The centre of the storm passed between the ship and the south Cape of Formosa on September 16, shortly after 1h. a.m.

The P. and O. SS. *Delhi* was just entering the passes of Hong Kong when the typhoon burst upon the colony; at noon on September 17 she was in lat. 17° 58′, long. 111° 35′, about 420 miles from the vortex, wind S., force 2, and a distinct E.N.E. sea swell was noted. It was not until 4h. a.m. next day that the breeze veered to W., with occasional squalls, barometer 29·78 inches. The ship dropped anchor near Green Island, and the wind freshened, being W. by N., 8 at 9h. 30m. and W. by S., 10 at 10h. a.m., while the rain fell with blinding violence; at 9h. 45m. the barometer reached its lowest point, 29·14 inches. The centre of the storm passed to the north of the *Delhi* between 9h. 45m. and 10h. a.m. As shown by the observations of these two vessels and those of the French mail steamer *Océanien*, which left Hong Kong for Shanghai on the afternoon of September 17, the centre of the storm travelled from Formosa to Hong Kong, about 380 miles, in 56½ hours, at a mean rate of 6·7 miles an hour; the rate of translation was probably checked by the very high atmospheric pressure to the north, but it

became faster as the centre progressed nearer the coast, where it reached 14·3 miles an hour; the high pressure to the north also made the gradient steeper, and so increased the violence of the vortex. The track of the storm was approximately W.N.W. or W. by N.

The Rev. José Algué, S.J., director of the Manila Observatory, has published an article upon the above typhoon in the Monthly Bulletin of the Philippine Weather Bureau for September. The observations at Santo Domingo (Batanes Islands) and at Aparri (Luzon) show how accurate were the warnings and particulars of the track of the storm issued by the Zi-ka-wei Observatory, and that the typhoon passed close to the north of Santo Domingo between 3h. and 4h. p.m. on September 15, the centre moving in the direction of N.W. by W.; the barometric minimum at the latter place at 2h. 30m. p.m. on that day was 29·290 inches, the mercury having fallen 0·572 inch since 8h. p.m. on September 14. Father Algué thinks it probable that a depression felt at Guam (Marianne Islands), lying to the eastward of Santo Domingo, on September 8, may have been caused by the passage of the typhoon about 200 miles to the north of that station; in this case its mean rate of progression to Santo Domingo would have been about eight nautical miles an hour.

Report of the Fernley Observatory, Southport, for the Year 1905.—This institution, which is maintained by the Corporation, occupies an important position between the Liverpool Observatory and the anemograph station at Fleetwood, and possesses an exceptionally complete equipment of standard self-recording instruments. The year was very dry, the rainfall being 26·31 inches, or 7·11 inches below the average. Owing to the position of the observatory on the coast of the Irish Sea, gales were experienced in every month, but although barometric pressure was lowest in November, this was one of the two calmest months, the other being May. The town enjoys a good amount of bright sunshine; in the year a duration of 1624 hours was recorded, or seventy hours above the average, being only about fifty hours less than at Brighton, and above 300 more than in the London district.

Annuaire météorologique, Observatoire Royal de Belgique, 1906.—Although, as pointed out by M. Lancaster, an *Annuaire* is not indispensable for a meteorological organisation, the results of its observations being given in other publications, it is a very convenient method of bringing together data useful to different classes of workers, including agriculturists, engineers, medical men, and others. The work in question is certainly most valuable, and contains, in concise and handy form, the yearly and average results of observations made at Brussels (or Uccle) since 1833, together with a summary of miscellaneous information, including tables and constants which are both useful and instructive to meteorological students of any country. To render the publication more attractive, it contains from time to time original articles by members of the observatory staff. Among those contained in the current volume we may mention one by M. Vincent on weather prediction, illustrated by fourteen maps, as well worthy of attention. The author looks for future improvement in the wider dissemination of daily weather reports and the instruction of persons interested in drawing their own conclusions from the synoptic charts, in decentralisation to some extent, in the preparation of local forecasts as in the United States, and, eventually, in each person becoming his own forecaster, from information supplied by the central offices.

Climate of Alaska.—In the *U.S. Monthly Weather Review* for June reference is made to an important memoir on this subject, by Dr. C. Abbe, jun., which forms part of Professional Paper No. 45 of the U.S. Geological Survey. Dr. Abbe summarises the materials collected during the last thirty years by the Signal Service and the Weather Bureau, and therefore supplements the useful memoir by Dr. Dall published in the Pacific Coast Pilot in 1879. The territory is divided into eight climatic provinces, for each of which much fresh information is afforded, especially as regards temperature and rainfall. The maximum shade temperature in the great Yukon basin is given as 90°, and 94°, on the Copper River plateau, is the highest reported from any of the Weather Bureau stations, instead of 112° or even 120° formerly spoken of. The lowest recorded temperature is −80°, at Fort Reliance, in January. The largest annual rainfall is 170·09 inches, at Fort Constantine; the number of rain days is 251, at Unalaska, being the highest number at any point in the United States.

Meteorological Observations, Bremen, 1905.—The publication of the results obtained at this important observatory under the superintendence of Dr. P. Bergholz forms part of the German *Meteorologisches Jahrbuch*, which is prepared on a uniform plan for all parts of the empire. The present volume is of more than usual interest, as, in addition to hourly readings and means from self-recording instruments for the year in question, it contains monthly, seasonal, and yearly means for the lustrum 1901–5, results for the thirty-year period 1876–1905, and for all observations available from 1803–1905. As the latter are not quite continuous, we quote the following data for the thirty-year period:—mean temperature, January, 32°·5, July, 62°·6; the absolute extremes were 93°·9 (May 28, 1892), −13° (December 4, 1879); means of the absolute monthly extremes, 11°·1, January, 83°·5, July. The mean annual rainfall was 27·48 inches; July, 3·64 inches, April, 1·63 inches; the greatest fall in one day was 3·39 inches (June 10, 1884). The mean percentage of bright sunshine for fifteen years was 32·4, as compared with 29 per cent. in London for twenty years.

BRITISH INLAND WATERWAYS.

THE commissioners appointed early this year to investigate and report on this important question, have exercised a wise discretion in publishing, as soon as practicable, the first portion of the evidence given before them by fifty-four witnesses, at twenty-two meetings, held between March 21 and July 31, relating almost entirely to English canals and inland navigations. This first instalment forms a fairly bulky Blue-book, with 375 pages of evidence, an index of ninety-five pages, various appendices, together with a list of English inland waterways, occupying 111 pages, and a map of the canal-systems and navigable rivers of England and Wales in two sheets at the end of the volume, coloured so as to indicate each separate system, with the name of the system printed in large letters of the same colour.

Since the evidence here recorded was taken, the commissioners have been hearing evidence in Ireland on Irish inland waterways, and have also resumed lately their sittings in London; and they further propose to obtain detailed information with regard to inland navigation in the Continental countries of Europe where it has been most fully developed, which will doubtless be published in due course. Accordingly, considering the large amount of matter with respect to inland waterways which will be gradually collected by this commission, it is very advantageous that it should be given to the public at intervals to give an opportunity of its being properly studied; and this arrangement has the further merit that it will enable future witnesses, by seeing the previous evidence beforehand, to supply omissions or correct errors.

A perusal of the engineering evidence alone suffices to show, by its conflicting nature, the magnitude of the task which lies before the commissioners, and the complicated problems which they will have to solve. The questions to be considered with regard to the improvement of inland waterways are:—first, the additional traffic that an improved waterway would be likely to attract; secondly, the size of barges which could most economically transport the traffic; thirdly, what would be the cost of a transformed waterway suitable for the passage of such barges, how far it should be carried inland, what connections should be formed with other waterways, and what return might be expected on the capital expended; and, lastly, by what means the funds might be raised for executing the proposed improvements.

The engineers of inland navigations being sometimes also the managers, or generally concerned in the management of their system, and being thoroughly conversant with the cost of improvements and with the working expenses, have for the most part dealt with the above questions in their evidence. One engineer suggests that the Government